

Organics Diversion in the City of Medford, Massachusetts



Tufts University Department of Urban and Environmental Policy and Planning

Field Projects - Spring 2019

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Urban and Environmental Policy and Planning



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Team Members



Team Members (Left to Right): Shoshana Blank, Cyatharine Alias, Melissa Gordon, Chelsea Alexander, and Jessika Brenin at the Boston Centralized Organic Recycling (CORE) facility in Charlestown, Boston, Massachusetts.

Table of Acronyms

Acronym	Description
AD	Anaerobic Digestion
ADA	Americans with Disabilities Act
CCC	Community Compost Company
CHP	Combined Heat and Power
CORe	Centralized Organic Recycling
DPW	Department of Public Works
EBS	Engineered Bio-Slurry
EPA	(U.S.) Environmental Protection Agency
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLSD	Greater Lawrence Sanitary District
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
GWP	Global Warming Potential
HH	Household
IPCC	Intergovernmental Panel on Climate Change
MassDEP	Massachusetts Department of Environmental Protection
MSW	Municipal Solid Waste
MTCO ₂ e	Metric tonnes of carbon dioxide equivalent emissions
OEE	Office of Energy and Environment (City of Medford)
OSE	Office of Sustainability and Environment (City of Somerville)
PAYT	Pay-As-You-Throw
ReFED	Rethink Food Waste through Economics and Data (national non-profit organization)
RFP	Request for Proposal
RFQ	Request for Qualifications
SSO	Source-Separated Organics
UEP	Urban and Environmental Policy and Planning (Department at Tufts University)
UN	United Nations
WARM	Waste Reduction Model
WM	Waste Management, Inc.
WTE	Waste-to-Energy facility
WRRFs	Water Resources Recovery Facilities

Glossary

Term	Definition
Aerobic composting	A process which uses microorganisms to break down organic materials in the presence of oxygen.
Anaerobic digestion (AD)	A process which uses microorganisms to break down organic materials in the absence of oxygen, producing methane gas (biogas) and digestate.
Biogas	Gaseous fuel, especially methane, produced by the fermentation of organic matter.
Biogenic emissions	Emissions from natural sources, such as plants and trees, which are part of the natural carbon cycle.
Carbon Dioxide (CO ₂)	A colorless, odorless gas that is formed in the decay or combustion of animal and vegetable matter, as well as fossil fuels. Is absorbed by plants during photosynthesis. An important heat-trapping greenhouse gas contributing to climate change.
Carbon Dioxide Equivalent (CO ₂ e)	A quantity that describes for a given mixture and amount of greenhouse gases, the amount of CO ₂ that would have the same global warming potential, when measured over a specified timescale (generally, 100 years).
Co-digestion	A process whereby energy-rich organic waste materials (e.g. oils, food scraps) are added to dairy or wastewater digesters with excess capacity, for the purpose of biogas production.
CORE facility	Co-digestion facility owned by Waste Management and located in Charlestown, MA. CORE is also a proprietary technology of WM, located in other cities.
Digestate	The material remaining after the anaerobic digestion of a biodegradable feedstock. Used as an additive to improve soil.
Emission	The production and release of something, especially gas or radiation.
Emissions factor	A representative value that attempts to relate the quantity of pollutant released to the atmosphere with an activity associated with the release of that pollutant. Units for waste emissions factors are often metric tonnes of pollutant (MTCO ₂ e) per ton of waste.
Global warming potential (GWP)	A measure of how much heat a greenhouse gas traps in the atmosphere, relative to carbon dioxide. Calculated over a specific time horizon, such as 20 or 100 years.
Greenhouse Gas (GHG)	A gas that contributes to the greenhouse effect by absorbing infrared radiation, trapping heat in the atmosphere.

