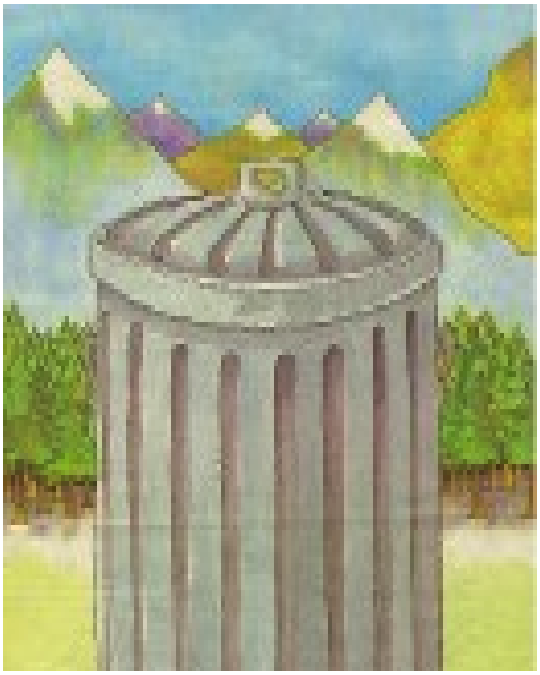
COLORADO

INSTITUTIONAL

FOOD WASTE

COMPOSTING GUIDE



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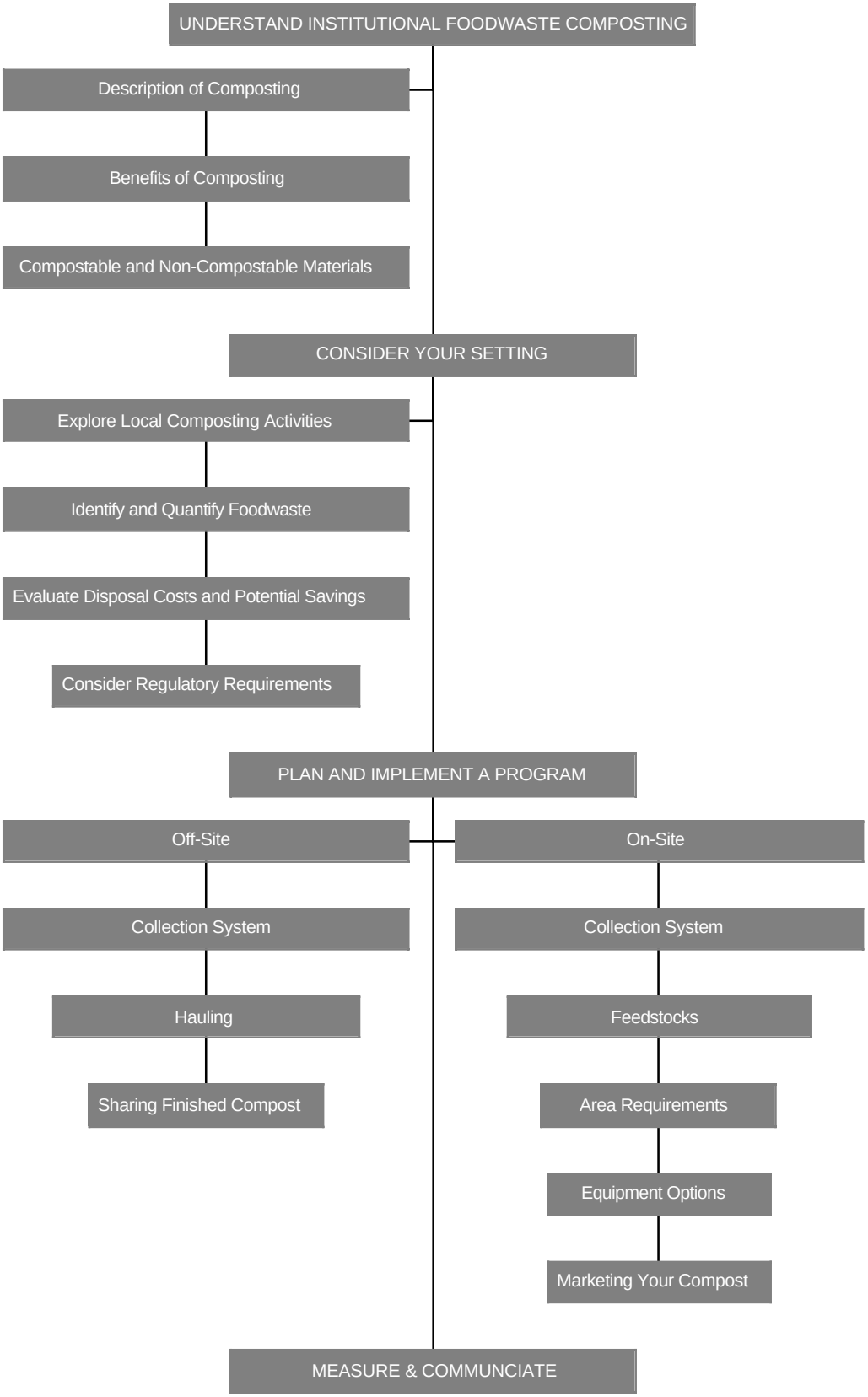

INTRODUCTION

The purpose of this Planning Guide is to help advance food waste composting in Colorado. New technologies are making composting an operationally viable, potentially cost-effective means of diverting organic food waste and low-grade, food-related paper. Additionally, new State regulations provide better direction and guidance for institutions/municipalities that, in the past, have had reluctance or difficulty with permitting requirements.

This Planning Guide includes operational, financial, promotional, and regulatory considerations toward implementing a program. It is designed primarily for institutions within Colorado, such as colleges and universities, hospitals, correctional facilities, school districts, and business parks.

This Guide is intended to be a starting point for planning a program and to access additional information. With this information you may discover other schools, businesses, institutions or government agencies in your community are interested and willing to develop joint ventures for composting.

This Guide follows a typical decision making process common to most successful composting programs. First step in this process is to understand the opportunities and challenges for an institutional-sized composting operation. This process requires a good understanding of current waste generation and disposal practices. With the information from this Guide, a more informed decision can be made whether to collaborate with an off-site composting operation or to invest in an internal, on-site program.

