



ON THE ROAD TO ZERO WASTE

SUCCESSES AND LESSONS FROM AROUND THE WORLD



GAIA is a worldwide alliance of more than 650 grassroots groups, non-governmental organizations, and individuals in over 90 countries whose ultimate vision is a just, toxic-free world without incineration.

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COVER CLOCKWISE FROM TOP LEFT: Alaminos (Anne Larracas), Buenos Aires (Cooperativa El Ceibo), Hernani (Gipuzkoa Zero Zabor), Mumbai (Michael Atkin), Flanders (OVAM), San Francisco (Larry Strong), Pune (Amit Thavaraj), Taiwan (Allianz SE), La Pintana (DIGA)

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**SUCCESSSES AND LESSONS
FROM AROUND THE WORLD**

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Check GAIA's website to read cases as they are added to the series:
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INTRODUCTION

Stories From the Front Lines of the Zero Waste Movement

Zero waste is both a goal and a plan of action. The goal is to ensure resource recovery and protect scarce natural resources by ending waste disposal in incinerators, dumps, and landfills. The plan encompasses waste reduction, composting, recycling and reuse, changes in consumption habits, and industrial redesign. But just as importantly, zero waste is a revolution in the relationship between waste and people. It is a new way of thinking that aims to safeguard the health and improve the lives of everyone who produces, handles, works with, or is affected by waste—in other words, all of us.

Zero waste strategies help societies to produce and consume goods while respecting ecological limits and the rights of communities; they ensure that all discarded materials are safely and sustainably returned to nature or manufacturing. In a zero waste approach, waste management is not left only to politicians and technical experts; rather, everyone impacted—from residents of wealthy neighborhoods to the public, private, and informal sector workers who handle waste—has a voice.

Practicing zero waste means moving toward a world in which all materials are used to their utmost potential, and the needs of people—workers and communities—are integrated into a system that also protects the environment while ensuring that nothing

goes to waste. It is much like establishing zero defect goals for manufacturing, or zero injury goals in the workplace. Zero waste is ambitious, but it is neither unachievable nor part of some far-off future. In small towns and big cities, in communities rich and poor, in the global North and South, innovative plans in place today are making real progress toward the goal of zero waste.

- Through incentives and extensive public outreach, San Francisco has reduced its waste to landfill by 77 percent—the highest diversion rate in the United States—and is on track to reach 90 percent by 2020.
- A door-to-door collection service operated by a cooperative of almost 2,000 grassroots recyclers in Pune, India, has been integrated into the city's waste management system and diverts enough waste to avoid 640,000 tons of greenhouse gas emissions annually.
- Aggressive standards and incentives for both individuals and businesses in the Flanders region of Belgium have achieved 73 percent diversion of residential waste, the highest regional rate in Europe.
- In Taiwan, community opposition to incinera-

tion pushed the government to adopt goals and programs for waste prevention and recycling that were so successful that the quantity of waste decreased significantly even as the population increased and the economy grew.

- An anti-incinerator movement in the Spanish province of Gipuzkoa led to the adoption of a door-to-door waste collection service in several small cities that has reduced the amount of waste going to landfills by 80 percent.
- In Alaminos, Philippines, a participatory, bottom-up approach proved that communities have the ability to solve their own waste management problems.
- In Mumbai, India, and La Pintana, Chile, a focus on organics has produced real value from their largest and most problematic portion of municipal waste.
- In Buenos Aires, by organizing into cooperatives and taking collective political action, grassroots recyclers called *cartoneros* have gotten the city to adopt separation of waste at source, an essential step toward its goal of 75 percent diversion by 2017.

The stories of these communities and others are detailed in this report. While few locations are bringing together all the elements of a comprehensive zero waste plan, many have in common a philosophy driven by four core strategies:

Setting a New Direction Away From Waste Disposal

Open dumps, landfills, and incinerators (including so-called waste-to-energy schemes) are part of a shortsighted and outmoded way of thinking that views waste disposal as cheap because true costs are not

taken into account. The costs of pollution, resource depletion, climate change, health problems, and human suffering are externalized onto the environment and people, including future generations.

Zero waste moves societies away from waste disposal by setting goals and target dates to reduce waste going to landfills, abolishing waste incineration, establishing or raising landfill fees, shifting subsidies away from waste disposal and into discard recovery, and banning disposable products, among other interventions. These policies are strongest when they incentivize community participation and incorporate the interests of waste workers.

Supporting Comprehensive Reuse, Recycling, and Organics Treatment Programs

Zero waste requires a system of safe and efficient recovery of materials so that the discards that are inevitably produced are returned to nature or to manufacturing. Such a system operates through separating waste at its source in order to reuse, repair, and recycle inorganic materials, and compost or digest organic materials.

Often, separate collection and processing of organics is the key complement to existing recycling efforts. Separate organics collection ensures a stream of clean, high-quality material which in turn enables the creation of useful products (compost and biogas) from the largest fraction of municipal waste. It also improves the recycling rate because the materials remain free of contamination.

Engaging Communities

Zero waste relies on democracy and strong community action to determine the direction of waste management programs. Citizens need to be part of the very design of the plan, and a lengthy initial consultation process can pay off with better design

and higher participation rates. Residents must actively participate in the programs by consuming sustainably, minimizing waste, separating discards, and composting at home. They should also be active in monitoring the implementation of the programs in their community.

A successful zero waste program must also be an inclusive one. Inclusive zero waste systems make sure that resource recovery programs include and respect the community and all social actors involved in resource conservation, especially informal recyclers whose livelihoods depend on discarded materials. The workers who handle waste should be fully integrated into the design, implementation, and monitoring processes, as it is the application of their skills and efforts which ultimately make the system function. A successful zero waste system will prioritize waste workers' safety and well-being and ensure that their interests are aligned with programmatic success. In some communities, where waste workers come from historically excluded populations, this may require ending long-standing discriminatory practices.

Designing for the Future

Once communities begin to put zero waste practices in place, new opportunities emerge. The residual fraction—that which is left over because it is either too toxic to be safely recycled or is made out of non-recyclable materials—becomes evident, and industrial design mistakes and inefficiencies can be studied and corrected. Zero waste institutes can help businesses and manufacturers establish cleaner and

more sustainable production processes and products even as government policies push them to do so. Zero waste goes beyond recycling programs and prioritizes the redesign of products. If it cannot be reused, composted, or recycled, it just should not be produced in the first place.

Specifically, zero waste emphasizes efficient use of resources; safe manufacturing and recycling processes to protect workers; product durability; and design for disassembly, repair, and recycling. Extended Producer Responsibility, clean production, reducing or substituting toxic materials, reducing packaging, and environmentally preferable purchasing are important strategies.

The communities discussed in these case studies, and many others around the world, are enjoying significant environmental, climatic, social, economic, and sanitation benefits from their adoption of various elements of zero waste. Every community is different, and no two zero waste programs will be identical. The variety of approaches profiled is indicative of the diverse approaches that all lead towards the same goal. Although some of these systems also currently include elements which are incompatible with zero waste, such as incineration, the positive elements offer a foundation on which to build comprehensive zero waste systems. For now, these communities offer enlightening examples of how the various elements function in the real world, in a wide variety of economic, cultural and political contexts. We can all learn from their efforts.

PUNE, INDIA

Waste Pickers Lead the Way to Zero Waste

By Neil Tangri



Rally for dignity. (photo: Amit Thavaraj © KKPKP/SWaCH)

Over the last 20 years, Pune's waste pickers¹ have created a remarkable transformation in their city's municipal waste management system and in their own lives. These informal sector collectors of recyclable materials formed a union to protect their rights and bring dignity to their work. The union has been so successful that it has allowed them to implement door-to-door collection, source separation, and separate treatment for organics, all while improving waste picker livelihoods and working conditions. Now, the waste pickers' own cooperative is pioneering a wider-reaching and more rigorous zero waste program.



PUNE

Maharashtra State, India

Area: 700 km²

Population: 3,115,431

Population density: 4451/km²

Average annual rainfall: 2,751 mm

Altitude: 560 meters above sea level

Average temperature range: 11°C to 37°C

Waste generation: 0.3 kg/capita/day

Avoided costs to city: US \$2.8 million per year

Like most Indian cities, Pune has long had an informal waste management system operating in parallel with an overburdened municipal system. Residents were obliged to place their waste in roadside containers made of steel (also called dumpsters or skips)—each capable of holding several cubic meters of waste—which were supposed to be emptied daily. In practice, the city only emptied about 40 percent of them each day, transporting the waste to the dump. As a result, overflowing containers was a common complaint of residents.

The containers did provide a livelihood for waste pickers, who would look through them for recyclable materials, which they bundled and sold to middlemen (*kabariwalas*). However, some of the more valuable material never made it to the roadside bin because house-maids or security guards would lay claim to it and sell it to itinerant scrap buyers. Other waste pickers worked at the landfill. Under the most noxious conditions, they recovered recyclables from what the city dumped there. All of this material was sorted, cleaned, and sold to industry, through a series of middlemen, for eventual recycling.

In Pune, 92 percent of waste pickers are women, almost all from the lowest, or Dalit, caste. Thirty percent are widowed or deserted, and another 50 percent are the primary breadwinners for their families. Before the union, they moved mostly on foot, covering a distance of up to 12 km per day with headloads of up to 40 kg. Some traveled by train or truck to the villages and industrial areas around the city. They left their homes at sunrise and returned at sunset after working a 10 hour day. The average daily earning was ₹60 (US \$1.12).

The occupation was extremely hazardous. Forced to use bare hands to rummage through putrefying garbage containing glass shards, medical waste, dead animals, toxic chemicals, and heavy metals, waste pickers collected bits of reusable, repairable, and marketable



Mangal Gaikwad lives in a slum in Aundh, Pune. The difference that her involvement in doorstep collection and in the Union made to her life is presented

in her own words. “Today I earn ₹3000 [US \$56]² from doorstep collection and the sale of scrap. The residents in the area who used to frown at me while I was at the garbage bin, now know my name and greet me. A resident gave me a second hand bicycle. I had never ridden one before. Today, I ride to work on that cycle. When I was a child I used to envy the children who went to school with their bags and water bottles while I had to go wastepicking. Since my work day is shorter now I was able to attend the literacy class in my slum. I am now literate. I am the Treasurer of the credit cooperative and the representative for my slum. I used to be terrified of my abusive alcoholic husband. Twice I sent him to a deaddiction centre. He stopped for a while but continues to drink. I am no longer terrified of him. I do not give him money to drink. I have bought a bigger house for ₹65,000 [US \$1200] from my savings and a loan I took from the credit cooperative.”

materials. Many sustained repeated injuries, illnesses, and diseases as a result of their work. Tuberculosis, scabies, asthma, respiratory infections, cuts, animal bites, and other injuries were common.

Other potential dangers in the city's dumps included injury from falling items—or even avalanches—in the mountains of waste, or being hit by moving vehicles when scrambling to get to the materials being dumped. In addition, there were frequent squabbles between

waste pickers over territory, and they had to compete from the bottom of a hierarchy of domestic workers, sweepers, and others who had first claim to any materials of value. **Without rights to the garbage they lived on, the lives and livelihoods of waste pickers were very insecure.**

As bad as the physical conditions of work were the social conditions. Without any right to the garbage they sifted, waste pickers were often accused of theft. They frequently had to pay bribes to police and municipal workers; they were vulnerable to sexual assault; they were viewed with distaste, or worse, by most of the rest of society; their children were refused admission in schools; etc. Nevertheless, they preferred waste picking to construction or domestic work—the other principal occupations open to them—because it afforded greater independence, flexibility, and relative freedom from the feudal and often sexually exploitative relationships prevalent in those fields.

A Waste Pickers' Union

In 1993, with the encouragement of activists associated with a local university, some 800 waste pickers attended a citywide convention to give voice to their grievances. They resolved to engage in collective, nonviolent struggle to improve their conditions; thus was born Kagad Kach Patra Kashtakari Panchayat (KKPKP), the first waste pickers' union in India. **From the beginning, the union was established with a larger goal of fighting for social justice, and against social, economic, cultural, and political exclusion.** In particular, it has a strong focus on caste, class, and gender issues.

Until now we were counted among the animals;
Baba Adhav [one of the KKPKP organizers]
has brought us to sit here as humans.

— Hirabai Shinde, KKPKP member

KKPKP's membership rapidly grew to include 6,400 of the 7,000 waste pickers in Pune as it tackled a number of issues of concern to its members. One of their first victories was to confront police officers who had taken bribes and sexually propositioned waste pickers. Faced with several thousand waste pickers—who were starting to garner the support of politicians wanting their votes—the police backed down and returned the money taken. The success of this experience encouraged KKPKP to tackle even more issues. In 1995-96, they won official recognition from city government, which issued them identity cards—something that in practice protected them from police harassment but was also a tangible representation of their improving status in society.

In 1997, KKPKP created a credit cooperative with the participation of over 2,000 members; this freed the waste pickers from their dependency on usurious moneylenders. **Another crucial milestone was achieved in 2003, when the municipality took the unusual step of paying health insurance premiums for KKPKP members in recognition of their financial and environmental contribution to the city—the former calculated at €3 million (US \$3.85 million) per year.**



KKPKP meeting. (photo: Amit Thavaraj) © KKPKP/SWaCH

KKPKP realized early on that changes in the waste management system could deliver important benefits to waste pickers. If residents separated their waste at source and waste pickers retrieved it from individual homes through door-to-door collection, both would benefit: residents would have a convenience service while waste pickers would spend less time sorting waste and recover a higher percentage of saleable materials (since cross-contamination reduces the quality and amount of recyclable materials). However, getting residents to source separate their waste also created opportunities for middlemen and private companies to step in and claim those recyclables. When the Pune Municipal Corporation (PMC) considered handing the entire waste collection process over to a private company, KKPKP was compelled to act to prevent its members from being completely displaced.

From Scavengers to Service Providers—SWaCH Operations

For several years, KKPKP encouraged its members to establish door-to-door collection routines; many did so, and benefitted from the small service fees residents would pay as well as access to cleaner, better-separated recyclables. In 2008, KKPKP formed a cooperative, Solid Waste Collection and Handling (SWaCH),³ to regularize and expand this practice. Its aims are to guarantee members' access to recyclable material, to improve their working conditions and earnings, and to transform the status of the occupation from scavenging to service provision.

As of May 2012, SWaCH's approximately 2,000 members were providing door-to-door collection for more than 330,000 households, or 47 percent of the city, in both institutional campuses and in ordinary neighborhoods, on a contract basis. Its coverage continues to expand as more residents sign up for its services.

The uniformed co-op members generally use a



SWaCH members collecting waste. (photo: Mariel Vilella)

pushcart to collect waste from each house.⁴ Residents are supposed to source separate their waste, but compliance is modest: about 30 percent do rigorous wet/dry separation, and another 60 percent sort out some recyclables but mix other dry waste with the organics. The waste pickers do a secondary sort of dry waste, using the 19 sorting sheds provided by the PMC to pull out recyclable material from the non-recyclable. The sheds are critical for keeping the women and waste sheltered from the weather.

The members then sell their recyclables either to private scrap dealers or to one of KKPKP's own scrap shops, where they are assured of fair prices. Non-recyclable dry waste is put in roadside containers which are collected by the municipality; but because of higher recovery rates, fewer containers are needed than before SWaCH—in its first two years, the municipality was able to take 64 of them off the streets.

The transition from waste picker to service provider has not been easy. It has required new attitudes and behaviors from both waste pickers and residents; but these changes have been mutually reinforcing. The waste pickers have had to learn to be punctual, regular, and cordial in their work, and to professionalize their appearance. The residents have learned to treat them as workers and human beings. This change in



Composting operations on the Pune University campus.
(photo: Mariel Vilella)

the waste pickers' social status and self-perception is one of the most dramatic results of their organizing.

Tackling Organics for the Public Good

Traditionally, waste pickers have not been interested in organics (i.e., “wet” waste), as it had little commercial value. But organic waste is a major pollution issue: when buried in landfills, it generates toxic leachate, bad odors, and methane—which can cause landfill fires. And since it comprises more than 70 percent of Pune's waste stream, no waste management system can claim to be complete without tackling organic material. SWaCH has begun to prioritize proper organics management, but several other entities—public and private—are also processing organic waste, and not all the approaches are successful or compatible.

Pune has 15 biogas plants which process about 75 tons per day (tpd) of organics. The methane produced is burned in a generator to power street lights. This is widely considered the best treatment for organic waste, since it not only avoids the major problems associated with organics but also produces energy, and has minimal byproducts; even the slurry is usable as compost.

But the biogas plants are very sensitive to the introduction of plastic or hard-to-degrade waste

(including coconut shells, mango seeds and other woody organic matter), which frequently plug up the plants and take them out of operation. So the biogas plants limit their intake to mostly source-separated organic material from restaurants, which is relatively clean. Only one plant accepts organics from SWaCH, which struggles to get residents to fully source separate their waste.

Some of the organics that SWaCH collects from households go to centralized composting operations: Disha, a local NGO, operates one large (100 tpd) composting plant, and the municipality operates a few smaller ones. Again, contamination is a problem; although composting can tolerate higher levels of contamination than biogas, the resulting compost is of poor quality.

Most of the city's organics are not effectively separated and end up in mixed waste at a commercial facility where they are processed into two different products: low-grade compost and refuse derived fuel (pellets). Both are significantly contaminated with plastics and other toxins like mercury from lightbulbs, batteries, etc. These contaminants are released, and some new ones are created, when the pellets are burned.

In some communities, SWaCH offers a more environmentally sound alternative. Its philosophy is to deal with the organics as close to the point of generation as possible. SWaCH members, in addition to providing door-to-door collection, operate composting facilities at 40 apartment buildings and institutional campuses. These often take the form of simple compost pits, but some are more elaborate, with grinding machines and bacteria additives that speed up the composting process. SWaCH members only operate the facility; the resulting compost is owned and used by the community or institutions that generate the organic waste. **Since residents can see where their organics are being composted, and see SWaCH members cleaning the**

organics, they are far more rigorous in their source separation—which results in better quality compost. Apartment buildings operating on-site compost pits receive a five percent rebate on their real estate taxes, which far exceeds the cost of employing SWaCH members to maintain the compost pits.

Although on-site composting has the potential to solve the organics problem, the program is threatened by the introduction of burn technologies. In addition to the existing refuse derived fuel plant, the municipality has signed a contract to deliver 700 tpd to a new gasification plant. Since the company building the plant has no track record and Pune does not generate sufficient waste to supply the plant, the implications of this contract are unclear.

Table 1. SWaCH Waste Management (tpd)

	Dry	Wet	Total
SWaCH collects	180	420	600
For recycling	90		90
For compost and biogas		123	123
For disposal	90	297	387
Diversion %	50	29	36

Table 2. Organics Treatment in Pune (tpd)

SWaCH-operated compost facilities	2.5
Disha compost facility	100
Other composting facilities	5
Biogas	75
Refuse-derived fuel	1000

Note: Not all of these organics are collected by SWaCH.
Source: Personal communication, Aparna Susarla, SWaCH.

SWaCH Member Income and Organizational Finances

SWaCH members earn most of their income from two sources: the sale of recyclables and the service fee paid by residents. Some may supplement their income with other work, such as street sweeping, but waste work is generally preferred as it is more lucrative. Incomes vary significantly, depending on the route, among other factors: wealthier neighborhoods tend

to generate more saleable recyclables and also pay a higher service fee; but they are also more spread out, which increases transportation time and costs. Households pay a monthly fee, between ₹10 (US \$.19) and ₹30 (US \$.56) (higher in wealthy areas) for the door-to-door collection service; those who do not pay are cut off. Institutions and housing societies pay SWaCH, which then passes the money on to members. Private households often pay the waste pickers directly.

SWaCH takes five percent of the service fees as an administrative fee, which goes into building an operational reserve. In addition, SWaCH receives financial support from the PMC, which allows it to pay professional salaries and support positions that bring added value to the work, for example by doing extensive data collection.

SWaCH members generally earn between ₹4,500 (US \$84) and ₹6,000 (US \$112) per month, with more than half coming from the sale of their recyclables and the rest from collection fees; this is two or three times what most waste pickers earned before SWaCH. In addition, they often get other perquisites from the households they service: secondhand clothing, food, and access to water and toilets; SWaCH provides health insurance and some educational benefits, such as school books for their children.

