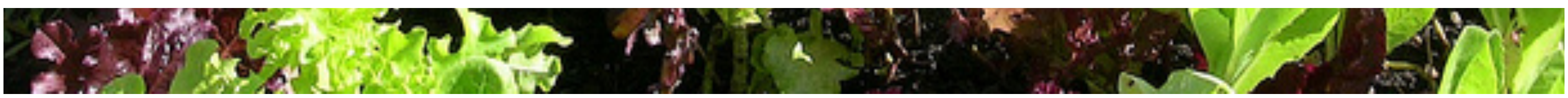
ORGANICS RECYCLING

ADDRESSING FOOD WASTE AND IMPROVING SUSTAINABILITY



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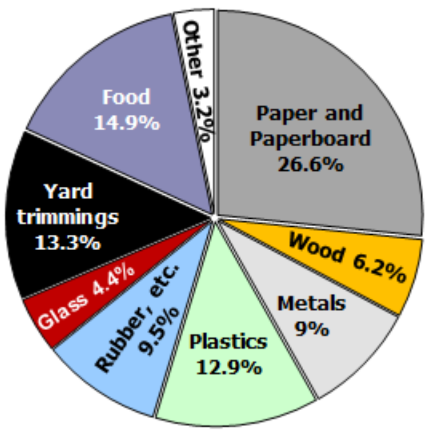
Organics Recycling – Addressing Food Waste and Improving Sustainability

Executive Summary

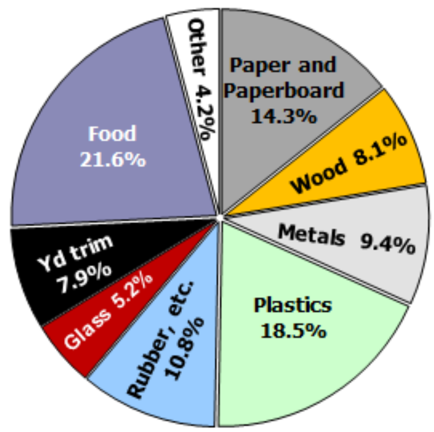
Organics recycling begins with the collection of organic materials separate from the waste stream with the objective of minimizing the incineration and or landfill of those materials. Organic materials that commonly enter the waste stream include food waste, landscape and yard waste, non-hazardous wood waste, and food-soiled papers that are often mixed in with food waste. The EPA reports that each year over 50% of the 167 million tons of waste disposed of in the U.S. is compostable, with food scraps making up a significant volume of the compostable organic material. It is also estimated that over 30% of food in the U.S. (over 133 million tons in 2010) is wasted every year. Waste food is the second largest category of municipal solid waste (MSW) *generated*, making up about 15% of U.S. total MSW annually (Figure 1). However, after *material recovery prior to landfilling*, a process in which considerable amounts of paper and yard waste are recovered for recycling, food scraps make up more than 21% of the weight of material that goes to landfills (Figure 2), making food the single largest category of landfill waste. Organics recycling programs are being developed to reduce the amount of organic materials in landfills.

Figure 1
Total MSW Generation (by Material), 2014
(258 Million Tons before recycling)



Source: USEPA (2017)

Figure 2
Total MSW Landfilled by Material
(136 million tons)



Source: USEPA (2017)

Cities around the world are implementing programs to address the financial and operational feasibility of different organics recycling programs. Educating the public about practices, policies, and desired benefits is an important part of each program. Methods for achieving greater recovery of organics from the waste stream vary based on location, and range from providing backyard bins; organized services for collection of compostable material; and/or mandatory enforcement of organics recycling regulations. For example, Hennepin County, Minnesota offers free or reduced cost composting bins to residents as part of integrating organic recycling into their waste management infrastructure while the State of California requires businesses to separate their organic materials,[1] and New York City, as well as many other municipalities, offer educational information and workshops to increase participation in organics recycling and decrease the organic material content in landfills.

[1] Assembly Bill No. 1826 was signed in 2014

Diverting organics from municipal solid waste offers the opportunity to reuse the materials for other purposes, including as a supplement to improve soil productivity, as a resource to feed people, as feed for animals, and as an energy source to supply industrial and municipal energy needs. Alternately, placing organics in landfills has environmental costs, including the fact that landfilling can increase emissions of methane, which is the second most prevalent greenhouse gas in the atmosphere. Similar to the motivations involved in *traditional recycling*[2], the benefits and costs of organics recovery are beginning to be addressed through new recycling innovations.

