Centralized Composting

Community, municipal, or tribal managed compost operations present an environmentally sound and beneficial means of recycling organic materials. A well-planned and effectively managed facility will pose few operational hurdles, be maintained within projected budgets, produce a quality compost product, and have community support.

Successful onsite organics composting requires:

- A plan of action
- Available land
- Appropriate equipment
- Proper management, and
- Community support

> This section is designed to present a basic overview of the compost process, site considerations, methods, and other components for onsite composting.
>
> *It is not an operators training guide.* Additional guidance and formal training is recommended and may be required by state regulation.
>
> A list of compost operator guides and other training information is contained in Attachment A.

Rural and small communities have a variety of organics processing options available—ranging from small to large-scale operations, using a range of processing technologies. These processes each has its advantages and can be combined to better serve the community and for cost efficiencies. Communities can start out with one facility using low level composting or mulching technologies, and later add additional facilities and/or higher level technologies for more rapid composting and to handle new materials, such as food scraps.

Small-scale operations can be designed to work in concert with larger, regional facilities or as standalone operations. At a small-scale facility, such as at a transfer station, materials could be stockpiled and later put through a grinder for size reduction for transport to a centralized facility or use as mulch or boiler fuel. If sufficient space and staffing allow, onsite composting could be done. Leaves, yard trimmings, and even food scraps could be appropriately composted by applying a low-level technology using a front-end loader for mixing and materials turning.

A regional facility (possibly operated by a regional government, solid waste district, or by a private company) could provide advantages in terms of economies of scale (thus lowering the per-ton cost) and in handling a variety of materials from multiple communities. The facility would need to be designed with storage areas to hold feedstocks until needed for mixing. The processing technology used at a regional facility can range from low/intermediate technology (such as windrows or static piles mixed by a windrow turner) to a high level of technology (enclosed systems of various types). A grinder may be required for size reduction of brush.

Regional processing facilities require a larger amount of land and may be less conveniently located for some residents. The capital investment and operating costs of larger processing facilities are usually out of reach of rural communities acting alone, however, regional cooperation lends itself to the development and management of these larger scale operations.

Small-scale operations may not capture the economies of scale presented by more central processing options (i.e., spreading fixed costs for equipment, land, and labor over a greater amount of handled material), they nonetheless provide cost effective solutions for communities where regional or private sector opportunities are limited.

A composting program should be a component in an organics management program, focusing on the "hierarchy" of organics reduction, recovery, and composting. An integrated program will reduce the amount of organics to be managed and help to control costs.

Smaller sites can be equipped to meet the processing needs of the community and not incur the costs of transporting materials to a central facility. Locally managed composting operations can be conveniently located where residents are dropping off wastes (e.g., a transfer station). The resulting compost product is also easily available to residents. Food scraps can be phased-in to the compost operation for additional diversion.

Community-Based Composting

Community composting presents a scalable organics diversion option that is applicable in virtually any community. Community compost programs can be established at community gardens, farms, schools, or other locations. They can be operated by not-for-profit organizations, governments, private sector, schools, housing associations, cooperatives, or through other arrangements.

According to the Institute for Local Self-Reliance's Growing Local Fertility: A Guide to Community Composting, there are ten basic types of community composting:

- Community Gardens
- Farms (Rural and Urban)
- Schools
- Drop-Off Networks
- Collection Entrepreneurs
- On-site Composters
- Off-site Composters
- Demonstration & Community Leader Training Sites
- Worker-Owned Cooperatives
- Home-based or Homesteader Hubs

Governments and community organizations can successfully implement community compost sites for handling yard trimmings and food scraps. Locally-based compost sites can be established at multiple locations in communities, providing a low-cost option for collecting and composting food scraps. Not-for-profit agencies and volunteers can be enlisted to manage the sites. Local and regional jurisdictions can provide loans and contracts to not-for-profit agencies for implementing community composting sites.

Management of community compost sites will require adoption of best management practices contained in this section. Depending on the type of composting technology employed and location, community composting operations may not want to collect meat, bones, or dairy due to concerns with odor and vermin.

Planning a Compost Operation

State or regional agencies may be able to provide assistance in planning and implementing a municipal composting operation. The planning process will be more or less complicated depending on the size of the operation, the types of materials to be processed, facility location, and the processing technology to be used. An operations plan is important to have in place no matter what size facility is planned.

Larger and regional operations should consider consulting with an engineering or technical firm to determine an appropriate compost site design and operation plan, if appropriately trained personnel are not on staff.

It is helpful to put in place a basic public relations campaign and to set up a citizens committee to be involved with the siting process from the beginning of the operation planning stages. Informing the public will help gain support for the project and help to educate residents about what's acceptable at the compost site. The committee can act as a feedback mechanism once the operation is running and can assist in troubleshooting as issues arise. This step is especially important if food scraps are to be accepted.

Planning for a compost operation involves:

- Estimating the volume of organics expected to be handled.
- Conducting a needs assessment to determine available land, staffing, and equipment that can be applied to the operation.
- Determining additional operating space required, as well as additional capital, staffing, and equipment requirements necessary for start-up, ongoing operations, and potential expansions.
- The feasibility of the composting operation planned.
- Siting specifics to be included in the plan – a schematic layout of the compost site, materials flow, leachate and storm water management, a listing of equipment and personnel (with their qualifications and/or training to be received), an overview of the composting method to be used, safety and fire emergency plan, monitoring techniques and record keeping, provisions for controlling odors, and a description of a contingency plan if the compost operation ceases.
- Include estimates on how composting could create cost savings and other benefits to the community and how costs and benefits of the operation will be tracked. Benefits could include: avoided landfill or incineration fees, the volume of landfill space conserved, avoided transportation costs, benefits of using compost on public property (and reduced expenditures on fertilizer and compost), and potential revenues received from tip fees and compost sales.

Locally based, small scale operations can measure approximate volumes by surveying residents to determine how they currently manage organics. Visual inspections of a sampling of waste brought in for disposal can also be conducted to estimate expected organics volumes. A survey can be conducted at a transfer station or farmers market. Communities that already collect leaves, Christmas trees, and/or seasonal yard waste will have a sense of the amount of material available for composting. Planning for regional operations may require a more formally conducted waste audit, taking into account the communities that will "feed" into the system.

Financing and Economics

Program costs will vary widely, depending on the size of the operation, existing equipment and personnel available, and other factors. Financing needs for smaller scale operations will be minimal if existing land and equipment are available for use in the operation. Site preparation can potentially be handled by municipal staff, depending on the requirements. If equipment is needed and more extensive site preparation required, financing professionals should be consulted. Regional facilities will need to more extensively plan capital investment requirements and determine effective financing options.

Funding Options & Cost Savings

- Tip Fees
  - Residents
  - Landscapers & other small commercial generators
  - Haulers
  - Keep fees lower than solid waste tip fees
- Sales of compost & mulch
- Cost Savings
  - Sharing equipment & labor
  - Used equipment
  - Calculating avoided disposal costs
  - Reduced soil & fertilizer purchase costs achieved through the use of finished compost

Program economics will involve:

- Evaluating program capital and operating needs and costs
  - Taking into account existing land, equipment, and personnel
- Determining tip fees (for residents, landscapers, and other small commercial generators)
- Calculating avoided disposal costs
- Estimating reduced soil and fertilizer purchase costs achieved through the use of finished compost
- Estimating potential revenue from compost sales
- Assessing the overall costs and benefits

Inclusion of a contingency plan in upfront financial planning is recommended, especially for larger operations. Planning for potential system modifications or expansions will allow issues to be managed without operation disruptions. Once the operation is running, efficiencies may also be created to improve the operation and reduce costs.

Community compost operations may involve contractual arrangements that factor in the economics outlined above.

Regulatory Compliance

Compost operation regulatory and permit requirements vary by state depending on the type and volume of materials accepted for composting. It is important that officials and compost operators understand the specifics of their state permitting requirements prior to planning and developing a compost site. Composting food waste typically triggers a higher level of permitting and more stringent regulatory requirements (monitoring records, etc.), although requirements for community and small-scale operations are usually less than for larger scale facilities. Small operations, such as yard waste composting at transfer stations, typically require little in the way of permit requirements other than a potential modification in the transfer station operating permit. Specific operation and site parameters are likely to be required for larger facilities. Operator training may also be required.

It is up to public officials and compost operators to know and understand the following:

- Key terms and definitions associated with the various types of permit requirements and classifications for handling and processing yard waste, source-separated food scraps, manure, etc.
- State compost operation classifications and operation requirements for each classification level.
- Types, sources, and volumes of materials that can be handled under the operating permit.
- Monitoring and reporting requirements.
- Any other regulatory and permitting requirements.
- Any restrictions on compost distribution, use, and sales.

Work with local boards of health and environmental commissions to determine if there are local ordinances, zoning or siting restrictions, or other compliance requirements that may apply. Obtain local approval of a site plan. Keep local agencies informed of operation plans and developments.

Best Management Practices Goal

Ultimately the management goal for any compost operation is to create the optimum conditions to promote the proper microbial decomposition of collected organic materials. It is essential that the process fosters sufficient microbial activity to create enough heat for the required amount of time to destroy pathogens and weed seeds. Best management practices dictate that the operation practice effective process control and operational efficiency to be able to handle problems (such as odor issues) as they arise, while manufacturing a usable, quality compost product.

Best Management Practices Goal

Results in quality compost in the shortest time possible with:

- Minimum odors
- Minimum environmental impacts
- Minimum process-related problems

The Composting Process

Successful composting depends on the promotion of optimum composting conditions—the appropriate mix of organic materials or feedstocks, appropriate particle sizing, sufficient moisture content, appropriate oxygen levels to support aerobic organism activity, and temperature.

Feedstock ("Ingredients"). Feedstocks are the raw materials used in the compost process. It is important to know and understand the characteristics of the feedstocks to be used in the operation. Feedstocks are characterized by their carbon to nitrogen ratio (see below). Depending on the type of feedstock, it can also serve as a "bulking agent" to provide porosity in the pile. Bulking agents are needed to help with pile stabilization and in aiding air flow through the pile. Wood shavings are a good bulking agent; wood chips can also be used but will need to be screened in the final process.

Healthy biological activity is essential to successful composting. Setting up the right environmental and conditions is fundamental to the process.

Feedstock characteristics also include the texture of the ingredient, the moisture content, and its pH (measure of acidity and alkalinity). A material's "bulk density" plays a role in how easy materials are to handle and mix, as well as contributing to the ease of air flow through the pile. The odor potential for the feedstock should also be considered; grass and food scraps, for example, have a greater potential for causing odors in a compost pile. The nutrient level of the ingredients will factor into the compost

end product results. Compost made from just leaves and yard waste will have lower nutrient value than compost made from manure or food scraps.

Nutrient Balance (Carbon to Nitrogen Ratio)**.** The carbon to nitrogen ratio represents the total amount of carbon in a material versus the total amount of nitrogen. A proper carbon to nitrogen (C:N) ratio is required to optimize composting conditions. A C:N of 30:1 to 40:1 is optimum for composting. If the C:N ratio goes below 20:1, odors are likely to occur and nutrients may be lost. If the C:N ratio rises above 40:1, the composting process slows down and temperatures will not rise to necessary levels. In developing a "compost recipe" operators must find a proper balance mixing available high nitrogen materials, including grass clippings, food scraps, and/or manure and available high carbon materials, such as dry leaves, wood chips, saw dust, straw or livestock bedding, and brush.

Table 1: Sample Carbon and Nitrogen Ratios of Various Organics [1]

Carbon Sources	***Carbon: Nitrogen Ratio***
Yard wastes	50 - 90:1
Straw/hay	50 - 80:1
Wood chips/sawdust	250 - 500:1
Nitrogen *Sources*	
Vegetable scraps	10 – 30:1
Fruit scraps	10 – 30:1
Grass & garden gleanings	10 – 20:1
Chicken manure	10 – 25:1
Cow manure	20 – 30:1
Horse manure	25 – 30:1

Proper particle size**.** Smaller feedstock particles allow for more surface area upon which the microorganisms feed helping to speed up the decomposition process. Smaller particles help to improve porosity (air flow), produce a more homogeneous compost mixture, and improve pile insulation to help maintain ideal temperatures. Particles that are too small, however, can pack down and inhibit air flow. Coarse materials, such a brush may require grinding prior to use in a compost operation. Large scale operations typically grind or chip materials to achieve particle sizes ranging between ¼-2 inches. A mix of particle sizes in the optimum range will feed the decomposer organisms, while allowing for adequate air flow and providing structure to the pile.

Moisture content**.** Water helps to transport substances within the compost pile and makes the nutrients in organic material accessible to the microbes to ensure healthy microbial activity. Depending on the type of organic materials being composted, additional moisture may need to be added, either through rainfall or intentional watering. If the pile is too wet, however, the organisms can drown due to lack of oxygen. An optimum "moisture content" (MC) of 40 - 60% is recommended. If the materials become too wet, dry feedstocks can be added.

[1] Adapted from Robert Rynk, "*On-Farm Composting Handbook*," Natural Resource, Agriculture, and Engineering Service, 1992.

Oxygen flow**.** The microorganisms in compost are "aerobic"—requiring air in order to thrive. Mixing the carbon and nitrogen materials together helps to provide the homogenous mix necessary for decomposition and promotes air flow. It is important that as materials are added that they do not become compacted. Aeration can be achieved by turning or "mixing" the compost or placing the composting materials on a series of perforated pipes ("forced air") to promote air flow. Adding "bulking agents" such as wood chips and will also help to aerate the pile. Aeration helps to speed up the decomposition process and is essential to keep the decomposition process from becoming anaerobic, which can cause odor problems.

Operations that accept grass clippings and/or manure should consider testing these feedstocks and finished compost for persistent herbicides. If contained in finished compost, these herbicides may harm plants.

Temperature**.** There are three stages of the composting process. Decomposer microorganisms are active during a certain temperature range. "Mesophilic composting" occurs as temperatures rise above freezing. As bacteria, actinomycetes, fungi, earthworms, and insects begin their decomposing activity, temperatures rise. As temperatures go above 110° F, Thermophilic microorganisms become active, increasing the rate of decomposition, and causing temperatures to rise. If properly maintained, a compost pile will generate its own heat though the microbial action involved in decomposition. Within two days a pile should reach temperatures between 120°F and 150°F.

These high temperatures are necessary for more rapid composting. To ensure that pathogens, parasites, and weed seeds are destroyed, the temperature needs to be at least 131°F (55°C) for 15 days with five turnings for turned windrow operations. For in-vessel or aerated pile systems, this temperature must be maintained a minimum of three days. Once temperatures stabilize, a "curing phase" is important to allow for additional stabilization and maturation.

Table 2: Optimum Conditions for Successful Composting[2]

Factor	Range	Ideal
Carbon to Nitrogen (C:N) ratio	20:1 - 60:1	25:1 - 40:1
Moisture content	40-65%	50 - 60%
Oxygen concentration	Greater than 5%	Much greater than 5%
Particle size	0.5 - 2" (1.5 – 5 cm)	Varies, depending on end market
pH	5.0 - 9.0	6.5 - 8.5
Temperature (F)	110 - 150°F	130 - 145°F
Bulk density (pounds per cubic yard)	Less than 1,100 (35 - 40 pounds per cubic foot)	Less than 1,100
Porosity	30% - 80%	50% - 80%
Conditions are those recommended for rapid composting; variations outside of these ranges can also result in successful composting.		

Recipe Development

It is important that compost operators understand the basic physical, chemical, and biological characteristics of organic feedstocks. It is also essential for any compost operator to know and understand the basic compost process. Recipe development will help operators better understand the process and to ensure the proper conditions for decomposition, given the materials available to the operation.

Step 1: What's the primary ingredient—what must be managed? What feedstock(s) are readily available? What are the characteristics of the primary ingredient—nutrient content, C:N ratio, moisture content, bulk density, pH, and potential for odors.

For many small operations the primary ingredient will be leaves and/or yard trimmings or brush. However, community compost sites may be specifically established to process food scraps.

Step 2: What are the complementary or secondary ingredients available? What are the characteristics of these? How can they be mixed together to properly compost with the primary ingredient? A proper balance of carbon and nitrogen, moisture, bulk density, etc. should be the goal. Strive to develop a recipe that creates an optimum mix using the appropriate ranges for the feedstock characteristics (refer to Tables 1 and 2).

For small scale operations, the diversity of material inputs may be limited. Rural and small communities might consider accepting manure and livestock bedding from local farms to mix with the leaves and brush collected from residents. If grass clippings and other vegetative matter (higher nitrogen) are accepted, these can be mixed with leaves (higher carbon material) for a relatively balanced compost recipe. Mixing one part grass or food scraps (by volume) with three parts partially decomposed leaves will promote increased composting of leaves and help to reduce odor issues with grass and food scraps.