Web of Accountability

SWaCH operates within, and is successful because of, a web of relationships that provide accountability to the major stakeholders in waste management. As a mass movement that can bring thousands of waste pickers, and sometimes other allied groups, into the streets, KKPKP has the ability to put pressure on local legislators who in turn can pressure the PMC. But SWaCH also has to maintain a regular, dependable service or face the ire of local residents, who have their own political influence and ultimately pay the taxes



A KKPKP Scrap Shop. (photo: WIEGO)

on which the PMC depends. **Over the years, the waste pickers and the municipal government have developed a strong working relationship; but it fundamentally rests on both SWaCH's provision of a quality waste collection service as well as KKPKP's ability to apply pressure through large street protests and media coverage.**

The PMC subsidizes SWaCH—both directly and by providing equipment—but also takes the heat if there are problems. This system of checks and balances is not static; it is regularly tested and constantly exercised. Ultimately, the working arrangement with the PMC is essential for the functioning of SWaCH's entire program.

Further Growth

SWaCH and KKPKP continue to grow and experiment with new approaches. In May 2012, SWaCH launched a zero waste program that encompasses several neighborhoods in an attempt to bring disposal rates as low as possible. The key will be residents truly complying with source separation mandates. This will dramatically reduce the disposal rate by diverting organics, and will generate a clean stream of organic materials for composting and biogas. SWaCH

members will need to educate residents and enforce the source separation rules.

Another goal is to increase coverage and integration of waste pickers into SWaCH. Currently, less than a third of the city's waste pickers are SWaCH members; some continue to do door-to-door collection on their own, without the SWaCH umbrella, and are reluctant to contribute five percent of their income to SWaCH. And there are many neighborhoods—where neither SWaCH nor independent collectors operate—that still need door-to-door collection and source separation.

Towards Inclusive Zero Waste

Over 20 years of organizing, KKPKP and SWaCH have achieved remarkable accomplishments. Waste picker incomes have risen from approximately ₹60 (US \$1.12) to ₹150 (US \$2.80) per day. One of the city's most marginalized and vulnerable populations has become integrated into society. Residents have benefited from improved waste management services at lower costs. The current program saves the city an estimated US \$2.8 million per year.⁵ Better treatment of organics reduces emissions of methane, an important greenhouse gas. Higher recycling rates translate to energy savings, reduced climate impact, and less pressure on natural resources such as forests.



SWaCH representative talking with waste pickers. (photo: Amit Thavara) © KKPKP/SWaCH

As SWaCH grows, the quantity of waste needing disposal will continue to fall. This will mean fewer waste containers in the streets, lower disposal fees, and less waste being burned—all of which will add up to environmental improvements and lower expenditures for the city.

Sources:

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Endnotes:

- 1 “Waste picker” is the term used in English by the KKPKP to refer to those workers in the informal economy who recover recyclable materials from trash. A variety of terms are used in different languages and locations around the world.
- 2 US dollar figures are based on exchange rate of US \$1 = ₹53.635 as of 12 May 2012.
- 3 “SWaCH” means “clean” in Marathi. In addition to its operations in Pune, SWaCH has a contract with the neighboring municipality of Pimpri-Chinchwad. The operations are rather different, however, and this case study focuses on SWaCH’s Pune program.
- 4 In neighboring Pimpri-Chinchwad, where SWaCH also operates, the cooperative operates small trucks to collect the waste.
- 5 Scheinberg estimates avoided collection and disposal costs at €2.2 million per year; PMC pays SWaCH about ₹400,000 per month. Not included are additional PMC expenses, such as the provision of protective gear to SWaCH members.

SAN FRANCISCO, USA

Creating a Culture of Zero Waste

By Virali Gokaldas



Advertisement for composting on a San Francisco bus. (photo: Larry Strong, courtesy Recology)

San Francisco has established itself as a global leader in waste management. The city has achieved 77 percent waste diversion, the highest in the United States, with a three-pronged approach: enacting strong waste reduction legislation, partnering with a like-minded waste management company to innovate new programs, and working to create a culture of recycling and composting through incentives and outreach.



SAN FRANCISCO

State of California

Population: 805,235

Area: 121 km²

Population density: 6,633/km²

Average annual rainfall: 518.16 mm

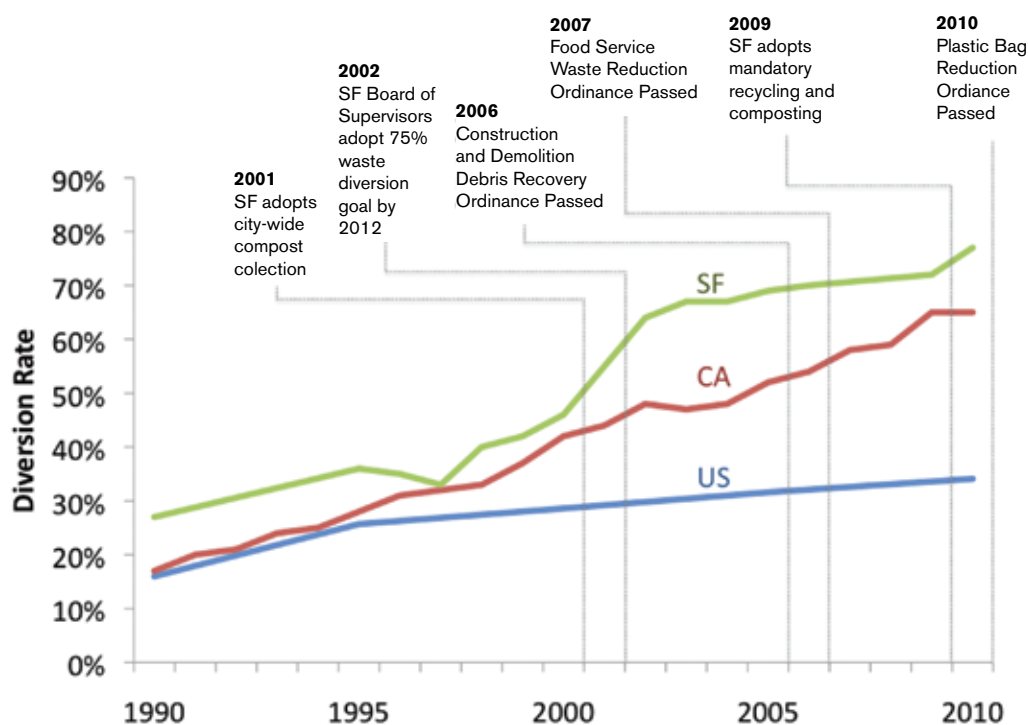
Average temperature range: 8°C to 21°C

Altitude: 16 meters above sea level

Waste diversion rate: 77%

Waste generation: 1.7 kg/capita/day

Figure 1. San Francisco Waste Legislation and Diversion Rates



Source: Adapted from San Francisco Planning and Urban Research Association, 2010.

The City and County of San Francisco is small for a major metropolitan area: only 127 km² houses 805,235 residents and hosts 1.3 million daytime workers. The population is highly diverse, and 1 in 2 residents do not speak English at home. About half of residents live in small multi-family dwellings, with a third owning their homes.

The city's waste is regulated primarily by the San Francisco Department of Public Works and Public Health. The Department of Environment (SFE) is responsible for reaching the city's zero waste goals. SFE works closely with Recology, the private waste management partner with a union workforce that collects, recycles, and disposes of all commercial and residential waste in the city. SFE's Zero Waste team focuses on outreach, implementation of city-mandated recycling programs in sectors, and advancing waste reduction policy at the local and state level.

Building upon Legislative Successes

San Francisco's zero waste journey began with enactment of a state law in 1989, the Integrated Waste Management Act. The law required cities and counties to divert 25 percent of municipal solid waste by 1995 and 50 percent by 2000. Over the last two decades, San Francisco built upon this requirement by passing several successive ordinances that targeted additional areas of the waste stream.

In 2002, the city set an ambitious goal to achieve zero waste to disposal by 2020. Since then, legislation has pushed the city, residents, and businesses to increase their recycling rates. These waste reduction laws include the Construction and Demolition Debris Recovery Ordinance of 2006 and the Food Service Waste Reduction Ordinance of 2007, which requires restaurants to use compostable or recyclable take-out containers. **In 2009, after residents and businesses became accustomed**



San Francisco waste pickers in the early 1900s.
(photo: courtesy Recology)

to voluntary composting, San Francisco passed a landmark law that *mandated* recycling and composting for all residents and businesses.

Most recently, the city passed an ordinance requiring all retail stores to provide compostable, recycled, or recyclable bags starting October 2012. All of these laws have been timed so that the necessary infrastructure is available, and participants are given support, tools, and education. The legislation also empowers SFE to roll out programs to every home and business and enforce rules as needed.

One reason for the continued engagement on zero waste is a citizen base that demands a political commitment to environmental sustainability. San Francisco has activated and empowered civic leaders, including advocates from the environmental field. For example, the Commission on the Environment, a seven-member group that advises the Board of Supervisors, includes an environmental attorney and eco-educator. This group highlights cutting-edge research on environmental issues, and spearheads resolutions and ordinances that then go on to the mayor and Board of Supervisors for a vote. The Board of Supervisors, in turn, reflects the environmental ethics of its residents

and regularly approves environmental legislation.

Another driver for passing these waste reduction laws is the cost associated with landfilling at the Altamont Landfill in Livermore, 82 km away, where San Francisco hauls its waste daily. The city, which does not own its own landfill, contracted with Waste Management for capacity at Altamont in 1987. The contract allows for 65 years of capacity or 15 million tons of capacity, whichever arrives first. At a rate of 1,800 tons daily, the city expects to hit its capacity limit by 2015 or, based on newer diversion figures, by 2016. In anticipation, San Francisco just awarded its next waste disposal contract to Recology, at a new landfill in Yuba County, under similar terms: 10 years or five million tons of capacity, whichever comes first. Hence, increased diversion and hitting zero waste goals will continue to create real savings in landfill costs.

Partnering with a Local Company Yields Inventive Programs

Along with laws obliging residents and businesses to reduce their waste and source separate, San Francisco has developed a robust collection and pricing scheme with its waste-hauling partner, Recology, to complement these efforts. The relationship with Recology dates back to the early 1900's when waste collection was an informal sector activity. Following the earthquake in 1906, the waste pickers created loose federations to compete better. Two companies emerged in the 1920's: Scavengers Protective Association and Sunset Scavenger Company. At the same time, the city began regulating the industry and awarded these two companies exclusive refuse collection licenses in 1932. Each company developed unique and complementary expertise—one in densely packed downtown San Francisco, and the other in outlying residential districts. These companies eventually merged to form Recology, now the sole waste collector in San Francisco.

Over time, the city and Recology have developed a symbiotic relationship. San Francisco conducts oversight, policy development, outreach, and research on technology and best practices, while Recology creates, tests, and runs infrastructure to collect and process trash, recyclables, and compostables. Even though the company has an exclusive right to collect under the 1932 Ordinance, and there is no contract, San Francisco maintains influence over Recology's activities primarily through a rate-setting process that occurs every five years. The city also meets with Recology weekly to discuss any outstanding issues and next steps for programs.

One outcome of this collaboration is San Francisco's current recycling system, the Fantastic 3. **Started in 1999, the Fantastic 3 program uses black, blue, and green carts for trash, recycling, and composting, respectively.** Fully rolled out in 2003, businesses and residences segregate waste at the source, and double-chambered back-loading trucks pick up the trash and recycling bins. Smaller side-loading trucks pick up compostables. The Fantastic 3 program was one of the first in the United States to scale up collection and composting of biodegradable waste.

Garbage and recycling collection rates are structured to incentivize recycling and composting for both Recology and its customers. All customers pay a minimum collection service fee to Recology, plus additional fees based on the volume of garbage they create. For residents, Recology provides recycling and composting services at no additional cost. For businesses, these services are discounted up to 75 percent of trash services to encourage businesses to cut down on the more expensive garbage fee. With this strategy, Recology profits in two ways: first it retains the revenue it receives from recycling and composting services, as well as final sale of recyclables and compost; second, it receives up to a US \$2 million bonus based on exceeding

company-wide diversion goals and reducing city-wide disposal. To help meet goals and increase the value of diverted materials, the company has invested heavily in recycling infrastructure, including mixed-recyclables materials recovery facilities (MRF) and several regional composting sites. Notably, it has also developed a market for compost that goes to local farms and gardeners, thereby improving its own return and closing the loop.

Also noteworthy is that San Francisco has a thriving informal recycling sector, thanks to the statewide bottle bill that places a 5 or 10 cent value on glass and plastic bottles and over 20 recycling centers in the city where residents or collectors can redeem them. The city has a small population of people who make a living collecting cardboard, metal, and e-waste which have higher value markets because of environmentally preferable purchasing rules for state agencies, state laws requiring post-consumer recycled content, and access to robust domestic and international markets.



Composting poster for an apartment building.

Another benefit of the longstanding relationship with Recology is that the city and company both value local hiring and well-paying, union jobs. The agreement between Recology and the Port of San Francisco for leasing land at Pier 96 includes a first-source hiring provision. This requires Recology to fill entry-level jobs first with San Francisco's Workforce Development System, so that these jobs go to economically disadvantaged people from the city. The jobs are well paying, with a starting rate of US \$20/hour compared to the city minimum wage of US \$10.24/hour. The city also requires that Recology provide health benefits for workers. For its part, Recology prides itself on employee well-being and ownership; employees bought out the company in 1986 and started an employee stock options plan. Out of 2,500 employees, approximately 80% own shares in the company. Recology drivers and recycling sorters are represented by the Teamsters union.

program has one manager, four experts in commercial waste, three in residential waste, and three focused on the city government (see chart below). In addition, there are several people focused on toxics reduction in a different program, as well as a separate Outreach division. These 11 positions are responsible for all strategies, programs, policies, and incentives to reach zero waste.

For the commercial sector, one position is focused on construction and demolition waste, working with builders and contractors to deconstruct and recycle building materials at Recology's MRF in San Francisco. Two positions work to help companies fully adopt the Fantastic 3 program and ensure they are in compliance with San Francisco's mandatory recycling and composting law. **Out of 18,000 to 20,000 commercial accounts, approximately 80 percent of companies were separating their organics by 2012;** SFE's focus is now the remaining 20 percent. The last commercial role is focused on policy initiatives such as Extended Producer Responsibility, statewide legislation, or ballot measures.

In the residential sector, all buildings with fewer than six units separate their organics for collection, as do most of the large-scale multi-family dwellings (7,200

Shifting to a Culture of Zero Waste

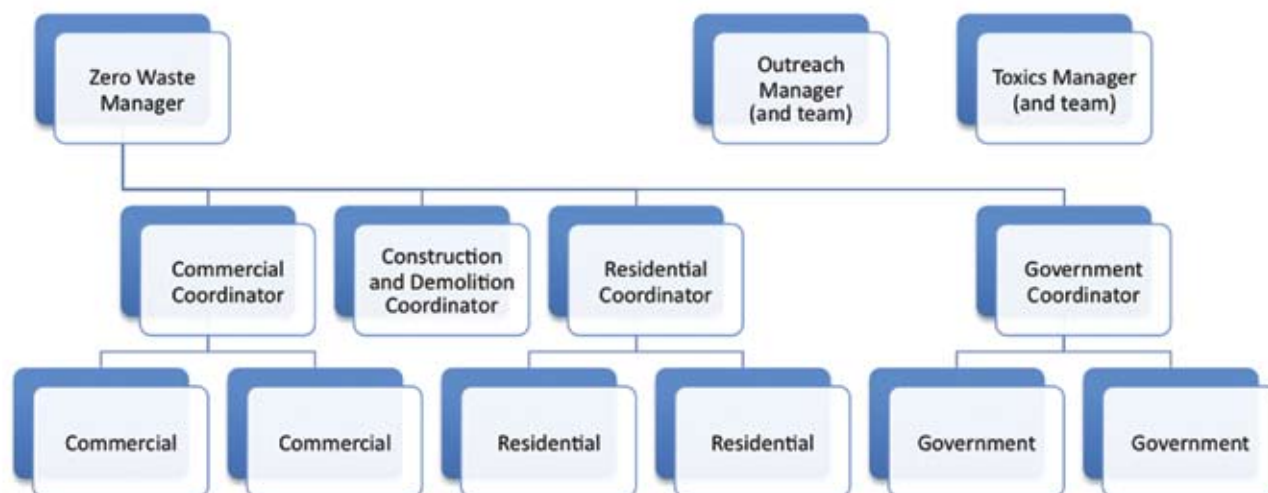
The city of San Francisco has been extremely successful in altering the minds, habits, and culture of its citizens to accept the goal of zero waste. In the US, this is no easy feat, especially given negative perceptions related to food scraps and wet waste in general. In March 2012, the city marked its millionth ton of organic waste turned into compost. Milestones and metrics like these have been essential to creating the story of zero waste.

The city's Zero Waste division is comprised of 11 employees, assigned to different waste segments. The



The blending pad at Jepson Prairie Organics, a modern compost facility used by San Francisco. (photo: Larry Strong, courtesy of Recology)

Figure 2. San Francisco's Department of Environment Zero Waste Division



Source: San Francisco Department of the Environment.

of 9,000). The city is now focusing on the remaining 1,800 buildings of six or more units that may not be composting, estimated to be 20 percent of buildings in San Francisco. This includes public housing, single-room occupancy residences, and rent-subsidized buildings.

One goal is for city government, which produces 15 percent of the city's waste stream, to lead by example. For this reason, three people are primarily focused on government waste reduction and management. To help reduce waste, an online virtual warehouse facilitates exchange of surplus supplies among city agencies. It also aids the city in green purchasing.

In addition to the small Zero Waste team, there are separate outreach programs within SFE, employing 20 environmental advocates. Most of these positions come from Environment Now, an annual green job training program run by SFE. Participants in the Environment Now program come from all over San Francisco, particularly underserved communities of color. These city employees conduct outreach activities on behalf of all the programs at SFE, including Energy Efficiency, Renewables, Toxics Reduction, Clean Air, and Urban Forestry and Gardening. Because they

hail from these areas themselves, the advocates are able to reach traditionally hard-to-reach audiences and improve community participation in environmental initiatives. For the Zero Waste Program, outreach occurs after program rollout, to help create recycling and composting habits once the infrastructure is in place.

Part of the success of SFE can be credited to consistent funding—not from the city, but directly from the rates paid for garbage collection. The overall budget for the Zero Waste Program is approximately US \$7 million annually. These funds come out of an account Recology pays into regularly from its collection revenues.

Future Goals and Zero Waste

San Francisco landfilled 15 percent less in 2010 than it did in 2009. More astounding, its disposal in 2010 was approximately half what it was in 2000. In 2010, San Franciscans each generated 1.7 kg of waste, 77 percent of which was recycled. The city estimates that of the remaining 23 percent another 75 percent is recyclable, which would bring the recycling rate up to 90 percent. The city is close to ensuring full



Recology truck with advertising. (photo: Recology)

adoption of the Fantastic 3 program; it has taken two decades for a behavioral and cultural shift to occur across the city. While SFE goes after adoption by the last 20 percent of larger multi-family dwellings and businesses, it is also setting its sights on a new plant to sort the garbage itself. A low temperature, mechanical/biological separation plant, possibly with anaerobic digestion, would allow sorters to pull apart bags of garbage and recover smaller parts of the waste stream. Ideally, this would be in place before the zero waste deadline of 2020.

Through a unique synthesis of regulation, a long-term partnership, and engaged outreach, San Francisco is creating a model zero waste program.

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ALAMINOS, PHILIPPINES

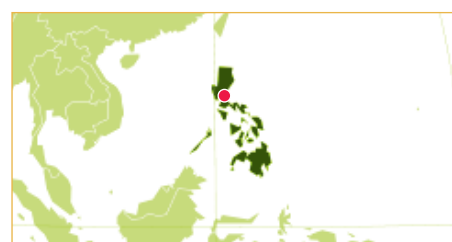
Zero Waste, from Dream to Reality

By Anne Larracas



Eco-shed, composting garden, and collection vehicle of Barangay Sta. Maria, Alaminos. (photo: Anne Larracas)

Alaminos is at the forefront of implementing the Philippines' decentralized waste management law. Through an NGO partnership, village leadership has established comprehensive zero waste strategies, including backyard and village-level composting, source separation programs, and small-scale sorting facilities. As a result, open burning and dumping have virtually ended, and informal sector recyclers are recovering more materials, under better conditions, and selling them for better prices than before. All this was made possible by a bottom-up planning process that brought together local officials and stakeholders to generate zero waste plans at the village level.