Hauler	A company who collects and transports solid waste for the purpose of disposal or recycling.
Landfill	A system of garbage disposal in which the waste is buried between layers of earth to build up low-lying land.
Methane (CH ₄)	A colorless, odorless flammable gas which is the main constituent of natural gas. It is a product of biological decomposition. A heat-trapping greenhouse gas contributing to climate change.
Municipal solid waste (MSW)	Waste collected by municipalities or other local authorities. MSW typically includes: food waste, garden and park waste, paper and cardboard, wood, textiles, disposable diapers, rubber and leather, plastics, metal, glass, and other materials (e.g., ash, dirt, dust, soil, electronic waste).
Nitrous Oxide (N ₂ O)	A colorless gas produced by combustion and fertilized agricultural soils. A heat-trapping greenhouse gas contributing to climate change.
Non-biogenic emissions	Emissions from the combustion of fossil fuels and other materials that are not biomass.
Organic waste	Waste that contain materials which originated from living organisms (animals and plants). Examples include food, paper, wood, sewage sludge, and yard waste. It is biodegradable.
Pay-As-You-Throw (PAYT)	A municipal program in which residents are charged for the collection of municipal solid waste, based on the amount they throw away.
Source-Separated Organics (SSO)	The system by which waste generators segregate compostable materials from other waste streams at the source for separate collection.
Tipping fee	The charge levied upon a given quantity of waste received at a waste processing facility.
Toter	The typical upright plastic container used for residential trash and recycling collection. These are wheeled carts that are typically 64-gallons in volume.
Waste-to-energy incinerator	The process of generating energy in the form of electricity and/or heat by burning waste to boil water that powers steam generators.
Wastewater	Water that has been used in the home, in a business, or as part of an industrial process.
Wheelabrator Saugus	A waste-to-energy incinerator located in Saugus, MA.

Executive Summary

Purpose

The purpose of this report is to help the City of Medford evaluate the options for a municipal organics diversion¹ system that prioritizes positive environmental impacts and financial feasibility, while also considering public opinion. However, we believe that information would benefit other municipalities interested in organics diversion in the Greater Boston Area. The key research questions are:

- What are the environmental, social, and economic advantages and disadvantages of the following alternatives for the City of Medford?

1	Department of Public Works (DPW)	Municipal DPW establishes staff team and truck fleet to coordinate organics collection in-house.
2	Expand Waste Management, Inc. Contract	Municipality expands current waste management contract with Waste Management, Inc. to include curbside organics collection.
3	Curbside Pick-up with Private Hauler	Municipality contracts with a private hauling company to provide curbside organics collection.
4	Drop-Off Sites	Municipality establishes and maintains organics drop-off site(s).
5	Request for Qualifications (RFQ)	Municipality puts out a RFQ to identify a preferred private hauling company with which participants can contract.
6	Business as Usual	Municipality does not take action on organics collection at this time.

Figure 1 Alternatives Considered for Medford's Organics Diversion

- What are the different technologies for food waste diversion (composting, anaerobic digestion, co-digestion), as relevant to the available local options?
- What are the barriers to large-scale food waste diversion in the Greater Boston Area?
- How do we consider community and political need, interest, and will in deciding on a municipal organics diversion program that best fits Medford?

¹ There are various methods of diverting food waste and other organic material, including composting, co-digestion, and anaerobic digestion. Though it is common to refer to any food diversion as "composting," we use "organics diversion" to encompass all methods, and specify "compost" when we mean the specific method of piles of food waste and other organics (yard waste) that are turned and become soil.

Major Findings

Municipal Case Studies

Municipalities shared various pathways for organics diversion, ranging from researching and choosing not to divert organics, to offering drop-off sites, to running a curbside pickup program. Most began due to residents' requests and began with a pilot program. Below is a table comparing the basics of each diversion program.²