Recipe development resources are contained in Attachment A.

[2] Adapted from Rynk.

Composting Technology

Processing technologies can range from "minimum-level" to "high-level." The site requirements, labor and equipment needs, length of processing time, and costs are different for each technology level, but the end product—finished compost—is essentially the same, although quality will vary. The amount of time necessary for processing depends on the materials to be composted and the technology and process applied.

A "minimum level" technology is a low cost option primarily suitable for managing leaves and sometimes other brush. Materials are collected and piled in windrows (long rows) or piles, typically using available municipal space. This operation requires a front loader or other equipment, such as a backhoe or manure spreader to mix materials, form and turn the windrows, land for the operation, and minimum staffing. A well-constructed pile or windrow, with well blended materials and proper moisture can be minimally turned (as little as once per year). It can take up to three years to complete the composting process.

"Low level" technology is applicable for managing leaves, grass clippings, and brush. Brush is shredded and materials are piled in windrows approximately 6' high and 12' wide. Water is added to achieve and maintain a moisture content near 50%. Temperatures of 140°F to 160°F for optimal composting conditions should be reached within a week. Materials in the windrow are then turned once every 3 – 4 months, resulting in the process being complete within 9 – 12 months. A front loader, tractor, or bobcat is required for making and turning the windrows and a thermometer for monitoring the compost. If brush is accepted, a grinder (owned, contracted, or rented) will be needed to process brush and limbs into a consistent particle size. The process serves to divert organics from the waste stream and create a compost product at a relatively low cost and with minimal staff requirements.

Depending on the space availability, material types and volumes, and staffing, a more "intermediate-level" or moderate technology could employ more aeration for faster decomposition. Turning the materials more regularly and temperature monitoring are required for more rapid composting. Alternatively, equipment for a static pile, including a blower system and piping ("aerated static pile"), can be used for aeration. Compost covers (or systems such as GORE® Cover or *Ag*-Bag) can also be employed to speed decomposition and control odors. Composting can also be done indoors to control odors. More attention

Food Scrap Composting

Introducing food scraps into the composting process should be phased-in to allow for proper recipe development and management.

Greater attention to the proper carbon: nitrogen balance will be required to compost food scraps and prevent odor issues from developing.

Carbon sources and pre-processed bulking agents should be stockpiled to ensure sufficient carbon sources for mixing. Once food residuals are delivered to the site they must be immediately mixed with the carbon materials.

Community compost and smaller operations may want to collect just vegetable scraps and no meat or dairy to reduce odor & vermin concerns.

Whether to include soiled paper products & compostable plastics must also be decided. These too add concerns, such as litter control and potentially longer processing times required for full decomposition.

to recipe development and proper mixing of materials will be needed. More active composting can result in finished product within six months. These systems are scalable for uses in community composting to larger operations and are appropriate for handling food scraps.

"Higher-level" technologies using windrow turning equipment, large scale aeration systems, or in-vessel systems can be beneficial for processing yard waste and brush with biosolids (sewage sludge) and/or food waste. These systems are designed to control odors and complete the composting process more rapidly, often within four months. Windrow turners are effective more mixing food scraps and aerating windrows to reduce odors. Less expensive windrow turners can be tractor driven. In-vessel systems usually consist of a rotating drum or tank with a mixing system. These systems can be costly; however, they may be appropriate for regional operations. Smaller-scale and specially designed in-vessel systems can be cost-effective for handling food scraps at institutions, commercial establishments, and community composting operations.

Compost Methods

A range of composting methods can be adopted, although piles and windrows are most commonly practiced with smaller operations. Each method can employ varying levels of technologies discussed above.

Compost pile

A "static pile" can be managed "passively" where the piles are turned infrequently. Materials are stacked into a pile and left to decompose with minimal maintenance. This is the least labor intensive method, with piles being turned one-to-four times a year. It is also the least expensive option, requiring minimal equipment. A tractor, front loader, or even a manure spreader can be used to stack and turn materials. A passive leaf pile can take three to five years to turn into compost. Odor issues can arise when piles are turned due to anaerobic conditions that develop.

A "passively aerated pile" can be achieved by piling materials on perforated piping or on top of bulking agents (such as wood chips). This method is effective for composting leaves, yard trimmings, and manure, but not recommended for food scraps.

Materials must be thoroughly mixed before building the pile in order to ensure aerobic composting. The process will take a year or more for finished compost, depending on feedstocks. Alternatively, piles can be turned more frequently, about once per week, using a bucket loader or front loader in order to create more rapid decomposition. Passively managed piles are successfully used in rural composting operations, where equipment and staffing is limited. Low technology is required, along with minimal management. Dry and large-particle size feedstocks can be mixed in to give the compost pile adequate porosity for aeration.

Aerated Static Pile

An "aerated static pile" involves building a compost pile on top of a "forced air" system. A perforated pipe (ten inch diameter) is connected to a blower system to blow air through the decomposing materials. The system may be a positive (pressure) aeration or negative (suction) aeration. Materials must be well mixed before piling in order to create a homogeneous mixture with good porosity. A layer of peat, wood chips, or finished compost can be used to cover the materials to add an insulation covering and help to control odors.

This method helps speed up the composting process by ensuring proper air flow. It does require a higher level of technology, with moderate capital and operating costs, due to the initial purchase and installation of pipes and blowers. It also requires a site with utilities. After two to ten weeks of composting in the aerated static pile, the material can be turned into another aerated system or windrowed to finish the compost process. This system presents an excellent, scalable process for managing food scraps.

The advantages of the aerated static pile include less use of front end loaders for turning and less labor once the piles are built. The initial construction of the pile does require substantial labor to mix and build the pile. Also, the monitoring and maintenance of blowers will require trained personnel. Moisture loss can be considerable, so should be closely monitored. Odor control can be maintained through covering the pile with chips or finished compost. The pile should sufficiently reach temperatures of 131°F for a minimum of three days. The process takes up to 6 months to produce compost ready for curing.

Aerated static piles can also be constructed in "compost sheds or bins," using wood or cement walls. Aerated piping is laid down on the floor of the bin. Concrete floors can be installed for easier long-term maintenance with the aeration piping running through grooves formed into the cement. The walls of each bay within the shed should be wide enough to allow for maneuverability by a front loader for stacking materials. Sheds can be covered to reduce run-off and drainage.

Tips:

- Materials should be mixed thoroughly into the pile to form a "haystack" type pile 4' – 6' high.
- Piles should be no more than 6' high and 12' wide in order to ensure sufficient air movement through the pile.
- Aerated piles should start with a higher initial moisture content and include a bulking agent or carbon source with higher percent of larger particles to promote greater aeration.
- Use a porous, well-aged capping layer (such as wood chips or finished compost) to cover the pile in order to better promote decomposition and to reduce odor potential.

- Sufficient space should be available for additional piles, depending on the volume of organics collected.
- It is beneficial to place a layer of woodchips over aeration pipes to help protect the pipes and assist in air flow through the pile.

Windrow

A windrow is a long, narrow pile of mixed compost feedstocks. Windrows are typically 10' – 16' wide by 3' – 8' high, depending on equipment used to build the windrow. Windrows can be built and turned using a manure spreader or front loader. Windrows can be affectively managed using low to intermediate technology and moderate management intensity.

A "*passively aerated windrow*" system can also be designed using perforated piping. Materials are stacked into windrows over a series of perforated pipes, laid out on a grid with 12-19 inches between the pipes. The piping should be 10-12 inches in diameter with holes at 12-inch intervals. Wood chips laid over the pipes will aid in air circulation and help to protect the pipes from breakage. Air moves through the windrows through a "chimney effect," drawing air from the sides and bottom of the windrow. Initial upfront labor is intensive, requiring sufficient mixing and stacking of materials to form a homogenous mixture with good porosity. The method is relatively low in overall maintenance and equipment needs, however, requiring a front loader or bobcat for mixing and stacking, and the piping for aeration. The method works well for retaining moisture in the composting material and has a relatively low potential for odor.

Passively aerated windrows do require a longer time for composting, typically 6 –10 months to produce finished compost, and a relatively large area for the composting materials. Because materials are not turned, the ability to adjust the composting mixture is limited. Temperatures may not reach the suggested 131°F for pathogen reduction, so this system is not recommended for processing food scraps or manure.

"*Aerated or turned windrows*" are maintained by regular turning of the organic materials using a front loader or windrow turner. Aerated windrows can be used to decompose large volumes of diverse organic wastes, including food scraps. Regular turning provides aeration, helps to rebuild porosity through the windrow, and also promotes the breakdown of feedstocks through active remixing of materials. Windrow management is more intensive, requiring regular monitoring of temperatures in order to determine compost activity and turning frequency. When windrow temperatures fall below 120°F, the windrow requires turning. Turned windrows are common in many operations as they allow for a good balance of flexibility, process control, and affordable economics for most composting facilities.

Turned windrows have the advantage of being able to be maintained with commonly available equipment (such as a front loader) and windrows are flexible enough to handle wide range of materials. Turned windrows allow for the adjustment of the feedstock mixture during composting.

With the right feedstocks and proper turning, the windrows will reach the suggested 131°F for parasite elimination. Community compost operations can even turn windrows using shovels or a small loader.

Turned windrows require sufficient space to allow for anticipated volumes to be managed during the active compost phase; substantial amounts of water, depending on the materials composted and the weather may also be needed. Windrow turning can also generate odors, so precautions should be taken to turn materials primarily in the early morning hours and on weekdays if odors are a concern. Turned windrow compost operations have relatively low capital and moderate operating costs. Up to 6 months are required to produce compost ready for curing.

A "*modified static pile*" allows for a hybrid system where an aerated static pile is used in the initial phase of composting, followed by turned windrow during later phase of active composting. This system effectively combines the advantages of both technologies.

A more "high technology" windrow system would employ specialized windrow turners. A windrow turner uses an auger to turn and grind and mix materials within a windrow. Self-propelled windrow turners require a higher level of capital investment, plus specially trained staff to operate and maintain the equipment.

Tips:

- Keep windrow piles as straight and uniform as possible. Thoroughly blend materials without compacting them. Check and adjust moisture level by adding water or dry bulking agent. Move materials from surface to center of windrow and vice versa.
- When turning with a frontend loader, lift material and let it cascade down to maximize aeration and porosity. Re-shape the windrow for consistent dimensions and smooth sides.
- If building more than one windrow, leave sufficient space between them for drainage and to allow for turning. For low technology operations, using a front loader, a 15 to 20 foot aisle should allow for adequate maneuverability when turning the piles.
- Composting time varies depending on how often the pile is turned or how efficiently it is aerated. Minimal turning of windrows will require three to five years for piles to decompose and cure; low-level technology, with increased windrow turning, would take six to eight months, followed by curing. Once composted, organics can be moved to the curing area to allow for composting of new materials in the windrow area.
- Temperatures should be monitored daily during the active compost phases and after turning the windrow. Measurements should be taken at various depths (e.g., at one foot and three feet into the pile) and at least every 75 feet along the windrow. Always turn and aerate a pile or windrow if temperatures reach above 160°F.
- Once the active composting phase for pathogen reduction is met, materials can be turned weekly or as needed until ready for curing. Curing time can range from 30 to 60 days.
- Moisture management is important. If the windrow is too dry, add water when turning and rebuilding the windrow. Start by watering the outside of the pile before mixing materials into the

Regimes for Pathogen Reduction

- Turned Windrow: 15 consecutive days with temperatures ≥131°F (55°C) with 5 turnings
- Aerated Static Pile: 3 days with temperatures ≥131°F (insulated pile)
- In-vessel: 3 days with temperatures ≥131°F

center. Shape the windrow to increase rain infiltration. If the windrow is too wet, turn it to release excess water vapor or mix more dry carbon material into the pile. Allow compost to dry somewhat but maintain adequate moisture (35%-45%).

- Windrows typically reduce 60% in volume during active composting; two windrows can then be combined into one to free up space. Be sure to track when windrows were formed.
- If using a passive aeration system, pre-mixing of feedstocks is crucial to ensure proper composting. Materials can then be laid out over perforated piping.
- The size of the windrow must be sufficient to achieve desired temperatures, but within the size necessary to build and turn using available equipment. Large windrow dimensions are appropriate up to 8 feet high. Oversized piles often are the cause of odor because they can compact and limit air flow. Undersized piles may lack the thermal mass necessary to sustain high temperature.

In-Vessel

An "in-vessel" compost option involves mixing and making compost in a fully "environmentally controlled" enclosed operation, such as a drum or container with an agitating mechanism. These systems can handle large volumes of any type of organic material and can operate in any climate year around. In-vessel systems vary widely, from rotary drum composters ("Earth Tub™") to composting "chambers" and "box or tunnel" systems. These systems create compost more rapidly compared to other methods. Finished compost is usually achieved in 2–4 months.

In-vessel systems work well for operations that will be handling significant amounts of food scraps or biosolids, particularly if the operation is located where odor issues are likely to be a concern. In-vessel systems reduce moisture loss and water needs and require a smaller footprint for composting. Odors are easily controlled and the method is effective in eliminating pathogen concerns.

A higher degree of expertise and training in operating in-vessel systems is required. In addition to the relatively high capital investment, a front loader or similar equipment is required for loading the materials into the containment vessel. A site with utilities is also needed. Smaller in-vessel units, including systems adapted with forced air systems, can be used by community compost operations.

Siting Parameters

Check with state and local regulatory agencies prior to siting a compost operation in order to ensure that the operation is in complete compliance with permitting requirements. "Set-backs" or distances from waterways and structures may vary depending on the materials and volume to be composted. There may be little in the way of distance requirements for composting smaller volumes of leaves and yard trimmings.

The following provides general guidance for siting compost piles or windrows:

- From 100' – 500' from wells and potable water sources
- Adequate distance from wetlands, surface water bodies (streams, ponds), and flood plains; recommended at 200'
- Minimally 200' away from residences and 50' from property lines
- A low water table to reduce flooding risk on the site
- A high soil percolation rate, but not excessively permeable soils in order to avoid standing water.
- Gently sloped surface (1-3% grade)

Site Selection and Design

In general, the space needed for composting depends on the amount and type of material to be composted and the type of composting system. A lower technology system may require more space because of the slower decomposition time involved in the composting process. Two to twenty acres should be adequate for most rural/small town composting operations. Consideration needs to be given to high generation periods—the fall for leaves and early spring for brush and yard trimmings. Community compost operations will vary in size, depending on volume and the system used.

A turned windrow composting operation can typically handle 4,000 to 6,000 cubic yards per acre of materials, depending on the equipment used to turn the materials, the windrow height & width, and the width of the aisles.

If a separate curing area is used, it can accommodate 6,000 –7,000 cubic yards per acre.

A diagram or plan of the compost area is essential to determine prevailing wind direction, traffic flow patterns, land slope, runoff patterns, surrounding land uses, and the location of wetlands or water bodies. The Natural Resources Conservation Services (NRCS)[3] or state environmental agency may be able to provide assistance with site planning, soil information, and drainage control. Ideally the compost area should be located on an evenly graded gently sloped surface (1% - 3%). This will help to prevent ponding and move runoff to the drainage filter area or storm water system. Windrows should be parallel to the slope.

In siting the operation it is important to consider the size of the facility, the volume of materials to be processed, and the types of materials to be accepted. Larger operations and those that accept significant amounts of food scraps will want to be sited away from residential areas. A "buffer zone" around the site is crucial to alleviate any nuisance issues, including noise, blowing material, dust, potential traffic concerns, and odor. Operations may want to consider using shrubbery or fencing to screen the area from view.

The site plan should include, at a minimum, a material receiving area (where organics are dropped off), an active composting area (where materials are layered into a pile or windrow), and a curing area (where finished compost is allowed to cure). The design should consider adequate space for equipment movement and be laid out in a logical manner for effective process flow that allows for material drop-off, mixing, composting, and curing with minimal movement of materials.

[3] http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/

A mixing area should be designed into the operation, depending on the volumes and types of materials accepted. Mixing and chipping or shredding can be done in or near the material receiving area. If leaves will be mixed with manure it will be beneficial to thoroughly mix the materials; a mixing area is essential if food scraps are to be handled. If food scraps are composted, additional carbon and bulking materials should be stored onsite. Food scraps will need to be covered and mixed immediately upon being delivered to the site in order to reduce odor problems. Many facilities lay down a bed of bulking materials, such as ground yard trimmings, to absorb liquid associated with food residuals.