ALAMINOS

Pangasinan province

Population: 84,000

Area: 166.23 km²

Population: 84,000

Population density: 505/km²

Average annual rainfall: 2,751 mm

Altitude: 0-20 meters above sea level

Average temperature range: 22°C to 32°C

Waste generation: 0.3 kg/capita/day

Alaminos is home to the most popular tourist destination in the province and the first national park in the country, Hundred Islands National Park. Widely known for its beautiful beaches and abundant wildlife, the park attracts more than 160,000 visitors a year and generates hundreds of jobs and millions of Philippine pesos in revenue for the city.

As with other local government units (LGU) in the country, Alaminos City is divided into *barangays* or villages, of which there are 39. Each *barangay* is headed by a publicly-elected council led by a *Punong Barangay* or village chief. Among many things, *barangay* leaders participate in local planning and governance for the city and the *barangay*, and are in charge of passing and enforcing laws, especially those pertaining to waste management.

Traditionally, the majority of the waste produced in Alaminos has consisted of biodegradable or compostable materials but, as is typical for a fast-developing city, non-biodegradable packaging and products have become a part of everyday life. In recent years, the proliferation and disposal of non-recyclable products have increasingly become more problematic, especially in Alaminos' coastal areas where they threaten marine life and spoil the natural beauty of the city. Tourists to the Hundred Islands also contribute by bringing in and disposing of plastic packaging.



Burning of agriculture waste was a common sight in Alaminos during harvest season. (photo: Anne Larracas)

Waste management in the Philippines is covered by a 2000 law popularly known as Republic Act 9003. Before its passage, waste was managed almost wholly by municipal governments that typically would haul mixed waste to a central dumpsite. Under the new law, the public and all levels of government share responsibility for managing waste, with the biggest tasks—ensuring segregation, composting, proper collection and storage, and building infrastructure—resting with *barangay* officials.

Specifically, RA 9003 stipulates that all LGUs should have and implement a comprehensive solid waste management plan for the “safe and sanitary management of solid waste generated in areas under its geographic and political coverage.” **It also mandates the construction of a materials recovery facility in each *barangay*, segregation at source, *barangay* and municipal composting, and 100% *barangay*-led segregated collection. It outlaws mixed waste collection and open burning as well as uncontrolled and semi-controlled dumpsites.**

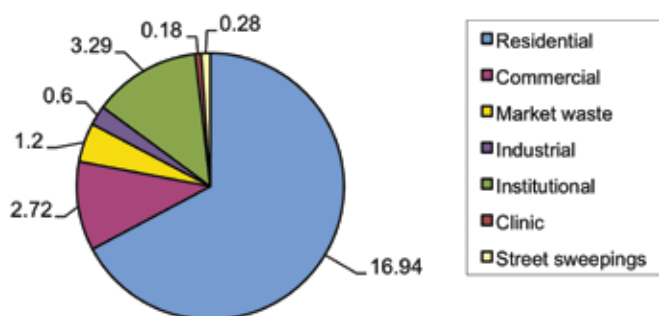
Situation on the Ground

However, by 2009 waste management programs at the *barangay* level in Alaminos, as in most of the country, were non-existent. Attempting to make the *barangays* conform to RA 9003, the city first encouraged and later mandated that the *barangays* take more responsibility for waste management. Neither approach was effective. Alaminos was still maintaining a central dumpsite; waste was collected daily by the city, but in only 14 of the 39 *barangays*. The remaining villages had to deal with their own waste, which led to widespread open burning and dumping. Households did not practice waste separation, and mixed waste collection was still commonly practiced. The city had built a materials recovery facility in 2004, but for years it was under-utilized due to lack of a

comprehensive waste management plan.

A survey done by the city classified the waste into three streams: biodegradable, non-biodegradable, and residual. Biodegradable waste, roughly two-thirds of the total, consisted of kitchen and garden waste, animal waste, and human waste. A small non-biodegradable stream was comprised of metal, glass, rubber, dry papers/cartons, cloth, dry leather/feathers, and recyclable plastic. The remaining third was residual waste including sanitary napkins, plastic bags, ceramics, composite packaging such as Tetra Paks, and candy wrappers. The total volume of waste generated in the city (25 tons per day) mostly came from residences, as shown in Figure 1, and was projected to increase 1% each year. In order to implement RA 9003, clearly the citizens of Alaminos City would need to be active participants.

Figure 1. Sources of Waste Generated in Alaminos (tons per day)



Note: Actual 2004 figures.

Source: Alaminos 10-year Solid Waste Management Plan Draft

To address the growing volume of waste, the city planned to take out a bank loan to invest in a waste conversion facility that would transform solid waste into hollow building blocks and compost. The facility was projected to cost ₱26 million (US \$605,000). The technology was untested however, and many believed that it was unwise for the city to invest a substantial amount in an unproven technology, particularly one that promoted centralized collection.

The Birth of a Zero Waste City

In August 2009, the Global Alliance for Incinerator Alternatives (GAIA) proposed a partnership with the city government. The Zero Waste Alaminos project was born the following month. GAIA provided one staff member for the project team, as well as training in zero waste in the form of skillshares, meetings, technical information, assistance in strategic planning, and support to *barangay* leaders as they drafted their own waste management plans. GAIA also provided financial support (for printing educational materials, buying shredders for organics and plastics, awarding mini-grants for barangays to build eco-sheds or purchase vehicles, etc.). The city provided two full-time employees for the project team, transportation for the team and trainers, logistical support for all activities and trainings, technical assistance, and support in strategic planning for the *barangays*. A fourth team member was recruited from Mother Earth Foundation (a GAIA member) to serve as a consultant for all the *barangay* technical consultations.

After two years, ten *barangays* had achieved and five were close to achieving full compliance with RA 9003, and many of the other *barangays* were well on their way.

Intervention and Strategies

To begin, a comprehensive survey was administered to assess and record the existing waste management practices throughout Alaminos. Team members travelled to all 39 *barangays* where they interviewed *Punong Barangay* (village chiefs) and documented what they saw.

Workshops were held to begin conversations among leaders at the *barangay* level about waste segregation and collection, composting, the RA 9003 law, the components of the Zero Waste Alaminos project, planning, etc. Each *barangay* sent three

representatives; city officials, including all department heads, were also in attendance, as was the project team.

After the workshops, the *barangays* held technical consultations and assemblies back in their villages. These meetings, held over a 14-month period, were the key to the Alaminos project's success. Technical consultations required the attendance of the entire *barangay* council. At the end of the consultation, a complete waste management plan—including a calendar of activities, investment plans for infrastructure or equipment, a budget with funding sources, and task assignments—was generated and signed by the entire council and all residents in attendance. This plan was then used as the blueprint for the *barangay's* waste management program and was presented in assemblies to residents for approval and comments before it was implemented. While the project team was typically very active in leading the technical consultations, once the *barangays* had formulated their own waste management programs, the participating leaders took ownership of the project in their *barangays* and led the assemblies themselves.

Additional stakeholders from various city departments, city workers in waste management and collection, and representatives from junk shops, the tourism industry, the boat owners' and operators' association, hospital and medical health facilities, academia, business, and various religious sectors were consulted in separate sessions to expand participation in implementing RA 9003. **As a result, resorts and inns established composting facilities and improved waste segregation, tourists were educated and reminded about the strict no-littering and waste separation policies, hospitals and clinics started to implement waste segregation, and schools and universities improved their waste segregation and composting practices.**



A team member interviews a *Punong Barangay* about the current waste management system in his village. (photo: Rei Panaligan)

At the end of the Zero Waste Alaminos project, a second comprehensive survey was administered to evaluate the implementation of the management programs developed through the course of the project. Each of the 39 *barangays* were visited by project team members who interviewed residents and recorded all changes related to waste management that had occurred since the initial survey was conducted.

The survey targeted 10 percent of the population in Alaminos and revealed both positive and negative results. A high percentage of residents were practicing waste separation (88% of those surveyed) and composting (53%), and many said they knew about their village's waste management program (56%) and the national law (63%). On the other hand, some residents (58%) said that the information they received from barangay officials about waste management was not enough, and there were those who were not participating in the program because they felt it was too cumbersome. Still, the majority expressed appreciation for the new waste management program in most of the *barangays* and were willing to support and participate in the city's program.

Lessons Learned

The Alaminos project encountered multiple challenges and roadblocks. Initially, political tensions threatened to prevent the project from getting off the ground. An existing rivalry between city and many *barangay* officials made some of the *barangay* leaders apprehensive and even hostile to the idea of cooperating with the city. **A grassroots approach allowed many milestones to be achieved in a few months, in contrast to the top-down strategy employed by the city government previously.** While the city's government-organized workshops on waste management were attended by only a handful of *barangay* leaders, the project's first zero waste workshop had more than 100 *barangay* official participants, and 21 out of 39 *barangay* leaders attended a second workshop months later.

The project team worked with all the *barangay* leaders regardless of their political affiliations. Consequently, the project's momentum and the stakeholders' enthusiasm were easily sustained, and activities after the elections were immediately resumed with few problems. GAIA's most important role in Alaminos over the two years may well have been as liaison between city and *barangay* officials who had not seen eye to

eye about waste management for years. The presence of a neutral force facilitated objective discussion and resolution of important issues.

A brochure supplied by GAIA during and after the *barangay* meetings was very helpful in reinforcing key messages from the technical consultations and assemblies. *Barangay* leaders were able to give brochures (poster size) out to people when they visited. The residents were asked to sign a log book saying that they had received the brochure. Later, when officials saw open burning and other signs of prohibited activities, the residents were no longer able to use the old excuse that they did not know the law. Open dumping and burning decreased significantly. In 2009, almost every field had a pile burning; by 2011 there were almost none. It also helped tremendously that there are no hazardous industries in the city, and that Alaminos already had some great initiatives in place, such as the vermicompost program and a program to promote organic agriculture.

Most importantly, the city government fully committed to the zero waste vision, providing employees to serve full-time as members of the project, who were highly respected by *barangay* leaders.

Results

The project grew by leaps and bounds in the span of two years. While in 2009 almost no *barangays* had begun implementation of RA 9003, in 2011, 25 had local ordinances on waste management that specifically banned open burning and dumping and mandated household segregation and composting.

Backyard composting has long been common in rural areas throughout the Philippines; many locals have practiced open burning for decades and believed that burning waste—especially agricultural waste—is beneficial to the soil, helps plants bloom, and drives away pests. Before the project, it was not unusual to



Barangay officials and residents in all 39 barangays of Alaminos were included in discussions about proper waste management. (photo: Anne Larracas)



An eco-shed is checked to make sure it is being used properly by the barangay. (photo: Anne Larracas)

find non-biodegradable waste mixed in with compost. Fifteen *barangays* are now consistently implementing pure composting. Vermicomposting has also increased, and the city has provided *barangays*, as well as selected schools that started their own vermicompost programs, with worms and organic fertilizer.

Seventeen *barangays* have started comprehensive collection systems—including collection schedules, collection vehicle(s), collectors, a working MRF (materials recovery facility), and in some cases, fees collected from residents—that were agreed upon by their village councils and residents. Fifteen of these are also segregating at source.

Thirty-two *barangays* have built eco-sheds which provide temporary storage for residual, hazardous, and small amounts of recyclable waste. These materials are then collected by the city and brought to the city materials recovery facility for processing (residual waste) or long-term storage (hazardous waste).

In many *barangays*, there is ample space for backyard composting, so the waste collected and brought to the materials recovery facilities is mostly residual. Since the waste is typically collected twice a month, residents are reminded to clean and store dry residual waste so that it will not smell or attract pests.

Recently, the city announced a “No-segregation, no-collection” policy. Residents will receive a warning if their waste is not separated. After a couple of warnings, it will not be collected. The city has already seen a noticeable reduction in the volume of overall waste, as well as a reduction in organics and recyclable matter in the waste collected, although the changes have not yet been measured.

The city has considered—but not yet passed—a ban on plastic bags. However, it has put in place a residual waste management program to address plastics collected from the *barangays*. **Plastics are shredded, mixed with concrete in a 40/60 ratio, and turned into pavers that are used to improve**

sidewalks in the city center. The entire sidewalk in front of City Hall and the Alaminos Cathedral has been renovated using these bricks. Several public schools in the city have also received the pavers to improve their walkways. The bricks cost about half as much as traditional pavers, and the city plans to commercialize their production.

In 2010, the city council passed into law the first zero waste city ordinance in the country, a local version of RA 9003 that includes a stronger provision against incineration and specifies how Alaminos will implement collection and conduct public education, among other things. This historic legislation upholds segregation at source, sets a target for waste diversion, and reinforces the national ban on incineration by declaring it a prohibited act.

The Informal Sector

Before the Zero Waste Alaminos project, approximately 35 waste pickers were working in Alaminos City. While the intention was to integrate these individuals into the project from the beginning, they unfortunately left the city during preliminary project negotiations. However, in early 2012, the central Alaminos City dumpsite was supporting as many as 50 or 60 waste pickers.

The number is larger because of improved conditions and access to new sources of materials. For instance, before the project, all residual plastic waste was brought to the dump, and waste pickers were forced to rummage through organics in order to collect any salvageable materials. **As a result of the city's "No-segregation, no-collection" policy, there are fewer organics mixed in and waste pickers can more safely recover recyclables and plastics.** Furthermore, waste pickers are able to collect clean, separated plastics from public service buildings (e.g., churches, schools) and sell them back to the city for a set price of ₱2.50/kilo (US \$.06). In pre-project days, the price of materials was sometimes



Pavers made from concrete and recovered plastic are used to improve walkways in the city. (photo: Anne Larracas)

up to the whim of the buyers. Today not only collection is easier, selling is as well.

In fact, the city allots an average of ₱25,000 (around US \$600) per month to buy the bulk of the plastic wastes for its sidewalk paver program from the waste pickers. Even when there are fewer recyclables to collect, the waste pickers still earn reliable income (₱700 - ₱1500 or US \$16.50 - \$35.50 per week) this way.

Recyclable waste continues to be directly sold by residents to itinerant junk buyers who come to the villages on a daily basis. The project has actually benefitted the itinerant buyers as well as the waste pickers. Since waste separation is now mandatory in many *barangays*, recovery of useful materials has increased, so the buyers can buy from more households.

Last but not least, ***barangays* have gained a greater appreciation for the service provided by the itinerant buyers**—especially after learning that the *barangay* leaders were responsible for collecting all discards from the households. Because the work of the itinerant buyers reduced the volume to be collected, the *barangays* did not need to hire many new employees or any larger vehicles to accommodate

all of the discards from the households. In addition, many *barangays* were able to implement a bi-monthly rather than a more frequent collection schedule, thereby saving labor costs. In some *barangays*, the itinerant buyers became the official waste collectors for the village. In others, the fees normally charged itinerant buyers were eliminated in exchange for their collecting recyclables from all the houses.

The Road Ahead

Although implementation of waste management programs has increased in the *barangays*, much more needs to be done. Two years is surely not long enough to reverse decades of old habits. Ten *barangays* passed every facet of the final evaluation with flying colors, while nine of those that did not pass were at least halfway to achieving their waste management goals. The remaining villages have much to do, but with the proper foundation now in place, many are expected to progress with their program implementation in the coming months.

Sources:

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Facts And Figures Cy 2010, City of Alaminos, Pangasinan, Philippines.

Field visits and interviews by the author.

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HERNANI, SPAIN

Door-to-Door Collection as a Strategy to Reduce Waste Disposal

By Cecilia Allen



Protest calling for a moratorium on the construction of the incinerator and in support of a zero waste plan. (photo: Gipuzkoa Zero Zabor)

The regional waste management consortium

in Spain's Gipuzkoa Province, faced with a nearly full landfill in 2002, proposed building two new incinerators. Citizens strongly opposed the incinerators and prevented one from being built. Although the second is now under construction, Hernani and two other small cities in the region have established an ambitious program of door-to-door collection of source-separated waste, including organics, that has been enthusiastically embraced by residents. The amount of waste going to the landfill has been reduced by 80 percent. With new political leadership opposed to incineration, door-to-door collection is poised to expand throughout the region.



HERNANI

Province of Gipuzkoa

Population: 19,300

Area: 40 km²

Population density: 485/km²

Average annual rainfall: 1,400 mm

Altitude: 44 meters above sea level

Average temperature range: 9°C to 20°C

Waste generation: 0.86 kg/capita/day

Waste diversion rate: 79%*

Waste to landfill reduction rate since the beginning of the program: 80%**

Public spending per capita in solid waste management: US \$115 per year

* Estimated as resources recovered out of the total produced.

** Compares waste landfilled in April 2010—the last month of the former system—and amount landfilled in April 2011.

Practices vs. Technology

Hernani is a city of over 19,000 residents in the Basque Country of Spain. Together with nine other municipalities, it is part of the San Marko *mancomunidad* (a free association of municipalities), created to manage solid waste jointly. At the provincial level, all the *mancomunidades* plus the provincial government comprise a consortium that promotes and manages the Gipuzkoa Integrated Waste Management Plan. Hernani's former municipal waste management system strongly relied on waste disposal complemented by a limited recycling system. While citizens could voluntarily dispose of recyclables in the four large containers placed on the streets, most of the city's waste went to the landfill.

In 2002, when the San Marko landfill was nearly full, the provincial government presented a controversial plan: the addition of another container for the voluntary recycling of organic materials and the construction of two new incinerators. Citizen opposition to incineration was immediate. Since then, the region has been immersed in a tenacious dispute between those who want to build the incinerators and those who promote

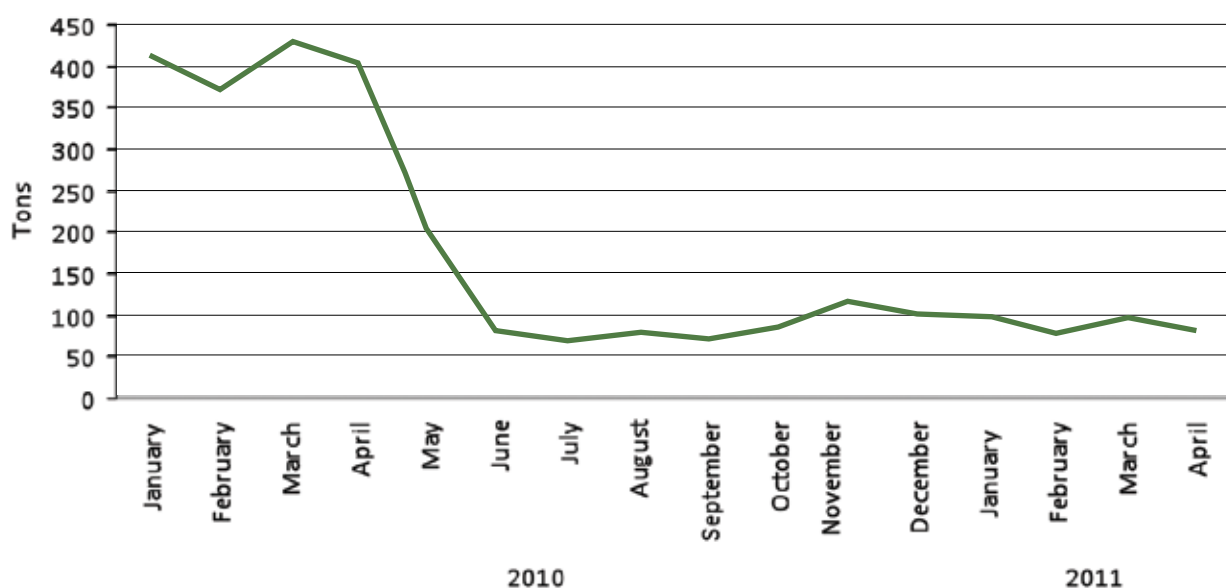
waste prevention policies and better source separation strategies. After years of struggle and mobilization, the people stopped one incinerator from being built, but the government moved forward on the other one.

Joining the citizens' opposition, some municipalities decided not only to reject the plan to build new incinerators but also to implement an alternative to burying or burning. Usurbil was the first municipality to do so. This town of 6,000 people established a door-to-door collection system of source-separated waste streams, including organic materials. In just six weeks, the amount of collected waste destined for landfills dropped by 80 percent. **The resource recovery rate registered in the first year was 82 percent.** In 2008, before door-to-door collection started, Usurbil was taking 175 tons per month to the landfill. One year later, the amount had dropped to 25 tons.

Implementing Changes

In May 2010, after two months of dialogue with the citizens to explain and solicit input on the new system, Hernani followed the model of Usurbil. The municipality distributed two small bins per household, placed hooks

Table 1. Municipal Solid Waste Landfilled in Hernani



Note: The door-to-door collection started in May 2010.