Background

The EPA reports that U.S. landfills and incinerators receive approximately 167 million tons of municipal solid waste annually.[3] Each year over 50% of the 167 million tons of waste thrown away is compostable, with food scraps making up the majority of the compostable organic material in the waste stream. The USDA's Economic Research Service, using 2010 data, estimated 31 percent food loss at the retail and consumer levels, amounting to approximately 133 million tons of food.[4] Approximately 21% of food scraps end up in landfills. Organics recycling programs are being developed to reduce the amount of organic materials in landfills.

What is Organics Recycling?

Organics recycling begins with the collection of organic materials separate from the waste stream. Organic materials that commonly enter the waste stream include food waste, landscape and yard waste, non-hazardous wood waste, and food-soiled papers that are mixed in with food waste. These materials account for over one half of materials landfilled, resulting in significant methane emissions due to inadequate conditions for anaerobic digestion of organics in landfills (see sidebar).

Landfill Background

"Dry tomb" is the most common landfill management practice. In this process waste is buried and sealed off from the environment.

Waste in a dry tomb landfill is separated from surrounding soil by a layer of geotextiles and clay. The design keeps the waste as compact as possible and minimizes internal moisture. This results in a reduction in the level of biological activity in the landfill. Consequently, the organic material breaks down with minimal moisture and oxygen. This also results in bacterial activity that generates landfill gases. These gases, including methane and carbon dioxide, are released to the atmosphere if not collected.

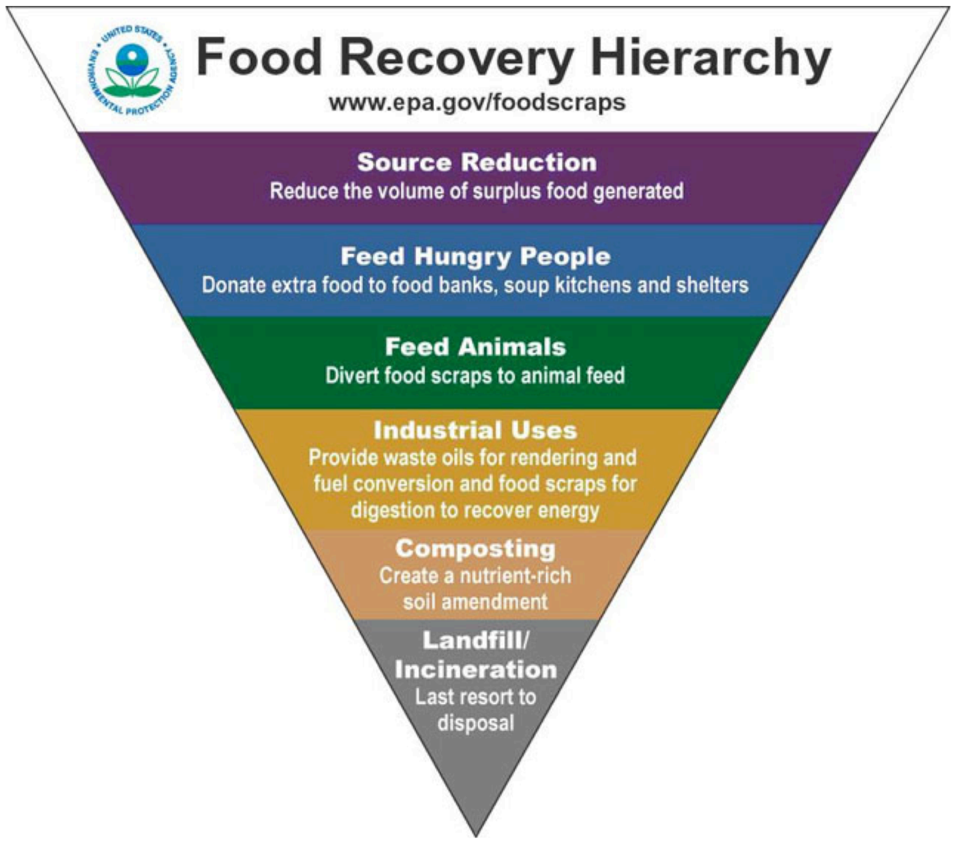
Methane produced from landfills can be captured and burned to provide energy; however, gas collection is not practiced at all landfills. Human activity accounts for 60% of global methane emissions, and landfills specifically contribute 20% of methane emissions in the United States.