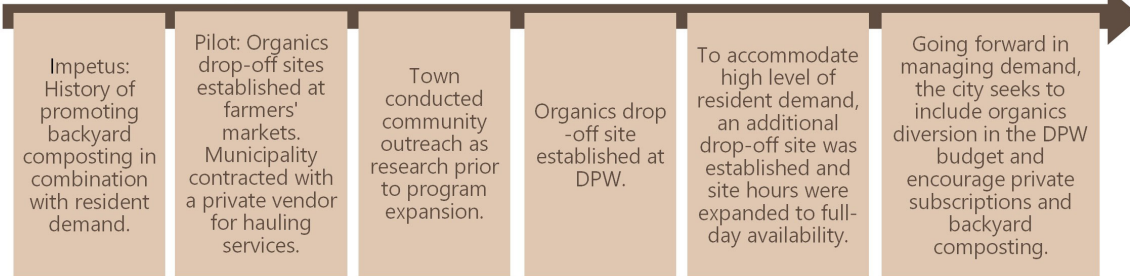
Table 1 Case Studies Comparison

Case Studies Comparison						
Location	Household Size	Current Participation Rate	Program Components	Organics : Garbage Tipping Fee Ratio (for Municipality)	Participant Cost	PAYT for Garbage Collection
	Geographic Size					
	Density					
Arlington, MA	18,632 HH 5 sq. miles 3,726 HH / mile	~2% (residential)	2 drop-off sites provided by municipality	Unknown	\$0	No
Cambridge, MA	49,000 HH 6.5 sq. miles 7,538 HH / mile	55% (residential)	Opt-out residential collection provided by municipality; Drop-off site provided by municipality; Commercial collection provided by private hauler contracting with municipality	\$65 : \$87	\$0	No
Boston, MA	268,304 HH 48 sq. miles 5,590 HH / mile	Unknown	5 drop-off sites provided by municipality	\$5 : \$68	\$0	No
Natick, MA	14,263 HH 15 sq. miles 951 HH / mile	1 - 3.5% (residential)	Pilot 1: Residential collection offered by municipality. Pilot 2: Drop-off site provided by municipality, as well as subsidized bins and bags for first 500 HH that sign up for private subscription.	1 : 1	TBD for drop-off; Varies for private subscription	Yes
Hoboken, NJ	24,812 HH 1.275 sq. mile 19,460 HH / mile	1% (residential)	Opt-in residential collection offered by municipally preferred private hauler; Commercial collection and residential drop-off site provided by municipality	\$40 : \$101	\$19 or 39/month for residential; \$0 for commercial and drop-off	No

The following figure is a visual representation of each municipality's process in developing its program. Individual profiles about each municipality can be found in the body of the report.

² Somerville is not included in the table because it does not have a municipally-run organics diversion program (see the Somerville profile for details).

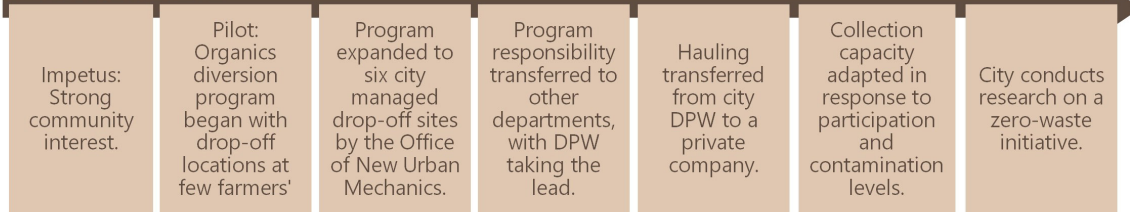
Arlington Pathway:



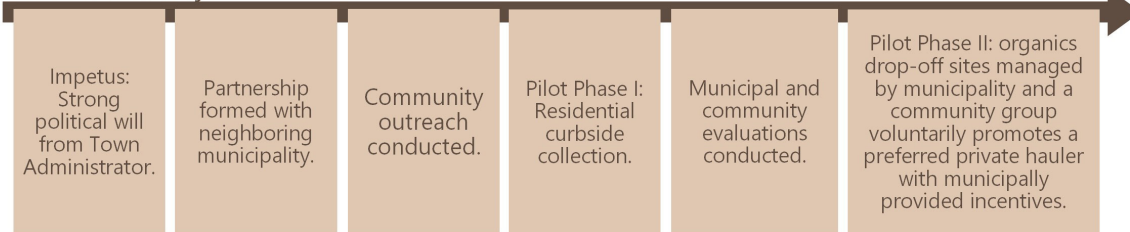
Cambridge Pathway:



Boston Pathway:



Natick Pathway:



Hoboken Pathway:

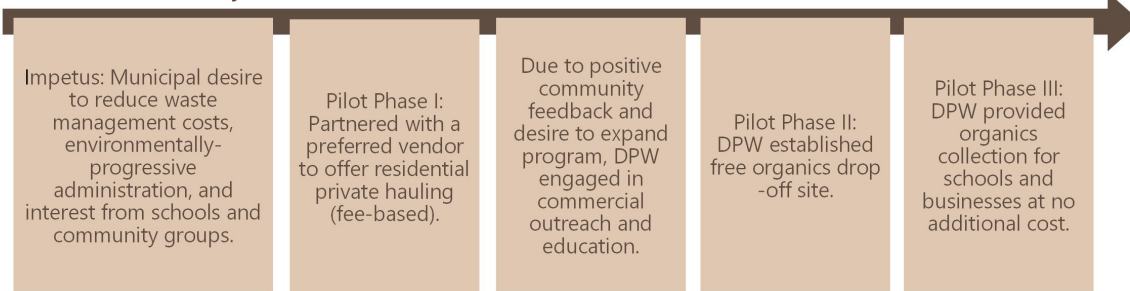


Figure 2 Municipal Pathways to Organics Diversion

Overall, municipalities have chosen to do either curbside pickup—run by the Municipal Department of Public Works or contracted with a private hauler—or a drop-off program. The table below shares learnings from interviews about the advantages of each of these methods and lists the corresponding municipal responsibilities.