Source: Based on data published by the government of Hernani: <http://www.hernani.net/es/servicios/puerta-a-puerta>.

to hang the bins and bags at the front of houses and buildings, removed the large containers from the streets, established waste segregation as mandatory, and launched door-to-door collection. Citizens began to place separated organics, light packaging, paper and cardboard, and residuals in front of their houses.

Each stream has a designated pick-up day: organics on Wednesdays, Fridays, and Sundays; light packaging on Mondays and Thursdays; paper and cardboard on Tuesdays; and residuals on Saturdays. Light packaging is placed in bags, and the government sells reusable bags for this purpose. Paper and cardboard are tied in bundles or placed in boxes or bags. Organics are placed in the bins provided by the government, and the residuals are disposed of in bags. The collection is done by a public company called Garbitania, created by the governments of Hernani, Usurbil, and Oiartzun. Collection is done at night, with a complementary shift during the morning. Each bin and each hook have a code that identifies the household that uses them. This allows the government to monitor separation in each household. If the collector identifies a stream that does not correspond to that collection day, s/he puts a sticker with a red cross on the bin and does not collect that waste. The information is given to the administration office, and the household receives a notice explaining why the waste was not collected.

For glass, the system of large containers on the streets was maintained, and door-to-door collection is done only in the old part of the city. A non-profit association created by producers, packers, bottlers, and recyclers handles this stream. The association is funded by contributions the packaging companies pay for each product they put on the market.

If someone misses the door-to-door collection, there are four emergency centers to drop off waste. There is also a drop-off site that takes bulky waste, electric and electronic devices, and other waste not covered by the door-to-door collection free of charge. For businesses,



Bins for organics used in Hernani and Usurbil.
(photo: Gipuzkoa Zero Zabor)

the collection schedule is the same as for households, with an extra day of collection for residuals. In rural areas, home composting is mandatory, and other streams are either collected door-to-door or taken to drop-off centers.

Under the new system, Hernani promotes home composting throughout the municipality. People can sign up for a composting class, request a home composting manual, and receive a compost bin for free. There is a phone line to get composting advice, and there are compost specialists who can visit households in need of assistance. **People who sign up to compost at home receive a 40 percent discount on the municipal waste management fee.** The fee for businesses varies according to the collection frequency and the amount of waste produced, using Pay As You Throw criteria.

The San Marko *mancomunidad* operates a materials recovery facility where light packaging is sorted for sale. Paper and cardboard are sold to a recycling company nearby. Organic materials must be taken 50 km away to a compost plant, operated by the provincial consortium. **Source separation is reflected in the material that Hernani takes to the compost**

plant, which consists of—on average—only 1.5 percent impurities (non-organics and other pollutants).¹

In the first full month of the door-to-door collection, **the residuals dropped by 80 percent, and the total waste managed decreased by 27 percent.**²

In 2010, the municipality landfilled 53.8 percent less waste than in 2009 (5,219 tons in 2009 and 2,412 tons in 2010), and door-to-door collection had only begun in May.

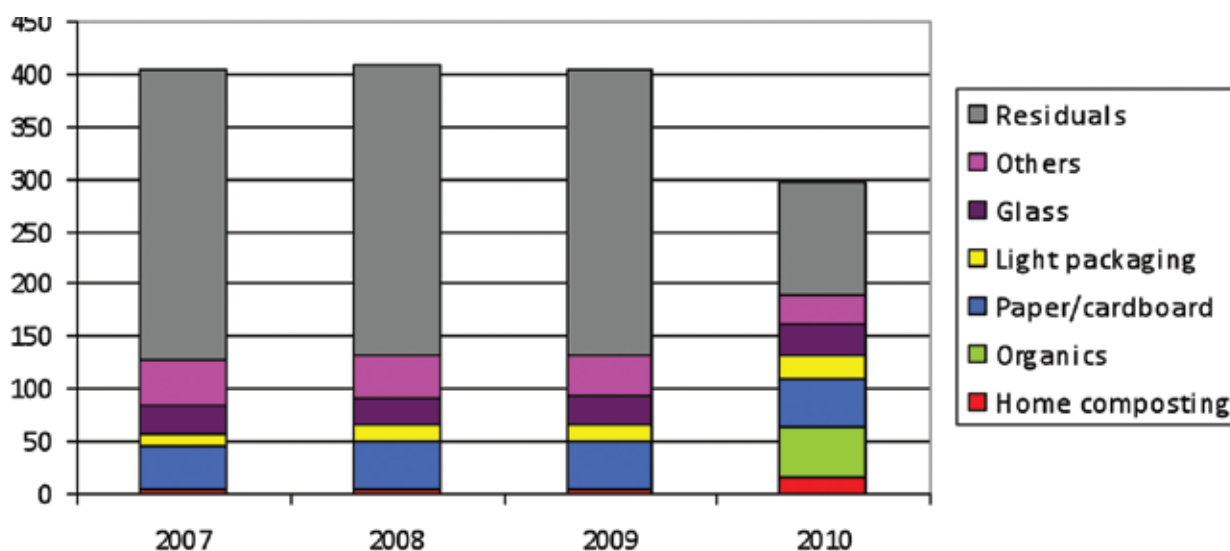
“Our state-of-the-art technology is the neighbors.”

Communication and community participation have been key to the success of the program. The conviction that the use of incinerators was the worst option and that door-to-door collection was feasible and the best solution for Hernani supported the change. **In the two months prior to the implementation of the new collection system, the government organized meetings to explain and revise the new system.** As the mayor declared, “Our state-of-the-art technology is the neighbors. If the neighbors separate well, there is no need to build an incinerator.”³

The governments that have implemented door-to-door collection programs have promoted the creation of citizens’ committees to monitor their implementation. Moreover, local *Zero Zabor* (zero waste) groups have emerged in these cities, building on earlier anti-incinerator movements. The different local groups are working together in *Gipuzkoa Zero Zabor*. In a few years, these volunteer activists have advanced the conversation from opposing incinerators to promoting an authentic zero waste strategy that focuses on preventing waste—through changes in design, production, and consumption—and recovering all materials discarded in a safe and sustainable manner.

Hernani joined other municipalities and groups opposing the incinerators and promoting the extension of door-to-door collection to the entire Gipuzkoa province. Despite the success of the door-to-door collection systems implemented so far, the construction of the incinerator in Zubietta is underway. Many municipalities in the region are reluctant to opt for zero waste strategies, and this threatens to undermine the progress being made in cities that use these strategies. However, after the municipal elections in July 2011, the political scenario changed.

Table 2. Evolution of Waste Streams in Hernani (kg per person per year)



Source: Mancomunidad de San Marko.

The groups supportive of a five-year moratorium on the construction of the incinerator began to administer most of the municipalities as well as the provincial government. Given this context, it is likely that door-to-door collection systems will continue to spread.

Waste Production in Hernani

In 2010, Hernani produced an average of 500 tons of municipal solid waste per month, and had a per capita generation of 0.86 kg per day, compared to 1.1 kg the year before. The recent economic crisis in Spain has resulted in a general reduction in waste production in the country. The implementation of the new door-to-door collection system and the communication campaign about waste may have raised people's awareness about waste, leading to changes in buying behavior. Finally, the former system of large bins probably made it easier for people to put non-residential waste in the bins (for instance, construction and demolition waste), and the current system of individual bins makes it more difficult to do that.

The following tables show the evolution of the composition of residential waste in Hernani before and

after adoption of the door-to-door collection system. Table 3 provides the specific amounts for each waste stream.

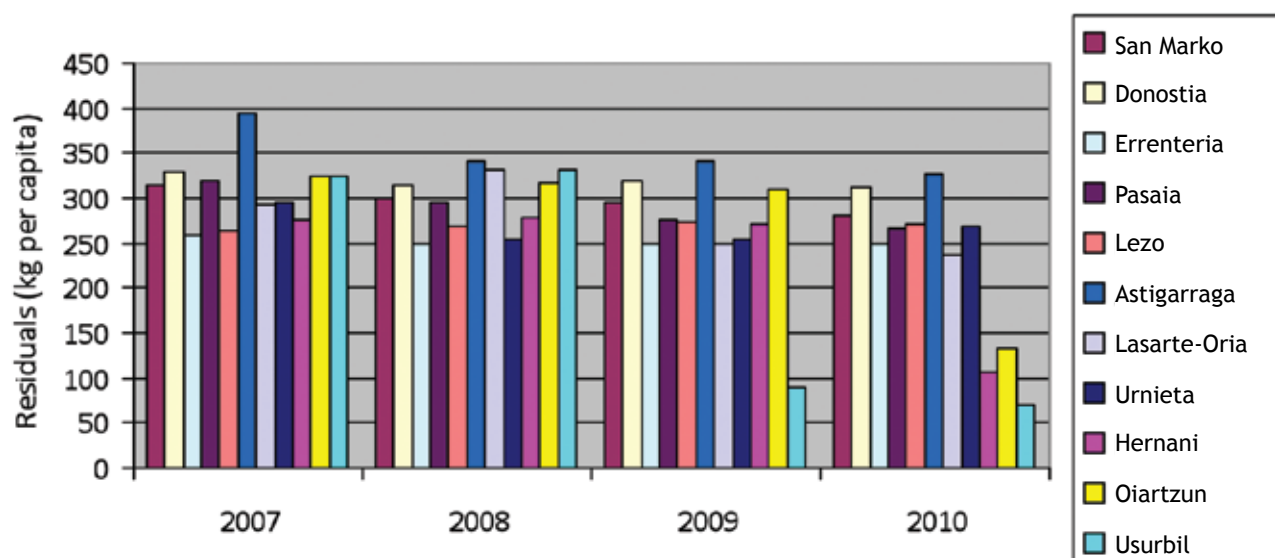
Table 3. Rates by Stream (kg per person per year)

	2007	2008	2009	2010
Home compost	4.5	5.4	5.7	17.1
Organics	0	0	0	47.6
Paper/cardboard	41.3	45.5	44.1	44.1
Light packaging	12.2	14.4	15.8	22.8
Glass	26.8	25.9	27.2	30.4
Others	43.6	40.5	40.6	27.6
Residuals	276	277	269.9	106.7
Total	404.4	408.7	403.3	296.3
Prior year change		1%	-1.4%	-26.5%

Source: Mancomunidad de San Marko.

The table below shows that Usurbil, Hernani, and Oiartzun have reduced the residual waste per capita in a very short time, while in other municipalities the figure remains constant. The fourth municipality to adopt door-to-door separated waste collection, Antzuola, has reported that 90 percent of the discards collected are separated for recovery, and residuals represent only 10 percent of the total collected there.⁴

Table 4. Decrease in Per Capita Residuals in Hernani, Compared to Other Municipalities



Source: Mancomunidad de San Marko.

Table 5. Estimated Cost Comparison of Door-to-Door System with the Previous System in Hernani

			Door-to-door system (€)	Traditional system (4 containers) (€)
Expenses	Collection		1,356,000	486,000
	San Marko	Contribution to the <i>mancomunidad</i>	210,000	210,000
		Residuals landfill	152,000	696,000
		Lapatx organics plant	156,000	0
		Maintenance of underground containers	0	40,000
Total expenses			1,875,000	1,432,778
Income	Light packaging		198,000	0
	Paper/cardboard		90,000	0
Total income			288,000	0
Net cost			1,587,000	1,432,778

Notes:

1. Annual calculation, estimated from 2011.

2. The comparison is done with the previous system of 4 large containers. Hernani did not make any comparison with the system promoted by the provincial government (i.e., 5 containers) but the data from Usurbil show that that system is more expensive than door-to-door collection and yields much lower recovery rates.

3. Income for light packaging and paper/cardboard is estimated, based on the average collection figures of 2010.

4. The municipalities must transport the organic stream to the Lapatx compost plant, resulting in increased costs. The average cost for Hernani is €130 - €135 per ton of organic waste taken to the compost plant (including transport to the plant).

Source: Oficina del Puerta a Puerta, Ayuntamiento de Hernani.

Table 6. Cost Comparison of the Door-to-Door and Container Collection in Usurbil

	Containers 2008	Containers & Door-to-door (as of March) 2009	Door-to-door 2010
Expenses (€)	493,444	565,961	670,015
Income (€)	135,447	202,669	452,269
Net cost (€)	357,997	363,292	217,746
Self-finance rate	27.4%	35.8%	67.5%

Source: Informe de Gastos e ingresos de la recogida de residuos 2006 - 2010, Ayuntamiento de Usurbil.

The government of Hernani compared the costs of the door-to-door collection system with the previous one that used four large containers, as shown above.

Usurbil has collected enough data to compare the actual expenses of both collection systems for a full year. **The results show that the door-to-door collection system is actually less expensive than the container system, mostly due to the income generated from the sale of recyclable materials.**

Skeptics of source separation maintain that the costs increase prohibitively when moving from one-stream collection to a differentiated collection system. Although collection expenses do tend to increase in most cases, that is not the whole story: the differentiated collection increases resource recovery, which offsets disposal costs and creates a source of income through the sale of recyclables (and organics, in other cities). As shown above, in Usurbil the new system was less expensive than the previous one. In the case of Hernani, the slightly higher costs for

the door-to-door collection were due at least in part to the need to transport the organics to a distant plant. It is also important to note that **the door-to-door collection and recycling system has the additional benefit of creating more jobs than waste management strategies that are based on mass burying or burning**; the extra money required to support the system provides a significant boost to the local economy. In total, 16 jobs were created in Hernani by door-to-door collection.

So far Usurbil, Oiartzun, Hernani, and Antzuola have begun implementing door-to-door collection of source separated waste, all with great results. Both governments and community groups are showing the positive changes produced by these strategies in terms of sustainable materials management, pollution prevention, and the local economy. Moreover, what they are showing is that a community-based waste management system can bring impressive results in a short period, if only governments dare to lead the way and count on their citizens.

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Mancomunidad de San Marko www.sanmarko.net.

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Data provided by Olatz Urrutibeaskoa, Environmental specialist, government of Hernani.

Special thanks to Pello Zubiria and Gipuzkoa Zero Zabor for the information and the photos provided.

Endnotes:

- 1 <http://www.hernani.net/es/servicios/puerta-a-puerta/499-karakterizazioak>.
- 2 Estimate based on waste production and collection data provided by Mancomunidad of San Marko.
- 3 Marian Beitialarrangoitia: "Tenemos una base sólida para poner en marcha el puerta a puerta." 5 December 2009. Published in <http://www.hernaniatezate.net/page/8/>.
- 4 <http://www.noticiasdegipuzkoa.com/2011/06/08/sociedad/euskadi/antzuola-anuncia-que-con-el-puerta-a-puerta-reciclan-el-90-de-la-basura> and <http://goiena.net/albisteak/hiru-hilabetean-hondakinen-90-berreskuratudute-antzuolan-atez-atekoarekin/>.

LA PINTANA, CHILE

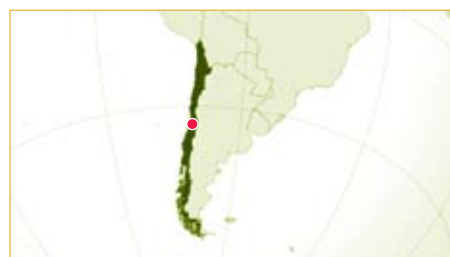
Prioritizing the Recovery of Vegetable Waste

By Cecilia Allen



Education activity showing outcomes of vegetable waste recovery. (photo: DIGA)

The Chilean community of La Pintana has found that recycling their largest segment of waste—fruits, vegetables, and yard clippings—can save them money, produce valuable compost, and reduce greenhouse gas emissions. The program cost very little to initiate and has grown steadily for seven years, through an ongoing education campaign about source separation for residents who reap benefits in the form of new trees and public parks. Though participation rates are still modest, La Pintana's vegetable waste¹ recovery program is already making a substantial contribution to the community's financial and environmental sustainability.



LA PINTANA

Metropolitan Region of Santiago

Population estimate for 2011: 210,000

Area: 30.31 km²

Population density: 6,928/km²

Average annual rainfall: 367 mm

Altitude: 635 meters above sea level

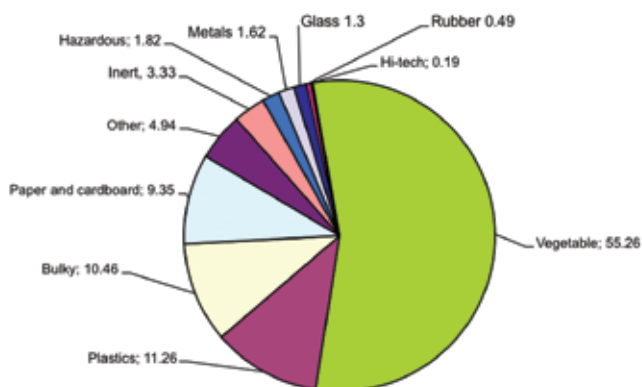
Average temperature range: 6°C to 21°C

Waste generation: >0.77 kg/capita/day

Public spending on vegetable waste management: US \$3/capita/year*

* This figure is only an estimate, based on program expenses per person covered.
Exchange rate: US \$1 = CL \$497.

Figure 1: Municipal Solid Waste Characterization in La Pintana (by percentage)



Note: The figure counts all municipal solid waste produced, including the materials recovered by the informal recyclers.

All over the world, municipalities have to manage increasing amounts of waste with scarce resources. Often, a large portion of the municipal budget for solid waste management is spent on waste collection and disposal, leaving little money for specialized programs. The situation in La Pintana—one of the communes² that constitute the heavily-populated Metropolitan Region of Chile—is no exception. Despite belonging to the national capital region, this is one of the poorest communities in the country, and 80 percent of the environmental agency's budget is allocated to the collection and disposal of solid waste. Nonetheless, while other governments might see this as an obstacle to the incorporation of waste prevention and resource recovery strategies, La Pintana focused on making better use of the available resources and started a promising program that is already yielding significant results.

The head of *Dirección de Gestión Ambiental* (Environmental Management Agency) of La Pintana explained the municipality's decision to take a new approach to waste management with the adage, "Insanity is doing the same thing over and over, expecting to achieve different results." Recognizing, as well, the importance of continuing that which is working well, the La Pintana commune identified all the actors involved in waste management (e.g., businesses, formal and informal recyclers, citizens, government

bodies) and their different levels of responsibility in waste generation. The municipality understands that discarded materials are resources, and as a result, waste is viewed as an opportunity, not as a problem to get rid of. The municipality also understands that the solutions need to be local. The further waste travels from the point of generation, the bigger a problem it becomes and the more likely its management will be unsustainable. **Thus, the priority is to manage resources as close as possible to where they are generated.**

Guided by this vision, an analysis of the local situation was carried out. First, a waste audit was conducted, which showed that the solid waste generated in La Pintana is 0.77 kg/person/day. Second, a characterization of waste by source was carried out (see Figure 1). Finally, a program based on waste streams (instead of source) was developed, guided by the principle that it does not matter if a given waste stream is produced by households or businesses; the treatment depends merely on its characteristics.

Separation and Collection

With this data in hand and the system designed, in December of 2005 the municipality launched its new program. Unlike many materials recovery strategies adopted in Latin America, this one did not focus on recycling dry materials, but on recovering vegetable waste. This decision was fundamental, since **vegetable waste is the largest waste stream, the one that makes recovery of recyclables more**



Worm beds in La Pintana. (photo: DIGA)



Leaflet to promote source separation. (poster: DIGA)

difficult, and the one that creates greenhouse gas emissions and leachates in landfills. The program was built upon existing infrastructure and local financial resources. It has been steadily growing since its launch, and while it still has only modest participation rates, there is an ongoing effort to increase participation whenever the budget allows for more public education campaigns.

The government provides 35-liter bins to residents for vegetable waste. People are asked only to separate out fruits and vegetables for collection and composting, not meat or dairy products, although some end up being mixed in anyway. The consumption of meat in this poor commune is very low, however, so there is little animal product waste. Whatever meat and dairy waste is produced goes to the landfill. The government is looking into treating these materials through *hermetia illucens* (black soldier fly) in the future.

The municipality conducts a communication campaign with residents in door-to-door visits. The outreach workers—mostly college graduates in environmental fields—are hired specially for these campaigns. During the visits and in the ongoing workshops held by the

government, source separation is emphasized.

The municipality provides people both direct and indirect incentives to separate their waste. Citizens receive free compost, and their neighborhoods are improved with the construction of public parks, planting of new trees, maintenance of sports clubs, etc., that improve their quality of life and their relationship with the environment.