Handling brush may require a pre-processing area for grinding the material to proper particle size. Consider whether a grinding operation is necessary and affordable. Larger operations will want to have an area for stockpiling bulking agents. Larger facilities and those accepting post-consumer food scraps or materials containing a significant amount of contaminants, may need a post-processing area for screening compost. Post-consumer food scraps composting will bring in additional issues with plastics and other potential contaminants that will need to be screened to be effectively removed. Consider seasonal increases in population (and thus materials generated) when planning the site. Be prepared to load finished compost into customer vehicles.

Being a good neighbor is essential in the siting process. When planning the siting and operation of a compost facility, it is important to keep in mind the various ways an operation may impact residents and nearby businesses. Potential problems at compost facilities relate to air quality (dust and odor), water management issues, traffic, noise, visual aesthetics, and vectors. In most rural areas these issues should present minimal concern due to lower population densities. Planning for potential impacts will help alleviate any future concerns, however. Traffic flow should be considered in order to minimize both noise and dust impacts on neighbors. All compost operations need to address drainage issues and ensure that any runoff is properly managed. An effective good neighbor strategy involves getting to know the neighbors and keeping them happy. Respond appropriately to all complaints.

Communities will also benefit from considering the handling of disaster debris at the compost operation. The ability to process disaster debris will substantially improve recovery time in impacted communities and offer a more cost efficient disposal option for organic debris (see Part XII, below).

Tips:

- Year-round accessibility will be necessary unless the site will only operate seasonally.
- Depending on the types of organics generators or collection vehicles anticipated, the site will need to be accessible for large vehicles.
    - Sufficient space for future expansion should be planned, if space allows.
- Access to a water source is necessary.
- Gate and a perimeter fence (or other barrier) is recommended to control access to the site and prevent illegal dumping.
- Signage is needed to control incoming traffic and public access to areas where equipment will be operating.
- An area to store finished compost should be established. It will need to be accessible to the public if materials are to be sold or given away.
- If possible, plan the site so that customers see the end product…not the feedstock unloading and mixing area.
- Set up the site so that the oldest finished product can be moved first.

- To the extent possible, sit up the site so that material movement is in as linear a fashion as site constraints allow and that nothing should move more than twice in its same physical condition.
- A neat site appearance is important. Product image and community approval reflects your operation. Don't let weeds grow on the finished product. Deal effectively with leachate/ponding. Consider the view from the road.
- Larger facilities (for example central processing facilities) may want to consider installing weather monitoring equipment.
- A truck scale may also be needed at central facilities that will be charging tipping fees based upon weight.
- An equipment garage will help secure and protect equipment.
- Office/employee facilities may be necessary, depending on the size of the operation and permit.

Siting Opportunities

A composting operation can be located as a "stand-alone" site or co-located with another facility. Operations can be located at transfer stations, public works yard, a landfill, recycling center, or wastewater treatment plant. There are many possibilities for siting community compost operations—including community gardens, vacant lots, and schools.

The amount of land required for the composting site depends on the volume and type of material accepted, the composting system, and the amount of time required for the process to complete.

- Typically 2 - 20 acres is adequate for most rural & small communities.

Co-locating the operation allows for sharing of existing infrastructure, including fencing, employee amenities (shelter, restroom access, etc.), water supply, electricity, etc. Co-locating can allow for better use of available space. Existing equipment located at the site may be usable for the compost operation. Co-location also allows for use of existing traffic patterns and impacts. The facility may be able to take advantage of existing permits; new impacts at a second site are avoided, including any potential citizen opposition.

Drainage System

Check with state and local agencies regarding drainage requirements for the type of composting operation planned. Larger facilities will most likely require specialized drainage structures, such as a retention pond. Plan drainage needs by first observing how water flows through the site.

The site should be graded to divert water from running onto the site. A gentle slope will help to drain leachate from the pile or windrows and runoff into drainage structures. Drainage structures include filter or buffer areas and diversion channels (grass, gravel, crushed glass, or geotextile-lined). Rain gardens and marsh areas work well in smaller sites. Filter sizing and design or run-off management may require professional assistance, depending on permitting requirements, the size of the compost area, or if leachate is a problem. Leachate retaining ponds or lagoons, as well as piping systems may be required. Contact the Extension Service, NRCS, or Conservation District or state environmental or agricultural agencies for assistance.

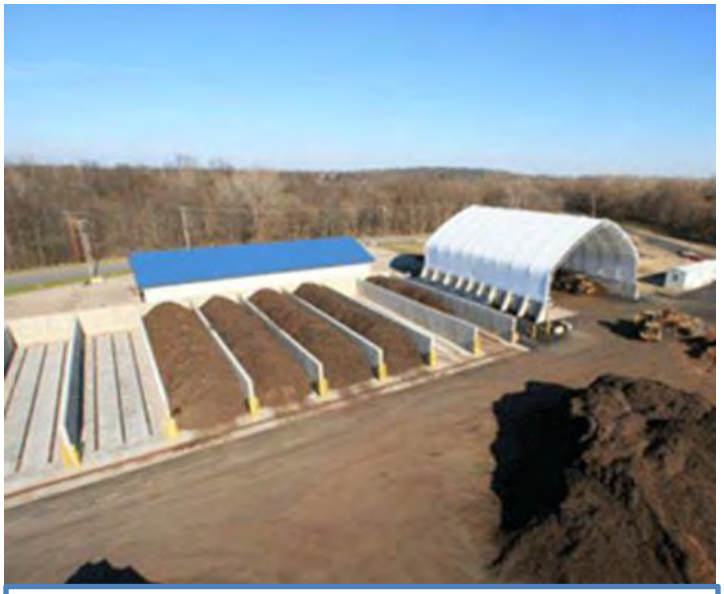
Tips:

- A grassy or vegetated filter/buffer serves as a relatively low cost drainage field. Crushed glass or other filtration material, covered with grass or vegetation provides a cost effective system.
  - Check with state and local agencies to determine if this drainage system is adequate—a more extensive drainage system may be required.
- Site grading to divert surface runoff from the up-slope side of piles will reduce leachate issues and help to control soil erosion around the site.
- Trenching can be used to capture or divert leachate.
- Install piping around larger piles or windrows or where seepage becomes an issue, to capture the wastewater and divert it to the filer area, drainage pond, or holding tank. Reusing the water to spray back onto composting materials may be a cost effective investment, depending on water needs.

Compost Pad

A firm and stable surface to support heavy equipment under varying weather conditions is necessary for the compost operation. Compacted soil is adequate as a pad for composting, as long as other precautions for siting the compost area are met (distance from water sources, filter area, etc.). When locating a pile on unimproved soil, soil types should be considered. Native soil with moderate permeability (not excessively or poorly drained) is best. Sand or silt soils may allow too much drainage, while clay soils will rut in wet weather making access and turning difficult.

As an alternative, six inches of compacted and graded sand or gravel should be installed if soil conditions are not sufficient for drainage. Small diameter dark gravel is recommended. Keep in mind, however, that gravel can present problems when mixing materials as it can become mixed in with the composting materials. A hard packed or cement mixing area is recommended. An impermeable paved surface or concrete pad provides an area that will limit mud problems and provides a good foundation for equipment. However, these options can be expensive.



Onondaga County Resource Recovery Agency (OCRRA) Aerated Static Pile Operation

Staffing

Staffing of a locally-operated compost operation will vary depending on the amount of material to be managed and the type and size of operation undertaken. For many rural operations staffing requirements will be minimal since pile or windrow management requirements will be infrequent. For operations handling a larger volume of materials, handling food scraps, or using more rapid composting techniques staffing requirements will increase.

Operations accepting just leaves or brush will have seasonal variations in staffing requirements. Requirements in the fall for handling leaves will necessitate more staff, as will the handling of grass and brush in the spring, if accepted. Incorporating food scrap collection into the operation will require year-around staffing.

For most rural, small community operations one or two employees will be sufficient. Typically, if the operation is co-located with a transfer station or other facility, staff at smaller compost operations can be shared to reduce overall employee needs. However, one person should have the role of compost operator or manager. This will ensure that one person knows the overall operation of the facility and is charge of ensuring that the facility is run effectively. All employees should, however, understand and know all aspects of the operation and how to deal effectively with issues that arise. Personnel duties will include monitoring materials as they come into the operation, ensuring best management practices, and monitoring and maintaining records.

Community composting operations may be managed by not-for-profit organizations or volunteer groups, such as garden clubs. Volunteers may be solicited to assist in maintaining the site. Operations which use a loader or which maintain vermicompost systems will need to ensure that staff or volunteers are properly trained.

Employee Training, Health, and Safety

Employee education, both ongoing and upfront, is important. Operator training requires at a minimum a basic understanding of the compost process. More rapid composting and handling food scraps requires that temperatures be monitored and moisture levels be assessed on a regular basis. Operators should be familiar with general troubleshooting guidelines to manage issues as they arise. If food scraps are introduced into the composting process, it is recommended that operators attend a formal compost training course. All employees or volunteers must understand the importance of proper monitoring of the compost process and record keeping. The operation will benefit from staff knowing how to use compost as well. Proper training and enforcement of all safety measures must also be observed.

See Attachment A for a list of operator training programs and resources. Check with state regulators for state specific compost operator training and certification requirements, as well as training opportunities.

Equipment operators of front loaders or other heavy equipment used in the composting process must be trained and properly certified. Whatever procedures that municipalities or other entities have in place for training and certifying employees for operating trucks and heavy equipment should also apply in the compost operation.

Equipment maintenance will also be a requirement. Employees will need to know how to run daily equipment maintenance checks. Additional maintenance and repairs will need to be scheduled and handled as a part of the overall operation requirements. A trained mechanic is a valuable asset to any operation, particularly larger facilities.

Proper sanitary measures must also be included in the training of compost staff. Hand washing equipment and sanitizing solutions should be provided in the compost area, along with instructions about proper hand washing before touching food, eyes, etc.

Personal protective gear should be provided, including hard hats and steel-toe boots, safety vests, eye and hearing protection, and dust masks or properly fitted respirators to wear when turning the compost. Individuals with allergies, asthma or other respiratory problems, weakened immune systems, and other conditions should not work in a composting operation.

Employee health and safety training should be included in staff meetings and ongoing training efforts; safety procedures should be posted. Records should be maintained on employee safety training, compliance of safety procedures, and any incidents or violations of proper procedures.

Public safety must also be paramount in employee training. The public should not be allowed in areas where equipment is operating.

Equipment and Tools

In many communities, existing public works, highway, or sanitation department equipment, including front-end loaders, shredders, chippers, and similar equipment may be available for sharing, especially in seasonal operations handling just leaves and brush.

Materials handling equipment such as a front-end loader or tractor with a bucket for loading, moving, and turning materials is essential for virtually any size composting operation. A large bucket size is best for efficient materials handling. Small community compost operations may be able to use shovels and pitch forks for turning materials, although a small tractor or loader will be beneficial.

If equipment is not already available for the operation, consult with other, similar operations, prior to purchasing a front loader or other piece of equipment. Learning from other operations about the necessary equipment to best meet the needs of your operation's parameters will help control costs and help to ensure operational efficiency. Ask equipment dealers to demonstrate or allow testing of equipment at your site. Consider renting equipment to meet seasonal needs or to experiment to see what works best for operational requirements.

Equipment considerations should also take into account potential expansion of the operation to include food residuals or other organics and handling disaster debris materials. Used equipment may

be available for purchase; check with regional equipment suppliers or consult Internet used equipment sites and government surplus. Consider lease to own options as well.

Pre-processing equipment may include a tub grinder or horizontal grinder used for grinding and size reduction of brush and yard trimmings. Both types of grinders are versatile for handling materials ranging from brush to stumps. Tub grinders work well for large diameter material (such as stumps and root balls) and brushy material. Horizontal grinders perform better for long material (such as trees and limbs) due to the long feed table on the grinder. Horizontal grinders also have heavier rotors better suited for contamination (such as plastic bags). Shredders are less frequently used and are typically not able to sufficiently process yard trimmings.

Pre-processing serves as a way to achieve size reduction in yard trimmings to produce consistent particle size and structure to serve as a bulking agent. Regional composting facilities and operations that handle large amounts of brush may want to invest in a grinder. Pre-processing also works well for facilities handling food scraps containing a high percentage of compostable service ware, as well as large volumes of materials bagged in paper or compostable plastic bags. Again, contact other operations to see what equipment has worked best for them. Initial contracting for these services allows for experience in seeing what equipment best meets the needs of the operation, before investing in purchasing the equipment.

Specialized composting equipment can include "turning machines" such as a windrow turner. Windrow turners are recommended for larger operations where the capital and operating costs of using the equipment can be offset by their higher throughput as compared with using front end loaders for turning. Windrow turners can be expensive, however, and not necessary at smaller scale operations. Smaller, tractor-pulled turners can be more affordable and beneficial, especially for handling food scraps.

A frontend loader works well for operations handling roughly 500 cubic yards per year of material or less. Larger operations and operations that will handle food scraps may want to consider a windrow turner. A windrow turner will more effectively mix and grind materials. It also handles larger volumes in a quicker amount of time than turning windrows with a front loader. A windrow turner is also effective in helping to provide better mixing and size-reduction and for mixing organics, such as food scraps or sludge and yard trimmings. Turners also work well for operations handling a large amounts of grass and also mixing materials brought in paper or compostable plastic bags.

Additional composting equipment could include a water truck for moving water around a site and spraying water onto piles or windrows; also useful for dust control and fire protection.

Post-processing equipment, such as a trammel screen, is the most effective equipment for separating finished fine-textured compost ("unders") from larger pieces ("overs"). Screens can also be used for separating plastic bags from compost and removing contaminants. Operations which use wood chips will need to screen material to remove the chips (these can be added again to new materials). Screening equipment is an optional addition to operations, but particularly beneficial for larger facilities and operations that accept post-consumer food scraps, as well as those which will be selling premium compost products.

Monitoring equipment includes a long-stem, non-mercury compost thermometer at least 2' -3' long. A thermometer is essential to ensure optimal composting conditions. Use of a thermometer will aid site operators in monitoring the pile/windrow temperature and determining the optimum time to turn the composting material.

Moisture meters and oxygen probes are helpful for obtaining additional diagnostic information. Compost thermometers, moisture meters, and oxygen probes are available at garden or hardware stores or on the Internet. A windsock is a simple tool that can be used to monitor wind direction.

Safety equipment for workers includes: hard hats and steel-toe boots; safety vests; dust masks; and eye and hearing protection.

Monitoring the Process

It is essential that all of the primary components be monitored in order to ensure proper composting. If the carbon:nitrogen ratio is proper, moisture levels adequate, and air flow sufficient, temperatures in the pile will rise to appropriate levels and be sustained for the required amount of time for pathogen and weed seed destruction. This will indicate that the biological process of organics decomposition is working. Temperature is the primary indicator of other factors, including moisture and oxygen levels.

Monitoring temperature, oxygen, moisture, and porosity serves as a "feedback" mechanism allowing compost operators to turn and manage piles or windrows to insure optimum composting conditions and avoid unnecessary turning. Observing, monitoring, and recordkeeping should be the foundation for decisions and activities at the compost operation, whether it's turning the materials and adding water because temperatures are below 120°F and moisture content is low or adding carbon or bulking agents because the materials are too wet. Observing, monitoring, and recordkeeping can help to determine the source of odors as they arise and will also indicate when the composting process is complete and ready for curing.

Field Measurement of Bulk Density

Bulk Density is weight per volume, (e.g., pounds per cubic yard, lbs/cy). A lower bulk density typically means greater porosity and better air flow.

Field Measurement:

- Weigh 5 gallons of feedstock in a bucket (net weight)
- Drop the bucket from 1 ft. height
- Adjust volume back to 5 gallons
- Measure net weight
- Multiply by 40.4

Field Measurement of Moisture Content

Pick up a handful of material, it should feel like a moist sponge.

- If water trickles out, then it's too wet
- If you can squeeze out some water then it's okay
- If you can't squeeze out any water then it's too dry

Weather monitoring is important, especially if odor issues are a concern. Wind direction and speed can be monitored in order to determine the best time to turn materials. If the breeze is blowing toward site neighbors, avoid turning materials until the direction has changed. Monitoring rain forecasts can be utilized for moisture management of the pile, utilizing the rain for adding moisture to the pile just before turning. Freezing temperatures will slow down the composting process. Windrows and piles can be built taller and wider, if space and equipment allow, in order to better insulate materials. Food scraps may freeze, so collection and processing methods should be adapted to the climate conditions.

To help prevent vectors and pests, immediately mix wet putrescible materials (such as wet grass, wet manures, or food scraps) with carbon sources or bulking agents to the proper proportions and form into a pile or windrow. If vectors or odors are a persistent problem, cover windrows with at least six inches of well-aged mulch, wood chips, or coarse compost.