Table 2: Organics Diversion Methods: Advantages and Municipal Responsibilities	
Curbside Pickup - Municipally Run	
Advantages	Municipal Responsibilities
<ul style="list-style-type: none"> • Works within municipal systems—relationships and internal systems knowledge already present. • Potential to increase number of municipal hires. • Can easily develop routes to match current routes, which is convenient for residents. • Over time, high participation can decrease trash tipping fees. 	<ul style="list-style-type: none"> • Purchase and maintain organics diversion trucks. • Add pickup route cost and labor to waste management budget. • Oversee complete operations from pickup to final drop-off. • Develop relationship with organics processing facility. • Advertise and educate about waste changes—intensive effort to create change in disposal culture. • Field large volume of resident concerns. • Obtain and maintain funding for project.
Curbside Pickup - Private Hauler	
Advantages	Municipal Responsibilities
<ul style="list-style-type: none"> • Convenient for residents to participate. • Private hauler runs most operations. • Over time, high participation can decrease trash tipping fees. 	<ul style="list-style-type: none"> • Contract and maintain communication with private hauler. <ul style="list-style-type: none"> • Work to make pickup on the same day as trash and recycling. • Advertise and educate about waste changes—intensive effort to create change in disposal culture. • Field large volume of resident concerns. • Obtain and maintain funding for project.

Drop-off Site ³	
Advantages	Municipal Responsibilities
<ul style="list-style-type: none"> Any resident can access bins at no/ low additional cost. Lower startup cost for municipality. Provides opportunity for residents to become comfortable with and excited about organics diversion. Potential to strategically locate bins to address resident fears of rodents and odor. 	<ul style="list-style-type: none"> Identify ADA accessible, animal and odor resistant, affordable bins. Identify location and obtain permission to install drop-off bins. Develop and submit proposal to Board of Health Commission. Actively reach out to neighboring residents to address concerns. Contract and maintain communication with private hauler. Develop system to track users (potentially online form). Advertise and educate about proper bin use. Monitor bins for appropriate usage. Maintain bins in different weather conditions. Obtain and maintain funding for project.

Preferred Hauler - Request for Qualifications (RFQ)	
Advantages	Municipal Responsibilities
<ul style="list-style-type: none"> Municipality does not develop a contract with the private hauler. Private hauler runs operations completely. Minimal cost to municipality for advertising. 	<ul style="list-style-type: none"> Release an RFQ and identify a preferred private hauler. Advertise and educate about the opportunity (could be shifted to private hauler).

Private Hauler Options

Several of the alternatives Medford could choose for organics diversion include a private hauling company. Many Massachusetts residents wanting curbside organics collection use a private subscription service, and some municipalities partner with private hauling companies to provide their residents with organics diversion service. The table below shows the possibilities for Medford to partner with each of eight private haulers and Waste Management, Inc. These companies were assessed regarding ability to service Medford, so additional information would be necessary to determine their suitability for other municipalities.

Table 3: Private Hauler Options	
Hauler	The Bottom Line for Medford
Agri-Cycle Energy	Agri-Cycle Energy would have the capacity for processing Medford's organic waste, but would likely need to partner with a local hauler who would be responsible for the curbside household pickup. Cost would need to be determined.
Black Earth Compost	Black Earth Compost is ready and able to begin compost collection in Medford, through private service to residents, or via a contract with the city, but more discussion is needed to determine specific cost.
Bootstrap Compost	Bootstrap Compost could be part of the solution for Medford, but does not have full capacity to serve all 18,000 households at this time. Bootstrap could provide curbside household pickup at various rates depending on the number of households participating.
CERO	CERO is interested in collecting Medford's organic waste, and has the capacity to compost it, but would need to partner with another company for curbside pickup or install drop-off sites or transfer location from which to collect the organics. Another idea for Medford is to install a small in-vessel anaerobic digester, i.e. hosting their own composting site.

³ Drop-off information from Charlotte Milan, "Tufts Organics Diversion Project: Arlington Write Up," April 11, 2019.