[2] In this paper, the term *traditional recycling* refers to the initial movement after the industrial age to recover materials, including paper, cardboard, glass, metals and plastics from solid waste during collection with the goal to reuse or repurpose the materials in order to decrease waste disposal.

[4] USDA. 2014. *The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States.* Available at: https://www.ers.usda.gov/webdocs/publications/eib121/43680_eib121.pdf

The EPA's *Food Recovery Hierarchy* (Figure 3) prioritizes the major alternatives available to reduce the amount of organics in landfills based on benefits to society, the environment and the economy.

Figure 3
Food Recovery Hierarchy



Source: USEPA (2013)

"The Food Recovery Hierarchy prioritizes actions organizations can take to prevent and divert wasted food. Each tier of the Food Recovery Hierarchy focuses on different management strategies for wasted food. The top levels of the hierarchy are the best ways to prevent and divert wasted food because they create the most benefits for the environment, society and the economy."

The EPA suggests that the greatest benefit can come from source reduction, then by utilizing excess food for human use, and then as feed for animals. Opportunities can also be sought to use excess food for industrial (e.g. energy production) and composting purposes as lower priorities. Landfilling and incineration are described as the last and least desirable options. Each of these is further described below.

Source Reduction

Source reduction is simply a strategy of decreasing waste generation. This has the greatest potential benefit to society, the environment and the economy. Advance planning is crucial in accomplishing source reduction. Making grocery lists, accurately inventorying current supplies and precisely aligning purchasing with use are examples of proactive planning to prevent waste generation. Realistic interpretation of freshness labels can also help to reduce waste.[5] Waste reduction, in turn, can decrease disposal costs including those embedded in local waste management rates.

Food for people

Feeding hungry people involves directing surplus food supplies from businesses and residents to people with limited access to food. Currently, grocery stores, bakeries, and buffet restaurants often donate to food banks, shelters or food recovery programs (FRP)[6] to divert their daily leftovers and receive potential tax or other benefits.

Food for animals

Feeding animals with food scraps is another way to divert food from landfills and may minimize disposal costs. Food scraps can be sold or donated to farms, zoos, or other animal and livestock facilities, or used as pet food when handled properly. Applicable regulations vary by state, with information generally available at local solid waste facilities, county agricultural extension offices or public health agencies. Methods and guidelines can be found on the USDA Animal and Plant Health Inspection Service website.

Alternative energy production

Both municipalities and industries can utilize organic materials as an alternative source of energy. Pyrolysis and gasification are the two primary processes used today to release energy from organic waste.[7]

Composting

Composting is a naturally occurring process whereby organic materials decompose in an oxygen rich environment (see sidebar on following page). The resulting material is called compost and is used as a soil amendment. Compost programs are being practiced globally in residential settings using backyard compost bins. Commercial and residential collection of compost is becoming more integrated into current waste management infrastructures, incorporating various methods for source separation (e.g., to separate leaves from woody debris or from kitchen scraps) to ensure quality compost can be produced.

Landfills and Non-Energy Producing Incinerators

Landfills and non-energy producing incinerators are destinations of last resort for managing waste organic materials. While incineration without energy recovery has declined markedly in recent decades, the practice persists in some regions.

[5] For discussion of this issue, see *"In Battle Against Food Waste, Rethinking "Use By" Labels",* Available at: http://news.nationalgeographic.com/news/2014/11/141120-food-waste-use-by-expiration-labels-ngfood/

[6] Food recovery program guidelines vary locally – see http://www.usda.gov/oce/foodwaste/resources/donations.html

[7] Gasification converts organic material into synthesis gas (an intermediate in producing synthetic natural gas) and carbon dioxide using high temperature and controlled oxygen inputs whereas pyrolysis is the use of heat without oxygen to create a chemical change in the physical nature of the material (e.g. creating charcoal).

Municipal-led Organics Recycling in the U.S.