For most small-to-medium sized operations, compost operators can successfully manage and monitor the compost process through some basic practices:

Observation—Daily observation of the composting materials will help to ensure that the process is occurring, odors are not an issue, and that there are no other concerns. Are the windrows or piles steaming (indicating proper heating and temperature rise)? Are materials looking different – is decomposition occurring, materials starting to slowing look like soil and less like leaves or brush. Is the pile uniformly composting? Are strong odors present? Are there persistent puddles of leachate or water?

Compost feel—Does the squeeze test indicate that there is moisture in the material—does it feel like a damp sponge so that when a handful is squeezed, the material sticks together and your hand is moist (about 50% moisture content). If the material is soggy and dripping when squeezed it is too wet and the pile should be turned; excessive moisture indicates that additional carbon materials should be added when turning. If crumbly and doesn't stick together the pile is too dry and water needs to be added. Piles should have their moisture content measured two or more times during active composting.

Temperature—Is the temperature rising appropriately for rapid compost? Does the temperature rise to at least 131°F in windrows, maintain this temperature for 15 days through 5 turnings (or 3 days for aerated static piles)?

Oxygen—Smell is the best measure of properly aerated composting for small-to-medium sized operations. If there is an unpleasant odor, chances are there are anaerobic conditions in the pile. This is an indication that the pile needs to be turned. Oxygen probes are also available to measure oxygen levels.

Odor problems are inevitable at some point in most compost operations. It is important that operators plan for this and be aware of the potential causes of odors and how to deal with specific occurrences.

Compost is "finished" and ready for curing (see below) once the organic ingredients in the pile or windrow are digested and bacterial activity declines. When decomposition is complete, or nearly completed, the compost pile heats up very little, even after turning or aerating the pile. Finished compost will have a uniform, crumbly appearance, and an earthy smell. Little if any of the original ingredients—leaves, twigs, etc. will be visible, although wood chips, if used, are likely to still be visible.

A quick and easy test to see if compost is "done" is to put a few inches of material in a small bag. Close the bag and set it in the sun for a few hours. Open it up; if there is a strong smell the compost is not done.

Track and Keep Accurate Compost Records

Monitoring incoming materials, whether from residents, landscapers, haulers, or other sources, should be done in order to limit contamination problems. If materials from businesses are accepted, such as processing wastes or food scraps, it is vital that a record of feedstock sources be kept and maintained. If the incoming material has a high level of trash or other contaminants in it, properly maintained records will help to determine the source of the contamination. If odor issues arise, records will help to indicate if the issues arise from the intake of certain materials. Additionally, if the finished compost tests high in herbicides or other toxics, records will help to locate the potential feedstock source.

Odor, leachate or ponding problems, and any other issues should be recorded, along with methods used to remedy the issue. For example, if odor is coming from the pile, was the pile turned to reduce any anaerobic conditions? If the pile was too wet, was additional carbon or bulking sources added? Records should also be maintained for any citizen complaints received and how the issue was resolved. It is also useful to note weather patterns—wind direction (for pile turning and in case of odor complaint) and rain occurrences and amounts (for pile watering needs).

Operations will want to monitor pile temperature and turning frequency. Operations with more than one pile or windrow will want to also note the date the pile or windrow was formed. A temperature chart should be kept to ensure that the 131°F is maintained for 15 days, noting turning dates as well for each pile. Watering times should also be noted in order to ensure proper moisture content.

Operation Management

Managing the composting process for appropriate C:N ratio, moisture content, free air space, and temperature is essential for maintaining a compost operation. Management activities involve material preparation, mixing, pile or windrow construction, aeration, turning, moisture control, and monitoring. Blower systems and other technologies used will also need to be monitored.

These activities are discussed above; however the following provides some additional tips:

- Before setting up the piles or windrows lay down a 6” - 8” layer of wood chips to enable airflow through the bottom of the pile. Pile premixed, “homogenous,” materials on top of the wood chips.
- In order to begin the compost process, materials need to be stacked at least 3’ – 5’ high.
- The compost temperature should be taken daily for 15 days (to ensure pathogen destruction), moisture levels accessed, and general appearance gauged during the active composting phase.
- In leaf and yard trimming piles, with proper ingredients and moisture level and where pathogens are not a concern, turning once a week during the first month or two of the process, then once or twice a month after that should be sufficient. If pile temperatures do not rise sufficiently, materials may require more frequent turning.

The University of Wisconsin-Extension Solid & Hazardous Waste Education Center conducted a survey of composting facilities licensed by the Wisconsin Department of Natural Resources (239 facilities; 97 facilities responded). An “average” composting facility in Wisconsin has two employees, is about 5.5 acres in size, and receives about 6,300 cubic yards of leaves, grass, and garden debris. Yard trimmings come from predominately residential sources; no tipping fee is charged; materials are composted in windrows; and compost is given away.

Joe Van Rossum, *Composting Trends in Wisconsin,* BioCycle, October 2012, p. 26.

- Once the temperature goes below 120°F materials should be turned until temperatures no longer rise. Materials should also be turned if temperatures rise above 140°F.
- Depending on the materials and compost management, the active composting phase will last 6 – 10 weeks.
- Sawdust can compact relatively easily, so may require the addition of straw or other material to allow sufficient airflow through the pile. Very fine sawdust, such as from carpentry or cabinetmaking (often used by horse operations), will more than likely require the addition of other bulking material.
- If possible, cover piles, especially in the winter, to retain temperature and moisture levels. Covering piles reduces pile leaching and will help the pile heat up faster on warmer days. Once the weather warms up sufficiently the pile or windrow should be turned. Covers can be removed in the rain to add moisture, if necessary.
    - Larger windrows do not need to be covered, but special windrow covers are available and help to promote more rapid decomposition.
- Bulking agents are recommended to keep on hand to be added to adjust the moisture level, texture, or the C:N ratio.
    - Common materials include: dry leaves, ground brush, wood chips, or straw.
- Shape piles with a flat or concave top to absorb as much rainfall, snowmelt, or watering as possible.
- As the compost process continues, piles will diminish in size. Contents from separate piles or windrows can be mixed together to conserve space and ensure that there is a sufficient volume of material to continue the composting process.
- If rapid composting is desired, it is important to stay within the preferred range of conditions for all factors impacting the composting process.
- Plan for annual site maintenance, to include an inspection and any necessary repair of working surfaces and drainage structures. Ruts and depressions in the composting area should be reconstructed, the slope maintained, and any needed clearing of drainage swales, channels, and retention ponds conducted.
- Practice good housekeeping at the operation. Keep litter picked up. Limit puddles of leachate. Maintain piles and windrows neatly.
- Limiting odor concerns:
    - When the pile is turned, especially with fresh materials in it, it will give off a strong odor. Try to turn it when the there is no wind and on cooler days. Consider turning it on a weekday when neighbors are less likely to be home. Mornings are usually the best time to turn materials.
    - Install a windsock to determine the wind direction and do not turn piles if the wind is blowing in the direction of neighbors.
    - If unpleasant odors persist, there is something wrong with the pile.
    - Odors can be contained by covering the composting materials with a layer of peat moss, finished compost, and/or woodchips (about a 4” layer) or using a compost cover.
    - Avoid leachate ponding as these create odors and are unsightly.
    - Become familiar with odor sources and set up process controls to deal effectively with them as they arise.

Curing Finished Compost

Curing is a necessary part of the compost process in order to ensure that the compost is completely done and ready for use. Cured compost is stable—biological activity in the compost is low and it is mature—the decomposition process is complete. Properly processed and cured compost is safe to apply to soil and plants without risk of binding-up soil nutrients or harming plants when applied.

> Curing is essential to reduce the potential for herbicides and chemical residues contained in grass clippings and some manures to more readily decompose, as well as to ensure that the compost is mature.

The curing process allows any remaining ammonia nitrogen to convert to nitrate nitrogen. Any remaining large woody particles will also continue to break down. By the end of the curing process compost ingredients (wood shavings, etc.) should not be recognizable. Wood chips, however, may not entirely decompose, and will require screening to remove from finished product.

Compost should be cured for a minimum of 45 days. The curing area will need to be about 25 percent of the compost pad size. Curing can be done in a designated area away from the composting materials to allow additional materials to be composted. Covering the curing materials will help to prevent nutrients from leaching out of the compost. Once cured, compost samples can be sent for analysis. In addition, cured compost should be sold or given away as soon as possible to retain the nutrient value of the compost.

Ensuring Compost Quality

Compost quality starts with effective and ongoing public education about what is acceptable and what is not. Customer outreach using brochures, website postings, social media and other methods must emphasize the importance of keeping organics contaminant free. Signage at drop-off locations or labels on collection carts (or bags) must clearly and concisely state what is acceptable for composting.

Residents and businesses must be taught that the composting process is impacted by plastic and other contaminants. It is essential that leaves and yard trimmings not be collected in plastic bags. Food residuals and produce scraps cannot contain plastic utensils, gloves, or other contaminants.

> Observation, monitoring, sampling, and testing are essential. Ongoing monitoring of temperature and moisture levels ensures that the compost process is working.
>
> Maintaining appropriate records to demonstrate that best management practices were followed will help to ensure that the finished compost product is free of potential pathogens and weed seeds and provide a record if issues arise.

Quality control requires active monitoring at the receiving point, as well as when organics are mixed into piles or windrows. Plastics and other contaminants should be removed immediately. If loads of organics are delivered to the compost site with unacceptable levels of contaminants, the load should either be rejected or pictures taken in order to discuss the issue with the generator. The type of contamination and generator should be recorded and tracked so that measures can be taken to eliminate the contamination at the source. Work with haulers to properly train their customers.

At a minimum, a compost test to analyze the basic nutrient content—nitrogen, phosphorous, and potassium (N:P:K:) levels of the cured compost is recommended. This test will indicate the soil amendment value of the compost and is helpful in marketing the material.

Operations that collect and compost substantial volumes of grass clippings or horse manure should have their compost tested for potential herbicide residues. Operations intending to sell the compost may want to have more extensive testing (additional nutrients, soluble salts, organic matter, and maturity) and chemical analysis of finished compost. Testing and product certification determines the compost quality and helps to ensure performance consistency. Bioassay testing—growing plants in finished compost using containers or plots—is an effective way for operations to indicate the quality of their compost and to ensure that harmful herbicides are not present.

Skowhegan, Maine

Table 3: Compost Troubleshooting		
Problem	**Possible Causes**	**Solution**
Piles have a strong or putrid smell.	• Pile may be too wet. • Oxygen is lacking & anaerobic conditions exist. • C:N ratio (<20) is low; excess N being released as ammonia.	• Turn pile & increase turning frequency until problem subsides. • Increase carbon sources, such as bedding. • Cover to protect from rain.
Pile is too wet.	• Insufficient carbon sources. • Bedding or manure is too wet. • Rain water or other water is entering compost.	• Add sawdust, straw, shredded paper or other dry amendments. • Turn more often. • Cover pile.
Pile is too dry.	• Compost amendments are too dry.	• Water lightly. Expose pile to rain, if possible. Add wet ingredients (such as urine-soaked bedding). Turn after watering.
Pile is not heating up	• C:N ratio is too high (>60), microorganisms not active. • Pile lacks oxygen. • Pile is too dry (cannot squeeze water from ingredients). • Weather is too cold for compost process.	• Add additional nitrogen—manure or vegetable scraps. • Turn pile. • Add water throughout pile & turn. • When weather warms, turn pile. Add additional materials to pile.
Pile heated up, but only for a short time.	• Materials may be too dense & not allowing sufficient air flow. • Pile is too dry. • If the pile has been active for more than a month, the compost process may be complete.	• Turn piles to ensure material distribution. Add nitrogen source and/or water to pile. • Turn pile again, water if necessary & continue monitoring temperature. Look for uniformity in material.
Decomposition process is slow. Temperature is too high.	• C:N ratio is too low (<20) causing high temperature which kills microorganisms that make compost work. • Pile lacks oxygen.	• Add carbon sources, such as leaves or bedding & turn pile. • Turn pile.
Pile is very hot >160°F). Mixture has turned gray (ash-like) & may smoke.	• Insufficient turning. • Ingredients are too dry.	• Turn materials & spread pile out to let it cool down. • Monitor closely.
Fly infestation; problems with vermin or other animals.	• Manure or food scraps are exposed to open air.	• Mix materials immediately & cover with bulking materials. • Turn more often for proper aeration & increase composting activity.
Viable weed seeds, pest larva, & pathogens in compost	• Temperatures in pile did not reach 130°F or did not stay at this level for sufficient time.	• Turn pile more frequently & make sure C:N ratio adequate to raise temperatures to 131°F for at least 15 days.
Pile has gone through 2 or more heating cycles, but compost still contains recognizable bedding material.	• Contains wood shavings or wood chips. These materials are slow to degrade.	• Monitor pile moisture, add water if necessary. Give pile additional time to degrade. Use as mulch instead of compost. Screen and reuse wood chips.

Post-Processing

Operations may want to consider screening; depending on the desired end use of compost and the level of contaminants in the finished compost. Operations that want to market and sell higher quality compost product will want to screen to produce more fine-textured, uniform product. Screening is also effective in removing non-decomposed woody particles, including wood chips and contaminants, such as plastic. A typical screen size varies from ¼ to ½ inch particle size depending on desired end-market specifications.

Compost Marketing

Primary compost markets for most municipal or community operations will include residents and municipal users, such public works and road departments, parks, and schools. Operations that make a quality compost product and plan on selling it to offset operational costs will want to market the compost to landscaping firms, agricultural users, nurseries, orchards, and other commercial users. Towns and regional jurisdictions may want to consider developing procurement policies to promote the use of compost products by municipal departments.

Ongoing promotion of organics management programs can incorporate the marketing of compost. Potential users could be alerted through onsite signage and social media methods to the availability of compost and the locations where it can be obtained. Compost use recommendations can be posted on local websites, social media, and on fliers. Consider developing demonstration gardens using compost. Work with Agricultural Extension, Master Gardeners, and garden clubs to promote the benefits of compost on gardens, turf, soil revitalization, erosion control, and more.

For larger operations, in addition to implementing educational programs, a comprehensive marketing strategy could include developing a product name; two or more compost products, including soil mixes; requiring communities to establish procurement policies; and developing specialized marketing campaigns that target potential compost users, including agricultural, landscapers, garden centers, and others.

Opportunities and Action

Composting requires good management and a high level of community cooperation and participation to be cost-effective. A poorly managed system can incur high costs, produce poor results, and negatively impact public support and participation. Proper application of best management practices and creating the optimum conditions for composting will ensure successful compost operation.

St. George, Maine

Compost presents communities with a viable end product that can be promoted for use by residents or sold to offset operational costs. Compost is visible reminder of the benefits of removing organics from the waste stream and creating a valuable soil amendment instead.

Involving the community in the initial planning of the compost operation can help to gain support. A citizen task force can be established or a public information hearing sponsored. Ongoing public involvement with the operation will help to have a proactive mechanism for dealing effectively with

any issues that evolve. Consider offering regular tours of the compost operation and be sure to respond quickly to complaints.

A feedback mechanism can help create two-way communication involving the operation—contamination issues can be dealt with more effectively if fellow citizens relay the importance of clean feedstocks. Similarly, businesses need to know when their materials arrive contaminated. A mechanism for rejecting materials that are too contaminated may need to be established. Communication should allow for input and feedback from customers. Do they have issues with the operation? Are they happy with the resulting product? Investment in upfront education to residents and businesses will pay off in cleaner feedstocks, a more efficiently operated facility, community support, and a better compost product.

Consider community composting as a means to provide low cost food scrap composting opportunities. Community compost sites can provide an invaluable educational opportunity for getting residents involved in food scrap composting. Community composting can effectively divert significant amounts of organics and offers a scalable model for any size community.

Action Tips:

- Adopt best management practices, and make a quality product. Communities, solid waste districts, and tribal nations that process their own organics provide a valuable service that goes beyond waste disposal.
- It is important that public officials and operation staff/volunteers promote organics as a valuable feedstock or ingredient in the compost process, not a waste requiring disposal.
- Consider conducting a marketing assessment to define the potential markets in the area prior to establishing a processing program.
    - An assessment can be a simple listing of municipal agencies, schools, institutions, landscapers, and others who will be willing to purchase compost.
- Promotion of local market development and implementation of purchasing specifications that foster the use of compost can assist in ensuring markets for compost products, whether manufactured at community, municipal, regional, or private compost facilities.
- Build on existing operations. Some facilities in a region may have the capacity to handle additional feedstock. Even expanding an existing site to accept more materials is usually more cost effective than starting a new facility.
- See NERC's Compost Marketing Guide and Compost Marketing Plan Template.

Who's Doing It?