City Compost	City Compost is ready to serve Medford households through curbside pickup. They would likely start by serving a subset of Medford through a pilot program. Rates would depend on number of households participating.
Garbage to Garden	Garbage to Garden is ready to serve Medford with curbside organics collection and they have the composting capacity to do so. They calculated a price estimate of \$250,000/year.
OffBeet Compost	OffBeet Compost does not have the capacity or proximity necessary to serve Medford at this time, nor are they interested in expanding to Medford.
Save That Stuff	Save That Stuff, although they have the capacity, is not a viable option for Medford at this time because they are not currently pursuing curbside household pickup. They are focused on expanding their commercial accounts.
Waste Management, Inc.	Waste Management, Inc. is a viable option for organic waste diversion. They could meet with the city and develop a proposal at any time. Costs and logistics would need to be figured out. The food waste would be diverted to the Boston CORE facility, and go through the co-digestion process.

Greenhouse Gas Emissions Analysis

We conducted a greenhouse gas analysis (GHG) analysis for the city of Medford to determine potential GHG reductions of diverting organics. Trash and food waste contribute to greenhouse gas emissions, so cities interested in reducing their emissions may conduct an inventory of their own overall emissions. In Medford, trash is a relatively small percentage of the total (GHG) emissions. The total GHG emissions for the city in 2016 were 343,800 metric tonnes of carbon dioxide equivalent emissions (MTCO₂e), and emissions from municipal solid waste (MSW) were 7,032 MTCO₂e, just 2% of the total emissions. According to Medford's GHG inventory, most of the city's emissions are from stationary energy and transportation.

Waste as Percentage of Medford GHG Emissions

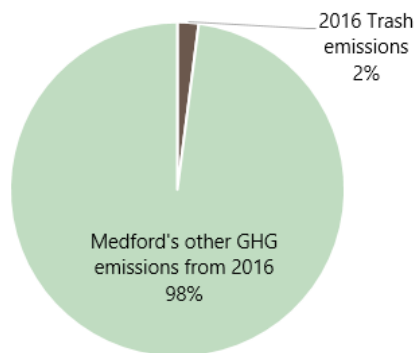


Figure 3 Waste makes up 2% of Medford's total GHG emissions. The rest of emissions come from stationary energy and transportation.

GHG Emissions from Medford's Waste

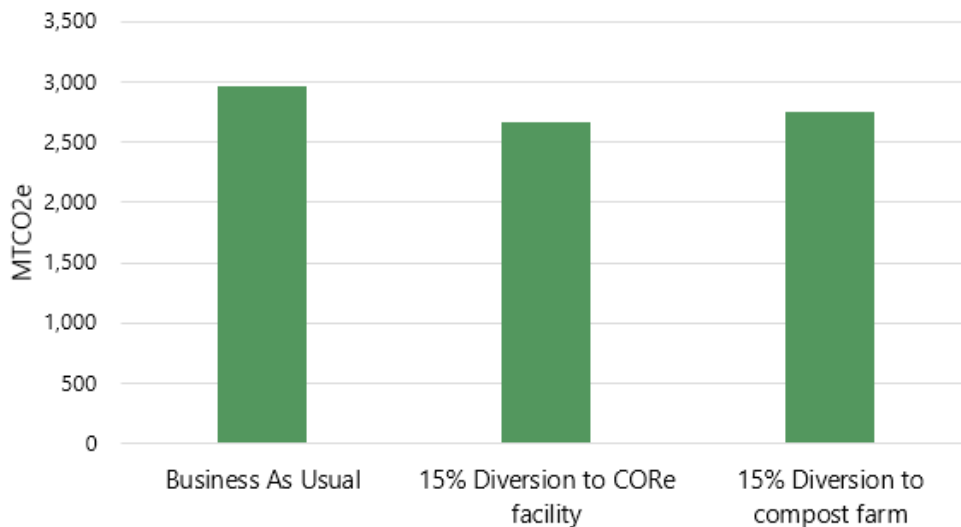


Figure 4 Medford's GHG emissions would be negligibly reduced if 15% of trash was diverted and hauled separately to the CORE facility or to a compost farm. This is equivalent carbon savings to 52 homes going carbon neutral for energy use for one year.

Public Opinion Analysis

We briefly assessed Medford's residents' interest in organics diversion. In Medford, since 2013, residents have been contacting Alicia Hunt, Director of the Medford Office of Energy and Environment, expressing interest in composting. Some residents currently compost in their backyards and many would be interested in a municipality-wide program. The main concerns about organics diversion from a non-representative sample of Medford residents include:

- Forced participation
- Unpleasant odors
- Increased rodent or insect activity
- Inadequate program education with public participation, intensifying the above concerns

The municipalities interviewed shared their public engagement strategies, presented on the next few pages.