UNDERSTANDING INSTITUTIONAL FOOD WASTE COMPOSTING

Description of Composting

Composting is controlled decomposition where aerobic (oxygen requiring) microorganisms break down leaves, grass clippings, food, paper products, and other organic materials into soil amendments. The microorganisms that break down the raw materials need oxygen, a moist environment, carbon and nitrogen for energy and protein synthesis, temperatures, and pH conditions that sustain microbial growth and activity. With proper conditions, the microorganisms, primarily bacteria and fungi, colonize on the organic matter, metabolize it, and release energy in the form of heat as a byproduct.

Composting may be easier than you think. Institutions around the country are using a variety of composting options to turn their wastes from a liability into an asset. This Guide, along with other sources of assistance, can help select the best option for your institution.

Benefits of Composting

Builds a Positive Image

- employees report favorably about participating in a successful program
- composting addresses an increased public concern for environmental quality

Economic Savings

- composting has real potential for reducing solid waste disposal costs
- finished compost reduces costs of fertilizers and other soil amendments

Education

- composting applies to a variety of curriculums such as chemistry, conservation, and horticulture
- class tours and information campaigns build awareness and support for your program

Environmental Concerns

- diverting organic materials from landfills reduces methane gas and leachate and the corresponding impacts on global warming and water pollution
- compost replenishes the earth's soil

Horticultural Benefits

- composting produces a great organic amendment for dry, infertile soil
- bacteria and organisms in compost build and improve soil structure
- mature compost provides nutrients and microorganisms essential for plant growth
- compost increases water retention and decreases irrigation requirements

Compostable and Non-Compostable Material

Compostable Material

- produce-trim from leafy vegetables, spoiled fruits, vegetables, salads
- day old breads and pastries, excess batter, spoiled bakery products
- dairy products-cheese, yogurt, ice cream, miscellaneous by-products
- floral waste and trimmings/plants
- leftovers that cannot be served again
- frozen foods
- coffee grounds/filters
- tea bags
- egg shells/ cartons
- meat trimmings (most facilities prohibit the inclusion of large bones or bulk quantities of grease, oils, and fats in the compost. Although these products are biodegradable, they are slow to decompose and may attract rodents or other animals. Local renderers are a better choice for handling significant quantities of this type of material)

Compostable Food Service Products

- biodegradable serviceware
- paper trays
- paper food wrappers
- napkins/paper towels
- wet or lightly waxed corrugated cardboard
- paper plates and cups

Common Food Waste Contaminants

- foil wrappers
- Polystyrene foam
- plastic gloves
- plastic utensils (forks, spoons, knives, plates, cups, stir sticks, lids, etc.)
- single serve containers (condiments, cream, etc.)
- plastic and wire ties
- plastic food wrap

CONSIDER YOUR SETTING

Explore Local Composting Activities

An initial step in planning your institution's program is an exploration of permitted and planned composting operations in your area. Local knowledge and resources are invaluable and will likely determine the options you select.

If composting facilities operate within a reasonable transportation distance, there may be a number of beneficial arrangements that can be negotiated. In this case it may be easier and less expensive to arrange for your materials composted at their facility. Your foodwaste might be the feedstock they need, especially if they're trying to source high nitrogen materials.

If there is an interest in establishing a composting program in your area, it is beneficial to cooperate with other institutions, local government agencies, hauling companies, and community groups. Equipment sharing is an example of this approach. Compost turners, chippers, and screening systems can be jointly-owned or rented. More collaborative approaches share the responsibilities for a program as a whole. For example: space for a composting operation can be provided by a county or local farmer, hauling and processing equipment can be supplied by private companies, and feedstocks can be provided by institutions and food service establishments.

Exploring local composting efforts will benefit your program eventually. Even if you do not partner with other programs, you can establish contacts in your area and learn what types of materials are currently

composted, what equipment is used. By "going downstream" first you can customize a program that works best for your setting.

Identify and Quantify Foodwaste

Organic materials can be categorized into **pre-consumer** food scraps, **post-consumer** food scraps, and most paper products. Pre-consumer food wastes are food scraps from meal preparation and grocery stores. Post-consumer food scraps are any leftover, uneaten food that has already been served.

In general, pre-consumer food scraps are more easily composted because it is fairly simple to train kitchen employees about proper separation techniques. Post-consumer food composting may require additional monitoring by trained staff to reduce the risk of contamination. Keeping things simple at first, such as beginning with pre-consumer composting, allows you to establish a successful collection system more easily. Continuous employee/consumer education, getting employees/consumers to “buy into the system,” and monitoring will help, as will color coded bins and appropriate signage. Once employees have been trained, minimal extra time is required to separate materials because it becomes part of the normal daily routine.

One way to estimate the amount of waste generated is to measure all of the scraps produced in each area during a typical operation week and project this amount over time. For example, if you have several stores or cafeterias, measure one typical container of food scraps and multiply this amount by the number of containers collected. Make sure employees are informed, and containers contain food scraps only.

Normally, disposal costs are billed by the cubic yard (a volume measurement). Therefore, measure food waste in the same unit of measurement as trash disposal. Standard container sizes and their volume capacity include:

5- gallon container - .025 cubic yards
30-gallon container - .15 cubic yards
55-gallon container - .27 cubic yards (National Solid Waste Management Association, 1985)

Volume-to-weight conversions for food waste vary considerably, depending on the type of food and its moisture content. If trash disposal at your institution is measured and billed by the ton, a standard container filled with representative samples of your institution’s food waste should be filled, then weighed for an approximate conversion between volume and weight.

If you are considering an on-site composting program (where the proper mix of feedstocks is important), measure the amount of each type of food going into your compost. By doing this, you will be able to properly gauge your compost mixture. The compost mixture is important for moisture

content, pH, and porosity, which are essential factors in the compost process. The sample chart in Appendix One can be used to help analyze your waste stream.

Determining whether food waste composting is right for your institution requires a fairly thorough assessment of your institution's waste generation and disposal practices. Most successful composting programs are usually individually structured to meet the financial and operational opportunities and constraints of a given institution.

Evaluate Disposal Costs/Potential Savings

Since Colorado has some of the lowest landfill fees in the country, diverting food waste cost-effectively can be challenging. It is extremely important, therefore, for food waste diversion to lower trash disposal costs. These savings can then be redirected to help fund additional costs of handling food waste separately.

A sample worksheet for calculating your institution's waste removal costs and potential cost savings from food waste composting is included in Appendix Two.

These savings are accrued more easily if your institution does trash hauling internally. If waste disposal is done by a private company, it will be important to revise hauling arrangements or contracts to get reduced rates for collection of separated food waste and/or reduced frequency of trash pickups.