Formalized organics recycling in the U.S. is a relatively young field having begun in the 1980s. However, informal strategies for organics recycling have been around for a long time. Implementing an organized, large-scale and cost-effective system is a slow process that requires participation on multiple levels. Today composting programs are being increasingly implemented across the United States and Europe. Since 1990, organics recycling in the U.S. has increased from diversion of 2% of the total solid waste stream, to recovery of more than 33%, with much of this attributable to composting. Substantial gains in organics recycling have also been achieved globally, although not universally.

One of the largest barriers to overcome is the lack of participation in organics recycling beyond concentrated collection points such as restaurants and cafeterias. Individual participation will be needed to achieve significantly greater recycling levels. Increased participation by individuals is directly related to development of an efficient infrastructure that can support both businesses and individuals. Greater recycling participation would better support transportation and employee costs for haulers, by providing more bins to collect per route. Inefficient collection systems can discourage participation in organics recovery.

Education and incentives (and penalties) play a significant role in engendering organics recycling. Education is critically important at all levels of the food recovery hierarchy. Current education strategies stress the importance of organics recycling, and provide information about proper recycling. Pamphlets, websites, public events, and direct outreach to business entities are among the tools commonly used. Incentives and penalties can be used to guide priorities, creating motivation to recycle.

Case Studies

The following case studies provide examples of approaches to organics recycling and reduction of organics disposal in landfills.

Composting History

Organic material has been naturally decomposing and providing nutrients to the soil since organisms first appeared on the planet.

There is evidence of organized composting in texts dating back to the Akkadian Empire in ancient Mesopotamia, where people used clay tablets to track manure use in agriculture. Texts from ancient Greek, Roman, Israeli and Arab cultures described the use of rotted straw and other organic material for uses similar to composting in their agriculture. Composting was also employed throughout the Renaissance and to the present day through a wide range of methods. Early New England farmers formulated 10 parts muck to 1 part fish as compost for their soil.

Research in the early 20th century by Justus von Liebig, Sir Albert Howard, J.I. Rodale and others advanced the chemical understanding of the composting process. Their work aided in the identification of humus, the ideal material composition of compost, and ways in which composting increases soil quality for farmers.

Minneapolis, Minnesota

Minneapolis is the largest city in Minnesota, with a population of about 411,000 and an estimated 178,000 households (2015 census data). The current waste management system for the city includes collaboration with Hennepin County (in which Minneapolis is located) and the use of a single yard waste collection site, two transfer stations, and the Hennepin Energy Recovery Center (HERC). The waste stream composition for the county is shown in Table 1.

Table 1
Hennepin County Waste Composition (Foth 2013 Study)

Material Group	Material	Mean (%)
Organic Waste		**33.1**
20	Food Waste	14.0
21	Liquid Waste	1.5
22	Food – Soiled and Non-Recyclable Paper	7.8
23	Compostable Food Service Ware & Other Compostable Items	1.1
24	Yard Waste	8.7

The City of Minneapolis and the Hennepin County Division of Solid Waste and Recycling began a pilot collection route for organics in September 2008. The goal was to assess the cost and feasibility of separating organic materials in the waste management system. The study entitled *Assessment of Residential Source Separated Organics Collection Options* was conducted in South Minneapolis, and involved 5,370 homes. Residents were not charged extra for source-separated organics (SSO) services in the course of the study.

Four collection and separation options for haulers and residents were offered, with participation on a voluntary basis:

- Option 1 (Current Practice): No SSO sorting: Organics mixed and disposed with municipal solid waste and existing yard waste collection program.
- Option 2 (SSO Alone): Separate collection of SSO: Organics separated from MSW for collection (with or without a tipping fee subsidy)
- Option 3 (SSO + Yard Waste): A combination of SSO and yard waste collected (with or without use of Blue Bags[8]).
- Option 4 (SSO + mixed MSW): Use of Blue Bags to separate SSO from MSW.

Participation and recovery rates for each collection/ separation option were used as determinants of those options that were most cost effective and efficient in terms of hauler routes. A key metric was estimated greenhouse gas emissions linked to additional collection traffic and hauling.

The City's current seasonal yard waste collection program (Option 1) has a cost of $2.95 per dwelling unit per month. This current practice is the most cost effective option and also offers the lowest GHG impacts from hauling due to the need for only one truck per route. The study found that Option 2 was the most cost effective option for adding the collection of Source-

[8] Communities may utilize unique and specific colors for collection bags to support separation and identification of recyclable materials. The use of "blue bags" is common for the collection of organics. In addition to being a blue color, the bags are also often designed to be compostable.