The system for collecting separated waste was organized by simply rescheduling existing routes. Consequently, neither the costs nor the number of trucks increased. Waste is still picked up six days a week: three days for vegetable waste and three for the rest. One third of the city is serviced by the municipality, and the rest by a private company; both collect two waste streams: vegetable and other. The separated collection system is done only in those households and businesses that have been reached by the communication program.

So far, almost 80 percent of the households have been visited, although it is estimated that overall only 28 percent of the households are separating their vegetable waste. According to the municipality, the low participation rate is the consequence of some bad experiences with the collection service (e.g., trucks that did not meet the schedule) and a lack of space to keep two bins in multi-story buildings. Expanding the collection program and treating more vegetable materials is an ongoing effort. Whenever it has the funds available, the municipality undertakes new communication campaigns to increase participation rates. On average, the amount of municipal solid waste collected daily and transported to the organics treatment plant and the landfill is 214 tons. This figure includes both vegetable and other waste coming from households, businesses, street markets, and maintenance of public areas, but does not count recyclables being channeled through other mechanisms (see below).

Payment for the collection system varies according to source. For households, the service is paid by taxes. Businesses pay a fee based on the amount of waste produced. Street markets must hire a collection service on their own, and the waste must be separated as well.

The Informal Sector

The government is focused on recovering vegetable waste, and does not run programs to recycle dry materials. Nonetheless, a portion (there is no exact estimate) of these materials is recovered through two channels. One is through “green points” built by the municipality, where non-profits place containers for people to drop off glass, plastics, and Tetra Pak containers. The non-profits manage the green points and keep the income from the sale of the materials. The other channel is through informal recyclers. The leaflets that the government hands out to citizens to encourage source separation also ask them to separate paper and metals and give them to informal recyclers. The informal recyclers collect these materials directly from households and then sell them for recycling.

Although the municipality does confer a degree of recognition upon the informal recyclers, it has also blocked their efforts to organize, and they still work in precarious conditions. The government's perspective is that the municipality is willing to encourage people to hand recyclables to the recyclers but that it is ultimately a private business, so the informal recyclers

need to develop and maintain their business on their own. The National Recyclers Movement of Chile (MNRCH) has put effort into getting them organized, but without success. According to MNRCH, the government was not supportive of these efforts, fearing that people from other communes would join the new organizations. Early in 2011, there appeared to be some interest from the commune in working towards the organization of informal recyclers after they participated in an expo organized by informal recyclers in Brazil, but this interest seems to have waned after the person in charge left her position. The full inclusion of the informal sector in the formal waste management system—with payment for their service and the rights and protections of any formal worker—remains a challenge.

Recovery and Treatment

Once collected, the source separated vegetable waste is transported to a 7,500 m² treatment plant located within the commune. The site includes a 5,000 m² compost site that handles 18 tons of vegetable waste per day. It also includes a vermiculture area of 2,000 m², with 136 worm beds 15 meters long, that treats between 18 and 20 tons of vegetable waste per day. Total input in this plant, including vegetable waste from households and street markets as well as yard trimmings, is 36 - 38 tons per day. The waste arrives very well separated, with only 0.04 percent of impurities (mostly plastic bags that some people still use in the containers). Four people work at the site, each



Compost plant in La Pintana. (photo: DIGA)



Furniture made out of scrap wood in La Pintana. (photo: DIGA)

earning a monthly salary of about US \$600, which is above minimum wage and comparable to other similar jobs. The 2011 annual budget for maintenance and operations was US \$31,000.

Initial investments in the program were low; the original treatment plant consisted of a small compost pile and some worms. As the program has grown over time, more piles have been added to the plant and the worms have been reproducing naturally, so most of the costs have been operational costs.

The municipality also has a mulching plant, a nursery, and an “urban silviculture” program that includes a wood shop. In the shop, furniture, signs, flower pots, and crafts are made out of scrap wood, and citizens can learn woodworking skills. The exact amount of materials recovered through the silviculture program is unknown, but an estimated eight tons of garden waste are recovered daily by pruning and mulching.

Total recovery of source-separated vegetable waste is at least 44 tons per day, including residential waste, yard trimmings from maintenance of green areas, and vegetable waste from street markets. That is 20.5 percent of all the waste collected in La Pintana. From residential waste alone, the government calculates that 23 percent of the vegetable waste produced is being recovered. The remaining 77 percent of vegetable waste that is not being source-separated by residents is currently landfilled, along with other waste streams. In 2010, the commune sent 61,257 tons of municipal solid waste to the landfill, about 170 tons per day (157 tons of residential and commercial waste, 11 tons of street market waste, and 2 tons of waste from the maintenance of green areas).

In addition, about 1,000 liters of used kitchen oil are recovered daily, which are turned into biodiesel fuel for municipal collection trucks and grinders that

make woodchips to use as mulch.³ Construction and demolition waste is managed privately by the producers. Thus, the municipal investment is confined to recovering vegetable waste and disposing of residuals.

Cost Savings Through Local Solutions

The entire municipality has a budget of approximately US \$25 million annually. The breakdown of the environmental agency budget is shown below.

Table 1. Budget of Environmental Programs and Waste Management

Programs	US \$
Compost and vermiculture plant operation costs	31,036
Environmental education	69,000
Other*	611,513
Sub-total environmental programs	711,549
MSW collection**	1,632,683
MSW disposal	1,284,139
Sub-total collection and disposal	2,916,822
Total environmental agency	3,628,371

* Includes various environmental programs, such as nursery and urban silviculture, clean commune program, protective equipment, animal care, and others.

** Includes service of sweeping and cleaning in street markets.

Note: Environmental programs figures reflect the 2011 budget. The collection and disposal costs are estimated based on the expenses during the first three months of 2011.

Source: Dirección de Gestión Ambiental, La Pintana.

The new system is actually less expensive than the previous one in which all the waste was landfilled, mainly due to a reduction in transport and disposal costs. For every trip that is made to the compost plant instead of the transfer station, 22 km of travel are avoided. Also, the use of biodiesel instead of fossil fuel saves the municipality US \$100 per day. In terms of treatment costs, materials recovery in the vermiculture and compost municipal plant is far less expensive than sending waste to a private landfill. As a result of the compost and vermiculture

plant operations, daily savings in disposal costs are estimated to be US \$754.

Table 2. Cost Comparison of Waste Treatments

	US \$ per ton
Vermiculture	1
Composting	3
Landfill	19

Source: Dirección de Gestión Ambiental, La Pintana, 2011.

As mentioned above, the capital costs for the new program were low and covered by local financial resources. Most of the expenses incurred since the program started have been operation costs. The program has been expanding since it started, and current plans aim to increase the compost and vermiculture program and add new techniques such as the cultivation of larvae of *hermetia illucens* (black soldier fly). This insect is being considered as a method to process vegetable waste (it has been found to be a very fast decomposer of organic waste, particularly interesting for the treatment of meat and guano) as well as a source of fuel, given that the larvae are very rich in fat.

Despite being a very poor community, La Pintana shows that a good analysis of the local situation, the setting of clear goals, and an efficient use of resources allow municipalities to do more than just waste materials in landfills. By focusing on the largest and most problematic waste stream—organic materials—the community has made a large impact with a small budget. While the program still has ample room to grow, it has clearly established ways to reduce environmental and economic damage while recovering useful materials, which are then used to improve the local environment and promote residents' participation.

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Movimiento Nacional de Recicladores de Chile (National Recyclers Movement of Chile).

Endnotes:

- 1 The local government makes the distinction between vegetable waste (including food waste and yard waste) and organic waste (that would include any carbon-containing material, including paper and even plastics). To respect the approach of the local government, the term “vegetable waste” is used here instead of organic materials.
- 2 In Chile, a commune is the smallest administrative division of a territory, equivalent to a municipality in other countries.
- 3 Mulch is a cover of organic matter like woodchips, grass clippings, or straw that is placed on the soil. Among other things, mulch improves soil fertility, helps control weeds, maintains moisture, and reduces erosion.

MUMBAI, INDIA

Waste Picker-Run Biogas Plants as a Decentralized Solution

By Virali Gokaldas



Parisar Bhaginis in their uniforms. (photo: Michael Atkin)

Mumbai's rapid growth, high density, and sheer size present significant challenges for its waste management system. The enormous quantity of waste generated in the city makes large-scale, technologically driven "solutions" tempting. However, the opposite approach—a highly decentralized, people-powered model of waste management—has proven successful. Dry waste is separated out for recycling while organic waste, Mumbai's largest and heaviest waste stream, is treated close to its source through composting pits and biogas. This approach has reduced the need for costly transportation and landfill space while providing green jobs for waste pickers.



MUMBAI

Maharashtra State

Area: 603 km²

Population: 12,479,608

Population density: 20,696/km²

Average annual rainfall: 2,167 mm

Altitude: 14 meters above sea level

Average temperature range: 17°C to 33°C

Waste generation: 0.53 kg/capita/day



Parisar Bhaginis operating a biogas plant. (photo: SMS)

Mumbai, the financial center and industrial hub of India, is a megacity divided into 24 wards, each with its own budget and responsibility for solid waste management. The city government, known as the Municipal Corporation of Greater Mumbai (MCGM), utilizes both a communal collection system where residents bring waste to collection points (78%) and a house-to-house collection system where apartment building managers collect the garbage for pickup on designated routes (22%). The waste goes either to transfer stations or directly to one of three local landfills. For 2013, the city estimates a total cost of ₹2,019 crores¹ (US \$375 million) for solid waste expenditures, a 40 percent increase from 2012. The budget reflects large anticipated increases in transportation, compacting, and dumpsite expenses.

There are currently three local dumpsites for Mumbai's waste. The oldest, Deonar, has been in operation for over 80 years—much longer than the typical 30-year lifespan—and is scheduled for closure. All the city dumps have traditionally been a source of income for waste pickers who scour the piles for reusable and recyclable items. However, this is quickly changing, as the landfills are either being covered daily with soil or closed off to waste pickers by private operators.

While the Indian Municipal Solid Waste Rules of

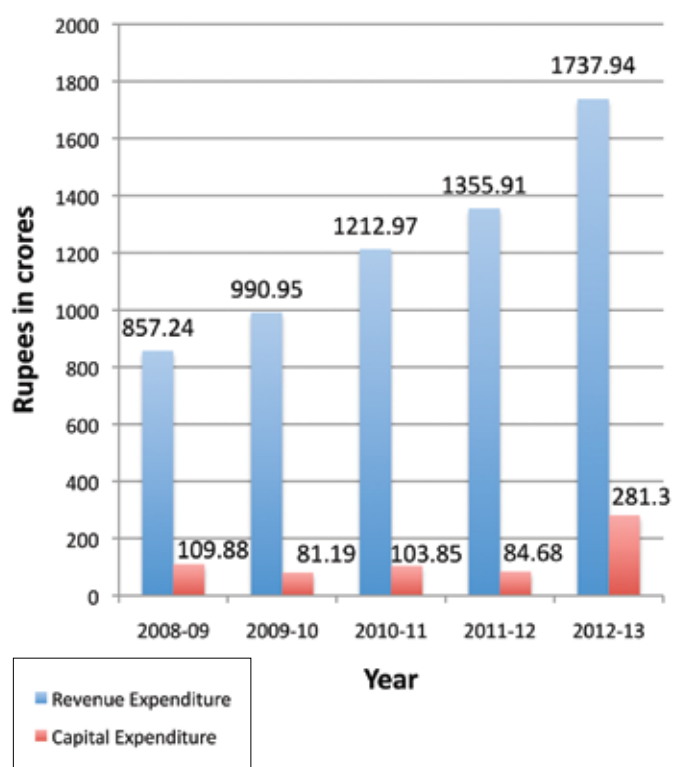
2000 require source separation of waste and prohibit landfilling of biodegradable waste, **there is no formal recycling or composting program. However, there is a thriving informal recycling economy.**

A large percentage of dry recyclables—meaning paper, plastic, metals, and glass—are recycled by households or alternately, by waste pickers. This recycling sector is considered to be 'informal' because it is not regulated by government agencies, and there are no rules for pricing recyclable materials or protections for the health and safety of the waste pickers. Nevertheless, their work reduces waste transportation costs, provides raw materials to recycling facilities, and helps to protect the environment.

A Decentralized Approach to Zero Waste

In specific wards of Mumbai, there is a growing movement to formalize the waste-picking sector and address the growing issue of municipal waste by integrating zero waste principles into waste

Figure 1. Solid Waste Costs for Greater Mumbai



Source: MCGM 2012

management. One non-governmental organization, Stree Mukti Sanghatana (SMS), has been training and organizing women waste pickers since 1975. Because poor, low-caste women comprise 85 percent of the waste picker population, SMS started the Parisar Vikas (PV) program in 1998 to train this group as “*parisar bhaginis*,” or “neighborhood sisters,” teaching them the principles of zero waste, how to sort and handle waste from multi-family dwellings, composting and biogas plant management, gardening, and how to organize as worker cooperatives and negotiate contracts. The organization also helps with contracting and marketing for individual workers and cooperatives.

SMS Operations

Through SMS programs, including PV, a total of 600 women work in almost 150 locations in Mumbai, ranging from institutional campuses to housing apartments. Although each site is unique, at most locations these waste pickers pull out, aggregate, and sell dry recyclables. In addition, depending on the nature of the waste stream and the contract, the *bhaginis* offer other services, such as dry waste collection (including Tetra Pak collection), composting, buildings and grounds cleaning, collection of dry waste in hospitals, and operation of small-scale biogas plants.

Table 1. Summary of SMS Operations

	Sites	Workers	Wet Waste (kg)	Dry Waste (kg)
Composting	27	57	1,714	418
Cleaning	26	42		318
Dry Waste Collection	70	282		14,212
Hospitals	19	35		1,670
Biogas Plants	8	13	7,055	39
Total	150	429	8,769	16,657

Source: SMS 2012

Depending on the site's size and operation, women waste pickers can play several roles in the waste

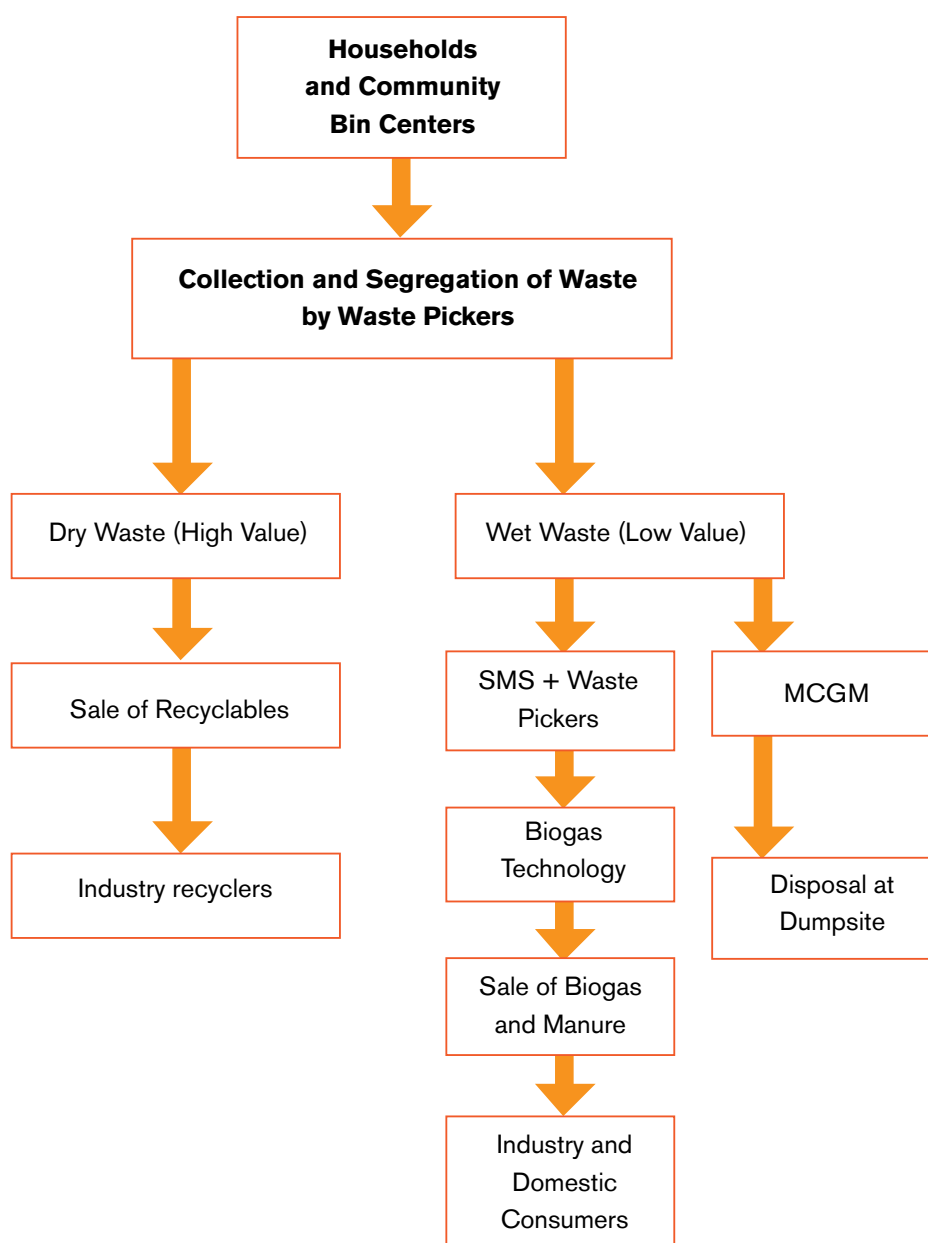


Dry waste collection, Tetra Paks. (photo: SMS)

management process, shown in Figure 2 below. They collect waste directly from households or community waste bins, and separate it. They bundle the dry, recyclable waste for sale to industry recyclers. Residuals and organics are either picked up by the city for disposal at dumpsites, or by SMS to be processed in composting and biogas facilities that produce manure and biogas for industry and domestic end uses.

***Bhaginis* earn income from the sale of recyclables and at many sites also receive a service fee for collecting, sorting, or managing composting pits/biogas plants.** Most earn ₹100 - ₹150 (US \$2 - \$3) per day from collection fees and sale of recyclables, though this can vary considerably depending on volume collected and sale prices. Some apartments pay the waste pickers directly; others pay the co-op. In many locations, *bhaginis* earn a regular, additional income from running a biogas plant or composting pit. There is a team structure with one supervisor for every four or five *bhaginis* on site; additionally, each ward has a supervisor. There are also specialized positions such as composting supervisors who work citywide overseeing compost operations. Supervisors are paid ₹5,000 - ₹6,000 (US \$90 - \$110)

Figure 2. Parisar Vikas Waste Management Process



Source: Adapted from MIT Colab 2010.

per month; senior employees can make up to ₹8,000 - ₹9,000 (US \$145 - \$165) per month.

Contracts

SMS serves as the umbrella organization that runs the PV program and other services for waste pickers. It has also developed a sister organization that markets, negotiates, and signs contracts on behalf of individual members. In addition, there are ten waste

picker cooperatives that manage sites. Initially, SMS signed contracts on their behalf, but the signing and management of contracts is transitioning to the cooperatives themselves.

The cooperatives enter into recycling contracts with institutions, apartment complexes, businesses, and the municipality. They have seen the greatest success with private institutions and campuses, such as the Tata Institute for Social Sciences. At the institute, a



Collection of dry waste with city vehicle. (photo: SMS)

cooperative operates a snack bar, sorting operation, and biogas facility. The snack bar generates 25 - 30 kg of clean, source-separated, organic waste per day. Supplemented with outside sources, this feeds the 100 kg/day capacity biogas plant. Gas from the plant meets a quarter of the canteen's cooking gas needs. The operation has been so successful that the institute added another 500 kg/day plant at its larger canteen, and is constructing a third plant to service their new 1,000-student hostel.



Collection of dry recyclables. (photo: SMS)

SMS has been seeking out new opportunities where apartments are being constructed or areas are being re-developed. **Creating a recycling program at new or re-designed developments has proven easier than where residents or businesses already have an established waste routine.** For example, Vasundhara, an SMS cooperative, applied to provide recycling services for a special export business zone. The area hosts approximately 100,000 workers and 300 industries on 40+ hectares. The cooperative won the contract and now employs 18 *bhaginis* to collect the zone's 1 - 1.5 tons per day of dry recyclables; it will also be bringing a biogas plant online in June 2012.