- St. George, a town in Knox County, Maine (population 2,591) accepts yard waste, grass clippings, leaves, manure, specified food scraps (no meat or dairy), and wet and waxed cardboard from residents. The organic material is composted on a 30' x 30' composting pad at the transfer station. The Town website promotes the compost operation, along with backyard composting as a way to reduce the town's overall disposal costs. The Town also sells compost bins, food collection buckets, and compostable bags at reduced rates; a compost pamphlet is available for free download from its website.
- Buxton, Maine (population 8,034) runs a licensed composting facility at the town transfer station. Organics (including yard trimmings, manure, and wood shavings) can be dropped off at no cost. The town website promotes the program as saving the town money by reducing tipping fees. Compost is available for Buxton residents at a cost of $5 for a bucket full (a small pick-up truck load); transfer station attendants load the compost with a front-end loader.

- Skowhegan is the county seat of Somerset County, Maine (population 8,589). The town's Solid Waste Management Facility handles solid waste, recyclables, construction demolition debris, and organics. Brush, grass clippings, twigs, leaves, farm manure, and food scraps are composted. Two certified compost operators manage the facility. An impervious pad with erosion and sedimentation controls catches runoff from the compost pile with wood chips, which then are recycled back into the compost pile. Some 800 yards of compost are generated each year. Compost is offered free to Skowhegan residents; the highway department uses the compost to offset public landscaping needs.
- Growing Power, Inc. is a non-profit organization and land trust with multiple farm and community compost sites, in both urban and rural settings, located around Wisconsin and Illinois. The organization composts food scraps, farm waste, brewery waste, and coffee grounds using vermicomposting bins, static pile, and windrow composting systems. Growing Power provides collection services to restaurants in Milwaukee, collecting more than 400,000 lbs. of food scraps per week, along with 48,000-64,000 lbs. of brewery waste from Lakefront Brewery every week.
- ECO City Farms is a nonprofit organization focusing on community food issues in Prince George's County and the greater Chesapeake watershed. Its community composting model is an "urban farm," with their core operation an urban farm in the town of Edmonston, Maryland (population 1,445). Compost Cab, a private food scrap collection service for the Washington DC Metropolitan Area, provides roughly 700 pounds of food scraps each week for ECO City's compost operation.

- Nantucket, an island community in Massachusetts (10,142 population), recycles and composts nearly 90% of its waste. Nantucket has mandated composting for more than a decade. Residents divide their waste into two streams: recycling and organic waste. They can haul it away themselves for free or pay for a pickup service. At the Nantucket Solid Waste Recycling and Composting Facility wood and yard debris are processed; an enclosed in-vessel composting system is used to compost food scraps, soiled paper, yard trimmings, and biosolids.
- The Shakopee Mdewakanton Sioux Community, a federally recognized Indian Tribe in Prior Lake, Minnesota, launched its Organics Recycling Facility in 2011. The facility, operating on a 47-acre site located on land held in federal trust, accepts all organic materials including, brush, wood waste, source separated organics, manure, straw, grass, leaves, food waste, and paper waste. The facility has earned the Compost Certification Seal of Testing Assurance from the US Composting Council. Materials are composted in windrows; the operation has 100,000 ton capacity. Customers include residential, commercial, industrial, and community entities. Its proximity to the Minneapolis-St. Paul metro area has proven to be a positive business investment for the Tribe which charges tip fees for disposal and produces a range of compost and compost blends for retail and wholesale.
- The Eastern Band of Cherokee Indians runs two successful, large-scale composting operations—one for food scraps and one for biosolids—at the Qualla Boundary in North Carolina (8,092 population). The tribe credits well-trained composting operators with saving them thousands of dollars in tipping fees annually. By selling compost to tribal members at affordable prices, community members are able to successfully garden. To reduce waste disposal costs, the Cherokee began composting biosolids from its wastewater treatment plant in 1995 and expanded its operations to collect food residuals in 1997. The tribe now composts approximately 72 tons of food waste and 96 dry tons of biosolids per month. The food waste, collected from seven local restaurants, including three within Harrah's Cherokee Casino, sells for $35 per ton, while the biosolids compost is sold for $15 per ton.

Excerpted from NERC's Organics Management and Composting Guide

Food Scrap Management

Athena Lee Bradley,

Northeast Recycling Council

www.NERC.org

What is NERC?

- Non-profit
- 10 Northeast states
- Mission: environmental sustainability through materials management
- www.nerc.org

or•gan•ics

noun

1. Of, relating to, or derived from living organisms: organic matter

2. Yard & landscape trimmings—leaves, grass clippings, tree & brush

3. Agricultural and land-clearing/forestry debris

4. Manures & biosolids

5. Food scraps & food processing residues

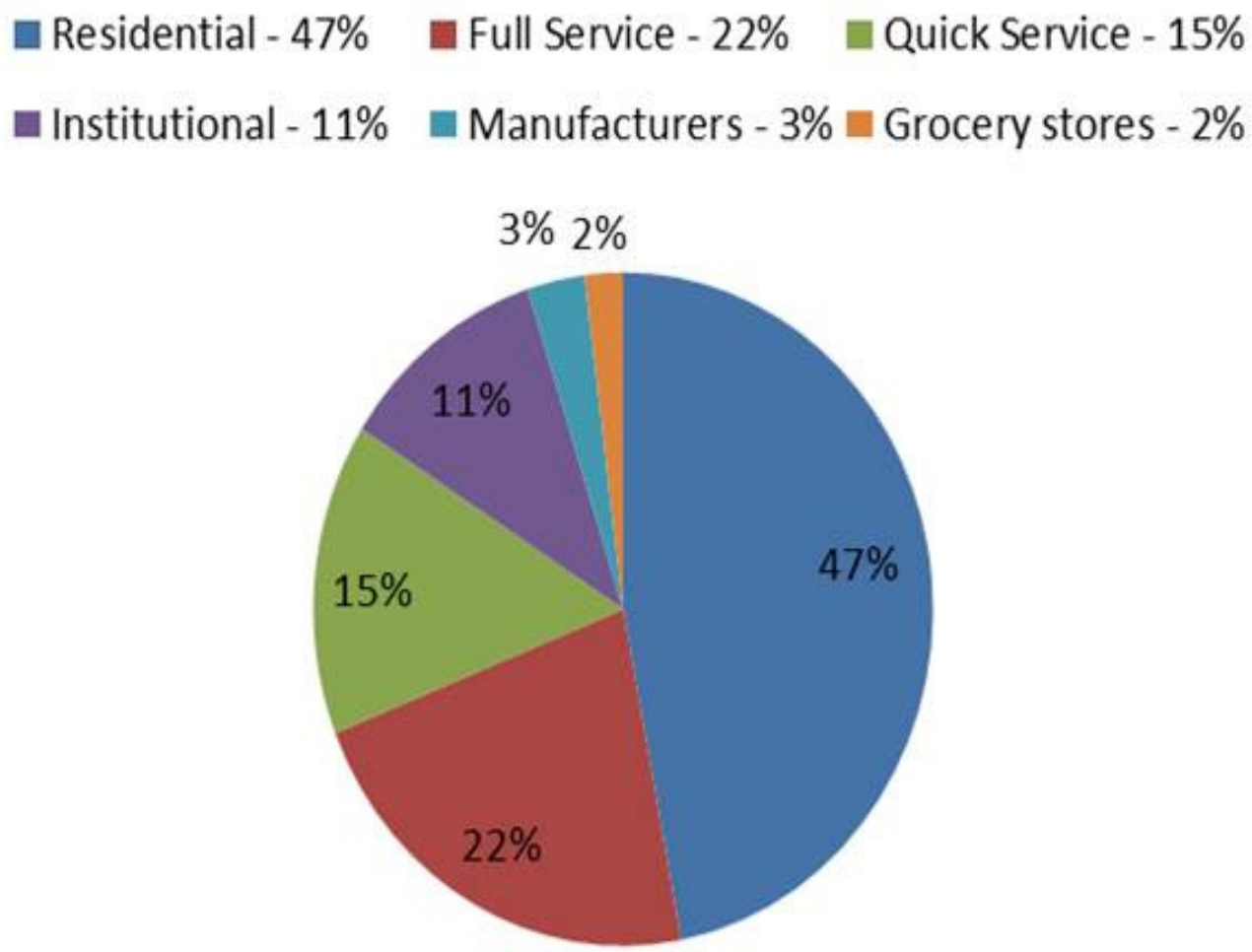
6. Non-recyclable/soiled paper—napkins, paper towels, pizza boxes & other paper products

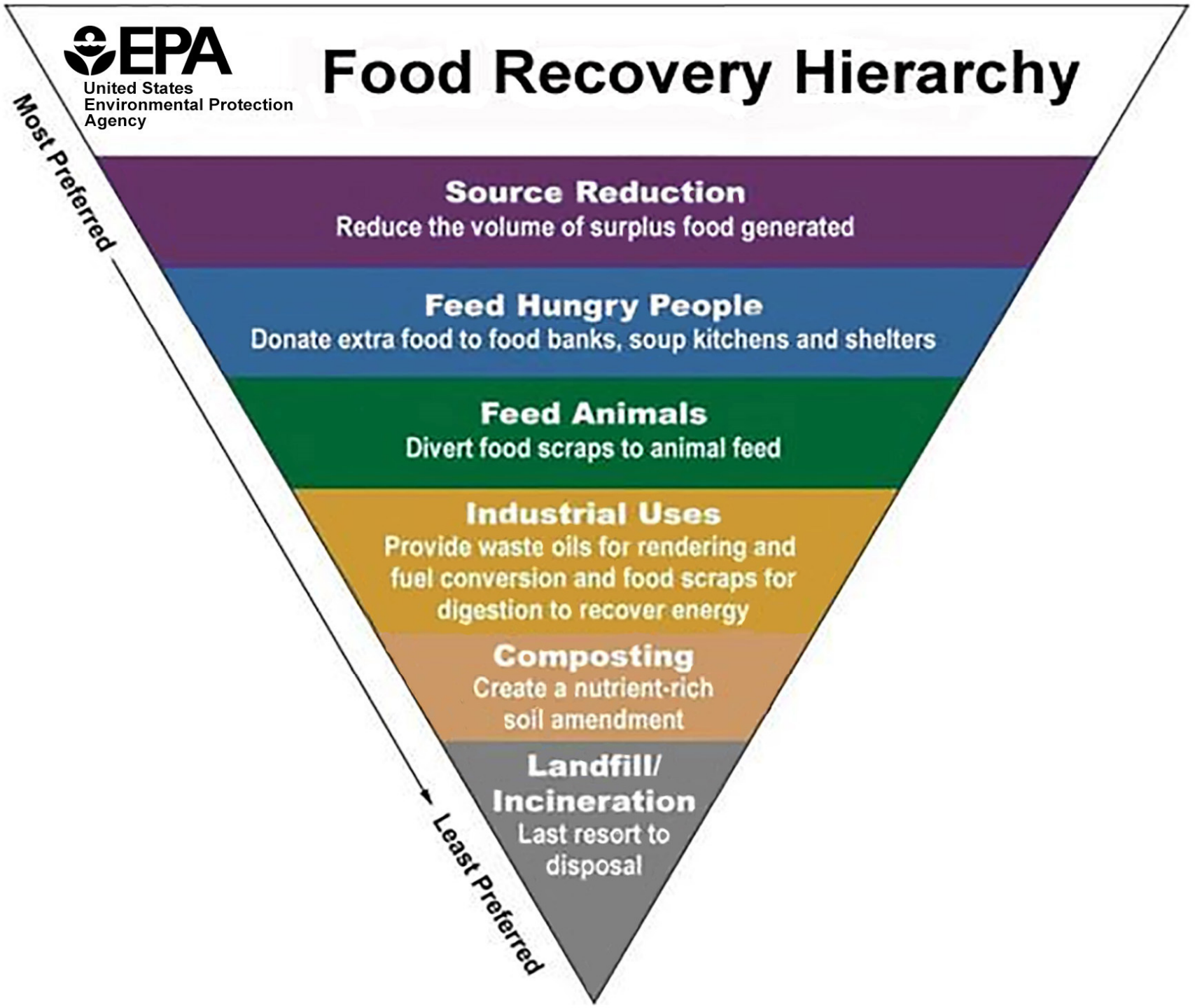
7. Items manufactured from organics—compostable bags, utensils, plates, cups and bowls made from corn and potato starch, bagasse, PLA, etc.

Percentage of Organics in MSW

- Largest component of municipal solid waste
  - *56%* of what we send to landfills & incinerators
- Yard trimmings are recycled at *57%*
- Less than 4% of food scraps recovered
  - *30-40%* of food is wasted in the U.S.
  - More than 20 pounds/person/month

Wasted Food


Residential - 47%
Full Service - 22%
Quick Service - 15%
Institutional - 11%
Manufacturers - 3%
Grocery stores - 2%
3%
2%
11%
47%
15%
22%


EPA
United States
Environmental Protection
Agency
Food Recovery Hierarchy
Most Preferred
Least Preferred
Source Reduction
Reduce the volume of surplus food generated
Feed Hungry People
Donate extra food to food banks, soup kitchens and shelters
Feed Animals
Divert food scraps to animal feed
Industrial Uses
Provide waste oils for rendering and fuel conversion and food scraps for digestion to recover energy
Composting
Create a nutrient-rich soil amendment
Landfill/ Incineration
Last resort to disposal

Benefits

- Reduced disposal needs & costs
- Reduces greenhouse gas emissions
- Food Recovery helps those in need
- Composting stimulates the local economy
  - Creates local jobs creation & business development
- Composting provides valuable soil amendment
  - Utilizing locally generated resources

Best Management Practices

Wasted Food Reduction

- Better food management practices are easy to implement

Tips on food waste reduction

- Monitor food expiration dates closely
- Improve food preparation procedures
- Adjust portion sizes

Food Expiration Labels

Know Your Food

- Eat the food in your fridge before shopping for more
- Make a menu
- Organize your fridge before shopping
- Make a shopping list
- Shop more frequently for fruits and vegetables
- Freeze items you know you won't be able to consume
- Use clear storage containers for leftovers & label
- Be creative with leftovers
- Learn how to preserve—freeze, can, or dry

Food Recovery

- Reduces food waste
- Helps those in need
- Regional food banks
  - Local charities or churches
- Mobile pantries
- Food to Animals

- 1 in 9 individuals in New Hampshire state are food insecure.
- The average American family throws out around a quarter of their food purchases
  - About $1,600 each year

Support your local food pantry!

Donate Right!

Who's Doing It?

- Food Recovery Network of NH
  - 189 Chapters
- NH Food Bank

Feed the Pigs – Schools and Businesses

- Barthold Farms
- St. Francis, Minnesota
- 23,000 tons of food scraps are fed to 5,000 hogs
- 400 businesses & schools

Recycle = Composting

- Backyard Composting
- Home Digester
- Vermicomposting
- Neighborhood Composting
- School & Special Events Composting
- Centralized Composting
- Anaerobic Digestion

What is Compost?

- Stable, soil/humus-like material
- Rich in organic matter & organisms
- Free of unpleasant odors
- Easy to handle
- Can be stored for long periods
- Valuable soil & potting media amendment

What is Compost, cont.?

- Value-added product
- It is not: mulch, fertilizer, manure, peat moss, topsoil
- It is not just one product!
- A manufacturing process

COMPOST

REDUCTIONS IN DISPOSAL NEEDS

REDUCED GREENHOUSE GAS EMISSIONS

HEALTHIER SOIL & PLANTS

BETTER NUTRIENT CYCLING

STIMULATES THE LOCAL ECONOMY

EROSION CONTROL & STORM WATER MANAGEMENT

Benefits of Compost on Soil

- **Improves Physical Properties:** Increases water retention; improves soil aeration and structural stability; resistance to water and wind erosion; root penetration; soil temperature stabilization.
- **Enhances Chemical Properties:** Increases macro- and micronutrient content; availability of beneficial minerals; pH stability; converts nutrients to a more stable form, reducing fertilizer requirements.
- **Improves Biological Properties:** Increases the activity of beneficial micro-organisms; promotes root development; can increase agricultural crop yields; suppresses certain plant diseases; acts as biofilter, bonding heavy metals.