Separated Organics to the current practice, but had the greatest GHG impact due to increased collection traffic and hauling. Option 2 was estimated to add a cost of $2.23 per dwelling unit for a total collection cost of $5.18. Option 4 was the least cost effective, with additional monthly hauling expenses at almost $8 per dwelling unit for a total collection cost of $10.71.

Table 2
Study Results for City of Minneapolis Source-Separated Organics (SSC) Collection Options showing Cost per Dwelling Unit (DU) (Foth 2013 Study)

SSO Collection Option	**Additional $ per DU per month, city-wide**
SSO Alone – with continued County tip fee subsidy (Option 2.a)	$2.23
SSO Alone – without any County tip fee subsidy (Option 2.b)	$2.54
SSO + Yard Waste – no Blue Bag (Option 3.a)	$2.42
SSO + Yard Waste with Blue Bag (Option 3.b)	$5.02
SSO + mixed MSW – with Blue Bag (Option 4)	$7.76

Hennepin County currently practices organics collection and recycling on a voluntary basis, meaning that residents are not required to separate organics for collection and can choose whether they would like to participate in the organics recycling program or not. Residents can sign-up with their local hauler and a number of options for increasing voluntary participation are being used including increased education, providing small green bins and compostable bags for collection, offering referral incentives, and providing a rebate for reduced trash generation.[9] Hennepin County distributes funds received from the State of Minnesota to cities to support curbside collection of residential recyclables and organics.[10]

Philadelphia, Pennsylvania

Philadelphia was a pioneer in curbside collection of recyclables, establishing a recycling ordinance in 1987.[11] Currently, enforcement officers are authorized to write $25 tickets to residents living in areas served by curbside recycling collection services who are caught not recycling. Commercial establishments and managers of apartment complexes that are not providing recycling options for their customers or tenants also face fines.

At the same time that residents face penalties for not recycling, they can also earn rewards as they recycle. Those enrolled have a sticker placed on their recycling bins which is scanned each time recycling is picked up. Structured similar to a frequent flier program, the more program enrollees recycle, the more points they earn; points are redeemable for a variety of deals and discounts. [12] However, because organics were not a part of the recycling mandate, Philadelphia

[9] For example, the City of Medina, Minnesota offers a $20 credit on the garbage bill for residents that sign-up for organics recycling and up to an additional $80 for referrals of up to four additional households. For more information, see: http://medinamn.us/wp-content/uploads/2010/08/Aug-Sept-2016-Newsletter-Story-Organics-Incentive-20-Credit.pdf

[10] The Hennepin County Residential Recycling Funding Policy is available at: http://www.hennepin.us/-/media/hennepinus/your-government/projects-initiatives/documents/residential-recycling-funding-policy.pdf?la=en

[11] http://www.recyclenowphila.org/downloads/Philadelphia%20City%20Controller's%20Report-%20May%202005.pdf

[12] More about Philadelphia's recycling rewards program can be found at: http://www.philadelphiastreets.com/recycling-rewards

has had difficulty meeting waste diversion rate goals for organics in recent years.[13] To start to address the issue, a study was conducted to assess the effectiveness of three different strategies for increasing organics recycling.

The final report *The Recycling of Organics: Opportunities for Municipal Programs and a Case Study for Philadelphia* (Bush 2011) summarized the impacts of the following organics recycling methods:

- Increase use of food waste disposers (FWD)[14] in kitchens[15]
- Implement curbside collection program for organics throughout the city
- Develop a community-based network of composting sites

The impact of implementing the methods are described below with tables demonstrating a comparison of costs and diversion rates for organics based on the proposed methods in the study.

Table 3

Food Waste Disposers (Diversion, Costs and Emissions per Year) (Bush 2011 Study)

	Baseline	Potential Increase	
Diversion Rate of Food Scraps	25%	50%	75%
Tonnage Diverted	8,578	17,156	25,735
Energy Costs (Savings)	$705.09	$1,410.18	$2,115.26
Tipping Fees (Savings)	($345,915)	($691,830)	($1,037,745)
Net Cost (Savings)	($345,210)	($690,420)	($1,035,630)
Emissions (Avoided) ($MTCO_{2e}$)	(974)	(1,948)	(2,922)
Emissions Added ($MTCO_{2e}$)	152	303	455
Emissions (Sink) ($MTCO_{2e}$)	(2,059)	(4,118)	(6,176)
Net Emissions (Savings) ($MTCO_{2e}$)	(2,881)	(5,763)	(8,644)