Compared to private contracts, SMS has had less success with municipal agreements. It contracts directly with the city to collect dry recyclables at several locations, using city trucks. However, these contracts tend to be less lucrative since the municipality provides the collection trucks only in the late morning, at which point most locations have already been picked over by the municipal staff.

Current contracts between the collector (SMS or the cooperative) and their customers are short, basic letters of agreement that allow *bhaginis* to come on-site to take dry recyclables away or to manage an operation for a set fee. The letters are typically signed and renewed on an annual basis and detail the number of *bhaginis* to be on site and the fee to be paid. Additional provisions include the necessity of safety and protection equipment, the need for identity cards to allow ease of access, and a requirement for worked hours to be documented.

Flexibility Leads to Stability

SMS's strategy with the Parisar Vikas program has been to localize the sorting and processing of waste as much as possible, whether on a large campus or at an apartment building. This decentralization requires greater tailoring, at the building or colony level, and makes it challenging to standardize and scale up solutions. However, it affords SMS several benefits. First, being adaptable to the customer has increased demand for services and allowed PV to thrive. Second, smaller-scale enterprises can respond quickly to changes in the recycling landscape due to turnovers in political leadership. For example, new commissioners can favor different

players and award waste contracts accordingly. Having a variety of contracts and models allows PV to continue even when one site may close. Third, the waste-picking sector itself has high turnaround; as women increase their income or their children begin earning money, they leave this work and move onto other activities. Keeping operations simple and having multiple sites lets PV manage turnover more easily. Finally, the model has allowed PV to experiment at different locations, leading to models like wet waste processing and biogas production. Having a model that is modular and opportunistic, that can provide services to complement its customer's needs, that has a diversified base of operations, and that has simple components has allowed Parisar Vikas to bid for a variety of contracts, weather political changes and high employee turnaround, and roll out new technology like small-scale biogas plants.

The waste-picking sector is vulnerable to the threat of privatization of waste collection. In 2012, the city awarded a 25-year contract worth ₹3,500 crores (US \$650 million) to a private firm to manage and close the city's landfills. The contract rules and state law governing waste management require that the company, at a minimum, integrate waste pickers into its operations, but this has not happened.

Table 2. Capacity Comparison of Different Nisargruna Biogas Plants

Capacity	Installation Cost (US \$)	Operating Cost/ Year (US \$)	Daily Water (recycled)	Daily Workers	Daily Biogas*	Daily Fertilizer (tons/day)	Space Required (m ²)
500kg	22,000	2,000	1 kL (500 L)	1 1 supervisor	.75 - 1	0.04 - 0.05	50
1 ton	30,000	3,000	1.5 kL (1 kL)	2 1 supervisor	1.5 - 2	0.08 - 0.10	80
2 tons	44,000	5,000	3 kL (2 kL)	3 1 supervisor	3 - 4	0.16 - 0.20	150
5 tons	100,000	8,000	6 kL (5 kL)	4 1 supervisor	8 - 10	0.40 - 0.50	300

*In Liquified Petroleum Gas cooking cylinder equivalents; one cylinder lasts 45 - 60 days in an average household kitchen.
Source: Nisargruna brochure.

Biogas: Creating a Local Food-to-Energy Cycle

A key innovation in PV's model is the adoption of a locally viable technology for biogas creation, called the Nisargruna Biogas Plant. **The plant was developed to convert on-site organic waste at an individual institution or apartment building into useful methane and high-quality manure (fertilizer) to then be sold back to households or local businesses.** It was designed to digest almost any biodegradable waste including kitchen waste, paper, animal dung, bio-sludge, poultry manure, agro-waste, and biomass. The plant design is highly scalable and can be made to handle 1, 2, 3, 4, 5, 10 or 25 metric tons of segregated biodegradable waste. A plant processing one ton of waste requires 10 KWh of electricity per day. Generally, the plant returns 10 percent of processed waste as nitrogen-rich compost.

The Nisargruna Biogas Technology

The Nisargruna Biogas technology has three stages of operation. First, waste must be properly separated before entering the biogas plant as some materials may damage the equipment. Even with good source separation, waste pickers conduct a sort on-site to pick out contaminants and inappropriate organic material. Hence waste pickers are a critical part of the operation's smooth functioning. Second, because microorganisms cannot easily digest solid waste, the waste is placed in a mixer with an equal amount of hot water to break down fibers and create a homogeneous slurry. This slurry enters into the aerobic tank to be converted to butyric, fumaric, acetic, and other organic acids. Finally, the acidic slurry transfers to the anaerobic tank, to be converted into methane. **The final products are nitrogen-rich manure, to be used on gardens, and methane gas, which can be used for heating or electricity.** The water used in the process is heated through solar power

and recycled for new batches. Out of every 100 liters of water used, 75 liters are recycled from the slurry.

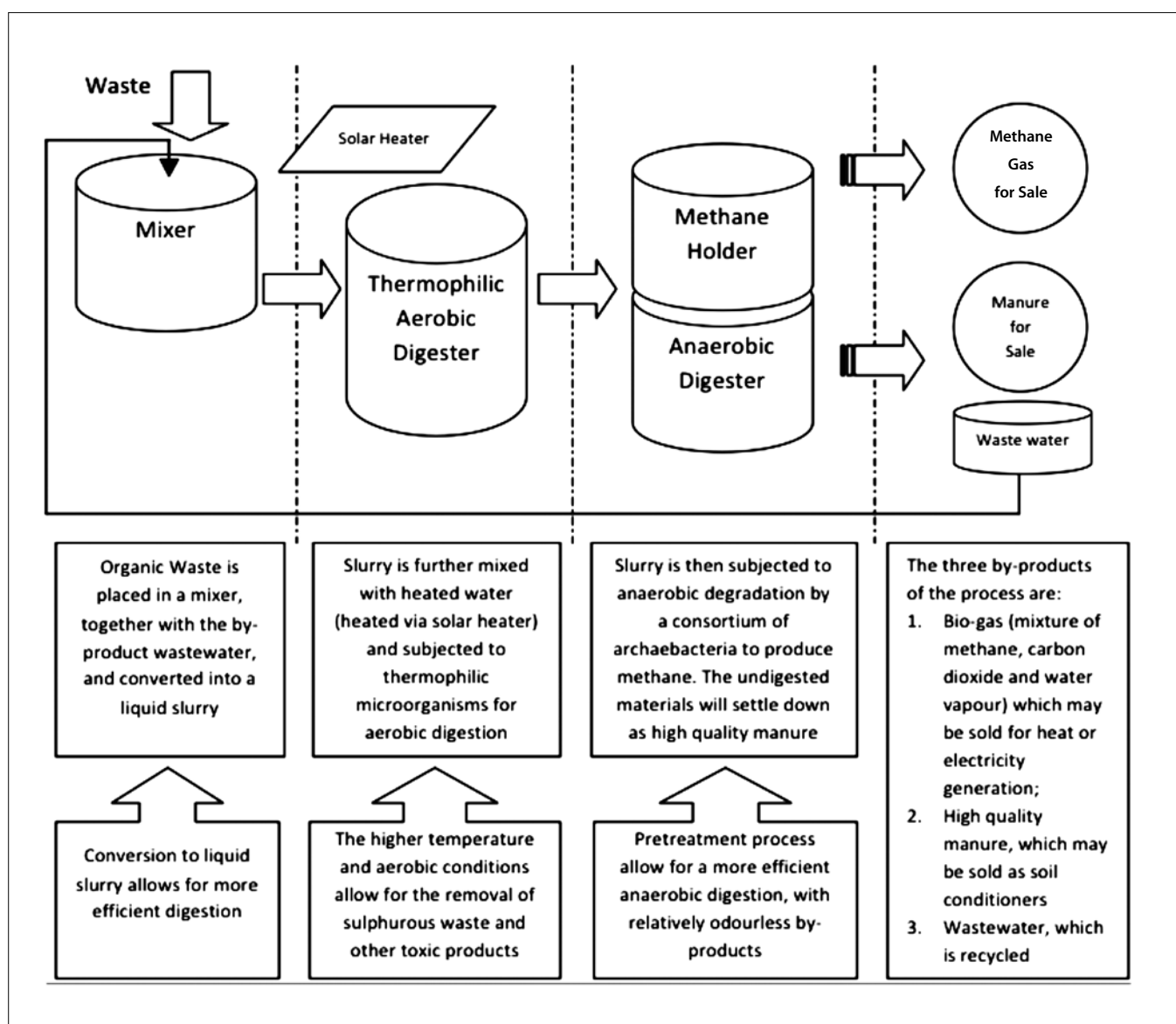
Plant operation is relatively simple as the technology was designed to be used by non-skilled workers. The most important human activity is proper segregation of material—the primary expertise of *parisar bhaginis*. Operators occasionally measure pH to ensure it is in the right range for digestion. The plant has an inspection hatch so *bhaginis* can scoop out any problematic material. Because of their size, the plants are more suitable for community garbage streams than for individual households. They are geared for city corporations, big hotels, government establishments, housing colonies, residential schools and colleges, hospitals, agricultural markets, and factories.

SMS and its cooperatives operate eight biogas plants throughout the city. **Each plant belongs to the institution or society where it is located, and *bhaginis* are contracted annually to operate them.** In all instances, customers utilize the gas for cooking, as the current plants are too small for cost-effective electricity generation.

Benefits

Unlike composting operations, a biogas plant does not create unpleasant decomposing odors, nor does it take up a large amount of space. **Only 50 m² are required for a plant that processes 100 kg per day.** The resulting biogas is 85 percent methane, more efficient than the 50 percent methane typical of most biogas plants, which SMS attributes to Nisargruna's two-step aerobic/anaerobic process. The small footprint, lack of odors, and direct use of biogas for heating mean that organic waste, the largest part of the waste stream, can be processed and used very close to where it is produced. This dramatically reduces the need for waste pick up, transport, and disposal, as well as the pollution associated with these activities. It also avoids the pollution that results from landfilling wet waste:

Figure 3. Nisargruna Process



Source: MIT Colab

methane emissions, toxic leachate, and odors.

The PV model generates value in three ways: waste collection, sale of recyclables, and generation of biogas or compost. In addition, the municipality saves considerable money in avoided transport and disposal costs. The income from recyclables varies significantly with market conditions, locality, etc. Waste collection and biogas are bundled together and compensated through service fees. These annual contracts range from ₹100,000 - ₹200,000 (US \$1,800 - \$3,700) depending on

the number of *bhaginis* on site and the extent of operations.

The avoided municipality costs are not reimbursed to PV at all. Yet these avoided costs may have the greatest economic impact. The city pays private contractors about ₹600 (US \$11) per ton to transport the waste and another ₹500 (US \$9) for disposal. So each one ton/day plant saves the city in excess of US \$6,000 per year.²

For a biogas plant handling five metric tons per day of

wet waste, the environmental benefits are significant. On an annual basis, the plant saves greenhouse gas emissions equivalent to 4,197 tons of CO₂ from recycling wet waste. The same plant creates, annually, biogas equivalent to 55,000 kg of liquefied petroleum gas and 10,000 kg of organic compost. This is in addition to the reduced impact of transportation on Mumbai's crowded streets.

SMS has successfully demonstrated the viability of decentralized waste management in one of the world's largest and most crowded cities. Although this approach takes more time to roll out than a one-size-fits-all city-wide strategy, its greater flexibility and customization is important to its success. Waste picker cooperatives are instrumental in managing source separation, and the small-scale biogas and compost pits have generated higher-paying employment for women waste pickers while significantly reducing the waste burden on the municipality.

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Endnotes:

- 1 One crore equals ten million.
- 2 Assuming 300 operating days per year.

FLANDERS, BELGIUM

Europe's Best Recycling and Prevention Program

By Cecilia Allen



Buy clever, buy less waste. (photo: OVAM)

The Flemish region of Belgium, Flanders, has become the vanguard of waste management in Europe. It boasts the highest waste diversion rate in Europe—almost three-fourths of the residential waste produced in the region is reused, recycled, or composted, and it has managed to stabilize waste generation. Thanks to far-reaching regional policies that are highly coordinated with local programs, waste management has remained decentralized, efficient, and highly effective.



FLANDERS

Population: 6.2 million

Area: 13,522 km²

Population density: 456/km²

Average annual rainfall: 850 mm

Average temperature range: 3°C to 18°C

Altitude: 5 to 288 meters above sea level

Waste diversion rate: 73%

Waste generation: 1.5 kg/capita/day

Spending on waste management per capita:
US \$116.33 per year

Figure 1. Per Capita Targets to Reduce Residual Waste in Flanders

1997 - 2001 Waste Plan

Target year	kg of residuals per person
1998	225
2001	220
2006	200
2010	150

2003 - 2007 Waste Plan

Target year	kg of residuals per person
2003	180
2005	165
2007	150

2008 - 2015 Waste Plan

Target year	kg of residuals per person
2015	150

Notes:

- The figures correspond to average Flemish levels. Different targets are set for different municipalities.
- The targets include residential waste, bulky waste, and waste from government activities; commercial waste is excluded.

Source: ARCADIS and Eunomia, 2008 and EIONET, 2009.

In Belgium, environmental issues are the responsibility of the regions, which establish policies independently from each other. The Flanders Public Waste Agency (OVAM) develops and monitors legislation and policies regarding waste management and soil remediation for the region. The 308 Flemish municipalities, in turn, handle municipal solid waste; almost all of them have grouped themselves into associations to provide these services collectively. There are currently 27 inter-municipal waste management associations in Flanders.

Regional Waste Diversion and Prevention Strategies

Regional waste management policies in Flanders go back to 1981, when the first Waste Decree, regulating the development of regional waste plans, was approved. Since then, every four or five years, new plans have been developed that outline waste policies and targets for municipalities to implement with OVAM's support. These waste plans set goals for the region, and include targets (for overall residential waste generation, separate collection, and residual waste after source separation and home composting) to be met by both the municipalities and the overall region. Over time, goals were met and then exceeded, allowing more ambitious goals to be set in subsequent waste

plans. **With these successes, the emphasis of waste management policies transitioned from disposal to source separation and recycling, and finally to waste prevention.**

OVAM's initial measures included promoting source separation, subsidizing the construction of recycling and composting facilities, and discouraging waste. As the program matured, the region developed a well-coordinated system of municipal, regional, and national policies that support decentralized waste management with a focus on prevention.

Collection and Treatment

Collection. Most cities belong to inter-municipal partnerships and run these services cooperatively, some employ a combination of inter-municipal associations and private or public companies, and a few operate independently, with no association. The means of collection varies from association to association, but generally includes a combination of door-to-door collection, drop-off centers, street containers, and retailer product take-backs. All but three municipalities in the region had collection of source separated materials by 2009.

Door-to-door collection systems usually take paper and cardboard, organic materials (including yard trimmings

and food scraps, but not cooked food), plastic bottles and cups, metal packaging and Tetra Paks, residuals, and bulky waste. There are also 337 “recycling parks,” or drop-off centers, in the region that handle about 50 percent of the residential waste. People must deliver the discarded materials separated and place them in the proper containers. Some products can be taken back to retailers.

In 2008, the municipalities spent €91.60 (US \$116.33)³ per capita on residential waste management. Collection and treatment systems are financed through a fixed annual tax and the Pay As You Throw (PAYT) tax.

Treatment of Organic Materials. The first plan for vegetable, fruit, and garden (VFG) waste was developed in the period 1991 - 1995 and led to the creation of the Flemish compost organization, VLACO. A non-profit organization constituted cooperatively by OVAM, the inter-municipal waste associations, private compost producers, and some independent municipalities, VLACO encourages organic waste prevention, promotes composting at all levels, certifies compost, and operates as a reference and assistance entity on organic waste materials.

Organic materials are treated through composting and anaerobic digestion. At the beginning of the 1990s, there was one centralized compost plant that received mixed residential waste, but the compost quality was so bad that source separation was made a requirement in the regional plans for organic materials. In the second plan for organic materials, passed in 1995, the inter-municipal associations required separate collection of green waste (produced in public parks and areas as a result of pruning) or VFG waste, and advocated home composting. Subsequent organic materials plans have focused on promoting further home composting and cycle gardening, and encouraging businesses to compost.

By 2010, there were 35 compost plants in Flanders (8 for VFG waste and 27 for green waste) and 29 anaerobic digestion plants that processed organic residential waste together with manure and agricultural waste. In total, 1,804,000 tons of these organic materials were processed in 2010. About 1 million tons were anaerobically digested and 804,000 tons were composted (for composting: 269,000 tons of VFG, 525,000 tons of green waste, and the rest discards from food processing industries).⁴

Approximately 4,900 tons of organic materials were composted or treated through anaerobic digestion every day in Flanders.

According to VLACO, 327,044 tons of compost were sold in 2010 (106,952 from food and yard waste and 220,092 from green waste) for different uses including gardening and landscaping (35%), horticulture and agriculture (7%), and others.

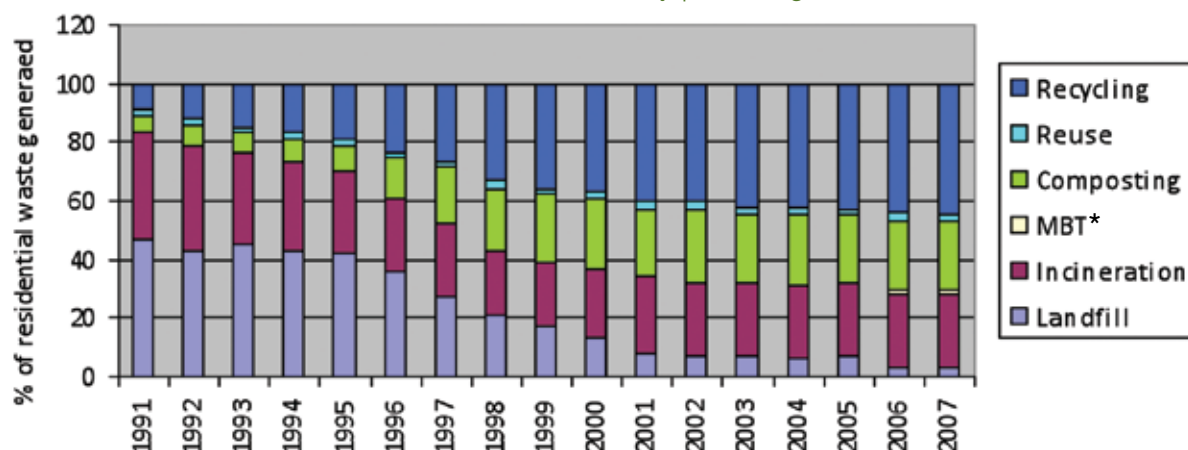
VLACO estimated the energy savings and reduction in CO₂ emissions resulting from compost production, compared to a scenario in which the organics were treated through incineration with energy recovery.⁵ It found that **in 2007, 480,000 fewer tons of CO₂ were emitted due to separate collection and composting of 833,000 tons of organic materials.**⁶ It also estimated that by composting organic materials, 80,000 to 110,000 m³ of water were saved that year.

Impact of Recycling and Composting

The past few decades have seen an increase in recycling and composting and a reduction in the amount of waste sent to landfills, while incineration capacity has remained stable since the beginning of the 1990s.

The optimization of separate collection, in conjunction with policies designed to reduce landfilling of waste, have enabled Flanders to significantly increase

Figure 2. Evolution of Residential Waste Treatments (by percentage)

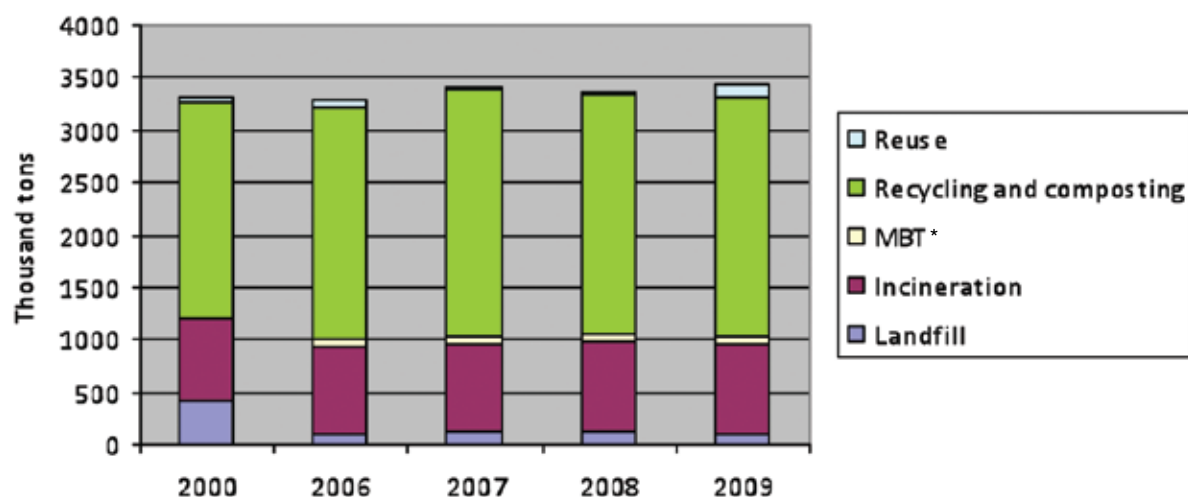


*MBT = Mechanical and Biological Treatment

Notes: Composting also includes anaerobic digestion.