A Request for Information letter can assist your institution in revising hauling arrangements. A sample is included in Appendix Three. This document should be sent to hauling and composting companies in your area. It should include basic information about your institution's food waste generation. This way, these companies can understand your institution's requirements and determine if they can provide hauling services for your food waste.

Don't Forget Waste Reduction

More than one quarter of America's food, or about 96 billion pounds of food a year, goes to waste--in fields, commercial kitchens, manufacturing plants, markets, schools, and restaurants (U.S. EPA). Waste reduction is a preferred strategy for institutions and includes practices like: preparing smaller portions, discouraging excessive napkin use by moving dispensers away from cafeteria lines and onto tables, and reducing the use of disposable cups by providing durable mugs and offering discounts to those who use them. Getting an 'A' at Lunch: Smart Strategies to Reduce Waste in Campus Dining (David Saphire, 1998), describes simple strategies used around the country to prevent waste though more efficient materials use. To download a free copy visit: http://www.informinc.org/geta.html.

Food Recovery and Gleaning is a growing national movement in the United States that provides an inexpensive means of helping to feed the hungry. For additional information from agencies and organizations around the country, visit the US Department of Agriculture: http://www.fns.usda.gov/FNS/MENU/GLEANING/RECOVER.HTMl

Consider Regulatory Requirements

The Colorado Department of Public Health and Environment (CDPHE) is responsible for the enforcement of regulations pertaining to composting in the state of Colorado. Revised State regulations (September, 2000) provide better direction and guidance to develop composting programs at institutional facilities.

Section 14 of 6 CCR 1007-2 contains requirements for four classes of composting facilities. Classes I, II, and III govern facilities that compost in excess of 50,000 cubic yards per year. Most institutions will generate, store, and process far less than this amount.

Class IV composting regulations are most pertinent to institutions in the State of Colorado. Pilot programs are subject to more stringent regulations than Class IV facilities (see Section 14 of 6 CCR 1007-2 for specific details).

Basic regulations for all composting facilities include:
- control surface water flowing onto the site and prevent surface water from leaving the site;
- control on-site and preventing off-site nuisance conditions such as noise, dust, odors, vectors, and windblown debris;
- prevent water pollution at or beyond the site boundaries;
- control access in order to prevent illegal dumping.

In addition, Class IV composting facilities must meet the following conditions:
- composting activities must occupy less than two acres in size;
- have 5,000 cubic yards or less of feedstock, including process or bulking material onsite;
- can only import a minimum quantity of bulking materials from off-site sources necessary to achieve appropriate porosity, moisture, or carbon-to-nitrogen ratio;
- can give away or sell up to 500 cubic yards of compost annually before meeting compost sampling and quality standards.

Before getting started, contact the CDPHE. The State's composting regulations contain helpful and important information that your institution should be aware of prior to the implementation of composting operation within. CDPHE's website has the entire document available for downloading.

Consulting with your county health department will provide help on local regulations that may be applicable specifically to your community. They can also provide information on local and State contacts.

PLAN AND IMPLEMENT A PROGRAM

Off-Site

Two general options exist for composting food waste once it's been diverted from other trash: 1) transport the material off-site to an approved composting facility or 2) establish an on-site composting operation. There are costs and benefits to each option.

In Colorado, three composting facilities are permitted to accept food waste (CDPHE 2002) These facilities have lower tipping fees than waste transfer stations or landfill operations. They also provide the processing equipment and labor, which can save your institution capital and staffing costs.

A partial list of institutions in Colorado that transport compostable materials off-site include:

- University of Colorado (Boulder campus)
- Coors Brewing Company (Golden)
- National Center for Atmospheric Research (Boulder)

Operation Example: Composting Company

A-1 Organics is a privately owned, commercial organics recycling company that operates multiple facilities along the Front Range. They are fully licensed and permitted to accept all forms of non-hazardous compostable material including yard trimmings, brewing excesses, food residuals, and low-grade paper. The finished compost is sold wholesale to local distributors.

Bob Yost, Vice-President New Business Development
970.454.3492
BobYost@A1organics.com

One of the biggest obstacles to composting off-site is finding a facility conveniently located to your institution that can accept food waste. A directory of permitted facilities is included in the Resources section of this Guide. Additionally, you can contact your city and county health department for a listing of municipal sewage treatment facilities. Some of these facilities compost sewage sludge as "biosolids" and may be willing to incorporate food waste into their operation.

The Request for Information (RFI) document in Appendix Three can help your institution plan for an off-site composting program.

Collection System

The collection system is a critical component to any food waste-composting program. The system for separating compostable's at the source and transporting the materials to a vehicle collection point should be as convenient as possible. The primary objectives of the collective system are to:

- Maximize the capture rate of compostable materials;
- Eliminate non-organic contaminants such as plastic wraps, rubber bands, glass, and metal;
- Minimize labor and space requirements.

Collection systems within different businesses will vary according to the specific needs of each business, space limitations, and general layout of work areas. In grocery stores and food service institutions, for example, collection containers can be placed at workstations in the produce, deli, bakery, and dairy departments. In cafeterias, containers can be placed near tray and silverware recovery stations if collecting plate scraps, and in the kitchen where preparation scraps are generated. In any case, containers should be conveniently located at points of generation and clearly labeled. Remember to place a trash container next to the composting container to help prevent contamination.

90, 60, and 30-gallon “polycart” containers

Containers

Plastic garbage containers are well suited for holding food scraps, and can easily be placed in areas where scraps are generated. Container size will vary, depending on the amount and type of compostable material generated and the amount of space available within the facility. Foodwaste can be heavy- especially when wet. Make sure you consider safe lifting limits when choosing containers. Clearly marked containers, such as green for food, blue for recyclables, and brown for trash, are helpful for proper participation.

In preparation areas, training of personnel is essential to good composting. Employees are normally required to properly separate pre-consumer materials in food preparation areas and, if post-consumer materials are composted, in collection and wash areas as well.

Frequent cleaning is recommended to eliminate odors. Some businesses prefer to use liners in collection containers. Compostable bags are typically more expensive than disposable plastic bags but can be composted along with their contents. Non-compostable bags, while less expensive, require the extra step of emptying the bags’ contents at the compost site. Because “de-bagging” can be very

labor-intensive, compostable bags are often preferable. Sources of compostable bags are listed in the Resources section of this Guide.

