

Food Waste Recovery:

A Model for Local Government Recycling and Waste Reduction

Overview

Food discards make up 10 percent by weight of the total municipal waste stream and can be a higher portion of commercial sector wastes. In 1997, of the 21.9 million tons of food waste generated in the United States, only 2.6 percent was recovered.

In California, 16 percent of wastes disposed consist of food. This represents almost 5.6 million tons per year. Restaurants, supermarkets, hotels, schools, produce markets, hospitals, prisons, and wholesalers are all large generators of food. Farmers, renderers, and food banks have long collected food discarded by businesses and institutions.

In the last decade, new initiatives have proven successful in recovering more food and converting it into valuable end uses. Curbside collection of segregated organics is growing in popularity. Most of these programs focus on commercial and institutional sectors, but some are also tapping food recovery from the residential sector.

Many commercial sector programs focus on offering collection of source-separated food discards to the largest food waste generators. Haulers from Southern California to Northern California are expanding such service. A growing number of commercial-scale composting sites are now permitted to handle many types of food discards. (See list on page 18.)

On-site small-scale composting systems at schools and other establishments are also on the rise. These range from in-vessel systems to simple worm bins. Other food recovery options include food donations, processing into animal feed, and rendering. And, of course, more attention could be given to waste prevention, such as educating restaurants to offer smaller portions (light meals or half portions).

One of the biggest challenges in diverting commercial food waste is overcoming the perception that segregating food waste is extra

work and a nuisance. Through outreach and technical assistance, operational food recovery programs are overcoming this obstacle.

On the residential side, backyard composting has been the main method of encouraging households in the United States to reduce food waste. However, in many European countries—such as the Netherlands, Austria, Germany, Denmark, and Switzerland—food discards are typically collected at curbside combined with yard trimmings.

These systems are slowly being adopted in North America. Seattle, in King County, Wash.; Lewiston, Maine; Dixon, Calif.; and San Francisco have all piloted such programs. Canadian cities with food waste recycling pilot programs include the Ontario cities of Caledon, Markham, and Kingston, Ontario; and Mission, British Columbia.

Halifax, Nova Scotia, and St. Thomas and Bracebridge, in Ontario, have citywide programs already in place. The City of Hutchinson, Minn., also collects food scraps for recycling. Most if not all of these programs have met with success.

In California, 294 local jurisdictions (56 percent of the total in the state) have existing separate collection programs for residential green materials. Another 48 (9 percent) have planned such programs. Adding food discards to these programs has the potential of significantly increasing diversion without greatly increasing costs.

This model study profiles the food recovery efforts taking place in San Francisco, Berkeley, and Santa Cruz, Calif. Each jurisdiction embraces a unique approach to facilitating food recovery.

San Francisco has the most comprehensive program of any jurisdiction in the state. The city and county solid waste agency has formed partnerships with local food banks, haulers, and end users to divert commercial and residential food waste to beneficial uses. Haulers are committed to providing commercial and residential customers with collection of food discards.

After several years of pilot programs, the city and its hauler are beginning residential food waste collection. With the “Fantastic Three Program,” the city will introduce food waste collection during the next few years. (For more detail on this program, see the CIWMB model study “Curbside Recycling, the Next Generation: A Model for Local Government Recycling and Waste Reduction.”)

To spur commercial sector food recovery, the city contracts with a consultant to assist program development and analysis. The consultant also provides training, monitoring, follow-up, and outreach to food waste generating customers with commercial food collection service (provided by the city’s haulers). The city has also funded indoor sorting containers to assist participants. In addition, the city and county have provided more than \$350,000 in grant money to help build the edible food recovery infrastructure.

The City of Berkeley has chosen to provide its commercial and institutional sectors with city collection services for food discards. It may be the only city in California providing a city collection service. The program, still in its pilot phase, has had tremendous success.

Santa Cruz County has taken a more modest approach than San Francisco and Berkeley. The county has used a series of relatively small grants to facilitate food recovery initiatives. One grant funded identification of food waste generators and food waste end users, and the linking of the two. Another grant funded the planning and development of on-site vermicomposting systems at camps, schools, and other establishments.

Other communities are also spearheading food recovery efforts. San Jose is funding two pilot projects to test in-vessel composting of food waste from supermarkets. BFI is implementing one pilot at the Newby Island Landfill using Green Mountain Technology’s in-vessel system. Zanker Road Resource Management is implementing the second pilot at its Z-Best Composting facility using the Ag-Bag system.

The City of San Bernardino operated a pilot program targeting 21 restaurants in May and June 1998. Food recovered from these restaurants diverted 4 to 6 percent of the city’s total municipal solid waste during these months.

The Alameda County Waste Management Authority’s support for the Alameda County Community Food Bank helped the food bank increase distribution of produce from 400,000 pounds to 2 million pounds. Orange County also works with a local food bank to encourage more food donations.

Several other jurisdictions have either operated pilot programs to recover food or are starting a program: the City of Rancho Mirage, West Contra Costa County, Palm Springs, Chula Vista, Ventura County, San Leandro, and Sonoma County.

Community Recycling & Resource Recovery’s project in the Los Angeles area may be the largest food waste diversion project in the world. Grocery waste and waxed cardboard are collected from more than 1,000 grocery stores and mixed and composted with green waste at the company’s Bakersfield composting site. California BioMass provides a similar outlet for food recovery efforts, also in Southern California. It has three composting facilities that accept food discards from Orange, San Bernardino, and Riverside counties.

Many college campuses such as UC Davis and UC Berkeley are using vermicomposting to divert their cafeteria wastes from disposal. A number of elementary schools are also using vermicomposting for their food discards (for example, Laytonville and Sierra Elementary School in El Dorado County). Other campuses, such as San Francisco State, are using in-vessel composting systems. On-site composting, whether high- or low-tech, offers the benefit of avoiding collection costs, which represent the bulk of waste handling costs.

California jurisdictions can build on the experience of these private and public sector initiatives in developing their own food recovery efforts. The potential for expanding food diversion in the state is high, because the state already has a strong composting infrastructure and markets in place to use compost products. Food discards have the added benefit of enhancing the composting process and the quality of compost products.

Table 1: Comparison of Sample In-Vessel Technologies

Company (system name)	Type	Feed System	Capacity (tons per unit or container)
NaturTech (Naturtech)	Aerated bin	Batch	20
Green Mountain (Comptainer)	Aerated bin	Batch	15–25
Wright Environmental (Wright Tunnel)	Plug flow static bed	Continuous	Depends on unit size
Celto Canadian (BioReactor)	Aerated silo	Continuous	4–5
Farmer Automatic (Compost-Matic)	Agitated bay	Continuous	80
Stinnes Enerco (BioContainer)	Aerated bin	Batch	5–15
ABCTI (Ag Bag)	Aerated bags	Semi-batch	Depends

Source: Applied Compost Consulting Inc., Oakland, California (December 1995).