Source: Christof Delatter, VVSG quoted in Green Alliance, 2009.

Figure 3. Evolution of Residential Waste Treatments (by weight)



*MBT = Mechanical and Biological Treatment

Note: Composting includes anaerobic digestion.

Source: MIRA, 2010, page 114.

recovery of recyclable and compostable materials while decoupling waste production from economic growth, a significant and unusual achievement. However, policies and practices have not yet enabled a reduction in total waste generation.

Strategies for Municipal Governments

Targets and regulations. The Flemish government mandates source separated collection throughout the region. In order to encourage improvements in

separation, it also sets targets for per capita residential waste production, home composting, and maximum residuals, which must be met by all municipalities.

Landfill and incinerator restrictions. As a way to discourage burying and burning, the government implemented landfill and incinerator restrictions in 1998 and 2000. As a result, landfilling of unsorted waste, separated waste suitable for recovery, combustible waste, and all pharmaceuticals was banned. Incineration of separated recyclables and unsorted waste was also prohibited.

Incinerator and landfill taxes. In addition to incinerator and landfill restrictions, OVAM uses financial mechanisms to discourage burying and burning. There is an environmental tax for residual waste treatment that ranges from €7 (US \$9) per ton for incineration to €75 (US \$95) per ton for landfilling. In 2009, the revenues from these levies totaled €28 million (US \$36 million). About 40 percent of this amount was used to finance the subsidies in the environmental agreements with the municipalities (see below). Adding the taxes to the treatment tariffs charged per treatment, landfilling costs €135 (US \$171) per ton, while the cost of incineration comes to between €77 (US \$98) and €137 (US \$174) per ton.

Agreements. OVAM signs agreements with municipalities to carry out waste prevention activities. These agreements include obligations for municipalities to hold waste prevention campaigns, provide technical or financial assistance to citizens to reduce waste, sponsor specific campaigns for target groups like schools, etc. These agreements often include subsidies to finance public education campaigns as well as things like home compost programs, promoting reusable nappies, and school water fountains.

Subsidies. OVAM also provides investment subsidies to municipalities and inter-municipal associations for waste prevention, separation, and treatment. In 2009, €5.5 million (US \$7 million) were provided as subsidies to build drop-off centers and compost plants, implement Pay As You Throw systems (see below), and other activities.

Environmentally preferable procurement. OVAM helps municipalities through a web application that contains tips and a questionnaire for choosing more sustainable options in office supplies, cleaning products, electric and electronic equipment, varnish, and paints. The application can be used by citizens as well.

Designing Out Waste

Tools to prevent waste. One of OVAM's central strategies to prevent waste goes to the root of the waste problem: the very design of products. To address this, the agency has created a set of tools to promote clean production and sustainable design. These include:

- **“ECOLIZER”** – a tool for designers to estimate the environmental impact of products. It includes a set of environmental impact indicators relating to materials, processing, transport, energy, and waste treatment, allowing designers to identify opportunities to reduce those impacts by changing the design. For instance, one can calculate the environmental burden of a coffee machine by finding scores for different indicators—the materials, the manufacturing process, the related transport, and the treatment after the product is discarded—and then evaluating possible changes in the design of the coffee machine to reduce its environmental burden score.
- **Eco-efficiency assessment** – a program to evaluate the efficiency of small and medium companies. It identifies points of intervention for reducing waste, improving energy and water efficiency, increasing recycling, and so on.



The Ecolizer tool. (photo: OVAM)

The test is free of charge. OVAM consultants follow up to implement the changes. As of 2009, 1,000 companies had been assessed.

- **MAMBO** – a software program that allows companies to calculate the direct and indirect costs associated with waste, including those resulting from waste treatment and inefficiency.
- **Inspirational online database** – a collection of case studies of businesses that have implemented clean production and eco-design methods.

Subsidies and incentives. The regional government provides subsidies to second-hand shops. In 2008, OVAM provided €936,000 (US \$1.19 million) in subsidies for reuse and recycling centers. In 2009, Flanders had over 110 second-hand shops employing a total of 3,861 employees and serving over 3.6 million paying customers. The government also organizes “Ecodesign awards” for students and professionals as a way to encourage innovations in waste prevention. The prizes range between €400 and €4,000 (US \$508 to US \$5,080).

Extended Producer Responsibility. Flemish waste legislation⁷ makes it mandatory for producers, importers, and retailers of certain items to take back waste products and meet collection and recovery targets. These obligations apply to batteries and accumulators, vehicles, printed matter, tires, electrical and electronic equipment, lubricating and industrial oils, lighting equipment, animal and vegetable fats and oils, and medicines. People can return broken or obsolete products to retailers free of charge. Producers are then responsible for management and treatment of the products according to specific requirements that include recovery targets. In most cases, non-profit organizations handle the product take-backs. For instance, in the case of batteries and accumulators, the industry created BEBAT, an

organization comprised of over 800 members, to handle this stream. An extra charge collected from the sale of every battery (€0.12/US \$0.15) and flashlight (€0.20/US \$0.25) funds the system. Used batteries can be dropped free of charge in containers placed in stores, schools, and public buildings. Metals from inside the collected batteries are then recycled.

Deconstruction, not demolition. By law, new construction projects that generate over 1,000 m³ of debris must present a “deconstruction” plan and waste inventory and are responsible for recycling this waste. According to OVAM, 90 percent of construction and demolition waste—11 million tons—was recycled in 2010. While this stream is not part of residential waste, the logic of Extended Producer Responsibility is applied.⁸

Waste Prevention Strategies Directed at Households and Individuals

Pay As You Throw (PAYT). The hallmark of this significant waste prevention strategy is the application of graduated taxes to different types of waste. Most expensive is the collection of residual waste, followed by the collection of organic materials, with the lowest taxes applied to plastic bottles, metal packaging, and drink cartons. Collection of paper and cardboard, glass bottles, and textiles is free. Tax on bulky waste varies depending on the quantity.

Elements of PAYT vary among inter-municipality associations. Some use bags (charged at €0.75/US \$0.95 - €2.50/US \$3.18 per 60 liter bag), others use bins with electronic chips that charge according to the volume or weight of the waste. For larger containers, there is taxation per volume (€2.50/US \$3.18 - €3.76/US \$4.78), per weight (€0.15/US \$0.19 - €0.20/US \$0.25 per kg) and per pick up (€0.25/US \$0.32 - €1/US \$1.27).

Home composting. The promotion of composting is another central strategy to reduce the volume of waste collected from households. In Flanders, successful approaches have included annual charges for the collection of organic materials (€40/US \$51 for a 120 liter bin), educating citizens about home composting through communication campaigns, promoting “cycle gardening” to reuse yard waste, encouraging composting at schools, and composting demonstrations at community compost plants. A “compost masters” program has also been established, through which citizens are trained in composting and then encouraged to work as volunteers training other citizens and assisting them to compost properly. By 2008, 4,000 citizens had been trained, and there were 2,500 active master composters. These efforts have yielded significant results: **it is estimated that about 100,000 tons of organic materials were kept out of the collection and management system in 2008, thanks to home composting.** In densely populated areas, the government encourages community compost plants, where citizens can take their organic materials. These facilities usually use compost bins, and so do not take up much space. The success of this program continues to grow. **By 2010, approximately 34 percent of the Flemish population—almost two million people—was composting at home.**

Green event assessment and guide. Online tools are available for organizers to calculate the ecological footprint of their events and to prevent waste during events. The agency also maintains an online list of places that lend reusable tableware for events and parties.

Additional waste prevention campaigns for citizens include promoting the use of tap water instead of bottled, encouraging bulk purchasing, and discouraging the use of packaging and disposable bags. Others include “Please No Publicity” stickers distributed to citizens to reduce junk mail, online tests

to find opportunities to prevent waste, and publications to help citizens interpret product labels.

Federal Waste Prevention: Regulating Products That Enter the Market

Although waste management is a local and regional responsibility, the Belgian federal government sets the standards for products that enter the market and eventually become waste. It has enacted a number of such laws, guided by the Polluter Pays Principle and the desire to promote sustainable production and consumption patterns. These policies include:

- an Eco-tax Act, approved in 1993, for items like beverage containers, some packaging, and disposable cameras and batteries;
- a sustainable material management strategy;
- a federal act on product standards, passed in 1998, that discourages producers from manufacturing items that increase waste problems or pose health or pollution risks;
- the adoption of standard labels for products meeting certain environmental and social criteria; and
- the publication of a green procurement guide in 2003.

In addition, several cooperation agreements have been signed with the regional governments containing key waste reduction measures.

Special rules for packaging. Throughout Belgium, packaging is the producer's responsibility. Packagers, importers, and those who sell packaging and packaged products bear responsibility for packaging waste. All parties responsible for packaging

must take back these items and meet recovery targets. This program covers the entire nation and is monitored by an inter-regional packaging commission. Nearly all the companies that produce household packaging are grouped in a single organization known as FOST Plus. Each participating company pays a fee based on the type and amount of packaging they are responsible for introducing into the market. The organization funds the public collection, sorting, and recycling of these materials.

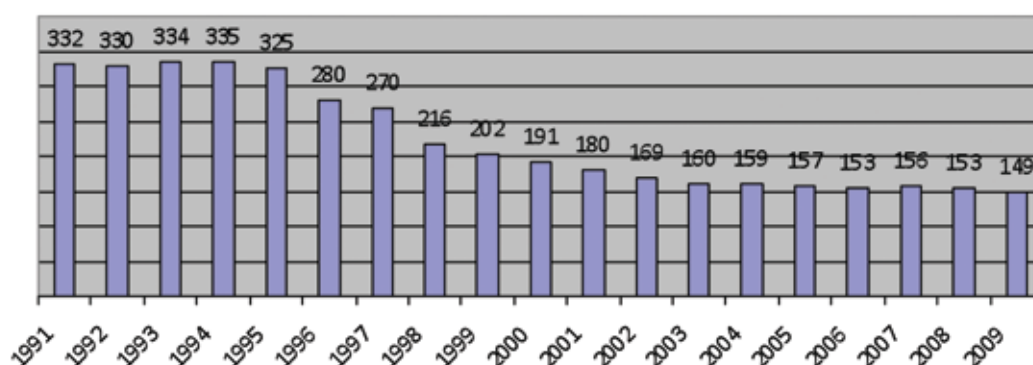
According to FOST Plus, the recycling rate for household packaging in Belgium has increased from 28.1 percent in 1995 to 91.5 percent in 2010, when a total of 690,828 tons of material were recycled.

Flanders accounts for 60 percent of the total household packaging recycled in the country (415,763 tons in 2010). FOST Plus estimates that compared to incineration, recycling prevented the emission of 860,000 tons of CO₂.⁹ A 2006 study estimated that the total cost per inhabitant for the packaging management system in Belgium, accounting for income from recycling sales, was €5.78 (US \$7.34) per year.

Prevention Plus Diversion Means Less Residuals

As a result of the waste prevention and diversion strategies put in place over the last 20 years, Flanders

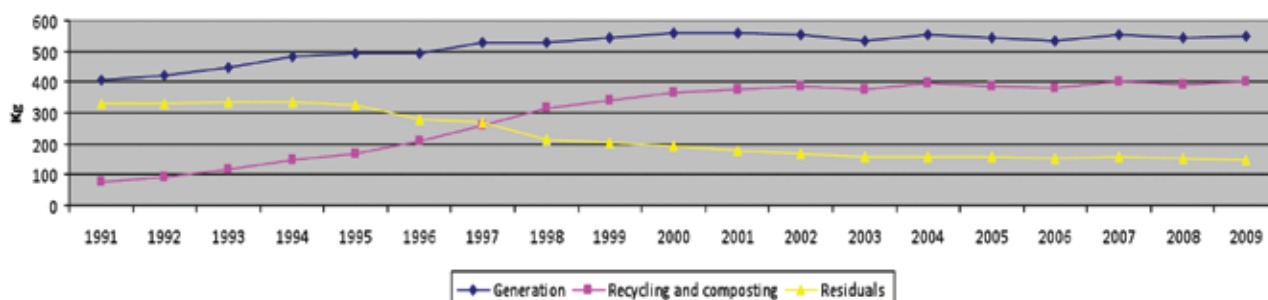
Figure 4. Evolution of Residuals in Residential Waste.



Source: OVAM.

The figure above shows that residual waste has been steadily decreasing in Flanders, beginning in the mid-1990s when the region started adopting waste prevention targets and developing a materials recovery circuit. The graphic below shows the evolution of residential waste generation, recovery, and residuals over the past two decades:

Figure 5. Evolution of Waste Generated by Residences.



Note: Residuals go to landfill or incineration.

Sources: OVAM, 2004 and OVAM 2010b.

has some of the lowest residuals per capita and best waste prevention results in Europe. **Per capita waste generation has held steady since 2000, showing a rare example of economic growth without increased waste generation.**

Figures 4 and 5 show how residential waste in Flanders has been impacted by its waste reduction and prevention strategies. By 2007, 42 municipalities showed levels of residual waste below 100kg/person/year. Two municipalities generated less than 70 kg per capita: Herenthout (pop. 8,350) produced 59 kg/person/year, and Balen (pop. 20,000) produced 66 kg/person/year.¹⁰ **The regional target of 150 kg of residuals per capita was achieved by 2009.**

The transition from an end-of-pipe approach—focused on waste disposal—to a front-end approach—focused on production and consumption patterns—has put Flemish policies at the leading edge of waste management in Europe. This change of vision has been successfully complemented with materials recovery programs that allow discards to be reintroduced in the market or in nature. Phasing out waste incineration would help complete the path to sustainability; but it continues because the existing incineration capacity locally and in Europe makes incineration more cost-competitive in the short term than the interventions required to further increase diversion.

By dividing responsibility appropriately between municipal, regional and national governments, Flanders has successfully implemented a comprehensive strategy for waste prevention, recycling and composting. The results speak for themselves: stable waste generation and the highest diversion rate in Europe.

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Endnotes:

- 1 Data from 2009; 73% of the municipal solid waste produced is reused, recycled, composted or treated through anaerobic digestion.
- 2 Amount spent by municipality in household waste management in 2008. Source: OVAM, 2011.
- 3 Based on an exchange rate of €1 = \$1.27 on 17 May 2012.
- 4 Personal communication with OVAM staff, August 2011.
- 5 Recovering only electricity, not heat.
- 6 The study estimates a CO₂ saving of 624 kg CO₂ per ton of green waste composted, and 517 kg CO₂ per vegetable, fruit and garden waste composted. In that year, 465,000 tons of green waste and 350,000 tons of vegetable, fruit and garden waste were composted. Source: VLACO.
- 7 VLAREA <http://navigator.emis.vito.be/milnav-consult/consultatie?language=en>.
- 8 Bouw- en sloopafval: de helft van ons afval, OVAM.
- 9 Fost Plus annual report 2010. Available online at <http://www.fostplus.be/>.
- 10 Source: OVAM.

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 not 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 km²

Population density: 642/km²

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.

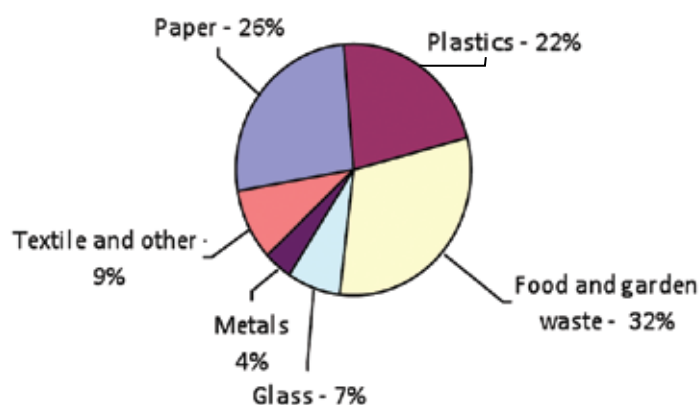
Dozens of anti-incineration meetings were held and communities organized widely against these plans. This grassroots movement was consolidated in 2002 with the creation of the Taiwan Anti-Incinerators Alliance (TAIA). As a result, by 2002, only 19 of the 36 planned incinerators had been built. The total 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.

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.

Figure 1. Municipal Solid Waste Characterization in Taiwan



Source: Li-Teh Lu, et al, 2006

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

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**



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

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/ewtotal10002.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

Table 2. MSW Production and Treatment in Taiwan

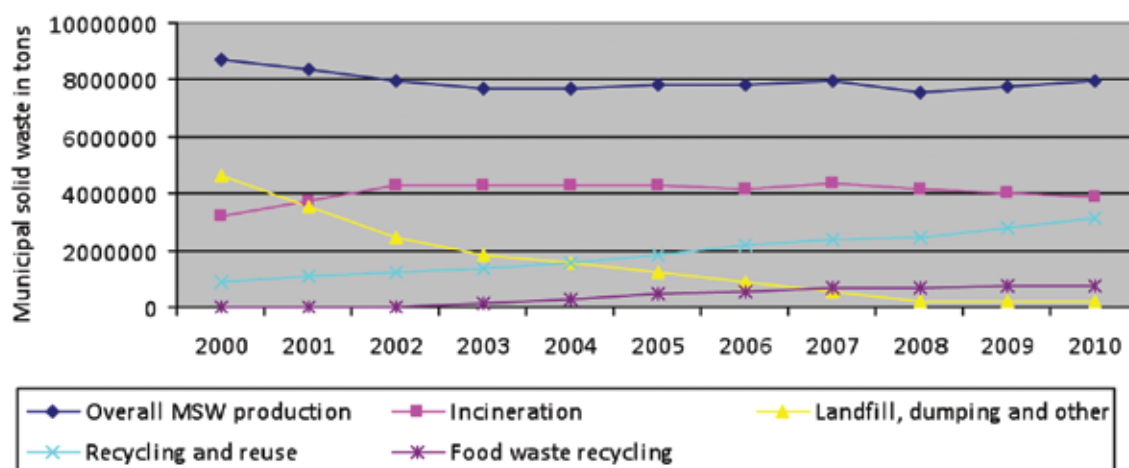
2010	Tons per year	%
Garden and bulky waste recycled	80,217	1%
Food recycled	769,164	9.6%
Garbage recycled	3,035,617	38.1%
Subtotal Recycled	3,884,998	48.7%
Landfilled/buried	181,771	2.28%
Incinerated	3,888,641	48.8%
Other	2,191	0.02%
Subtotal Disposed	4,072,603	51.1%
Total Waste Generated	7,957,601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

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

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.

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BUENOS AIRES CITY, ARGENTINA

Including Grassroots Recyclers

By Cecilia Allen



Workers from El Ceibo Cooperative collecting recyclables and promoting source separation. (photo: Cooperativa El Ceibo)

The story of waste management in Buenos Aires describes how *cartoneros*, or grassroots recyclers,¹ by their persistent commitment to recycling, have won not only recognition but legal and financial support from the city government. As recently as 2001, waste picking was illegal. Since then, *cartonero* cooperatives have organized themselves, educated residents on the environmental benefits of recycling, and lobbied the city government for a cleaner approach to waste management with allied environmental and social organizations. The result: an about-face in the city's approach to waste, including separation at source and giving waste pickers exclusive access to the city's recyclables. While enforcement has been inconsistent, a big portion of waste pickers today enjoy a safer work environment and improved access to resalable materials, while Buenos Aires' forward-thinking legislation is held up as a model that other cities are copying.