Hauling

Just as trash hauling needs to be prompt and reliable in order to avoid health and safety problems, so too does foodwaste hauling. Some institutional generators of food scraps have found it easier and more economical to do the hauling themselves. Others contract with private waste haulers to collect and deliver the materials to a permitted composting site. In either case, try to optimize vehicle capacity and collection frequency. If the vehicle is too small, excessive transportation costs may result from travelling to the compost facility too often. Conversely, small loads in a large vehicle may not warrant use of the equipment. The goal is to match foodwaste generation and collection frequency with the right-size vehicles. When done properly, problems are prevented and transportation costs is kept to the minimum.

The Request for Information document in Appendix Three can be used to help evaluate hauling options.

Sharing Finished Compost

You can often negotiate beneficial arrangements with a composting operation in exchange for providing your institution's feedstock to them. For instance, if there is annual give-away of finished compost by a municipal program, your institution may be able to receive an amount of finished compost proportionate to the raw material supplied. A common arrangement with companies who sell their finished product is to buy the finished compost back at a reduced rate. Your institution may also be able to arrange "custom composting" where the processor creates the type of finished compost best suited for your needs (i.e. large, unscreened material for erosion control, finely screened material for flower beds, or compost blended with topsoil for landscaping).

PLAN AND IMPLEMENT A PROGRAM

On-Site

On-site (or internally run) composting programs differ from off-site programs in their levels of complexity, capital investment, and oversight required. While it is relatively easy to arrange collection and transportation of foodwaste from your institution to an approved composting operation nearby, an on-site operation requires considerably more planning and equipment costs. There are also ongoing

costs for processing labor and program administration. However, on-site programs provide greater landfill disposal savings and lower transportation costs than off-site options. On-site composting provides greater savings in fertilizer and soil amendment costs as well as the potential of selling finished product for profit or use on site.
In some areas of Colorado, an on-site program may be the only composting option. If permitted facilities are too distant, transportation costs make an off-site option impractical. However, even with facilities nearby, numerous institutions have chosen the on-site option due to the benefits it provides.

If your institution has a permitted composting facility in the area, consider starting your program as an off-site operation. Then, when employees become accustomed to the collection system and volumes become predictable, an on-site program is much easier to implement.

Collection System

Collection systems for on-site programs and off-site programs are similar. They should both maximize diversion of foodwaste, discourage non-compostable contaminants, and minimize space and labor requirements. One important difference in collection systems however is hauling where there will likely be much shorter hauling distances to an on-site composting facility. As mentioned, these savings can help defray costs for equipment and labor for an on-site program.

Feed Stocks

The compost recipe is an important factor when you are planning to compost on site. The composting process will work most effectively if a well-balanced mix is achieved. Porosity (spaces through which air and moisture can pass) is the single most important property in the initial mix. Porosity is achieved by using large particle size material such as woodchips. Porosity is also influenced by moisture content. If the moisture content is excessive, pore spaces will be filled with water instead of air. Dry bulking materials serve to increase the porosity of the mix and will absorb excess water if a mixture is too high in moisture.

Carbon and nitrogen (C:N ratio) are essential to microorganisms that break down organic material. In the process of breaking down the organic material, microorganisms use the carbon as an energy source and the nitrogen as the building block for protein synthesis.

Excessive nitrogen rapidly increases the temperature of the compost pile, necessitating frequent turnings to release heat and provide oxygen. In the finished compost, excess nitrogen can be harmful to plants. Most bulking material will increase the carbon content of the compost. Ideal composting conditions will have a 30:1 available carbon to nitrogen ratio. Food scraps by themselves typically have a 15:1 carbon to nitrogen ratio. A starting formula for mixing food scraps and bulking materials is 2 to 3

parts of bulking materials by volume to 1 part food scraps. The amount of moisture in the food scraps will ultimately determine the final ratios. Accurate records are important for keeping track of different mixtures and subsequent compost results.

Area Requirements

The surface area required for composting depend's on the volume and type of food scraps processed, the size and shape of pile, windrow or in-vessel technology used, and the time required to complete the process. Static piles and turned windrow methods require more land than the more intensive forced aeration and in-vessel system methods.

At a minimum, space will be needed for unloading incoming food scraps, mixing and blending materials, storing equipment, wood chips or other bulking agents, and for curing and storing the finished compost. Often, compost that is ready for curing, storage, and marketing can be moved off the compost site.

In addition, distances between the property line and the facility, and distances from residences or places of business must be considered. These buffer zones help to minimize possible odor, noise, dust, and visual impacts.

Outdoor compost sites can be located on moderate to well-drained, hard-packed soil with a gentle slope for good drainage. A slope of about two percent is desirable to prevent ponding of water. Windrows should run parallel to the slope, rather than across, to allow runoff water to move between the piles rather than through them. The initial site preparation will usually require grading and may require surfacing with gravel or compacted sand to allow year-round use.

Keep a neat, clean site with special attention to the following:

√ Daily cleaning of all equipment used at the site to prevent food scrap build-up
√ Immediate clean up of any food spills that may occur in receiving, loading, or composting areas.
√ Keep routes to and from these areas as short and direct as possible.
√ Eliminate excess water and maintaining good drainage around the compost area to avoid stagnant puddles.
√ Avoid adding lime to piles, it causes ammonia to be released.
√ If after following good housekeeping practices, odors continue to be a problem, consider using a biofilter system.

Concrete and asphalt pads can also be used, usually at sites where soils are highly permeable or where ground water levels rise too close to the surface. A paved site offers some advantages in terms of access, equipment operation, and ground water protection, but these advantages must be weighed against added surfacing costs, as well as difficulties in managing runoff. Most outdoor food scrap compost sites have paved surfaces, which are recommended due to the need for year-round access.

Aesthetics

The process of composting changes the appearance of food waste into a dark, soil-like product. As the compost process proceeds, the particle size of the organic material decreases. However, any plastics and glass that once contaminated the raw material can still be visible because they are non compostable. Although the now shredded plastics and glass are inert materials, they can significantly affect the visual quality of the soil when the compost is applied to land. These inert substances present major constraints to the more widespread use of municipal solid waste compost.

Odor control is critical to the success of a compost facility. One of the easiest ways to avoid odors is to establish good housekeeping practices or use a biofilter, which absorb and break down odors. They can be as simple as a 6-inch cover layer of finished compost, shredded bark, or other materials over a static pile. Some facilities (usually indoor, fully enclosed facilities) use a blower or ventilation system to collect odorous gases and transport them through a filtration medium.

Equipment Options

A number of different methods exist to compost food waste. Appendix Five summarizes some of the advantages and limitations of each.