Program Characteristics

There is no single strategy for diverting food discards to beneficial uses. Food can be donated to charities, converted into animal feed, rendered into soap or other products, and composted. Food waste can also be avoided through prevention strategies.

Food waste generators can divert their food discards to one or more end uses. Unspoiled food can go to food banks. Local and national food bank programs frequently offer free pickup and provide reusable containers to donors. Liquid fats and solid meat products can be used as raw materials in the rendering industry. Many renderers will provide storage barrels and free pickup service.

Five basic types of approaches are in use: (1) unaerated static pile composting, (2) aerated static pile composting, (3) aerated windrow pile composting, (4) in-vessel composting, and (5) vermicomposting or worm composting. Unaerated static piles are better suited for small operations and generally cannot accommodate meat or grease. Aerated static piles and windrows can handle meat and grease with frequent turning and careful temperature and moisture control.

In-vessel composters are enclosed temperature- and moisture-controlled systems. They come in a variety of sizes and have some type of mechanical mixing or aeration system. In-vessel composting can process larger quantities in a relatively small area more quickly than windrow composting and can accommodate animal products. Vermicomposting uses red worms to break down organic materials into a high-value compost (worm castings). It cannot accommodate animal products or grease.

Composting can be done on-site where it is generated (using low- or high-tech strategies) or done off-site at a commercial composting facility. Vermicomposting and in-vessel systems are gaining popularity for use on-site where food is generated. Table 1 compares some in-vessel technologies.

Establishments that compost on-site will avoid collection costs, which generally represent the bulk of waste handling costs. For on-site recovery, establishments need to have space and devote staff resources to operating and maintaining the composting system. Alternatively they may be able to hire a company to install and oversee on-site composters.

In the commercial sector, the following basic steps can facilitate food recovery:

- Identify large food waste generators. Table 2 lists various food-related industries and the portion of waste they dispose as food.
- Assess the possibility of establishing on-site composting systems (in-vessel systems, windrows, or worm bins). Two main factors need to be considered: available space and staff time to properly operate and maintain the system.
- Identify end users for food discards. These include food banks, renderers, farmers, and composters. Assess the types of materials each can process.
- Work with select end users (especially food banks and renderers) and haulers to provide collection service for segregated food discards. Materials accepted will depend on materials end users can process. The existence of a composting facility permitted to handle all types of food discards will result in the highest diversion and program flexibility. Make the program as easy as possible. Hotels, restaurants, and grocery stores can have high employee turnover, so avoid elaborate material separation requirements.
- Contact food waste generators to promote either on-site recovery of food discards or collection of these.
- Provide technical assistance, rate incentives, and bins to encourage food waste generators to participate. Grants to help offset the costs of on-site composting equipment can help spur this activity.
- Perform ongoing outreach to expand and maintain the program. Emphasize the economic benefits to participating businesses.

Residential programs are different. The most successful pilot and full-scale programs have the following elements:

- Collecting food discards with yard trimmings in a toter at the curbside.
- Allowing residents to set out soiled paper with their food discards.
- Collecting organics weekly. (Some European programs collect organics one week and trash

Table 2: Food Waste Generators

SIC	Industry	Food (% of Waste Disposed)	Food Disposed (tons/employee/yr)
54	Retail Trade—Food Stores	45.1%	1.25
58	Retail Trade—Restaurants	43.9%	1.10
51	Wholesale Trade—Nondurable Goods	29.6%	0.40
82	Services—Education	24.2%	0.13
20	Mfg.—Food & Kindred Products	23.0%	0.41
70	Services—Hotels/Lodging	15.3%	0.18
Varies	Public Administration	11.4%	0.05
80	Services—Medical/Health	7.0%	0.04

This data is based on sorting garbage samples from individual businesses in Southern California. Material recycled is not included. Figures may not reflect the composition at a particular business or in a particular area.

Source: Business Group Waste Compositions, Solid Waste Characterization Database, CIWMB www.ciwmb.ca.gov/WasteChar/BizGrpCp.asp (February 2000).

the other, with organics collected weekly during the warmer months. Aerated carts can allow for biweekly collection.) In California, putrescibles are required by code to be collected weekly.

- Providing households with a lidded pail to use in their kitchen for collecting food scraps.
- Encouraging residents to rinse out their totes and pails as needed.
- Allowing residents to line their pails or curbside bins with paper bags or newspaper (if they wish).

Allowing Food to Remain Mixed with Other Garbage

Some haulers are allowing food to remain mixed with other garbage to keep costs down and to solicit participation by their customers. To avoid contamination problems, customers need to effectively recycle glass bottles and other recyclables. This option is best suited for establishments such as supermarkets that generate a very high portion of food discards. BFI is practicing this method in San Jose's pilot project, and Golden Gate Disposal & Recycling in San Francisco has also collected this way.

In the City of San Bernardino's two-month pilot program, targeted restaurants were not aware they were participating—it was a blind pilot. The city's commingled recyclables program had been operating for four years. The restaurants were basically generating “clean loads” of food discards as their trash, which the city diverted to composting.

Costs, Economics, and Benefits

Commercial food waste generators may economically benefit the most from diverting their unwanted food to beneficial uses. This is especially true if haulers offer reduced rates for collection of segregated organic materials. By reducing the number of trash pickups, costs tend to go down.

Residential households can also directly save money if they pay their haulers variable rates for trash. While haulers include the cost of organics collection in the rates they charge their customers, from the residential customer perspective, recycling and organics collection come free of charge.

Cities who offer collection services can benefit too. Tip fees at composting facilities are generally cheaper than tip fees at landfills. The challenge is to implement a collection program for organics that does not add to total program costs. One major benefit of diverting food discards set out as trash is cost savings. No investment in new vehicles or other equipment is needed. This option may only work well with establishments that do a good job of recycling glass and other dry recyclables, and with those that mostly discard food.

In residential programs that already have a weekly yard trimmings pickup, adding food can increase diversion without adding significantly to costs. Additional start-up costs may be incurred for kitchen pails and outreach. These costs could be recouped through ongoing savings in disposal fees.