Backyard Composting

Promoting Home Composting of Food Scraps

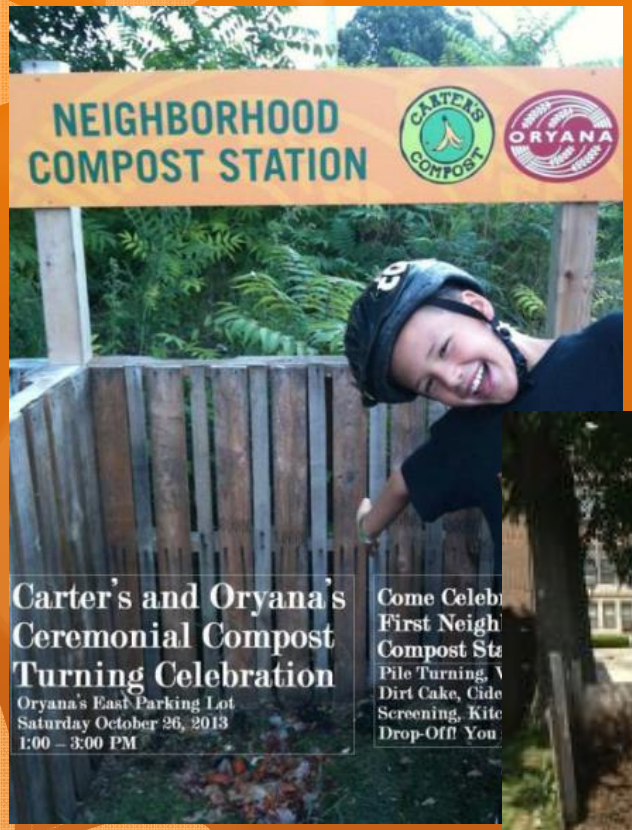
- Provide tips on how to compost food scraps
  - Adequate carbon (leaves, soiled paper, straw, etc.)
  - Always cover food scraps with carbon & soil
  - Cover with lime to deter fruit flies & vermin
  - Line bottoms of compost bins with thin wire mesh
- Promote and sell compost digesters, such as the Green Cone™

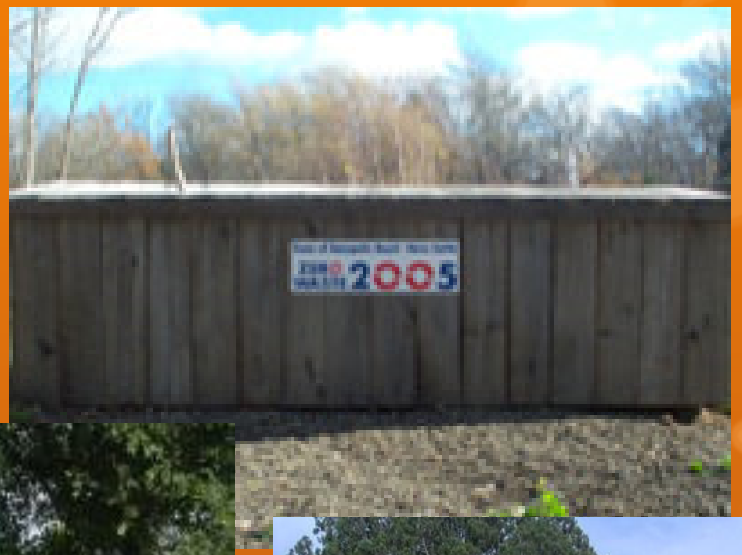
Home Digester

Community Composting

- Community gardens
- Low cost option for any community
- Benefits the elderly & multi-family residents
- Households share the experience of composting & the benefits

Community/Neighborhood





Who's Doing It?

Central Vermont Solid Waste Management District

- Promotes onsite management of home generated organics
  - Educational outreach
  - Sales of compost bins & the Green Cone digester

Who's Doing It?

Annapolis Royal, Nova Scotia

- Zero waste goal
- Biweekly curbside collection for recyclables & trash
- Promotes onsite management of all household
  - Home composting
  - Green Cones for food scraps & grease
  - Neighborhood Composters –large wooden composters
    - Built & maintained by the town for residents

Food Scrap Collection

From What Sources?

← Households

Supermarkets→

← Institutions

Restaurants →

Commercial Collection

Commercial Containers

In-Vessel
High Technology,
Moderate-High Initial Cost

Commercial Food Scraps Load

Bob Spenser, WSWMD

BW Organics Rotary Drum For Food Scraps
Mass Natural Fertilizer, Westminster, MA

Bob Spenser, WSWMD

Beyond Yard Waste: Residential Food Scrap Composting

Residential Organics Collection

- Options
  - Drop-off (transfer stations, recycling centers)
  - Door-to-door service (“curbside”)
  - Modified curbside
  - Standalone options or in combination
- Arrange for processing— mulching/composting
  - Municipal, farm-based, or commercial operations
  - Prior to establishing collection system

Starting a yard trimmings composting program & then adding food scraps allows for more extensive diversion with relatively minimal additional costs.

Drop-off System

- Works effectively in areas where residents already deliver their household discards to landfills or transfer stations
- Lower community participation when compared with curbside collection systems
- If properly incentivized & promoted, can achieve relatively high diversion

Drop-off System, cont.

- Staffed site is essential
  - Monitor materials & reduce contamination
  - Controlled access
  - Answer resident questions about acceptable materials
- Placement of collection containers
  - Transfer stations
  - Public works yards
  - Landfill or recycling center
  - Other location(s) in a community (e.g., retail store)

Drop-off System, cont.

- Store & transfer to off-site organics processing site
- Collect food scraps for onsite processing
- Containers
  - 30-40 cubic yard roll-off dumpsters—mixed yard waste/food scraps
  - Dumpsters or carts—food scraps

Private contractors

- Provide rental containers
- Transportation to a processing site/contract processing onsite

Municipal/Public

- Existing municipal vehicles & equipment
- Existing containers; used containers

Drop-Off Food Scrap Collection

- Can supplement residential curbside collection &/or allow multi-family residents, schools, & small business generators to participate
- Option as a food scrap collection pilot
- Issues to address if accepting food scraps:
  - Keeping bears & other critters out
  - Bins should remain locked & secure at night & when unattended
  - Completely cover scraps with a thin layer of sawdust

Action Tips

- Simple, concisely worded fliers
  - Distributed to residents at start of the collection program; periodically
- Signage at the point of collection
- Website & social media

Community Composting NYC

CR: David Hurd, GrowNYC

Transfer Station Drop-off

Compostables

COMPOST

Bear-Resistant Containers

FOOD & PAPER
COMPOSTING
in the designated dumpster
Yes - DO Compost:
All food waste
• Meat, fish, bones, dairy, eggs, eggshells
• Fruit, vegetables
• Bread, rice, pasta
• Tea bags, coffee grounds & paper filters
No - DO NOT Compost:
• Plastic bags, wrappers, plastic wrap
• Liquids
• Tissues
• Plastic utensils
• Styrofoam or plastic cups or plates
• Pet waste or bedding
• Trash
• Plastic, metal, glass

amend ORGANICS
Sort your Compostables to
yes:
nope:
paper cups, paper plates, compostable cutlery, paper tissues & towels, paper take out & pizza boxes, paper egg cartons
styrofoam & plastic cups, plastic plates, plastic cutlery, straws, plastic wrappers, plastic egg cartons...
tea bags, coffee grounds & filters
meat, seafood, bones & fat
recyclable paper & recyclable food boxes, milk cartons, juice boxes
all dairy & egg shells
pizza, pasta, baked goods
plastic bags & packaging
all plants, flowers and all fruit & veggie scraps
silverware, glass, metal
if in doubt about any items, ask us!
info@amendorganics.com

Turning Food Waste into Soil

COMPOST GUIDELINES

1. Keep compost and trash separate! This is critical.
2. Put all items for composting in the container marked COMPOST.
3. Keep the compost container lid closed when not in use.
4. On compost collection day, make sure that all compost totes that are more than half full are at the designated pickup area.

YES
COMPOST THESE:

Meat, bones, fish and seafood
Seafood shells
Fruits and vegetables
Eggs, eggshells, paper egg cartons
Milk, cheese, other dairy
Dressings, condiments, sauces
Soups
Flour, bread, all pasta and pastries
Coffee grounds and filters
Nuts, nut shells
Spices
Oils, fats

NO
PUT THESE INTO THE TRASH:

Paper products, including:
- ✔ sugar and flour bags
- ✔ waxed milk and juice containers
- ✔ soiled cardboard
- ✔ sugar and sweetener packets

Plastics, including:
- ✔ utensils
- ✔ straws
- ✔ sticks
- ✔ bags
- ✔ twist-ties
- ✔ plastic wrap
- ✔ packaging
- ✔ PLU stickers

Floral products, including:
- ✔ plants
- ✔ cut flowers

Cloth, including:
- ✔ handi-wipes
- ✔ cloth rags

Rubber bands

What's a PLU sticker?

PLU stickers are the labels often found on fresh fruits and vegetables that identify the cost at the check-out counter. These stickers are plastic, so please keep them out of the compost bin!

Northeast Kingdom Waste Management District
224 Church Street
P.O. Box 1075, Lyndonville, Vermont 05851
(802) 626-3532 or (800) 734-4602
www.nekwmd.org

Cart Label

ORGANICS ONLY
Yard Trimmings
Leaves
Food Scraps
Food-Soiled Paper
Shredded Paper
NOT ACCEPTABLE

Who's Doing it?

Franklin County Solid Waste District, Massachusetts

- Manages municipal organics drop-off programs at 4 transfer stations
- Food scraps & soiled paper
- Technical assistance for schools & special events

Who's Doing it?

Chittenden Solid Waste District

- Carts at its 7 drop-off centers
- No charge to drop off food scraps
- Residents provided with a free 4-gallon bucket with a lid to use in their kitchen

Who's Doing it?

Northeast Kingdom, Vermont

- 12 drop-off locations
  - 23 schools
- NEKWMD provides collection
- Transported to local farm for processing

Residential Curbside

Curbside Organics Collection

- Organic materials placed at curb separate from other household waste & recyclables
  - Collected the same day as trash, alternate weeks, or special days
  - Weekly pick-up is most effective
- High participation rate due to convenience
- Low population density in rural and small town areas makes hauling more costly & inefficient

Collection Options

- Municipal collection
- Contracted to hauler or processor
  - Know where and/or how the material is to be processed
- Modified curbside – “neighborhood” collections
  - Bins placed in designated neighborhood sites, roadway cut-outs, etc.
- Program model impacts design & costs
  - Container & collection vehicle requirements
  - Route allocation & frequency

Opportunities and Action

- Program goals
  - Materials
  - Diversion rate goal
  - Anticipated participation rates
- Conduct a needs assessment
  - Existing equipment available & equipment needed
- Municipal or contracted services?

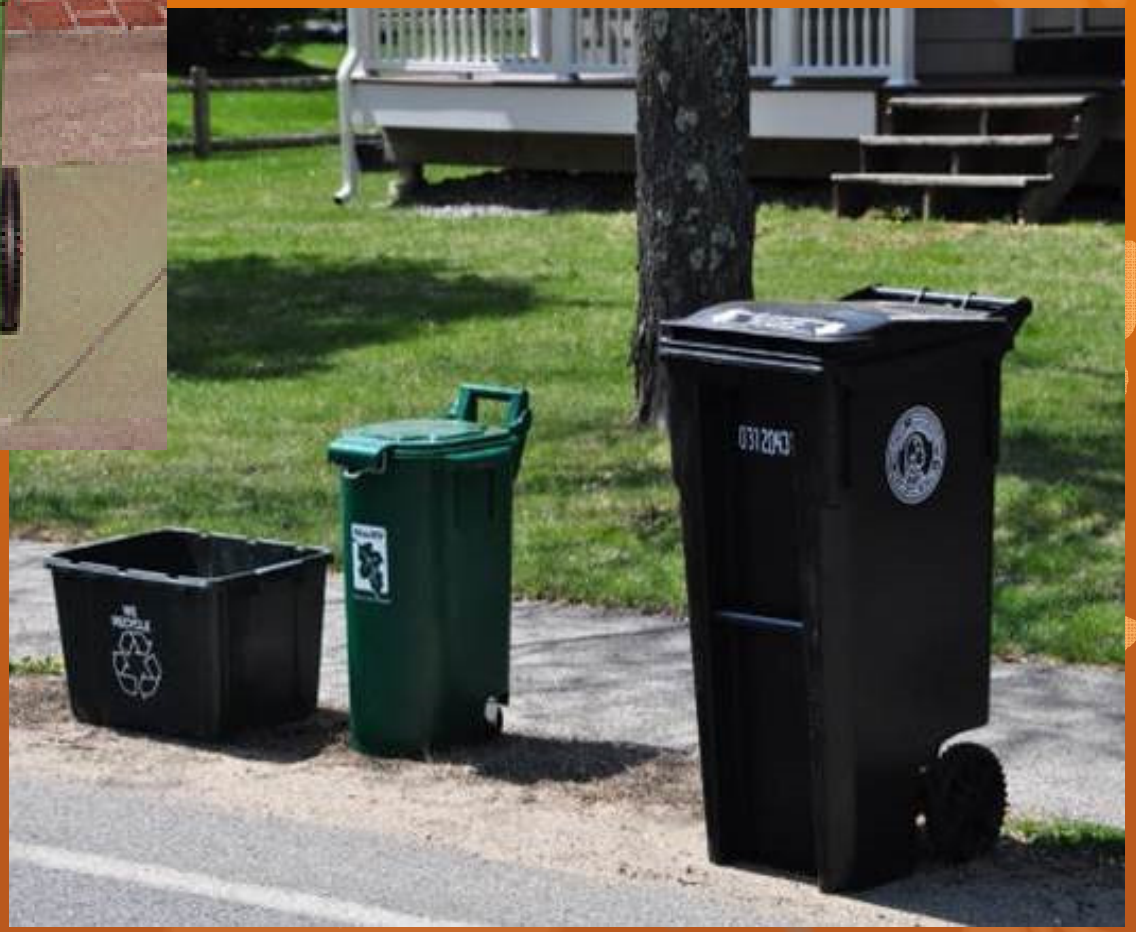
Opportunities & Action, cont.

- Designing of collection routes
  - Meet the needs of residents
  - Address the seasonal nature of leaf & yard trimmings generation (if co-collected)
  - Conserve costs through route efficiencies
  - Pilot on route basis
  - Consider dual collection vehicles

Container Choice

- Impacts staffing & equipment requirements
- Costs
- Resident participation rates
- Roll-out plan

Curbside Collection Options



Split-Body Collection

Who's Doing it?

Mr. Fox, Portsmouth, NH

- Residential curbside collection
  - Schools & businesses
- 10 communities
- $32/month for weekly &
  $16/month for bi-weekly

Who's Doing it?

Brattleboro, Vermont

- Curbside food scrap collection
  - Weekly, same day
- Split-body truck–Triple T Trucking
- Pay as You Throw garbage
- Trash $100/ton; food scraps - $45/ton
- Windham Solid Waste Management District's composting facility
- Averages 10 to 12 lbs/household/week

Who's Doing it?

Bridgewater Connecticut

- Offered to all 1,100 households in the town
  - Pilot program in April 2014 - about 140 households have signed up
  - Food scraps & soiled paper; currently no cost to residents
  - Kitchen container, roll of compostable bags, curbside cart, & program brochure
- Average of 9.65 lbs./household/week, under one percent contamination
- Collected by All American Waste; composted at New Milford Farm
  - Tip fees - $20 to $30/ton less than disposal
- Trash & recycling is subscription based
  - All American Waste is developing operational efficiencies for the new service

Who's Doing it?

Hamilton & Wenham, Massachusetts

- Citizen-led initiative
- Hiltz Disposal collects organics & recyclables with a split body truck
- Weekly collection
- Bricks End Farm processes the organics
- Hamilton switched trash collection to every other week

Who's Doing it?

Cambridge, Massachusetts

- Pilot curbside collection
- Weekly pickup to 5600 households
- No charge

Who's Doing it?

Princeton, New Jersey

- Piloted food scrap collection in 2010
- Now offered to all 9,500 households
- Subscriptions are $65/year for weekly collection of all food scraps, soiled paper & yard trimmings
- Participants receive a 32-gallon cart, kitchen collector, & a supply of compostable liners

Who's Doing it?

Huron, Ohio

- Food Scraps are placed in an "organic container"
  - Paper bag, newspaper, cardboard boxes
  - Placed in the yard waste cart
- Residents charged $50/quarter for waste, recycling, & compost
- Contracted collection service
- Hauled to Barnes Nursery & Compost Facility

Who's Doing it?