The composting technology used by an institution depends on:

- Amount of space available
- Type and amount of food scraps generated
- Ability and means of collection
- Economic feasibility, which can include initial capital investment, permit fees, labor, fuel, maintenance, repairs, upkeep, taxes, electrical, and distribution of end product

Passively aerated windrows supply air to the composting materials through open-ended perforated pipes placed under each windrow. Cooler air is drawn into the pipes by a chimney effect as hot gases rise upward out of the windrow. This method requires placing the compost mixture on a porous foundation (sawdust, wood chips, straw, or finished compost) to absorb moisture and insulate the windrow. A covering layer of sawdust, wood chips, or finished compost is also needed to insulate the pile, and help to absorb moisture, odor, ammonia, and to discourage flies. Because there is no turning and remixing in this method, the materials must be thoroughly premixed before being placed in the windrow. Windrows in this method generally are 4-6 feet high, no wider than 10 feet, and can be any length.

CWMI Ithaca, New York

Turned windrows are elongated piles that are agitated or turned on a regular basis with a machine such as a front-end loader or specially designed equipment. Regular turning and mixing of the materials help to further break down particles, creating more surface area for microbial colonization, faster

decomposition, and a more homogeneous end product. Turning and mixing also increase the porosity of the pile and release trapped heat, water vapor, gases, and odors. Turned windrows can vary in size depending on space availability and type of material being composted. The recommended size is 5-6 feet high, 10-12 feet wide, and as long as is appropriate for the site. This size pile has advantages in the winter. Turning and mixing a pile when the surface is frozen can introduce ice into the center of the pile and cause the composting process to slow or even stop completely. Sometimes it may be necessary to stop turning for a while until temperatures moderate. With this size pile, the center will be insulated and composting can continue even when temperatures drop below freezing.

If beginning a windrow composting program fits your institution's budget and needs, you may want to use the **Colorado Compost Wizard©.** It is a technical guide to starting a windrow-composting program. The compost wizard is an MS-Excel based computer program that provides technical information for facility design. Contact:
Jason Governo, University of Georgia
Www.compostwizard.com
706-542-6119

Aerated Static Piles are formed essentially the same as passively aerated windrow, but the network of pipes is attached to blowers that are used to force air through the pile. Piles can be bigger, generally 5-8 feet high and 10-16 feet wide. The width of the piles depends on the layout of the pipes; some piles are very wide with multiple pipes running through them. This method is more expensive than the previously mentioned methods because it requires additional equipment and relies on electricity to operate the blowers. However, this method can also speed up the composting process.

In-Vessel Systems can take many different forms, from highly mechanical systems that can produce compost ready for curing in 20 days, to fairly simple containers that may use forced air or mixing within the container to expedite the process. One type of in-vessel system uses transportable containers that can process material on-site or be hauled off to another location to complete the composting process. These modular, airtight composting vessels usually include computerized aeration systems for moisture and temperature control, and built in record-keeping, mixing, loading, and screening equipment. But, some may be as simple as multiple bins with perforated piping for aeration. Containerized composting systems are generally used when it is essential to move a lot of material through quickly, where odor may be a problem, in urban areas, or where space is limited. In-vessel systems can provide excellent process control for composting food scraps and other organic materials that are difficult to handle, and offer the advantage of protection from severe weather.

Earth Tub by Green Mountain Tech.

Operation Example: In-Vessel Composting

Hutchinson, Minnesota Contact: City Manager Gary Plotz 320-587-5151

The Hutchinson, Minnesota facility began its operations in February 1995. The facility started with four forty cubic yard digesters and one twenty cubic yard biofilter allowing for a composting capacity of 4-6 tons/day. In April 2001, the facility was expanded to accept 20 tons/day. They processes leaves, chipped wood, animal waste, wood shavings, sawdust,soy scrapes, food scraps from restaurants and grocers, paper products and residential source separated organics. The finished compost is used in city operations for parks and forestry. It is bulk marketed at $10.00/cubic yard.

Operational Example: Vermicomposting
Beginning in 1999, the Delta Correctional Women's Facility has been using two worm wigwam containers funded by a grant from the Colorado Department of Corrections. Currently, processing 100 lbs. /day of pre-consumer salad trimmings, eggshells, and coffee grounds. The worm bedding consists of shredded documents from the facility. The composting program has had positive impact on inmates by teaching alternatives. Due to mild weather the past three years, the worm wigwam heaters are not being used. In summer months, the wigwams are located in shaded areas for temperature control. Worm casings are used at the facility in green houses, flowerbeds, and as needed. A portion is also sent to a local men's facility where it is used on tomatoes and floral arrangements sold to local businesses. This has eliminated the need for purchasing fertilizer. The facility has plans to add two more wigwams in summer 2002.
Delta Correctional Facilities in Delta, CO.
Amy Koklich 719-269-4704 x 3808

Vermicomposting utilizes worms to break down a variety of organic materials, including food scraps. Initially, bedding is prepared, using moist paper, wood chips or other bulking agents. Then the food scraps are mixed into the bedding. Worms added to the bedding work their way through the pile, digesting both the decomposing organic matter and the microorganisms that are also engaged in the decomposition process. As the worms digest the material, they excrete castings, a quality soil amendment rich in minerals and nutrients. There is no need to turn the piles; the worms provide natural aeration, although some degree of porosity is initially required. Once the worms have worked their way through a section, the castings can be screened out.

Vermicomposting requires high moisture content in the mix and mild temperatures to create a suitable habitat for the worms. Red worms, the most commonly used, cannot tolerate temperatures lower than 33 degrees or higher than 96 degrees Fahrenheit and this type of system is not commonly found outdoors in areas where freezing temperatures occur. Unlike conventional composting, the organic material does not reach high temperatures. Depending upon the final use of the compost, additional heating and/or drying steps may be required. There are also pile size limitations to this method. Piles should be no higher than 2-3 feet, though widths are limited by system design. Again, there are varying degrees of sophistication with this composting system- anywhere from single units designed for home use to large scale industrial systems utilizing multiple rows of insulated units equipped with shredders, screens, heating, cooling and ventilation capable of processing up to a ton or more of organic materials per day.

Worm Wigwam by EPM, Inc.
Www.wormwigwam.com

Marketing Your Compost

An important use of compost in the **agricultural industry** is as a soil amendment for eroded farmland. Farmers in the United States are becoming concerned about the reduction of organic matter in soil and are aware that maintaining healthy land depends on this. Agricultural use of compost remains low because the product is weighty and bulky, which can make transportation expensive and some agricultural users have concerns regarding potential amounts of heavy metals and other possible contaminants in compost. The potential for contamination becomes an important issue when compost is used on food. If the compost is applied well before planting, this concern is decreased immensely. Encouraging farmers to use compost reduces erosion and improves water quality.