What Local Government Can Do

Local jurisdictions can take any number of steps to facilitate food recovery:

- Devote staff time to linking commercial food waste generators with haulers and end users, and to encouraging organics diversion in general.
- Provide grants or contracts to facilitate food recovery efforts. Recipients could include food waste generators, to assist them in purchasing on-site composting systems; haulers, to collect food scraps; and end users, such as food banks, to help them purchase needed equipment.
- Provide technical assistance to food waste generators to help them design, implement, and troubleshoot food recovery programs.
- Add food discards to residential yard trimmings collection programs, or work with haulers to do this.
- Fund or share costs of and/or work with haulers/processors to develop a pilot project, start up a facility, or initiate another food recovery project. (The City of San Jose has given BFI and Zanker Road about \$100,000 each to perform a one-year pilot project.)
- Work with local and State enforcement agencies to help composters through the

permitting process. (For example, the City of San Jose worked with the local enforcement agency [LEA] so that it was prepared for haulers' permit requests to collect food.)

- Work with private haulers to amend franchise agreements to include the collection of source-separated food discards. (Palm Springs amended its franchise agreement with its hauler.)
- Develop a local composting facility or other end user if none exists.
- Adopt and enforce ordinances to mandate source-separation of food discards. (Ventura County has a mandatory recycling ordinance requiring businesses to recycle specified materials. Once its composting facility is operational, the county can use the ordinance to encourage food recovery.)

Funding Mechanisms

Collection services are generally funded by rates haulers charge their customers.

Santa Cruz County funds its grant programs through a solid waste service assessment collected with property taxes. San Francisco funds its grant programs from ratepayer funds. Its contract for outreach and technical assistance is also funded this way.

Berkeley funds its commercial sector food scrap collection program through its refuse fund, which comes from refuse fees. Alameda County has helped the city purchase some equipment.

Tips for Replication

Commercial Programs

- Identify what businesses are generating food discards, and target these businesses based on type and size.
- Identify businesses that use food discards (such as composters, vermicomposters, animal feeders, animal feed manufacturers, tallow companies). Finding a composting facility that is permitted to take all types of food will result in greater flexibility and higher diversion. If composting facilities can only take vegetative materials, these materials are still worth targeting.
- Try to make matches and distribute information on users to generators so they can make their own matches.
- Place the highest use value on edible food redistribution. When developing a program, work with and support local food donation organizations to incorporate edible food recovery.
- Work with haulers to develop a collection strategy and financial incentives for participating businesses.
- Put time into working with businesses. Provide monitoring and follow-up. Remind businesses that they reap many benefits from participating, including financial and public relations.
- Conduct outreach and find different ways to promote the program. A brochure can help inform businesses about the program. Health departments and chambers of commerce can help deliver messages to businesses.
- Be flexible. As with any new program, be willing to fine-tune the program to meet the needs of cities and customers. Find out if the level of service is right (such as pickup frequency). If not, make adjustments.
- Use front-end loader trucks to collect food discards. Front-end loader trucks are better equipped to handle heavy containers than rear loader trucks.
- Consider providing biodegradable and compostable bags for customers to line their containers as needed. Bags will keep containers cleaner and prevent food scraps such as dough from sticking to containers, but they will also add to costs.
- Devote a staff person or employ a consultant to work with generators to set up composting systems at generators' sites.
- Offer seed money to cover part of the cost of equipment for on-site diversion.
- Promote business customer recognition programs via local business associations.

Residential Programs (based on San Francisco's experience)

- Provide participation incentives to residents through variable trash rates. Even if these rates were already in place, conduct outreach and remind residents that they can reduce their trash volume and save money through food recovery.
- Add food discards to your existing yard debris collection program if you have such a regular program. Adding food discards is not much of an additional cost, and it improves compost product quality.
- Spread the message that separating food discards is not difficult. Residents can use paper bags and/or newspapers to line their bins.
- Target all types of food—not just vegetative food—in order to increase participation, diversion, and compost product quality.
- Commingle the dry recyclables to simplify residents' set-out and sorting requirements. Food scraps mixed with yard debris is one sort; commingled dry recyclables is a second.
- If you choose commingled recyclables set-out and collection, do not overcompact recyclables once collected. This will cause glass breakage.
- Co-collect trash and recyclables to increase collection efficiency.



San Francisco's Fantastic Three program includes carts for recyclables, food and other organics, and trash.

Case Study: San Francisco Commercial Food and Organics Recycling

Overview

In San Francisco, a variety of programs divert food discards from the commercial sector.

Redistribution of Edible Foods to Food Service Agencies. The San Francisco Food Bank collects and redistributes edible discarded produce and other food; Food Runners (mostly volunteer) collect and redistribute prepared foods from restaurants.

Recovery of Food Processing Waste and Inedible Produce by Farmers as Animal Feed. Dairy farmers pick up food processing waste (such as brewery grains and tofu residuals) as well as the inedible produce sorted by the food bank. The farmers use the food discards as dairy and heifer feed.

Recovery and Processing of Dry Bakery Discards into Animal Feed Products. Dext Feed (San Jose) collects discarded bread, flour, and other dried bakery products in the San Francisco area.

Collection of Food Service Grease and Meat for Rendering. Four rendering companies serve San Francisco, including Darling International based in the city.

On-Site Composting of Cafeteria Food Discards at Schools and Universities. San Francisco State University and San Francisco City College each have an in-vessel composting program. Ten schools (mostly elementary) have small-scale vermicomposting programs.

Collection and composting of food and other organics from the commercial sector. Two haulers, Sunset Scavenger Company and Golden Gate Disposal & Recycling Company, offer collection service. Each use different collection approaches. Organics are delivered to the Sanitary Fill Company transfer station and then hauled to the B&J composting facility in Dixon, 65 miles away. All four companies are wholly owned subsidiaries of Norcal Waste Systems.

Hundreds of food-related businesses are involved in one or more of these diversion efforts. More than 300 businesses and institutions are included in the composting collection programs alone.

Nearly 3,000 tons per year of excess edible food are diverted from landfill disposal. Of this, almost 700 tons is produce alone.

Diversion through animal feed (including rendering) is more than 21,000 tons per year. Diversion through commercial composting collection was more than 10,000 tons per year for 1999 and continues to grow. In all, the city diverted more than 37,400 tons of commercial organics in 1999. This represented approximately 33 percent of the organics generated by the commercial sector and about 3 percent of the city's overall commercial waste stream (including construction and demolition materials).

Table 3: San Francisco Commercial Food and Other Organics Diversion Results

	1999 Tons/Year
Food redistribution	3,000
<i>Food bank program</i>	<i>2,000</i>
<i>Edible produce</i>	<i>500</i>
<i>Animal feed</i>	<i>200</i>
<i>Food Runners</i>	<i>600</i>
<i>Direct contributions</i>	<i>NA</i>
Sunset Scavenger	6,400
Golden Gate Disposal & Recycling	4,000
Animal feed markets*	14,000
Rendering*	10,000
Total commercial organics recovered	37,400
Percent of commercial organics diverted	33%
Commercial diversion level (% by weight)	3%

*Based on data from earlier years. Estimates are conservative.