Wayzata, Minnesota

- Food scraps & soiled paper are placed into a Blue Bag Organics compostable bag
- Blue Bag goes inside the regular garbage cart
- Transported to a transfer station where the Blue Bag is removed for transportation to a compost facility

Who's Doing it

Earthgirl Composting

- Curbside collection of food scraps & soiled paper for households, small businesses, & special events in two counties in Vermont
- Participants provided a 5-gallon bucket
- Organics are delivered to Grow Compost or Green Mountain Compost
- Participants are charged based on collection frequency

Food Scrap/Organics Processing

Processing Options

- Small vs. Regional
- Municipal, farm, private operations
- Range of processing technologies—from very simple to complex technology systems
- Each system has its advantages
- Can be combined to better serve communities & for cost efficiencies

On-Farm Composting

- Provides opportunity to divert organics
  - Without public investment in space, equipment, & staffing
  - Farm operations may have more flexibility in permitting requirements
- Helps farms diversify their operation
  - Manufacturing a valued added product
  - Soil amendment for farm fields
  - Sold to bring in additional revenues

Opportunities and Action

- Outreach to area farms to determine interest
- Hauling – municipal? Farm? Private sector?
- Work with state regulators & the farm to ensure compliance with regulations & permits
- Provide household/business education
- Foster market development by purchasing compost for town use & promoting the product to local businesses & residents

Who's Doing it?

Always Something Farm

- Croydon, NH
- Leaf, grass clippings, yard waste manure, & food scraps (no meat or dairy) accepted at no cost

Grow Compost of Vermont

- Started as a small farm operation in Moretown, Vermont
- Farm waste & food scraps from restaurants, schools, households

Who's Doing It?

Bear Path Farm

- Whately, Massachusetts
- Food scraps from town transfer station to mix with local horse bedding, leaves, & produce waste
- Town employee hauls the food scraps to the compost operation

Holiday Brook Farm

- Dalton, Massachusetts
- Leaves, brush, horse manure, bedding, & produce scraps &wet cardboard supermarkets

Private Sector Composting

- Partnerships to promote resident & commercial customers
  - Reduced tipping fees
  - Flexibility in accepting loads (e.g., resident drop-off)
- Economies of scale—multiple community, county or solid waste district jurisdictions—more economically appealing for larger scale private composting operations
- May profit from locating in rural, agricultural areas & servicing more populated area

Private Sector Cont.

- Publicly owned & operated facilities
  - Typically land, equipment, & other necessary infrastructure would be available at such a location
    - Landfill, MRF, nurseries
  - Private haulers to provide collection services

Opportunities and Action

- Explore potential private-sector businesses, landscapers, garden centers, etc. to establish composting operations
- Publically owned & privately managed operations present a model
  - Public land can be used to establish a compost facility that is operated by a private company
- Promote compost product sales

Opportunities and Action, cont.

- Provide training/outreach to businesses
- Provide outreach to households

Who's Doing It?

Clear View Composting, Orange, Massachusetts

- Food scraps from town transfer stations, schools, & events
- Built special "bear proof" enclosure for collection carts

Sonoma Compost

- Operates the Organic Recycling Program on behalf of the Sonoma County Waste Management Agency
- Yard trimmings & vegetative food discards collected curbside from residents of Sebastopol
- Food scraps from restaurants in Sonoma

Regional Organics Management

- Developing concept in the management of trash and recyclables for rural, low population density areas or geographically isolated communities
- Materials are collected & consolidated to reduce transportation costs & promote waste diversion
- Regional operation of central composting facilities would allow for cost efficiencies for capital investment of land & equipment
- Private-public partnership

Opportunities and Action

New Mexico's Rural Recycling initiative

- "Hub and spoke" model for rural collection and processing infrastructure
- Regional recycling processing centers within larger communities known as "hubs."
- Smaller communities or "spokes" are encouraged to provide collection containers for recyclables & arrange for transportation of the collected materials to these hubs

- Presents a replicable model for regional organics processing facilities.
  - "Spokes," rural and small towns act as the collection point for organics
  - Organic materials are transported to a regional facility
  - Cost efficiencies in processing & allow for development of more marketable compost

Community Composting

CR: David Hurd,
GrowNYC

Containment – In-Building

Bruce Fulford

Windrows

Cedar Grove Composting
Seattle, WA region
Gore Cover systems
Aerated static piles

Bruce Fulford

Quasar Food Scrap AD Facility Collinwood, Ohio

Bob Spenser, WSWMD

Green Mountain Technologies, Inc. (GMT)
CONTAINERIZED COMPOST SYSTEM™ (CCS)

Bio-Solids Composting in Wilmington, VT

Bob Spenser, WSWMD

Centralized Composting Operation BMPs

Successful centralized composting requires

- A solid plan of action
- Available land
- Appropriate equipment
- Proper training and management
- Community support

Funding Options

- **Tip Fees**
  - Residents
  - Landscapers & other small commercial generators
  - Keep fees lower than solid waste tip fees
- **Sales of compost product**
  - Mulch – grind brush, wood, pallets
  - Compost – quality product can be sold to offset costs

Cost Control

- Sharing equipment & labor
- Using available public land
- Used equipment
- Calculating avoided disposal costs
- Reduced soil & fertilizer purchase costs through use of compost

Planning a Compost Operation

- Estimating the volume expected
- Conducting a needs assessment to determine available space, staffing, & equipment
  - And, additional land/operating space, staffing, & equipment required
- Capital & operating requirements necessary for start-up, as well as ongoing expenses

Planning, cont.

- Know your regulations/permit requirements
  - Consult state agencies
- Feasibility of the operation
- Public involvement

Siting Specifics

- Schematic layout
  - Site
  - Materials flow
  - Leachate & storm water management
  - Equipment & personnel list
    - Qualifications and/or training

Siting Specifics, cont.

- Composting method
- Safety & fire emergency plan
- Monitoring techniques & record keeping
- Provisions for controlling odors
- Contingency plan

Financing

- Capital & operating requirements will vary widely
- Needs for smaller scale operations will be minimal, if existing land & equipment are available for use
  - Site preparation & drainage requirements can potentially be conducted in house, depending on the requirements
  - If equipment is needed & more extensive site preparation required, financing professionals should be consulted
- Regional facilities will need to extensively plan capital investment requirements & determine effective financing options

Composting Technology

- Processing technologies
  - Minimum-level
  - Low-level
  - Intermediate-level
  - High-level
- Site requirements, labor & equipment, & costs vary
- Processing time—*function of*:
  - Feedstocks
  - Technology applied
  - Labor: mixing, turning, & monitoring the process

Composting

- Controlled, aerobic (requiring oxygen) biological process
- Results in the decomposition of organic materials
- Occurs naturally in nature
- Microorganisms (bacteria, fungi, other organisms)
  - Digest organic residues for food and energy
  - Speeds up the decomposition process
- Primary end-products—carbon dioxide, water, & compost

Compost Process

- Combining organic materials in proper ratios
- Containers/vessels, piles, or rows
- Turn or aerate to provide adequate air flow
- Sufficient moisture to accelerate decomposition
- Cure “finished” material maturity

Five Primary Components

Feedstock and nutrient balance (Carbon:Nitrogen Ratio)

- "Green" materials (Nitrogen)—grass clippings, food scraps, manure
- "Brown" materials (Carbon)—paper, dry leaves, wood shavings, brush

Particle size

- Smaller particles
  - More surface area upon which the microorganisms can feed
- Helps to speed up the decomposition process
- Improves porosity (air flow)
- A more homogeneous compost mixture
- Mowing, grinding, chipping, or shredding

Five Primary Components, cont.

Oxygen flow

- "Aerobic"—requiring air to be active
  - Turning or placing materials on aeration system
  - "Bulking agents"—wood chips, shredded newspaper

Temperature

- Mesophilic—active at lower temperatures
- Thermophilic—above 120°F (131°F)
  - Necessary for more rapid composting
  - Ensure that pathogens & weed seeds are destroyed

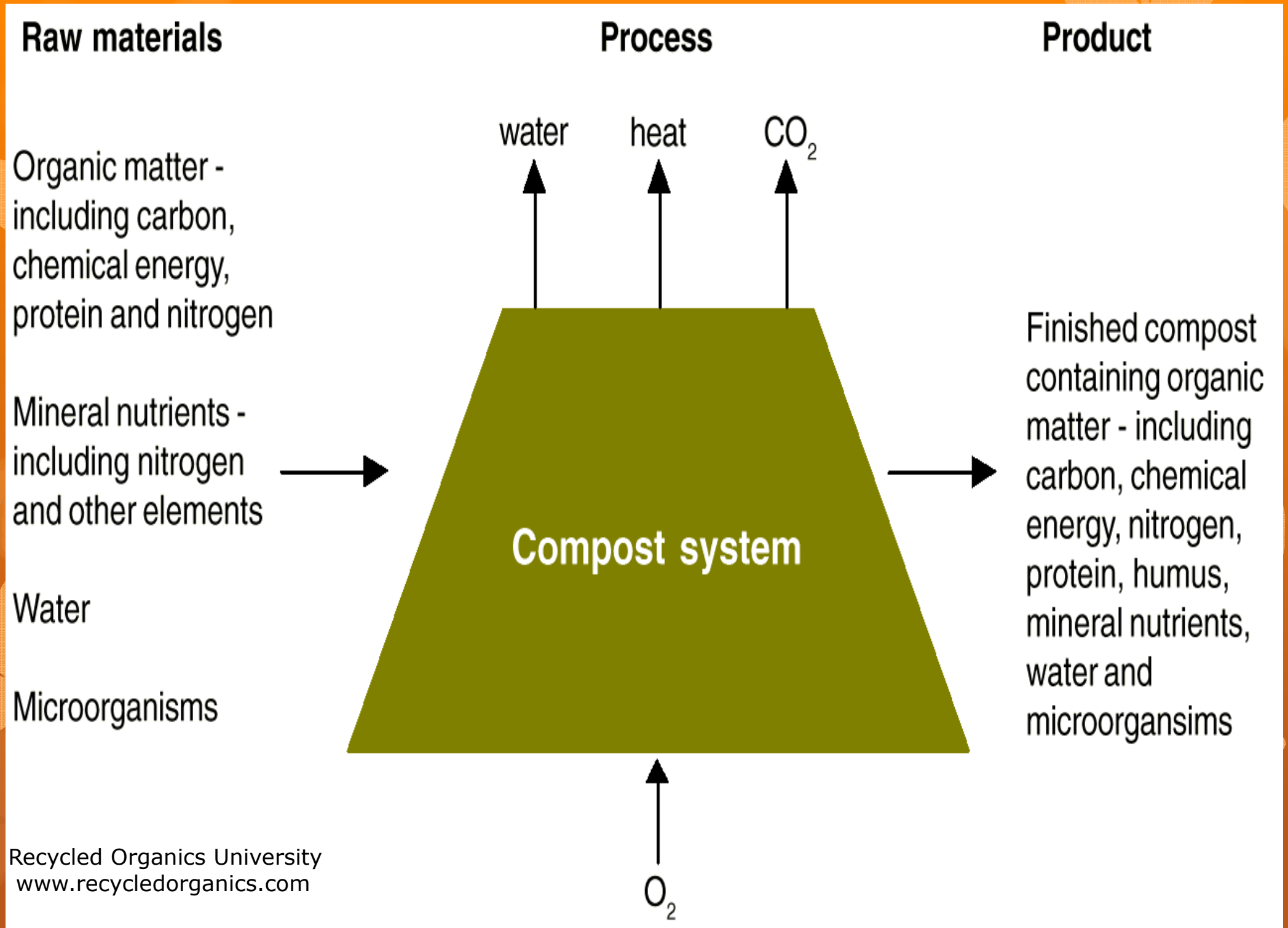
Five Primary Components, cont.

Moisture content

- Required to keep the microorganisms in compost alive & active
- Helps to transport substances within the compost pile
- Makes nutrients accessible to the microbes
- Should feel like a damp sponge…moist, but not dripping when squeezed

Best Management Practices (BMPs)

- Produce compost in shortest time possible with:
  - Minimum odors
  - Minimum environmental impacts
  - Minimum process-related problems
- Efficient Materials Movement
  - Nothing should move more than twice in its same physical condition
  - Move in as linear a fashion as site constraints allow
  - Timing production


Raw materials
Process
Product
Organic matter - including carbon, chemical energy, protein and nitrogen
Mineral nutrients - including nitrogen and other elements
Water
Microorganisms
water
heat
CO_2
Compost system
O_2
Finished compost containing organic matter - including carbon, chemical energy, nitrogen, protein, humus, mineral nutrients, water and microorgansims

Elements of Composting

- Aeration – Oxygen concentrations - 10-14+%.
- Carbon to Nitrogen (C:N) Ratio – 20:1-60:1
  - Preferred 30:1-50:1
- Moisture—40 to 65 percent
  - Preferred 50 – 60%
  - Like a damp sponge

Elements of Composting, cont.

- Optimum pH range - 5.5 to 8
  - Preferred 6.5 – 8.0
- Temperature – 120° - 160°F.
  - *Process to Further Reduce Pathogens (PFRP)*
  - 131°F for 3-15 days (*f* of system)

Elements of Composting, cont.

- Bulk density < 1000 lbs. per cubic yard
- Particle size (diameter in mm) – 3-13
- Porosity, structure, texture - particle size, shape & consistency influence aeration
  - Adjust with bulking agents – raw materials
  - Compost recipe
  - Grinding or mixing

The Recipe

- What feedstock(s) do you have available?
- Characteristics?
  - Nutrient content
  - C:N ratio
  - Moisture content
  - Bulk density – how easy it is to mix/handle materials
  - pH
  - Potential for odors – grass clippings, food scraps

The Recipe, cont.

- Carbon – Essential for mixing with food scraps
  - Leaves, ground brush
- Bulking agents – wood shavings, chips
  - Provide porosity
  - Pile stabilization
  - Aid air flow

The Recipe, cont.

- Adding food scraps
  - No more than 20%
  - Balance C:N ratio, moisture, bulk density, etc.
- Observation, feel of compost, temperature, trial & error
- Calculations

Sample Carbon and Nitrogen Ratios of Various Organics

Carbon Sources	Carbon: Nitrogen Ratio
Yard wastes	50 - 90:1
Straw/hay	50 - 80:1
Wood chips/sawdust	250 - 500:1
Nitrogen Sources	
Vegetable scraps	10 – 30:1
Fruit scraps	10 – 30:1
Grass & garden gleanings	10 – 20:1
Chicken manure	10 – 25:1
Cow manure	20 – 30:1
Horse manure	25 – 30:1

Adapted from Robert Rynk, "*On-Farm Composting Handbook*," Natural Resource, Agriculture, and Engineering Service, 1992.

Getting the Right Mix

- Compost Mix Calculator: Solves for the total carbon to nitrogen ratio of up 4 materials (or less) in a mix
  - http://www.klickitatcounty.org/solidwaste/fileshtml/organics/compostCalcAbout.htm
- Green Mountain Technologies
  - http://compostingtechnology.com/resources/compost-calculator/
  - Highfields Recipe & Pad Size Calculation Worksheets
  - www.highfieldscomposting.org

Healthy biological activity is essential to successful composting—setting up the right environment and conditions is fundamental to the process.

Process Management

- Know the compost process
- Essential equipment: loader, screen, thermometer
- Cover

Windrows

- Front loader, backhoe, or manure spreader
  - Mix materials, form & turn windrows
- Land for the operation
- Minimum staffing

Windrows

- Access to water
- Monitor temperatures
  - PFRP
- Cover – tarp, GORE™, chips

Windrows

- Typically 10’ – 16’ wide by 3’ – 8’ high
- Keep windrow piles as straight and uniform as possible
- Blend materials without compacting them
- Check & adjust moisture level
  - Add water or dry bulking agent
- Move materials from surface to center of windrow and vice versa
  - When turning with a frontend loader, lift material, let it cascade down to maximize aeration & porosity
  - Re-shape the windrow for consistent dimensions & smooth sides
- If building more than one windrow, leave sufficient space between them for drainage & to allow for turning

Windrows, cont.

- Monitor temperatures daily during the active compost phases & after turning
  - Take measurements at various depths (e.g., at one foot and three feet into the pile) & at least every 75 feet along the windrow
  - Always turn and aerate a pile or windrow if temperatures reach above 160°F.
- Once the active composting phase for pathogen reduction is met, materials can be turned weekly or as needed until ready for curing
- Curing time can range from 30 to 60 days

Windrows, cont.

- Moisture management is important
  - If is too dry, add water when turning & rebuilding the windrow
  - Start by watering the outside of the pile before mixing materials into the center
  - Shape the windrow to increase rain infiltration
- If the windrow is too wet
  - Turn it to release excess water vapor or mix more dry carbon material into the pile
  - Windrows typically reduce 60% in volume during active composting
- Two windrows can then be combined into one to free up space
- Track when windrows were formed

Windrow Composting
Low-to-Intermediate Technology, Costs, & Labor

Town of Skowhegan Leaf, Yard, Food Scraps

Mark King, ME DEP

Screening Compost

Front Loader or Windrow Turner

County Operation

Aerated Static Pile

- Blower system & piping
  - Build compost pile on top of a “forced air” system
- Perforated pipe (10-inch diameter) connected to a blower system
  - System may be a positive (pressure) aeration or negative (suction) aeration
- Materials must be well mixed before piling to create a homogeneous mixture with good porosity
- Cover with a layer of peat, wood chips, or finished compost (insulation & odor control)

ASP, cont.