Table 4

Curbside Organics (Diversion and Costs per Year) (Bush 2011 Study)

Diversion Rate of All Organics	25%	50%	75%	100%
Tonnage Diverted	38,917	77,834	116,750	155,667
Percentage of Waste Stream	6.24%	12.5%	18.7%	25.0%
Landfill and Incineration Tipping Fees (Savings)	($2,475,105)	($4,950,211)	($7,427,316)	($9,900,421)
Organics Tipping Fees	$1,751,254	$3,502,508	$5,253,761	$7,005,015
Net Costs (Savings)	($723,852)	($1,447,703)	($2,171,555)	($2,895,406)

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[13] Organics are not a part of the mandatory Commercial Solid Waste and Recycling Plan in Philadelphia.

[14] Food Waste Disposer: device to grind up food and flush it away into sewer system

[15] Food collected in this way is recycled by the Philadelphia Water Department into energy and fertilizer.

Food Waste Disposers - Examination of the impacts of greater use of food waste disposers (Table 3) revealed that greater use (50% or 75% as compared to 25% baseline) would slightly increase energy costs, but result in considerable savings in garbage tipping fees and significant reductions in carbon emissions ($MTCO_2e$). Based on findings of this study, the City of Philadelphia began requiring that all new residential construction include in-sink food waste disposers; the law went into effect on January 1, 2016. Organic waste collected in this way is recycled by the Philadelphia Water Department into energy and fertilizer.

Curbside Collection - The analysis of potential impacts from greater curbside collection (Table 4) also showed financial benefit in the form of reduced tipping fees for all scenarios evaluated. A further benefit of increased organics recycling was the potential to reduce methane emissions as organic content in landfills was reduced. While this study showed benefits to greater recycling of organics through expanded curbside collection, it also showed benefits to increased curbside collection in general. Curbside collection of recyclables was subsequently expanded, but without inclusion of organics in collection programs. In 2013, Philadelphia's Streets Department distributed 60,000 recycling bins to residents and also published for the first time a Business Recycling Toolkit. The city also has a program to recruit volunteers to support city recycling efforts at public events. These and other initiatives were key factors in helping the city to markedly improve waste diversion from landfills. Diversion rates increased from 53% in 2008 to 74% in 2014, with 46% of waste recycled and 28% combusted with energy recovery. While the 74% diversion rate is impressive, the volume of municipal solid waste landfilled in 2014 amounted to 2.5 million tons, indicating that opportunity for improvement remains.[16] Recently, Philadelphia has set a goal to become a zero waste city by 2035.[17]

Community-wide Compost Sites – Despite recent gains, the problem of organics recycling has not been solved in Philadelphia. The idea of establishing a community-based network of composting sites was never implemented, with some of the city's compostable waste instead sent to a facility in Wilmington, Delaware. That facility, however, closed in 2014 due to code violations and odor complaints. As of this writing, food composting facilities in Philadelphia are limited to area prisons, which began composting food scraps in 2011. Otherwise, there are no composting facilities with the capacity to accept large volumes of food waste. With the announced goal of zero waste, city leaders are now focused on the question of how to divert more organic matter – grass, leaves, and food waste. Investment in composting infrastructure, expansion of collection systems, and expansion of education efforts are among the steps needed to achieve recycling goals.

Bottom Line

Organic material makes up a significant part of the waste stream with food waste often the largest component. Strategies for making use of food to the maximum extent possible before it goes into the waste stream are of high priority. Diverting these materials can feed people, be used to feed animals, produce compost to improve soil quality, or used for energy generation instead of being disposed of in landfills. The presence of food wastes in landfills increases methane emissions and raises environmental and human health hazards. Source-separated collection, residential composting, creation of publicly accessible composting sites capable of handling large quantities, greater use of in-sink garbage grinders, incineration for energy recovery, and education programs to increase public awareness are among the strategies to address the problem.

[16] http://www.philadelphiastreets.com/images/uploads/documents/swrac_goals_comm_handout_dec_2015.pdf
[17] http://planphilly.com/articles/2017/02/06/composting-in-philadelphia-where-we-are-and-where-we-are-going

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