Source: Jack Macy, San Francisco Solid Waste Management Program (February 2000).

The City's Role

The City and County of San Francisco's solid waste management, through its recycling program (SFRP), has provided assistance in developing, implementing, and expanding many of these programs. Partnerships have been developed with the San Francisco Food Bank, San Francisco's garbage collection companies, regional composting facilities, dairy farmers, and local colleges, among others. The SFRP helped with the planning and development of these programs, and it also provided funding for equipment, outreach, and technical assistance in program implementation.

The city, for instance, contracts with Applied Composting Consulting, Inc., to provide on-site organics recycling training, monitoring, and assistance to commercial food waste generators.

The city also provided technical assistance to schools, mostly start-up training and help with operating their worm bins.

Through its grant program, the city has picked up the major portion of the capital costs for the in-vessel composting systems installed at the San Francisco State University and at City College. Food Runners and the San Francisco Food Bank have received city grants too.

Edible Produce and Other Food Redistribution

In May 1996, the San Francisco Food Bank started five-day-per-week collection of edible food from 25 wholesalers at the San Francisco Produce Terminal. Since then it has since expanded to other wholesalers in the city. (Previously it collected produce twice a week.) Participating businesses benefit from the program by reducing their garbage costs and claiming a tax deduction for donated food.

The food bank collects food in its original packaging, as long as it is mostly edible, and transports it in a refrigerated truck to its warehouse where volunteers separate edible food from inedible food. More than 70 percent of the produce collected is delivered directly to member organizations that feed thousands of people daily in San Francisco.

A dairy farmer from Sonoma County picks up the inedible or spoiled produce from the food bank. He travels about 50 miles and picks up a 30-cubic-yard rolloff several times a week. The produce has enough value to provide this service free of charge. He blends the organics into his dairy and heifer feed (using up to 10 percent produce in his mix). He also sells the material to other farmers in the area.

The food bank has collected and diverted more than 1,300 tons of produce from San Francisco in the last two years (1998 to 1999) and is now diverting produce at a rate of 700 tons per year. Of this amount, more than 500 tons are redistributed as edible food, and almost 200 tons are used as dairy and cattle feed.

Sunset Scavenger's Collection Service

In August 1996, Sunset Scavenger started collecting produce that the food bank could not use from 25 wholesalers at the produce terminal.

Sunset Scavenger's source-separated collection and composting program has since expanded to more than 270 businesses, including wholesalers, large supermarkets, produce markets, juice bars, restaurants, and floral/plant shops. In addition to segregated produce, the company collects all types of food discards, floral and other plant trimmings, soiled paper, wooden produce crates, and waxed corrugated cardboard. Customers who segregate their produce can benefit from lower service rates.

Sunset Scavenger provides each participating business with a dedicated green container for source-separating their vegetative food and other acceptable organics. Relatively small generators are provided 32- and 64-gallon totes; large generators are provided 1-, 2-, and 3-cubic-yard containers.

The 3-cubic-yard containers are only for light produce. All totes and bins are covered and locked to avoid vector and odor problems as well as scavenging and illegal dumping. Pickup frequency varies from one to six times a week, depending on each business's needs. Sunset uses front-loading trucks that have been adapted to pick up totes.

Initially Sunset Scavenger delivered the produce to the Richmond Sanitary Composting Facility. This facility windrow-composted the organic material along with other yard trimmings it received.

Sunset now delivers its organics to Norcal's B&J composting facility in Dixon (65 miles northeast of the city). The facility is permitted to take all food material, including meat and postconsumer residuals.

This facility utilizes the Ag-Bag in-vessel technology. The Richmond Sanitary Composting Facility, which is only permitted to handle produce and no other food discards, played a key role in making the program work. The facility found that adding food to its yard trimmings sped up and improved the composting process and resulted in higher-quality compost.

In 1999 Sunset Scavenger's composting program diverted more than 6,400 tons of material. During the year, the company increased the number of participating businesses and monthly tonnage. At the beginning of 1999, it had 177 customers. By the end of the year, it had 252.

In early 2000, the company was adding more than 15 customers per month (most growth is in the restaurant sector). Sunset has set a goal of adding 200 accounts per year (for at least three more years) and diverting at least 13,000 tons per year through its composting collection program. It also aims to add all food collection to its food service customers.

Golden Gate Disposal & Recycling Company's Organics Collection Service

Golden Gate Disposal & Recycling Company (GGD) collects about 10 to 15 tons per day of source-separated "all food" scraps (pre- and postconsumer). The company collects seven days per week from more than 60 generators. Its customers are mostly markets and restaurants in the city's Chinatown, North Beach, and Fisherman's Wharf area. The large St. Francis Hotel recently joined the program (its food discards are not included in the above tonnage figures).

This dedicated food route grew out of an old swill collection route that GGD inherited from a hog farmer. He had been collecting food waste from these businesses every day for many years and bringing it to his hog farm in the Central Valley near Lodi. When the farmer went out of business, he offered the route to GGD, which saw it as a great opportunity to get into the food recycling

business, provided GGD could find a market for the material.

After other hog farmer and composting facility options fell through, GGD eventually was able to bring food discards to the B&J composting facility, when it received a permit to compost all food material.

GGD is experimenting with different collection approaches to minimize its customers' source-separation effort and costs. In addition to its collection of source-separated organics, GGD offers collection of organics mixed with other trash to some of its food waste generating customers. GGD asks that they do a good job of recycling bottles and cans. GGD does not offer its customers a rate incentive to source-separate organics. Thus, its new collection strategy keeps glass contaminants out of the compost but simplifies customers' set-out requirements.

These customers may not even be aware that their garbage is being composted. Because their garbage is typically high in organics, it generally has been within acceptable contamination levels for the composting facility. Because Golden Gate's sister company, Sunset Scavenger, emphasizes clean, source-separated organics, it dilutes the effect of Gold Gate's less clean materials.

Costs, Economics, and Benefits

The city's costs cover staff time for the organics recycling coordinator and an associate. Table 4 lists other costs the city has incurred in developing programs to recover organics from the commercial sector. Since 1996 these costs have totaled almost half a million dollars. Grants to the food bank account for \$258,600.

The city's contract with Applied Compost Consulting, Inc. represents another \$130,000 and spans three years (1996–99). The city renewed this contract for \$150,000 (for another three years).