The **landscaping industry** is another potential outlet for compost. A majority of composters in the United States are currently selling their compost to landscapers. Landscapers use compost as a soil amendment, in outdoor growing mixes, in topsoil, and in turf establishment and maintenance. Other uses for compost are in maintenance of lawns and parks, highway landscaping, sod production, athletic field maintenance, renovation, and construction. For some of these uses, landscapers require premium compost, which means that the product should have minimal odor, particle sizes of no greater than 1/2 inch in diameter, less than 50 percent moisture content, and no plant or human pathogens. The landscaping industry also requires that the materials used in its projects meet the specifications of the landscape architect or inspector. Since landscapers also have expressed concern about the possible presence of potentially toxic compounds in municipal solid waste (MSW) compost, tests should be conducted on the final compost product and the results made available to potential users.

The **horticultural industry** is one of the largest potential markets for compost of uniform consistent high quality. Compost is attractive to the horticultural industry because it is a source of organic matter and essential trace plant nutrients, increases the water-holding capacity of soil, improves the texture of soil, and enhances a soil's ability to suppress plant diseases. The use of compost in potting mixtures and in seedling beds has helped to reduce the need to apply soil fungicides in the production of certain horticultural crops.

Silviculture or forestry applications are a potentially large market for compost. Four segments of this market present viable opportunities: forest regeneration, nurseries, Christmas tree production, and established forest stands. Regenerating forests represents the largest potential market for compost in a silvicultural area. One long-term study, in which MSW compost was applied during forest planting, determined that MSW compost did provide forest growth ad-vantages while causing no detectable problems. Forest nurseries and Christmas tree production represent potentially low-volume/high-value applications of compost.

Compost uses applicable to the **public sector** include land restoration, parks and redevelopment, weed abatement on public lands, roadway maintenance, and median strip landscaping.

MEASURE AND COMMUNICATE

Good bookkeeping and reporting are common in all successful composting programs. Your institution's program will benefit over the long-term by establishing a manageable set of measurements, which can be maintained and easily reported within the institution and externally.

Operational measurements should include the amount of compostable material diverted from landfill disposal, and the types of foodwaste composted. Appendix One: Analyzing Food Residuals Composition can be used for these measurements.

Financial measurements relate to the cost-effectiveness of your program. Is your program contain or reduce costs landfill costs? These are two important questions that Appendix Two can help you answer.

Legally, institutions planning to sell or distribute large amounts of finished compost (over 5,000 cubic yards per year), are required to meet compost sampling and quality standards. Regular records of temperature and incoming feedstocks, along with periodic laboratory testing need to be documented and reported to the State. Even though you may not be required to provide this information, accurate record keeping is a good idea since it provides valuable information about the effectiveness of the composting method you use.

Good composting is good news. Promoting your program through press releases, periodic reports and other creative awareness campaigns, builds support both within your organization and from agencies around the state. Groups that are likely interested in hearing about your program are listed in the Resources Section of this Guide. Other activities like distributing small bags of finished compost for house plants is a positive reinforcement of the almost magical transformation that occurs through successful composting.

RESOURCES

Agencies and Associations

Colorado Association for Recycling P.O. Box 11130 Denver Co.80211 970-535-4053
A non-profit organization formed as the independent voice of public, private, and citizen recyclers in Colorado http://www.cafr.org/

Colorado Dept. of Public Health 4300 Cherry Creek Dr. S. Denver, CO 80246 303-692-2035
This webpage contains the Colorado class IV composting regulations.
http://www.cdphe.state.co.us/op/regs/100702.pdf

Colorado Office of Energy Management & Conservation 225E. 16th St #650 Denver Co 80203 303-894-2383 The Governor's Office of Energy Management and Conservation (OEMC) is Colorado's lead state agency on energy efficiency issues http://www.state.co.us/oemc/

Colorado Recycles 1675 Carr St #101 Denver, CO 80211` 303-231-9972
Colorado Recycles maintains a statewide recycling directory accessible at: http://www.colorado-recycles.org.

Environmental Protection Agency has done extensive research on large-scale composting and end market uses for compost. www.epa.gov;
The EPA's link to composting publications is: www.epa.gov/epaoswer/non-hw/compost

Southwest Public Recycling Assoc. PO Box 27210 Tucson, AZ. 85726 520-622-8082
SPRA is a non-profit, member-based association dedicated to helping communities develop sustainable recycling programs. Collectively, SPRA's members command premium prices at the marketplace and receive competitive rates on trucking. http://www.spra-recycling.org/

Equipment Contacts

Biocycle Journal of Composting and Recycling - contains articles and a resource section with links to Equipment and suppliers. http://www.jgpress.com/biocycle.htm

The Compost Resource Page - hosts general information, products, and services on institutional-sized composting http://www.oldgrowth.org/compost/

Resource Recycling - publishes a annual equipment directory http://www.resource-recycling.com/

Best Practice Information

The Master Composter website - contains extensive information and resources on all types of composting, links to buying composting materials, area specific composting information, and information on the master composter program. www.mastercomposter.com

The US Composting Council - is involved in research, public education, composting and compost standards, expansion of compost markets. www.compostingcouncil.org.

The Composting Council of Canada - is a national non-profit, member-driven organization with a charter to advocate and advance composting and compost usage. www.compost.org

The Cornell Waste Management Institute - is a leader in composting research and has extensive information on composting and also has several case studies on composting operations.
www.cals.cornell.edu/dept/compost, www.cfe.cornell.edu/compost/composting homepage.html

The Compost Resource - is intended to serve as a hub of information for anyone interested in the various aspects of composting www.oldgrowth.org/compost
The Worm Digest Homepage - articles, links, and the Worm Digest Forum www.wormdigest.org