- Speeds up the composting process by ensuring proper air flow
- Initial moderate capital costs & operating costs
  - Purchase & installation of pipes and blowers
  - Utilities & ongoing maintenance
  - Less daily labor
  - Using portable aeration equipment, an ASP System can be installed for $15,000 or less for a 10,000 ton per year compost facility.

ASP, cont.

- After two-ten weeks of composting material can be turned into another aerated system or windrowed to finish the compost process
  - Up to 6 months to produce compost ready for curing
- Excellent, scalable process for managing food scraps

ASP, cont.

- Homogenous “haystack” type pile 4’ – 6’ high
  - No more than 6’ high and 12’ wide to ensure sufficient air movement
- Start with a higher initial moisture content
- Include a bulking agent or carbon source with higher percent of larger particles to promote greater aeration

ASP, cont.

- Use a porous, well-aged capping layer
  - Wood chips or finished compost
- Sufficient space should be available for additional piles, depending on the volume of organics collected
- Place a layer of woodchips over aeration pipes to help protect the pipes and assist in air flow through the pile

Aerated Static Windrow Moderate Technology, Costs & Labor

Aerated Bins or Sheds

O2Compost

Onondaga County Resource Recovery Agency (OCRRA) Aerated Static Pile Operation

Process to Further Pathogen Reduction

- **Turned Windrow**: 15 consecutive days with temperatures ≥131°F (55°C) with 5 turnings
- **Aerated Static Pile**: 3 days with temperatures ≥131°F (insulated pile)
- **In-vessel**: 3 days with temperatures ≥131°F

Siting Parameters

- Check with state and local regulatory agencies prior to siting
- "Set-backs" or distances from waterways and structures may vary depending on the materials and volume to be composted
- The following provides general guidance for siting compost piles or windrows:
  - From 100' – 500' from wells and potable water sources
  - Adequate distance from wetlands, surface water bodies (streams, ponds), and flood plains; recommended at 200'
  - Minimally 200' away from residences and 50' from property lines
  - A low water table to reduce flooding risk on the site
  - A high soil percolation rate, but not excessively permeable soils in order to avoid standing water.
  - Gently sloped surface (1-3% grade)

The amount of land required for the composting site depends on the volume and type of material accepted, the composting system, and the amount of time required for the process to complete.

- Typically 2 - 20 acres is adequate for most small communities.

Site Plan

- Material receiving area
- Mixing area
- Active composting area
- Curing area

Mixing Area

- Mixing & chipping/shredding can be done in or near the material receiving area
- Storage of carbon & bulking materials nearby
- Cover &mix food scraps immediately upon dumping
  - Lay down a bed of bulking materials, such as ground yard trimmings, to absorb liquid associated with food residuals

Mixing Area

BioCycle

COMPOST RECEIVING AREA

Bob Spenser,
WCSWMD

Site

- Year-round accessibility
- Depending on operation, the site will need to be accessible for large vehicles
  - Space for future expansion
- Access to a water source is necessary

Site, cont.

- Gate & a perimeter fence (or other barrier) is recommended to control access to the site and prevent illegal dumping
- Signage to control incoming traffic & public access to areas where equipment will be operating
- Area to store finished compost
  - Accessible to the public if materials are to be sold or given away

Site, cont.

- Plan site so that customers see the end product…not the feedstock unloading & mixing area
- Set up the site so that the oldest finished product can be moved first
- Material movement is in as linear a fashion as site constraints allow
  - Nothing should move more than twice in its same physical condition

Site, cont.

- A neat site appearance is important
  - Don’t let weeds grow on finished product
  - Deal effectively with leachate/ponding
  - Consider the view from the road
- A “buffer zone” will alleviate any nuisance issues, including noise, blowing material, dust, potential traffic concerns, & odor
  - Use shrubbery or fencing to block view

Drainage/Buffer

- A grassy or vegetated filter/buffer serves as a relatively low cost drainage field
  - Crushed glass or other filtration material, covered with grass or vegetation provides a cost effective system
- Rain gardens & marsh areas work for smaller sites
- Check with state and local agencies to determine if this drainage system is adequate—a more extensive drainage system may be required

Drainage/Buffer, cont.

- Site grading to divert surface runoff from the up-slope side of piles will reduce leachate issues and help to control soil erosion around the site
- Trenching can be used to capture or divert leachate
- Install piping around larger piles or windrows or where seepage becomes an issue
  - Capture wastewater and divert it to the filer area, drainage pond, or holding tank
- Reusing the water to spray back onto composting may be a cost effective

Compost Pad

- Firm &stable surface to support heavy equipment under varying weather conditions
  - Compacted soil is adequate
  - Native soil with moderate permeability (not excessively or poorly drained) is best
- Six inches of compacted and graded sand or gravel should be installed if soil conditions are not sufficient for drainage
  - Small diameter dark gravel is recommended
  - Gravel can become mixed in with the composting materials
- Hard packed or cement mixing area is recommended
  - Limit mud problems
  - Good foundation for equipment

Controlling Odors

BioCycle

Biofiltration

Bruce Fulford

Staffing

- For most small community operations one or two employees will be sufficient
  - If operation is co-located with a transfer station or other facility, staff at smaller compost operations can be shared
  - One person should have the role of compost operator or manager
  - All employees should understand & know all aspects of the operation and how to deal effectively with issues that arise
- Duties:
  - Monitoring materials as they come into the operation
  - Ensuring BMPs
  - Monitoring & maintaining records

Employee Training

- Basic understanding of the compost process
- Know how to monitor & record temperatures & assess moisture levels
- Be familiar with general troubleshooting guidelines to manage issues as they arise
- Equipment operators of front loaders or other heavy equipment used in the composting process must be trained and properly certified

Equipment

- Pre-processing equipment: tub grinder or horizontal grinder
- A frontend loader
  - 500 cubic yards/year or less
- Windrow turner
- Post-processing equipment: trammel screen

Monitoring Equipment

- Long-stem, non-mercury compost thermometer at least 2’ -3’ long
- Moisture meters and oxygen probes are helpful for obtaining additional diagnostic information
- A windsock is a simple tool that can be used to monitor wind direction.
- Safety equipment for workers includes: hard hats and steel-toe boots; safety vests; dust masks; and eye and hearing protection.

Observing, monitoring, and record keeping should be the foundation for decisions and activities at the compost operation, whether it's turning the materials and adding water because temperatures are below 120°F and moisture content is low or adding carbon or bulking agents because the materials are too wet.

Monitoring the Process

- *Observation*—Daily observation of the composting materials will help to ensure that the process is occurring, odors are not an issue, and that there are no other concerns.
  - Are the windrows or piles steaming?
  - Are materials looking different – is decomposition occurring, materials starting to slowing look like soil? Is the pile uniformly composting?
  - Are strong odors present? Are there persistent puddles of leachate or water?
- *Compost feel*—Does the squeeze test indicate that there is moisture in the material—does it feel like a damp sponge so that when a handful is squeezed, the material sticks together and your hand is moist (about 50% moisture content)

Monitoring the Process

- *Temperature*—Is the temperature rising appropriately for rapid compost? Does the temperature rise to at least 131°F in windrows, maintain this temperature for 15 days through 5 turnings (or 3 days for aerated static piles)?
  - Daily recording of temperature is essential
  - Note turning & watering dates
- *Oxygen*—Smell is the best measure of properly aerated composting for small-to-medium sized operations
  - If there is an unpleasant odor, chances are there are anaerobic conditions in the pile
  - This is an indication that the pile needs to be turned

- Once the temperature goes below 120°F materials should be turned until temperatures no longer rise.
- Materials should also be turned if temperatures rise above 140°F.
- Depending on the materials and compost management, the active composting phase will last 6 – 10 weeks.

Ready for Curing

- Once the organic ingredients in the pile or windrow are digested & bacterial activity declines
- Compost pile heats up very little, even after turning or aerating the pile
- Finished compost will have a uniform, crumbly appearance, earthy smell

Curing

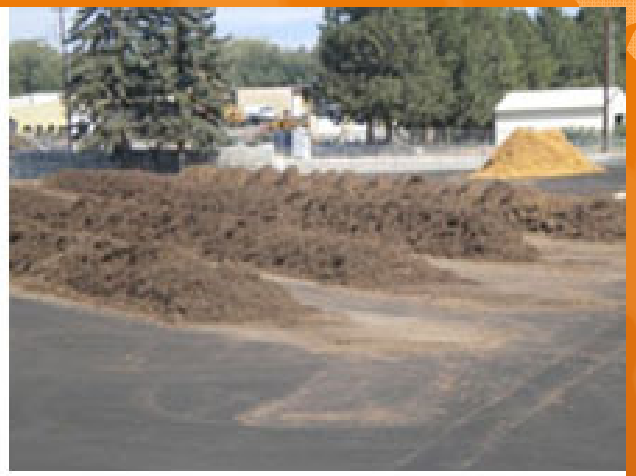
- Necessary part of the compost process
- Ensures that the compost is completely done & ready for use
- Cured compost is stable
  - Remaining ammonia nitrogen to convert to nitrate nitrogen
  - Remaining large woody particles will also continue to break down
- Compost ingredients should not be recognizable
  - Wood chips may not entirely decompose & will require screening
- Compost should be cured for a minimum of 45 days

Screening

Compost Test

- At a minimum—analyze the basic nutrient content—nitrogen, phosphorous, & potassium (N:P:K:)
- Bioassay testing

County Operation



Opportunities and Action

- Organics management program focusing on the "hierarchy" of reduction, recovery, & composting
  - Reduce the amount of organics to be managed
  - Help to control costs
  - Food scraps can later be phased-in for additional diversion
- Upfront education for residents & businesses will pay off in cleaner feedstocks & a more efficient operation
  - Involve the community in the initial planning
  - Feedback mechanism—create two-way communication

Compost Markets

- Erosion Control/Reclamation
- Agricultural applications
- Topsoil
- Nurseries/Silviculture
- Sod production
- Turf grass
- Public Works
- Construction sites
- Landfill cover
- Marginal soils
- Biofiltering
- Direct marketing
- Retail sales
- Landscapers and Lawn Care Companies
- Golf Courses
- Greenhouses
- Rainwater filters
- Roof top gardens
- Compost socks

Major Factors Affecting Compost Demand and Sales

- Compost quality
- Product consistency
- Product availability (meeting demand)
- Economics of transportation & distance to markets
- Economics & challenges associated with compost application
- Industry standards & specifications

Who's Doing it?

St. George, Maine

- Transfer Station accepts yard waste, grass clippings, leaves, manure, specified food scraps (no meat or dairy), & wet & waxed cardboard from residents
- Town website promotes the compost operation & backyard composting as a way to reduce the town's overall disposal costs

Who's Doing it?

Skowhegan, Maine

- Yard trimmings, brush, leaves, farm manure, food scraps are composted at the town transfer station
- Two certified compost operators manage the facility
- 800 yards of compost are generated each year

Who's Doing it?

Ulster County Resource Recovery Agency

- Aerated static pile to manage yard waste, food scraps, & other organics
- Tip fee $50/ton for separated organics (vs. $100/ton LF)
- Currently accepting food waste from supermarkets, grocers, and restaurants

“It’s Yucky…”
“It Smells…”
“It will attract mice, bears…”

Goals of Outreach/Education

Ensure participants:

- Learn about the program
- Know what's required
- Have concerns & questions addressed
- Learn what's in it for them

General strategies are applicable to virtually all education campaigns…

The message will be specific to the program

Getting Started

- Requested “behavior changes”
  - *What do you want participants to do*
- Address concerns

What’s in a word?

- Food scraps
- Materials management

What's the Program Requirements?

Put requirements in terms of practices they are already doing.

"Participation is simple—just scrape your plate into the compost bucket!"

Recycle More.
It's Easy To Do.

COMPOST
SF Environment
Recology

FEED ME!
Tea Bags
Vegetable Scraps
Fruit Scraps
FOOD SCRAPS
Egg Shells
Bread
Coffee Grounds & Filters
No Plastics or Meats

COMPOST ONLY
Fruit and vegetable scraps
Paper towels
Tea bags
Coffee grounds and filters
COMPOSTS!
Do not include:
Meat, dairy, grains
Paper cups or paper plates
Plastic or metal
If in doubt, throw it out
Questions? Contact the Multnomah County Sustainability Program
recyclinginfo@co.multnomah.or.us
or http://MHT/recycle

WE ARE NOT TRASH!

Universal Signs & Symbols

Consistent Images

Consistent Colors

Overcoming "Yuck Factor"

- Broad-based education to begin changing the culture, the language
- Continuously
- Be Consistent
- Seek Feedback
- Biobags/paper bags in kitchen bucket
- Collect soiled paper, pizza boxes

Overcoming "Yuck Factor," cont.

- Simple, concisely worded fliers
  - Distributed to residents at least at the start of the collection program
- Signage at the point of collection
- Website & social media

Tips to Provide Residents

- Line the kitchen collection container with newspaper or wrap food scraps in newspaper or paper towels
- Sprinkle baking soda in the kitchen container & the outside collection cart
- Wash the collection container thoroughly after dumping it
  - Rub vinegar around the rim of the bucket

Tips to Provide Residents, cont.

- Use a vacuum cleaner to remove fruit flies
- Put melon scraps directly into the outside collection cart (not in the kitchen container)
- After dumping the food scraps in the collection cart, cover with yard trimmings, shredded paper, or damp newspaper, a little soil

Give Back

RECYCLE YOUR FOOD SCRAPS

Ulster County throws away 40,000,000 lbs of food scraps each year

Composting is now available at the Ulster County Resouce Recovery Agency

Find us on Facebook

www.ucrra.org

Recycling & Composting
Saves Tax Dollars
Thank you
For Doing Your Share

NERC Can Help

We're experts in

- Waste reduction & recycling
- Recycling program design & implementation
- Organics management
- Green procurement
- C&D reuse & recycling
- Electronics recycling
- School reuse, recycling & composting
- Textile recycling programs
- Multi-stakeholder dialogues & negotiations
- & More!

Fee for service program makes NERC's sustainable materials management

expertise available at a reasonable price with outstanding results

Athena Lee Bradley

athena@nerc.org
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Food Waste Composting

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When is a Permit Required?

No permit to compost:

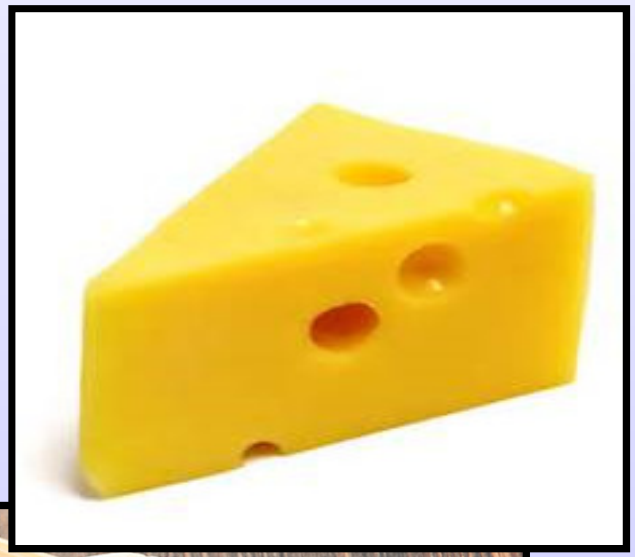
- only leaf and yard waste, manure, and approved bulking agents

- food at the site of generation (homes, schools, farms)

When is a Permit Required?

Yes – when food scraps:

- are from ***off-site***
- include ***meat/dairy***



When is a Permit Required?

No extra permit to compost food waste at Transfer Stations that already hold a Permit-by Notification (PBN)

- **Up to 20% of compost operations**
- **No meat or dairy**
- **Update Operating Plan**

What's the Deal with Meat/Dairy?

Odors & Pests

When is a Permit Required?

	No permit needed	Permit-by-Notification	Standard Permit
Yard Waste	X	-	-
Food Scraps	-	-	-
• On-site	X	-	-
• From off-site	-	X (< 30 TPD)	X (> 30 TPD)
• Meat & Dairy	-	-	X

Food Composting Rules

PAPERWORK!

- Written Operating Plan
- Annual Reporting to DES

Food Composting Rules

- Do not allow food to remain uncovered > 2 hrs.
  [otherwise, store in closed container(s)]
- Blend food into pile within 24 hours.
- Keep under aerobic conditions.
- Stabilize compost prior to distribution.