The work of Applied Compost ranges from program planning, surveying customers, and analyzing customer savings and other data to training, monitoring, follow-up, and outreach with customers.

Sunset Scavenger's composting program costs are estimated to be less than \$100 per ton. This includes collection, transfer, haul and compost facility tipping fees, outreach, and training. (Trash

costs are about \$150 per ton.) As an incentive to participate, businesses that just separate produce pay 25 percent less for produce collection than for garbage collection. These businesses can thereby reduce their overall disposal costs when they sufficiently reduce their garbage quantities and service. All-food collection service costs customers the same rate as trash.

Table 4: City of San Francisco's Costs

	Cost
Grants	
Refrigerated truck and partial year's salary for a driver (food bank)	\$97,100 (1996)
Forklift and pallet jack (food bank)	44,000 (1997)
Sorting conveyor system (Food Bank)	55,000 (1998)
Refrigerated truck and pallet truck (Food Bank)	62,500 (1999)
Truck, driver costs (Food Runners)	20,300 (1997)
In-vessel composter (SF State Univ.)	50,000 (1996)
In-vessel composter (City College)	23,000 (1999)
Contracted Technical Assistance	130,000 (1996-99)
Indoor Sorting Containers	11,000
Total Costs	\$492,900

Source: Jack Macy, San Francisco Solid Waste Management Program (February 2000).

Benefits of this program are manifold. Produce businesses save money through lower trash costs as well as through their tax-deductible donations to the food bank. Food service agencies save money through reduced purchases; they also boost the nutritional value of the food they serve. Farmers save money on feed costs. Composting facilities produce higher-quality compost through this program.

Some of the finished compost comes back to the city to be marketed as “Urban Earth” through the San Francisco League of Urban Gardeners. The city, through its efforts, also helps increase recycling and diversion of valuable materials from landfill disposal.

Sunset Scavenger and Golden Gate Disposal & Recycling become more effective and successful recycling companies. They have created innovative programs and have shown a good faith effort to help the city meet the requirements of the California Integrated Waste Management Act (AB 939, Sher, Chapter 1095, Statutes of 1989 as amended [IWMA]). They benefit by establishing themselves as the provider for these needed services.

The experience of two produce terminal vendors—Cooks Company and DeMatti Brothers—illustrates the cost-effectiveness to participating businesses. Cooks Company cut its trash bill by 45 percent within four months of joining the program. DeMatti Brothers reduced the size of its trash container by half and reduced the number of trash pickups from four a month to two a month, reducing its trash bill by 10 to 15 percent. Many produce markets and restaurants have reduced their trash by 90 percent and are saving up to 50 percent on their trash bills.

Some customers that had previously relied on sending their produce waste down the drain (to the sewage treatment plant) have switched to the organics program because of cost savings in their water bill.

Challenges and Opportunities in Implementation

One challenge the program faced was getting food waste generators to understand that participating was not hard. Many thought that separating food discards would take extra time and effort and be a nuisance. The city and its haulers are overcoming this challenge by making the collection convenient (such as through providing bins and/or simplifying sorting), providing rate incentives, working with businesses to reduce trash (and thus costs), and providing technical assistance and training.

Language obstacles were another challenge. San Francisco has a high non-English speaking population. The city produced bilingual and trilingual outreach materials.

Limited indoor and outdoor space presents a challenge for some food waste generators. The city has found that usually where there’s a will, there’s a way. Businesses can be creative in where they place containers to collect food discards. The city’s organics recycling program manager maintains that if businesses in San Francisco can do it, anyone can do it.

Illegal dumping has been a problem in some locations. Other businesses not participating in the program dump trash in the organics bins. The city, its consultant, and its haulers emphasize that outdoor organics bins of all sizes should be locked. This has cut down on the illegal dumping problem. Sunset Scavenger provides locks for its customers’ containers.

Odor and vector issues have not presented much of a problem. If they do, haulers can increase pickup frequency. Fewer than 5 percent of customers have complained about odor. These odors are primarily found in juice bars, which have extremely wet materials that decompose rapidly. Several customers that use trash compactors have actually reduced odors emanating from trash as a result of switching to organics collection and having the organics containers collected more frequently.

Washing out containers is the customer’s responsibility. While the city, its haulers, and the composter want to avoid the use of plastic bags, the bags can be screened out at the composting facility. The city and its partners are currently evaluating biodegradable bags, but these bags are more expensive than conventional plastic bags and may end up being screened out anyway.

One clear opportunity for the city to increase diversion further is to bring more food waste generators into the program. Less than 400 of the 7,000 food waste generators are now participating. The city has targeted the major generators (all wholesalers, all produce markets, food-service businesses, and large restaurants).

The fact that 33 percent of all organic material in the commercial waste stream is being diverted is testimony to the success of these efforts. Yet, opportunities to expand exist. Many large hotels, for instance, do not recover their food discards. The city has estimated that another 45,000 tons per year could be diverted if its commercial food recovery programs were expanded.

Funding Mechanisms

The composting programs of Sunset Scavenger and Golden Gate Disposal & Recycling are funded through the garbage rates they charge their customers. The city's funds also come from the garbage rates.

Case Study: Berkeley Commercial Food Scraps Collection Program

Overview

The City of Berkeley began its pilot food scrap collection program in 1997 after a waste stream analysis showed that 25 percent of city-collected refuse from the commercial sector was food scraps. The City of Berkeley is fairly unique in providing refuse collection services to its residential and commercial sectors.

In fact, city collection is required for putrescible materials, although other companies may collect dry refuse. Diversion of organic materials is an important element in the city's efforts to reach and surpass the 50 percent diversion goal. The food scraps collection program, which serves the commercial sector, is part of the city's multi-faceted organics management program. Other initiatives include green waste and wood diversion.

As of February 2000, the pilot program was collecting food scraps from 39 business accounts ranging from large supermarkets and restaurants to bakeries, coffee shops, juice bars, and diners. Generators may include any food scraps except meat, and they may also include flowers and waxed cardboard boxes. One customer, Pyramid Brewery, also diverts the diatomaceous earth from its filters. In all, the 39 businesses are diverting about 140 tons per month of food scraps. The program uses standard technology and can easily be duplicated by other cities.

Most of the businesses participating in the pilot food scraps collection program also recycle cardboard, brown bags, mixed papers, bottles, and cans under the city's commercial recycling service. Recovery of food scraps brings the recycling rate of these businesses to 50 percent or higher. The City of Berkeley reports a 42 percent overall recycling rate.