Colorado Composting Facilities

A-1 Organics	16350 Weld CR76	Eaton, CO 80403	800-776-1644
A-1 Organics Lost Antlers	6569 Highway 93	Golden, CO 80403	303-384-9232
A-1 Organics Rattler Ridge		Keenesburg, CO	800-776-1644
Boss Composting	PO Box 987	Brighton, CO 80601	303-659-5958
Cacaloso Compost Facility	0256 Flying Fish Rd.	Carbondale, CO 81623	970-963-0832
Colo. Women's Corr. Facility	PO Box 1600	Canyon City, CO 81212	719-269-4704 x8381
Delta Correctional Center	1140 G 1025 Lane.	Delta, CO 81416-9127	970-874-5870
Longmont Waste Treatment	501 E. 1st Ave	Longmont, CO 80501	303-651-8418
Pitkin County Solid Waste	PO Box 1276	Basalt, CO 81621	970-922-0878
Pueblo Minimum Center	1410 W 13th St.	Pueblo, CO 81003	719-583-5711 x3530
Rifle Correctional Center	0200 County Rd. 219	Rifle, CO 81650	970-625-1700 x3172
Twin Landfill Corp.	420 St. Paul St.	Denver, CO 80206	970-468-875-0355

GLOSSARY

AERATED STATIC PILE: composting system that uses a series of perforated pipes (or equivalent) as an air distribution system running underneath a compost pile and connected to a blower that either draws or blows air through the piles. Little or no pile turning is performed.
AERATION (for composting): bringing about contact of air and composting solid organic matter, by means of turning or ventilating to allow microbial aerobic metabolism (bio-oxidation).
AEROBIC/ANAEROBIC: occurring in the presence/absence of oxygen.
BATCH COMPOSTING: all material is processed at the same time, without introducing new feedstock once composting has begun; windrow systems may be batch systems.
BIODEGRADABILITY: the potential that an organic component can be converted into simpler compounds by metabolic processes.
BULKING AGENT: material, usually carbonaceous such as sawdust, wood chips, or shredded yard trimmings added to a compost system to maintain airflow by preventing settling and compaction of waste.
COMPOSTABLE: organic material that can be biologically decomposed under aerobic conditions.
CONTAMINANT: unwanted material; physical contaminants of compost can include glass, plastic and stones; chemical contaminants can include trace heavy metals and toxic organic compounds; biological contaminants can include pathogens.
CURING: the last stage of composting that occurs after much of the readily metabolized material has been decomposed. Provides for additional stabilization, reduction of pathogens, and allows further decomposition of cellulose and lignin.

DECOMPOSITION: the breakdown of organic matter by microbial action.
HEAVY METALS; TRACE METALS: trace elements whose concentrations are regulated because of the potential for toxicity to humans, animals, or plants, and includes chromium, copper, nickel, cadmium, lead, mercury, and zinc if present in excessive amounts.
INERTS: non-biodegradable products contained in compost (glass, plastics, etc.).
INORGANIC: substance in which carbon-to-carbon bonds are absent, mineral matter.
LEACHATE: Liquid, which has percolated through, or condensed out of mixed municipal solid wastes; extracted, dissolved, and suspended materials; liquid that drains from the mix of fresh organic matter.
MATURE COMPOST (synonym of COMPOST): the stabilized and sanitized product of composting. It has undergone decomposition and is in the process of humification (stabilization); it is characterized as containing readily available forms of plant nutrients, poor in phytotoxic acids and phenols, and low in readily available carbon compounds.
MOISTURE CONTENT: weight of water in material divided by weight of solids in material.
ORGANIC CONTAMINANTS: synthetic trace organics including pesticides and other synthetic chemicals.
PATHOGEN: an organism or microorganism, including viruses, bacteria, fungi and protozoa capable of producing an infection or disease in a susceptible host.
POST CONSUMER: food waste that is generated after distribution to the consumer (leftovers).
PRE CONSUMER: food waste that is generated by food preparation.
SOURCE SEPARATION: the practice, by primary waste generators such as households and businesses, of separating waste generated within the household or commercial operation into separate fractions, such as all newspapers together, all glass together, etc. and of placing them in separate containers for pickup by the waste hauler.
STABILITY: the degree to which the composted material can be stored or used without giving rise to nuisances or can be applied to the soil without causing problems.
STATIC PILE SYSTEM: similar to aerated static pile except that the air source may be controlled or may not be controlled.
WINDROW SYSTEM: composting mixture is placed in elongated piles, called windrows. These windrows are aerated naturally by a chimney effect, by mechanically turning the piles with a machine such as a front-end loader or specially designed equipment, and/or by forced aeration.
YARD TRIMMINGS: grass clippings, leaves and weeds, and shrub and tree prunings six inches or less in diameter, from residences and businesses.

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APPENDICES

APPENDIX ONE:
Analyzing Food Residuals Composition

Amount/Total Amount x 100 = Percent Composition

PRE-CONSUMER (Meal preparation waste)	Amount (Weight or volume)	Individual Amount / Total Amount	X 100 = Percent Composition
Vegetable Scraps			
Meat Scraps			
Breads			
Coffee Grounds			
Tea Bags			
Egg Shells			
Paper Products			
Other _____			

POST-CONSUMER (Leftover served foods)	Amount (Weight or Volume)	Individual Amount/ Total Amount	X 100 = Percent Composition
Breads			
Meats			
Vegetables			
Pasta			
Soup			
Casseroles			
Paper Products			
Other _____			

APPENDIX TWO:

Calculating Waste Disposal Costs

Name of Waste Removal Department or company _____

Contact Name / Telephone number _____

Contract Expires (if applicable) _____

Waste Removal Charges

	per		**X**		**=**	
waste hauling charge		unit of weight or volume		units of waste removed annually		**Annual Waste Hauling Cost (box 1)**

If applicable, distinguish:

	per		**X**		**=**	
tipping fees at landfill (distinguished from total charge)		unit of weight or volume		units of waste removed annually		**Annual Tipping Fees (box 2)**

	+		**+**		**=**	
Annual Waste Hauling Cost (box 1)		**Annual Tipping Fees (box 2)**		**additional charges** examples: container rental operating/maintenance etc.		**Annual Waste Removal Costs (box 3)**

APPENDIX TWO:

Projecting Potential Cost Avoidance

Activity	Total Annual Units Reduced (weight or volume)	X	Waste Removal Costs (from preceeding worksheet)	=	Annual Avoided Cost Potential
pre-consumer foodwaste diversion		X		=	
post-conusmer foodwaste diversion		X		=	
food service-related paper diversion		X		=	
foodwaste reductions i.e. foodbank donations smaller portions		X		=	
				Total	

APPENDIX THREE
Sample Request for Information
Page 1

Cover Letter

Composting company,
Recycling company
Municipality,
Hauler
Address

Greetings:

Our organization (indicate name of organization) is considering a composting program for the organic materials we generate. As part of the planning for this program, we are reviewing several options that may involve organizations such as yours.