BUENOS AIRES

Capital of Argentina

Population: 2,890,000

Area: 202 km²

Population density: 14,307/km²

Average annual rainfall: 1,146 mm

Altitude: 25 meters above sea level

Average temperature range: 11°C to 25 °C

Waste generation: 1.2kg/capita/day



Sorting materials in cooperative El Alamo Green Center.
(photo: ciudad de Buenos Aires)

A Context of Economic, Social, and Environmental Crises

Buenos Aires is Argentina's chief port and its financial, industrial, commercial, and cultural center. Located on the eastern edge of Argentina's most productive agricultural region, and linked with Uruguay, Paraguay, and Brazil by a great inland river system, the city is the distribution hub and trade outlet for a vast area. Traditionally, the city relied on landfilling to deal with its waste, with *cartoneros* operating without public recognition or legal sanction.

In 2001, Argentina's serious socioeconomic crisis led to a dramatic increase in unemployment, and many people in the city resorted to collecting and selling recyclable materials from the streets in order to survive. In fact, it is estimated that 100,000 *cartoneros* were working in the metropolitan region of Buenos Aires in 2001.²

The Implementation of a Legal Framework

In 2002, legislation known as Law 992 created the Urban Recyclers Program and annulled the decree that had banned waste picking in the city. **Law 992 formalized the role of *cartoneros*:** "The

Executive Power incorporates informal recyclers into the separated waste collection in the current waste management system." The law further recognized the "positive environmental, social, and economic impacts of recovery and recycling" and the "benefits of separating at source or before disposal, facilitating the work of informal recyclers and contributing to the cleanliness of the city and protecting the environment."³

Meanwhile, a waste management crisis was brewing that would compound the social crisis. **In 2004, the announcement of new landfills in Buenos Aires province triggered massive public opposition; so large, in fact, that the government could not find a municipality that would agree to host a new disposal site.** Furthermore, because of severe pollution and health problems in the surrounding areas, citizens rose up demanding the closure of two of the three existing disposal sites.

The people's opposition to such extensive landfilling, active campaigning by several environmental organizations, and the exponential increase in the number of waste pickers prompted a shift in the city's approach to waste management. The shift manifested itself in new legislation intended to expand recycling and make better use of resources. The Zero Waste law passed in 2005 built upon Law 992 and took further steps to include grassroots recyclers.

Law 1854's objectives include:

- Minimize waste by implementing source separation;
- Educate people and large waste producers about the need to separate waste and recyclables at source;
- Reduce the city's municipal solid waste (MSW) taken to landfills by 30% in 2010,

50% in 2012, and 75% in 2017 (compared to the tons landfilled in 2004), with the goal of achieving zero waste to landfill disposal in Buenos Aires city by 2020;

- Build recovery and recycling systems; and
- Increase the amount of post consumption materials that return to industry.⁴

Furthermore, the law banned municipal solid waste incineration—with and without energy recovery, within and outside the city—until a 75 percent reduction in waste going to landfill was achieved.

The law paid special attention to recycling and to those who were covering this task, the *cartoneros*' cooperatives. However, in practice the law was barely implemented. Reasons for this include: lack of political will to implement a system requiring significant participation from the residents and a sustained education campaign, government reluctance to adopt diverse strategies rather than a single one limited to landfilling, the projection that a system based on large street containers collected by private companies would be costly, pressure from the landfill company to adopt incinerator technology as the “magic” and “simple” solution, lobbying from collection companies and unions hoping to capitalize on possible changes in the system, narrow environmental and social perspective by the government, and lack of a critical mass of residents pushing for zero waste.

In fact, 2009 and 2010 were the worst years in terms of MSW disposal. In 2010, Buenos Aires city sent over 2,110,000 tons of waste to the landfill, instead of the 1,048,359 target established in the law. Consequently, between 2005 and 2011, Laws 992 and 1854 were reinforced by resolutions to:

- Direct some large waste producers (four and five star hotels, public buildings, and private

buildings over 19 stories) to separate recyclables at source;⁵

- Require those same producers to also separate the organic waste stream;⁶
- Begin a pilot project in three neighborhoods requiring food businesses, including hotels, restaurants, and party houses, to separate their organic waste at source;⁷ and
- Levy an “eco-tax” on those producing over 1,000 liters of non-recyclable waste per day.⁸

Waste Management System in Buenos Aires

The waste management system in Buenos Aires is mixed: a public system operated by private and public companies. The collection contracts awarded in 2004 divided the city into six areas, five of which are managed by the private companies Cliba, Aesa, Urbasur, Nittida, and Integra; the sixth area is covered by a public body of the government—Urban Cleansing Entity. The companies collect waste and transport it to three transfer stations located within the city. From there it is taken to the landfill “Norte III” by a public waste disposal company called Coordinación Ecológica Área Metropolitana Sociedad del Estado (CEAMSE).



Green Center managed by the cooperatives Recicladores Urbanos del Oeste, CERBAF, and Las Madreselvas. (photo: Maeva Morin)

According to the legislation, each collection company is supposed to take part in the recycling system in Buenos Aires by designing and constructing a resource recovery facility, or “Green Center,” in the area they service as well as provide the equipment, machines, and other elements necessary for it to operate.⁹ These centers should be built on sites owned by the government, and the activities of sorting, baling, and storing of materials for sale should be managed by the cooperative of waste pickers assigned to each Green Center.¹⁰

In 2010, when Buenos Aires landfilled 2 million tons of municipal solid waste, the government estimated that 50,678 tons were recycled. *Cartoneros* estimate they recycle over 190,000 tons of MSW per year, a number considerably higher than government estimates.¹¹

Table 1. Type and Amount of Materials Collected and Amount of MSW Recycled in Buenos Aires City in 2010

MSW (household)	903,083 tons
MSW (street sweeping)	136,999 tons
MSW (commercial, green, and bulky waste)	379,501 tons
Construction and demolition	648,115 tons
Total CEAMSE (landfill)	2,067,699 tons
Recycled in CEAMSE ¹²	40,093 tons
MSW recycled - government estimate ¹³	50,678 tons
MSW recycled - waste pickers estimate ¹⁴	190,000 tons

Source: Ministerio de Ambiente y Espacio Público de la Ciudad de Buenos Aires, Informe Anual de Gestión Integral de Residuos Sólidos Urbanos, Ley N°1.854, 2010.

The Cooperatives

The informal recyclers’ registry managed by the Recycling Department of the government listed 7,479 people as of August 2011. However, the government estimates the number of *cartoneros* in Buenos Aires to be 5,500, 2,500 of whom are organized and

3,000 of whom work on their own. Others provide similar estimates of about 6,000 waste pickers, half of whom are organized in cooperatives.¹⁵ Some of the 12 cooperatives are larger than others, some are older, and they provide different services and run different programs.

The El Ceibo cooperative was formed in 1997 by a group of 10 women who had been working together on housing and women’s rights issues since 1989. As explained by the cooperative’s president, they wanted to find a way to “do a nicer job without going through the trash.”

“Through the work of our cooperative alone, 200 tons of waste are prevented from being landfilled every day.”

– MTE

“We started to ask everyone to understand who owned the waste,” she said. “In the end, we learned that the waste was the property of its producer. That is when the socio-environmental program ‘El Ceibo recovers Palermo’ was born. The program is simple: it trains families on source separation of waste—paper, glass, plastics—that is, the materials that have value and can return to the production cycle.”

El Ceibo changed the perception and the process of recovering recyclables. **As a result, the informal collectors were known no longer as “cartoneros,” but as “environmental promoters,” working under more formal conditions—regular schedules, uniforms—and ringing the doorbells of the Palermo neighborhood residents to recover materials.**

Today, the El Ceibo Cooperative manages the Green Center of Retiro and operates as a successful business with collection agreements with large waste producers such as local companies, supermarkets, and the government. It has 67 members who earn

a monthly salary of A \$2,200 (US \$511) or more.¹⁶ The cooperative operates with its own resources, as it does not receive support from the government. El Ceibo receives a small amount (4 tons per day) from the public waste management system, through trucks operated by MTE, which collects materials from big producers and transports them to the Green Centers, following an agreement with the government. It also receives three tons per day from collection company Cliba and 0.6 tons from Aesa with different frequency. Finally, it conducts its own collection, using a truck and a van, of five tons per day of recyclables including paper, cardboard, plastics, glass, Tetra Pak and plastic film.¹⁷

Formed in 2005, the Movement of Excluded Workers (MTE) is the group with the most members (2,500). The city government provides the cooperative with buses and trucks to transport workers and the recyclable materials, plus a monthly incentive of A \$900 (US \$209) for each member, which is on top of what is earned through the sale of products. Workers also receive health insurance, risk insurance, and uniforms. Finally, the cooperative has a child care center as part of their fight against child labor, financed both by the MTE and the city and national governments. MTE recovers approximately 6,000 tons per month

Cooperative Recuperadores Urbanos del Oeste officially became a cooperative in 2008, but its core group of *cartoneros* has been working since 2002. It has been running the Green Center in Bajo Flores for two years (shared with cooperatives Las Madreselvas and CERBAF) and has 500 members (490 on the streets and 10 more working at the Green Center). The members working on the streets receive the government incentive of A \$900 (US \$209) and a percentage from the sale of materials; the ones working at the plant receive between A \$2,000 and A \$2,500 pesos (US \$465 – 581) per month depending on the amount of materials that enter the plant. Materials come from the recyclers collecting on

the streets and from the MTE.

Cooperative Del Oeste has been working since 2002 and has 30 workers. It has been co-managing the Green Center in Villa Soldati with cooperative Reciclando Sueños since January 2007. The cooperative receives around three tons of materials per day, 20 percent of which is residual waste. They collect materials that the neighbors separate, and most of what they recover comes from MTE. Members of the cooperative receive an incentive of A \$800 per month (US \$186), at least until December 2011. Currently the cooperative is struggling to purchase its own trucks so they do not have to rely on the government.

Working since 2003, Cooperative El Álamo has six trucks and 49 workers who manage four to six tons of waste per day, 90 percent of which is recycled. About 30 percent of what is collected comes from households, and 70 percent is from large producers. It runs the Green Center “Polo de Microemprendimientos” (Micro-enterprises park), co-managed with the cooperative Ecoguardianes 21, and a Green Center in the neighborhood of Villa Pueyrredon, where they collect door-to-door. For the last three years, the cooperative has had an agreement with the social welfare agency of the city government, through which it receives food. In addition, it trains citizens in recycling at the Agronomy School of Buenos Aires University.

Still Precarious Conditions for Cooperatives

The situation of grassroots recyclers changed dramatically over the past decade. Almost half of the *cartoneros* are now organized under cooperatives, and have not only gained recognition from the residents but from the government itself. Among their major victories are the management by grassroots recyclers’ cooperatives of all the Green Centers built under the waste management legislation, the official recognition

and inclusion of *cartoneros* in the waste management legislation, the creation of an agency within the government dedicated to *cartoneros*, the extension of alliances with local and international organizations and companies, and a dramatic increase in the budget allocated to *cartoneros* (according to a local source, **in 2007 the city government allocated US \$300,000 to grassroots recyclers; by 2008 it reached US \$30 million**).¹⁸

However, there remain many structural obstacles to the effective inclusion of grassroots recyclers in the public waste management system.

The multiplicity of actors in municipal solid waste collection (i.e., independent *cartoneros*, cooperatives, private companies) creates tension and competition for territory. The government's policy of treating the cooperatives inconsistently furthers feelings of distrust among the 12 cooperatives. As a result, they do not coordinate demands on the government or develop joint projects.

According to law 1854, the city was supposed to build five Green Centers in an initial phase and more in a second phase. Currently only five have been constructed. *The Annual Report on Solid Waste Management, Law 1854 of 2009*, noted that it was difficult to find available land for building this kind of structure. Lack of space in a megalopolis such as

Buenos Aires is understandable. However, another problem is that neighbors fear pollution and do not want waste treatment centers to be built near their homes.

Some Green Centers are not well equipped and some do not operate at capacity. A representative of cooperative Del Oeste claims that her center has not had gas or a sorting line since it opened in December 2007. Del Oeste receives three tons per day but could treat twice as much and thus could hire more people.

Another obstacle is that the government is not creating any market incentive to favor recycling industries or products. According to a member of cooperative Recuperadores Urbanos del Oeste, "The market of cardboard and plastic varies, and that is a problem when we want to sell. The government should set a price, or ideally we should sell directly to the government."¹⁹

In general, waste pickers are frustrated with the lack of consistent support from the city.

Cooperatives that do receive benefits or pay from the city find it necessary to fight to maintain them; those who receive less from the city than other cooperatives want to be treated equally. Said one Del Oeste member, "We do not have our own truck despite our having several signed agreements that the government would give us one." Despite all the legislation that has passed, the city is failing to enforce the laws.

Moving Towards an Efficient Recycling System

In 2010, the city government launched a new process for including *cartoneros* in the waste collection system: offering two separate contracts, one for dry materials and another for wet. The novelty was that the contract for dry waste was exclusive to recyclers' cooperatives. Therefore—for the first time—they



MTE member transporting recyclables. (photo: MTE)

would have access to the dry waste without having to compete with private companies. The rest of the materials—organics and non-recyclable residential waste—would be placed in large containers on the streets for collection by private companies.

The cooperatives had to present a plan that included:

- Door-to-door pick-up and transport of materials to Green Centers,
- Sorting and sale of materials,
- Training for members of the cooperatives,
- Inclusion of independent waste pickers,
- Education about recycling, and
- Eradication of child labor.

In exchange, the government committed to providing trucks, child care facilities, public transportation passes for recyclers, monthly incentives, health and accident insurance, uniforms, and safety equipment.

Looking Forward

Earlier efforts by the government to hide waste in landfills and ignore *cartoneros* have given way to open debates about the need to change the approach for waste management. In addition, the city's Zero Waste law and resolutions have been at the vanguard of waste management approaches in the region and represent a model for other cities in the region.

On the other hand, the implementation of those laws has been incomplete and inconsistent. For instance,

in order to effectively minimize waste in Buenos Aires, it will be necessary to treat organics separately.

A look at how much is spent on the recycling cooperatives, compared with private companies that handle the city's un-recycled waste, shows that massive landfilling is still the priority. The budget in the dry materials contracts is A \$120 million (almost US \$28 million) per year, while the contracts with private companies for wet materials totals A \$1,400 million (US \$325 million) per year. Meanwhile, the shadow of waste incineration continues to loom large, as various city and national bodies lobby for construction of waste-to-energy plants, a move that would seriously jeopardize recycling in the city as well as the livelihoods of grassroots recyclers.

By implementing its own legislation and investing in an earnest campaign to promote source separation of discards—including organics—Buenos Aires has the ability to position itself as a true leader in zero waste. Such an advance, if done properly, would capitalize on the expertise of the *cartoneros*, expand their already important contributions to the city, and showcase them as allies in waste management, so that recyclables recovery is never again associated with poverty in the city. The wealth of this local experience is an asset the city cannot afford to waste.

Source:

Based on the case study, *La incorporación de los recuperadores de residuos sólidos urbanos: un paso necesario hacia el reciclaje El caso de la Ciudad Autónoma de Buenos Aires*, by Maeva Morin.

Endnotes:

- 1 Grassroots recycler and wastepicker are terms used for people who recover recyclable materials from the waste stream. Some work at landfills and dumpsites; others recover directly from the source (houses, businesses, etc.) They sell the recovered materials to the reprocessing industry for recycling. A variety of other terms are used in different countries: *catador* (Brazil), *pepenador* (Mexico), *reciclador* (Colombia), ragpicker (India), etc. In Argentina, they are generally referred to as *cartoneros*, and so that term is used here.
- 2 Estimate by Francisco Suárez, in MESA, Pablo Edgardo, *Los recuperadores urbanos en la gran Ciudad metropolitana de Buenos Aires, Buenos Aires*, Prometeo libros, 2010 (p.45).
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- 4 http://www.buenosaires.gov.ar/areas/med_ambiente/basura_cero/ (13 October 2011).
- 5 Resolutions 50 and 808 of 2007 by Ministry of Environment and Public Space.
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Glossary

₱: Philippine peso. As of May 2012, approximately US \$1 = ₱43.

₹: Indian rupee. As of May 2012, approximately US \$1 = ₹53

Biogas: a technique (more formally known as anaerobic digestion) in which organic waste is kept in an airtight vessel until it biodegrades, producing a gas and a semiliquid digestate. "Biogas" also refers to the resulting gas, usually approximately 50% methane and 50% carbon dioxide.

Compostable: organic waste material that will readily biodegrade under ambient temperatures. Generally includes food waste, grass clippings, leaves, etc.

Controlled dumpsite: A dumpsite where access is restricted, both in terms of what waste can be deposited as well as who can enter the dumpsite (e.g., waste pickers).

Disposal/final disposal: the final step which ends the potential usefulness of waste by landfilling, dumping, or incineration.

Diversion rate: the proportion of waste that is not sent for disposal, i.e., is re-used, recycled, composted, or otherwise used. Some jurisdictions include estimates of waste prevention in waste diversion statistics.

Dumpsite: a site for final disposal of waste, generally without the controls or engineering improvements that characterize a landfill.

E-waste: discarded electronics or electronic components; these often contain small quantities of valuable metals which are difficult to separate from the low-value plastic.

Extended Producer Responsibility (EPR): a policy whereby the manufacturer of goods or packaging are responsible for recovering their products after use by the final consumer, to ensure their recycling or safe disposal. EPR incentivizes manufacturers to design products for recycling.

Greenhouse gas (GHG): gases which trap heat in the atmosphere, causing the greenhouse effect and exacerbating climate change. The principal greenhouse gases are carbon dioxide (CO₂) and methane (CH₄).

Grassroots recycler: a waste picker who belongs to an organization – be it a union, association, or cooperative – but is not a formal employee.

Informal recycler: a waste picker in the informal sector.

Informal sector: the portion of the economy in which workers do not have contracts or formal employment.

Landfill: a site for final disposal of waste by burying. An engineered landfill will have some or all of the following: waste compaction, daily cover, final cover, liners and leachate collection. Nevertheless, "landfill" is often used euphemistically to refer to many unimproved dumpsites.

Mixed waste: municipal waste which has not been sorted, or only poorly so. It contains organic matter (e.g. food waste), recyclables (e.g., paper, metals), non-recyclables (e.g., diapers), and often household hazardous waste (e.g., cleaning fluids, batteries).

Materials Recovery Facility (MRF): a plant in which a mixed waste stream or a mixed recyclables stream is sorted by mechanical or manual means into a variety of different recyclables and a residual stream.

Municipal solid waste (MSW): definitions vary by country, but MSW generally includes all solid waste from households, offices and commercial establishments. It generally does not include construction and demolition debris, sewage sludge, or industrial waste.

Open dump: a dumpsite where the waste is open to the air, i.e., it is not covered or capped.

Organic: In the context of waste management, organic material refers to putrescible materials. The largest component is generally food waste; in some countries, yard waste (leaves, grass cuttings, etc) is also a significant component. Paper, particularly food-contaminated paper, is often included but wood, particularly treated wood, which tends not to decompose readily, is generally excluded. Plastics, although carbon-based, are not considered "organic material" for waste management purposes as they do not biodegrade.

Pay As You Throw (PAYT): a system that charges individuals and businesses according to the amount of waste that they generate.

Polluter Pays Principle: a system in which polluters (individuals or firms) are charged according to the amount of pollution or waste they generate. This creates an incentive to minimize pollution.

Recyclables: material which can be recycled; generally implies there exists a market for such material.

Refuse derived fuel (RDF): the result of drying and processing waste into pellets or fluff, which are then burned (often in cement kilns).

Residuals: the waste left after the removal of compostables and recyclables; waste destined for disposal.

Source separation/segregation: the practice of sorting waste at the time and place of disposal into two or more categories. This avoids the need to sort waste later and reduces cross-contamination between different waste streams.

Take-back: a program under which manufacturers take back their products or packaging after use, e.g. soft drink companies which collect glass bottles for re-use.

Tons per day (tpd): one ton is 1,000 kilograms.

Waste minimization/waste prevention: the practice of avoiding waste generation in the first place. Examples include lightweighting packaging, plastic bag bans, and donations of edible but not saleable produce.

Waste picker: a worker, generally in the informal sector, who recovers recyclable material from waste and sells it for recycling. Waste pickers collect material from individual homes, offices and businesses, from the street and waste containers, and from dumpsites.

Waste stream: a distinct flow of waste from generation through transport, to disposal. Multiple waste streams may flow together (e.g., recyclables and mixed waste in the same truck) but as long as they are kept separate, they are distinct waste streams.

Zero waste: the goal and plan to continually minimize waste disposal (including incineration) towards zero. Includes a number of strategies, including waste prevention, source separation, toxics reduction, composting, recycling, etc. For a more complete definition, visit www.zwia.org.



www.no-burn.org
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