In the pilot program, city crews collect food scraps on the residential plant debris routes using a front-



Container used to set out food scraps.

end loader truck. (When the crew finishes collecting residential yard trimmings, they then collect commercial food scraps.) The city supplies customers with containers in which to place their discarded foods. The size of the container depends on the needs of the business. The city offers front-loading containers ranging in size from 1 cubic yard to 6 cubic yards, plus 32-, 64-, or 96-gallon carts.

The larger generators generally have the larger containers, but the size of the container also depends on space issues in addition to the amount of food scraps generated. Customers can line the carts with biodegradable compostable plastic bags, which the city also provides. Customers collect their food scraps at all generation points, such as receiving, food preparation, and cleanup.

Pickup frequency varies based on customers' needs. Initially, the city collected food scraps once or twice a week, but it soon became clear that some customers would need more frequent service. The city collects food scraps six days a week from some of its accounts.

City crews combine collected food scraps with plant debris at the city's transfer station. Gilton Resource Recovery picks up the organic material in long-haul trailers and composts it at its plant in Modesto, Calif., about 50 miles away. The site uses open windows.

Gilton Resource Recovery returns about 20 tons a month of the finished compost to the city, which gives it to schools and community gardens. City staff members work with public schools and a grant recipient to create gardens at the schools. Willard Middle School has received more than



The City of Berkeley provided a toter for food scraps.

200 yards of the compost and it sells the produce grown with it. Martin Luther King Jr. Middle School, in cooperation with Chez Panisse Restaurant, has created an award-winning garden. Called the edible schoolyard, the garden provides food for cooking classes and school lunches. This program has been a model for other school gardens.

The city provides a storage site for the compost and a front-loader and operator to load the trucks from the gardens and schools. The city also delivers large amounts of compost to schools. The schools and community gardens have indicated that the availability of free compost from the city, and the city's assistance in loading their vehicles, has been critical to their expansion and success.

In implementing the pilot program, the city set out to solicit the participation of the largest food generators. It did this by obtaining a list of all food-generating businesses (using appropriate SIC codes) provided by Alameda County and then making in-person visits with business owners and managers. The city also targeted food-generating

businesses in close proximity to each other to increase the program's collection efficiency. Two-person city crews do the collection. The recycling program manager, field representative, and recycling operations supervisor do the outreach, education, and monitoring.

Costs, Economics, and Benefits

The city charges participants in the food recovery program the same amount for separated refuse and food scraps collection as it would charge for the same level of refuse service. (The city charges approximately \$50 for steam-cleaning a customer's container.)

To encourage more businesses to sign up for the food scrap collection program, the city is investigating charging its customers a lower fee for collection of separated food scraps.

The city pays Gilton Resource Recovery \$25 per ton to transport and compost food scraps and plant debris. In contrast, tipping fees and transportation costs for refuse cost the city \$40 per ton.

The two-person crew collecting food scraps three days a week costs \$70,584 per year. (Three-day-a-week collection is the average collection pickup frequency.) These collection costs include benefits and overhead but generally represent labor costs only. Vehicle costs represent another \$50,000 per year, and bins cost another \$10,000 per year. In all, collection costs are about \$77 per ton and are expected to decrease as more businesses join the program.

While the city's refuse costs have not gone down as a result of the pilot program, the city's recycling coordinator believes that if the city operated a full route, these costs would drop because processing food waste is cheaper than disposing garbage.

Program equipment costs from start-up through February 2000 have totaled more than \$200,000. A grant from the Alameda County Waste Management Authority covered \$35,000 of these costs. The rest came from the refuse fund, which is made up of refuse fees (user fees). This source will continue to pay for equipment needs. The city has spent approximately \$9,200 for containers and carts and \$2,300 for biodegradable bags. The front-end loader cost \$195,000.

Table 5: Equipment Costs (Berkeley)

	Costs
Front-end loader	\$195,000
Containers	
One 6-cubic-yard bin	559
One 4-cubic-yard bin	473
Six 2-cubic-yard bins	2,325
Eight 1-cubic-yard bins	2,702
Twenty 96-gallon carts	1,007
One 64-gallon cart	46
Eleven 32-gallon carts	416
Two 3-cubic-yard compactors	Customer-owned
Four 3-cubic-yard bins	1,671
Bags (77¢ ea.)	2,300
Total Costs	\$206,499

Source: Debra Kaufman, City of Berkeley Recycling Program, Berkeley, Calif. (February 2000).

Challenges and Opportunities in Implementation

The city experienced two major challenges in implementing its program:

- The city initially used a rear-loader truck but soon found that containers full of food were too heavy for the truck.
- The containers would get extremely dirty each day because only food was going into them. Sometimes, sticky waste such as bread dough was difficult to get out of the container.

To solve the first problem, the city purchased a front-end loader truck. Not only has the truck eliminated the weight issue as a problem, but it has also increased efficiency because it can load bins and carts and efficiently collect various sizes of accounts on the same route.

To solve the second problem, the city purchased organic biodegradable bags to use as liners for the containers and to give to merchants to use for their food discards. It also now provides a monthly steam-cleaning service for the containers. The city charges approximately \$50 per cleaning.

Contamination has not been a problem, nor have odor issues. Generally the businesses participating in the pilot program are businesses that have a lot of food discards. Keeping the food scraps separate has not entailed a huge change for them.

One remaining challenge is expanding the program to all food waste generators in Berkeley (there are about 540). Once the city establishes an incentive rate for those who participate in the



A City of Berkeley front-end loader truck emptying a customer's food scraps.

program, it plans to expand to other food waste generators. In the short-term, the city expects to expand its pilot program to 50 to 80 businesses.

Funding Mechanisms

The pilot food scraps collection program, like all the city's recycling and refuse services, is funded from refuse fees collected from residents and businesses. There are no separate fees for any of the organics programs except for the drop-off of clean organics at the transfer station, which has a 30 percent reduced rate.

Case Study: Santa Cruz County Provides Seed Money for Private Initiatives

Program Description

Santa Cruz County offers grants for waste reduction and recycling projects. In 1997 Karin Grobe of Organic Recyclers Anonymous (ORA) applied for a grant to identify food waste generators in the county and link these with existing end users. This first phase of a now ongoing food recovery effort in the county was a success and led to several more grants.

ORA is now helping camps, schools, and other establishments implement on-site vermicomposting of their food discards. ORA staff work with the Skills Center, a local sheltered workshop, which sells worms, vermicomposting supplies, and “industrial size” 4 by 4-foot worm bins. Mid-scale food waste generators can use these bins. The Skills Center is a nonprofit organization that employs and trains developmentally disabled adults.

The county’s third grant to ORA for \$25,000 includes some financial assistance to food waste generators for purchasing on-site composting systems (for example, Earth Tubs or the Skills Center’s industrial worm bins). The county will pay up to half the cost of the equipment and supplies (such as worms and food collection carts).