This document includes some basic information about our agency's organic waste generation. We hope this information can help you determine if you are interested and capable of playing a role in diverting these materials to more beneficial uses.

Please provide reply with the requested information attached.
If you have any questions please call (indicate your phone#)
Thank you.

Sincerely,

APPENDIX THREE
Sample Request for Information
Page 2

Information About Our Organization

Our agency generates the following kinds of organic materials, in approximately the following quantities, from the following locations:

Pre-consumer food waste
- Examples include:

- Quantities:

- Locations:

Post-consumer food waste
- Examples include:

- Quantities:

- Locations:

Paper and related materials
- Examples include:

- Quantities:

- Locations:

Yard debris
- Examples include:

- Quantities:

- Locations:

APPENDIX THREE
Sample Request for Information
Page 3

Information About Your Organization

Does your organization currently collect or compost organic waste separately from municipal solid waste?

What types of organic wastes does your organization collect or process?

What types of collection containers for organic wastes are either provided or are compatible with your operation?

Is your organization able to supply containers to our agency sufficient for the volumes we produce?

What type of collection vehicle can your organization use to collect organic materials from the locations at our agency?

Based on the information provided by our agency, does your organization have a schedule of collection days, and billing structure? Please provide information.

If your organization processes organic materials, do you operate a State-permitted composting facility?

We would also appreciate other information that you believe to be relevant in our planning process. Your prompt attention to this will be greatly appreciated.

APPENDIX FOUR:

Composting Trouble Shooting Guide

Symptoms	Problems	Recommendation
Pile is soggy or smells sour	-Pile too large, not enough air -Pile not formed immediately -Pile too wet	-Form piles no wider than 12', no higher than 6' -Allow no more than 1-2 days between collection and pile formation -Spread to dry -Add more dry bulking materials and turn the pile
Standing water/surface ponding	-Inadequate slope -Improper windrow/pile alignment -Depression in high traffic areas	-Establish 1-2% slope with proper grading -Improve drainage, add absorbent -Run windrows/piles down to slope, not across -Fill and regrade
Inadequate Composting Rate	-Material too dry -Material too wet; pile too large leading to anaerobic conditions -Pile too small, leading to excessive heat loss -Uneven distribution of air, moisture, or nutrients	-Add water initially, or as a corrective measure when turning -Spread out to dry; remix, make pile smaller -Make 5-6' high to retain heat -Turn or shred pile, wetting if necessary
Center is dry & contains tough materials	-Not enough water	-Chip woody materials, moisten & turn
Ammonia odor	-Too much nitrogen	-Turn pile; add bulking material high in carbon, like woodchips or leaves -If static pile, add high carbon biofilter
Pile too hot, stops heating, smells	-Thermal destruction of microorganisms has occurred -Pile too wet -Pile too large	-Turn pile 2 days in a row & monitor temperature -Turn pile whenever temperature reaches 160°F -Reduce Size
Low Temperature	-Pile too small -Insufficient moisture -Poor aeration -Ambient temperature too low	-Combine Piles -Add water while turning -Turn pile -Remix when ambient temperature rises, or mix with other pile
Pile has gotten very wet from rain or snow	Excessive moisture has smothered or drowned microorganisms	Turn pile every day until it starts to heat again
Animal infestation	-Food scraps exposed -Lack of biofilter -Materials spilled outside of pile	-Process as soon as possible, add insulating cover -Add biofilter -Improve housekeeping, clean up spills -Get a cat! -Plant tall grasses to discourage nesting of birds
Mosquitoes/flies	-Presence of stagnant water	-Eliminate ponding -Remix weekly to turn surface eggs and maggots into hot interior where they will be destroyed

Source: Cornell Waste Management Institute

APPENDIX FIVE: On-Site Composting Method Assessment

Method	Advantages	Disadvantages	Approximate Cost (Size Dependant)
Unaerated Static Piles	-Least amount of maintenance when compared to other methods -No turning required -Low cost	-Longest composting time -Care must be taken with initial mixture to ensure porosity and air circulation -Must have available space to let piles sit for long periods of time	***Equipment***: Bucket loader, screener ***Startup cost:*** Vary based on cost of equipment: approx. $20,000 + ***Annual cost***: labor (10+ hr/wk), equipment maintenance, least expensive option
Passively Aerated Windrows	-Faster composting time than above -No turning required -Piping network underneath pile speeds up process	-Requires a porous foundation and a cover layer to absorb moisture and insulate the windrow -Must have available space to let piles sit for long periods of time	***Equipment:*** Bucket loader, piping, screener ***Startup cost***: Cost of equipment: approx. $20,000 + ***Annual cost***: labor (12+ hr/wk), equip. maintenance
Turned windrows	-Regular turning and mixing speeds up process -Effective in areas with freezing winter temperatures	-Front-end loader or specially designed equipment necessary	***Equipment:*** Windrow turner, tractor, screener ***Startup Cost:*** Cost of equipment from $20,000-$200,000. ***Annual cost:*** labor (20+ hr/wk), equip. maintenance
Aerated static piles	-Does not require turning -Network of pipes and blowers speeds up process, allows better control over moisture and temperature. -Piles can be larger due to forced aeration	-Higher overhead than other methods, due to electricity, blower and pipe network	***Equipment:*** Bucket loader, piping, screener, blower, electricity ***Startup cost***: Cost of equipment: approx. $20,000 —100,000 ***Annual cost***: labor (12+ hr/wk), equipment maintenance
In-vessel systems	-High degree of process control -Mechanical or automated control systems -Fastest method of composting -Transportable composting containers effective for urban areas -Protection from severe weather	-High cost of equipment, buildings, and overhead	***Equipment:*** Vessel, mixer, monitoring equipment, biofilter, pad, electricity, leachate control ***Startup Cost:*** 150 - 1,200 lbs/day: $20,000-$100,000, ***Annual:*** labor (7+ hr/wk), equipment maintenance ($100-$1000/year.)
Vermicomposting	-No turning required -Many different systems available, from single units to multiple rows	-Initial mixture must include appropriate bedding and adequate moisture and oxygen to sustain habitat. -Moderate climate if outdoors -Due to low temperatures, additional curing may be required.	***Equipment:*** Worm bin, mixer, temperature control (building and electricity), worms, bedding ***Startup Cost:*** 20 —1200 lbs/day: $600 - $80,000 ***Annual***: labor (7+ hr/week), worm and equipment maintenance ($500/yr.)