The county has also given grant money (\$19,600) to the Skills Center to help it set up production and marketing for its worm farm. It was through this grant that ORA and the Skills Center gained experience with industrial size bins, which enabled ORA to start on-site food discard management at camps, schools, and other establishments.

The county award program and general county support is helping more food waste generators in the county divert their food discards to businesses that want these materials. In particular, county-supported efforts have targeted and begun diversion of small generators’ materials using innovative approaches such as on-site vermicomposting systems.

Phase 1 of Organic Recyclers Anonymous Project

Under its first county grant of \$7,000, ORA gathered information on food discard generators (supermarkets, restaurants, food service institutions) and end users (composters, vermicomposters, animal feeders, animal feed manufacturers, and tallow companies) of pre-consumer food residuals. ORA compiled data through on-site interviews and phone surveys.

ORA developed databases of generators, users, and haulers of pre-consumer food and then matched generators with users whenever possible. ORA’s research identified 23 possible end users, from food banks and farmers to renderers, commercial compost operators, and animal feed manufacturers. ORA provided generators with a

database of users and names of haulers so they could make their own matches.

Example: Coast Produce. As result of ORA’s efforts, Coast Produce, a wholesaler of fruits and vegetables, contacted the Skills Center worm farm to arrange for the donation of perishable fruits and vegetables. Coast Produce has 300 customers, including grocery stores, restaurants, and food service businesses. It serves a geographical distribution area approximately 300,000 square miles in size.

Coast Produce first contacts charitable organizations that feed the poor, but they are unable to use all the company’s perishable residuals. The Skills Center worm farm, which uses the fruits and vegetables to feed more than 512,000 worms, picks up slightly more than a half-ton of fruits and vegetables per week from Coast Produce.

Full boxes are loaded onto a pallet and into a Skills Center truck with a forklift. Through the Skills Center pickup, Coast Produce avoids disposal of more than 26 tons per year and saves \$3,200 in hauling and disposal fees per year. Other food discards go to charitable organizations and dairy farmers.

The program costs Coast Produce nothing because users collect its food discards free of charge. Coast Produce simply needs to keep food waste separate from non-food waste and load pallets of food waste in boxes into users’ trucks. The company recovers 100 percent of its food discards (2,000 to 3,000 pounds per week, or 52 to 78 tons per year). This represents 43 to 65 percent of the total waste it generates (120 tons per year). Its total waste bill per year is \$15,160.

Phases 2 and 3 of Organic Recyclers Anonymous Project

Under a second and third grant from the county (\$4,000 and \$25,000, respectively), Organic Recyclers Anonymous contacted individual generators. The organization designed food discard diversion systems based on the locations, waste stream, and capabilities of the generators. Where appropriate, ORA staff worked with generators to choose and set up an on-site food diversion system.

As of February 2000, ORA was continuing to match generators with businesses that use food

discards as animal feed or compost feedstock. Five sites had already begun implementation of on-site vermicomposting: the Swanton Pacific Ranch (a learning facility), a Montessori School, the Live Oak School, the Redwoods Program/Juvenile Hall, and the YMCA Camp Campbell.

Two of the sites have bought worm bins made by the Skills Center. Two others made their own bins using information from the Skills Center, and one used small commercially available bins.

Phase 3 includes funds to pay for up to half the cost of infrastructure improvements (such as in-vessel composters, vermicomposting bins, and worms) for on-site systems at generators' sites. The grant also covers technical assistance to businesses adopting on-site composting or vermicomposting. Under phase 3, ORA developed a brochure to explain the diversion project to the business community. ORA distributed it via direct mail, chambers of commerce, and business associations.

Example: YMCA Camp Campbell. The YMCA Camp Campbell is one food waste generator that is now vermicomposting on-site due to ORA's efforts. The camp, a residential facility and conference center in the Santa Cruz mountains, serves 75,000 meals to 8,000 guests each year. The camp was discarding approximately 400 pounds of kitchen and dining room residual fruit and vegetable waste per month.

The camp purchased four industrial-sized worm bins and 20 pounds of worms from the Skills Center. Worms multiply quickly, so the worm population is expected to weigh 64 pounds by spring 2000. Kitchen and dining staff put all leftover fruit, vegetable, pasta, bread, and coffee grounds into two 50-gallon wheeled carts, which are emptied into the worm bins weekly. Worms convert the food residuals into vermicompost, a valuable soil conditioner.

The camp also incorporates the vermicomposting project into the curriculum of its environmental educational program. Approximately 6,500 young people who visit the camp are introduced to the idea of using worms to transform food scraps into valuable soil conditioner.

The worm castings are used for restoration projects at the camp to remediate the human impact on the natural environment. Restoration



Worm bins and campers at YMCA Camp Campbell.

projects include native plants that provide food sources for wildlife (one project is a butterfly garden). The environmental education program ties in nicely with Santa Cruz County's residential recycling, composting, and trash programs.

Waste Management, the county's franchise hauler, provides vermicomposting bins to residential customers at subsidized prices. Thus, children can learn about vermicomposting at camp and bring the information home to start a worm bin. As the worm population in the bins grows, teachers who bring students to the camp will be furnished with worms to start a classroom worm bin.

Costs, Economics, and Benefits

Santa Cruz County has awarded \$36,000 in grant money to Organic Recyclers Anonymous. The City of Watsonville also gave ORA a grant of \$1,000 for phase I of the project. Instead of collecting commercial food waste in this largely rural area, the county provides seed money (via its grants program) to spur food recovery and connect food waste generators with haulers and end users of food. Businesses and institutions that have embraced food recovery (either on-site or off-site) are realizing savings on avoided disposal costs.

The efforts of Santa Cruz County and ORA also help sustain the Skills Center worm farm, which is becoming a self-sustaining business for the sheltered workshop.

Challenges and Opportunities in Implementation

The County of Santa Cruz health department, which regularly inspects food service establishments, is concerned that vectors will be a major problem for on-site management of food discards at grocery stores and restaurants.

They have, however, tentatively agreed to distribute a brochure on recovering food discards specific to camps and conference centers. (Camps and conference centers can allow more space between food prep or storage area and composting area.) Also, space is limited at grocery stores and restaurants, so space for a composting system typically competes with other space uses (such as parking).

Santa Cruz County has recycling collection programs for its commercial/institutional sector. However, a waste characterization study done in 1999 revealed that food waste makes up 48 percent of restaurant and 33 percent of retail waste streams. ORA's efforts will help the county to divert this relatively high portion of the commercial waste stream from disposal.

The County's Role

By awarding grants to Organic Recyclers Anonymous and the Skills Center, the county has acted as a facilitator. (The county allocates about \$150,000 per year in waste reduction grants.)

The county further facilitated food recovery by mailing a letter on its letterhead from the director of public works to food waste generators in the county. The letter informed businesses about ORA's project and research, and it included a list of potential food waste users who might benefit by reducing their garbage bills. Local chambers of commerce and the local health department have further helped spread the word about opportunities to divert food waste to valuable end uses.

Contacts

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CIWMB Contacts

Food diversion contact: Chris Kinsella,
 (916) 341-6274, ckinsell@ciwmb.ca.gov.

Composting contacts

Organic Materials Management Section, Business
 Resource Efficiency Branch, (916) 341-6260.

Composting facility regulations: Alan Glabe,
 (916) 341-6714, aglabe@ciwmb.ca.gov.

Food contact for Organic Materials Management
 Program: Yvette DiCarlo, (916) 341-6587,
 ydicarlo@ciwmb.ca.gov.

Compost Sites Permitted to Accept Food

Note: The CIWMB provided some of the contacts
 below. Other sites may also exist.

Folsom MRF & Composting (34-AC-0002)
 560 East Natuma St.
 Folsom, CA 95630
 Contact: Tim Linn, (916) 355-0151

Community Recycling Composting Facility
 (15-AA-0307)
 10440 Taxford St.
 Sun Valley, CA 91352
 Contact: Thomas Fry, (818) 767-2779

San Joaquin Composting (15-AA-0287)
 P.O. Box 5, 12421 Holloway Road
 Lost Hills, CA 93249
 Contact: J. Scott Deatherage, (805) 797-2914

B&J Landfill Composting (48-AA-0083)
 6426 Hay Road
 Vacaville, VA 95687
 Contact: Chris Choate

Z-Best Compost (43-AA-0015) in Gilroy
 625 Charles Street
 San Jose, CA 95112
 Contact: Grey Ryan, (408) 277-6868

Newby Island Compost (43-AN-0017) in San Jose
 1601 Dixon Landing Road
 Milpitas, CA 95035
 Contact: Gill Chesos, (408) 262-1401

California BioMass Composting
 (33-AA-0259) in Thermal
 Victor Valley Regional Composting
 (36-AA-0403) in Victorville
 10397 Alder Ave.
 Bloomington, CA 92316
 Contact: David Hardy, (909) 875-6441

Gilton Resource Recovery Composting Facility
 (50-AA-0016) in Modesto
 1722 Mono Drive
 Modesto, CA 95354
 Contact: Eugene Gilton, (209) 527-3781

Resources

CIWMB Publications

Many CIWMB publications are available on the Board's Web site at: www.ciwmb.ca.gov/Publications/.

To order hard copy publications, call 1-800-CA-Waste (California only) or (916) 341-6306, or write:

California Integrated Waste Management Board
Public Affairs Office,
Publications Clearinghouse (MS-6)
1001 I Street
P.O. Box 4025 (mailing address)
Sacramento, CA 95812-4025

The CIWMB Web site lists information on the following topics:

California regulations on composting:
www.ciwmb.ca.gov/Regulations/Title14/default.htm.

Organics recovery initiatives and resources:
www.ciwmb.ca.gov/Organics/

Composting facilities in California:
www.ciwmb.ca.gov/SWIS/.

Worm and worm bin suppliers in California:
www.ciwmb.ca.gov/Organics/Worms/WrmSupply.htm

Other Resources

BioCycle: Journal of Composting & Recycling, published by JG Press, Inc., (610) 967-4135, www.jgpress.com/.

In particular, see Steven Sherman and Leana Schelvan, "Food Residuals Recovery in California," *BioCycle*, September 1999; and Jack Macy, "San Francisco Takes Residential Organics Collection Full-Scale," *BioCycle*, February 2000.

U.S. Environmental Protection Agency fact sheets:

"Don't Throw Away That Food: Strategies for Record-Setting Waste Reduction," (EPA-530-F-98-023, 1998). Available on the Web at www.epa.gov/epaoswer/osw/publicat.htm or by calling the RCRA hotline at 1-800-424-9346.

WasteWi\$e Tip Sheets, "Managing Food Scraps as Animal Feed" (EPA-530-F-96-037); and "Donating Surplus Food to the Needy" (EPA-530-F-96-038). Both are available free from the National Service Center for Environmental Publications, Cincinnati, Ohio, 1-800-490-9198.

"Food Donation: A Restaurateur's Guide" (52 pages), available for \$3.95 from the National Restaurant Association, 1200 17th Street, N.W., Washington, D.C. 20036-3097, 1-800-482-9122.

Jean Bonhotal and Karen Rollo, "Compost: Because a Rind is a Terrible Thing to Waste." Available from Cornell University Media Services Resource Center, 7 Business & Technology Park, Ithaca, NY 14850. (607) 255-2080, Dist_Center@cce.cornell.edu.

"A Guide to Commercial Food Composting, Composting Council Research and Education Foundation, 4424 Montgomery Avenue, Suite 102, Bethesda, MD 20814. (301) 913-2885.

Skills Center Worm Farm and Organic Recyclers Anonymous, Industrial Size Worm Bin Vermiculture System (1999). Available from Jeffery Smedberg, County of Santa Cruz Recycling Programs, 701 Ocean Street, Santa Cruz, CA 95060. (831) 454-2373, fax (831) 454-2385, recycle@co.santa-cruz.ca.us.

The publications below are available from Flowerfield Enterprises, 10332 Shaver Road, Kalamazoo, MI 49024, (616) 327-0108, fax (616) 327-7009, www.wormwoman.com.

Binet Payne, "The Worm Café: Mid-Scale Vermicomposting of Lunchroom Wastes." This manual describes how a teacher and her students developed a system to compost lunchroom waste with worms and saved their school \$6,000 per year.

Mary Appelhof et. al, "Worms Eat Our Garbage: Classroom Activities for a Better Environment." This curriculum uses more than 150 worm-related activities to develop problem-solving skills in children grades 4–8.

Mary Appelhof, "Worms Eat My Garbage." Newly revised and updated, this manual provides complete illustrated instructions on setting up and maintaining small-scale worm composting systems.

Credits/Disclaimer

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The statements and conclusions in this case study are those of the contractor and not necessarily those of the Board, its employees, or the State of California. In addition, the data in this report was provided by local sources but not independently verified. The State and its contractors make no warranty, express or implied, and assume no liability for the information contained in this text. Any mention of commercial products, companies or processes shall not be construed as an endorsement.

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, Flex Your Power and visit www.consumerenergycenter.org/flex/index.html.