Table 4: Municipal Community Engagement Strategies	
Municipality (How do residents participate in organics diversion)	How has the Municipality engaged with residents?
Arlington (Voluntary - Opt In)	<ul style="list-style-type: none">• Outreached at a farmers' market and set up a pilot drop-off site at market.• Created a webpage dedicated to composting on city website and regularly update with workshops and events.• Door knocked and sent letters to neighbors close to where organics diversion bins were to be cited to address concerns.• Held several informational sessions for the neighborhoods near the bins to allow residents to voice concerns for the town to address before putting in bins.• Expanded hours for drop-off bins to respond to resident demand.

Somerville (N/A)	<ul style="list-style-type: none"> • Conducted research based on resident demand • After completing a consumption-based GHG Inventory, will develop a public engagement/community outreach campaign to increase awareness on the impact that personal choices (e.g. consumption) have on GHG emissions
Cambridge (Voluntary - Opt Out Method)	<ul style="list-style-type: none"> • Ran pilot programs to manage challenges. • Door knocked in pilot area to ask for feedback. • Used postcard mailings, press coverage, truck wrap advertising, messaging and educational pamphlets. • Committed staff time to resident outreach and education. • Conducted outreach during public events, staffed by Recycling Advisory Committee (appointed by City Manager). • Created simple and clear educational materials to explain how to divert organics. • One year after city-wide roll out: re-evaluated methods and suggested resident volunteers educating others on routes with low participation rates.
Boston (Voluntary - Opt In)	<ul style="list-style-type: none"> • Responded to resident demand for composting by developing program. • Created pilot drop-off at farmers' markets to respond to resident demand. • Adjusted number of bins at drop-off locations to accommodate high resident demand. • Manage a webpage with information and quiz about the drop-off program.

<p>Natick (Voluntary - Paid)</p>	<ul style="list-style-type: none"> • Outreached at public events, included an art display. • Posted on community facebook groups. • Created email list from sign ups at public events to build a newsletter listserv. • Conducted focus groups at the end of first pilot and encouraged residents to organize. This lead to the creation of Natick Neighbors Compost, a community group leading outreach and education for private organics collection subscriptions.
<p>Hoboken (Voluntary - Paid Residential, Opt In Method - Commercial)</p>	<ul style="list-style-type: none"> • Bulk of outreach and education done by Hoboken Green Team, a volunteer group of residents. • Partnered with local middle school eager to compost to help with outreach and education to other schools. • Engaged with businesses to increase program visibility.

Barriers Analysis

The barriers to large-scale organics diversion in the Greater Boston Area can be grouped into three topics:

- Cost (Table 5)
- Participation (Table 6)
- Operations (Table 7)

Table 5. Addressing Cost: Barriers and Municipal Solutions to Large-Scale Organics Diversion in the Greater Boston Area		
Category	Barrier	Municipal Solutions
Cost	➔ Low budget prioritization	<ul style="list-style-type: none"> ✓ Establish zero-waste legislation and advocate for state zero-waste policies. ✓ Consolidate financial responsibility for organics diversion in a single department. ✓ Reduce competing costs of waste management (e.g. improve route efficiencies, identify new recycling markets). ✓ Increase general waste management budget.
	➔ High operational costs	<ul style="list-style-type: none"> ✓ Identify alternative sources of funding (e.g. MassDEP grants). ✓ Support the development of nearby organics processing facilities. ✓ Support the development of automated hauling equipment.
	➔ High contextual costs	<ul style="list-style-type: none"> ✓ Increase visibility and achieve economies of scale in organics diversion by conducting strong program outreach, education, and responsive adaptation. ✓ Take advantage of MassDEP resources such as the Municipal Assistance Coordinator, recycling grants, and organics diversion maps for locating and partnering with neighboring cities and private haulers. ✓ Phase in a volume-based PAYT system for garbage collection.

Table 6. Addressing Participation: Barriers and Municipal Solutions to Large-Scale Organics Diversion in the Greater Boston Area

Category	Barrier	Municipal Solutions
Odors and Animals	➔ Participants are concerned about rodents and odor	<ul style="list-style-type: none"> ✓ Communicate pest and odor prevention best practices through outreach and education to minimize issues and assuage fears.
	➔ Bins and drop-off locations give off odors and are susceptible to animals such as squirrels and raccoons	<ul style="list-style-type: none"> ✓ Construct locking bins and storage containers from heavy-duty plastic. E.g. cities of Cambridge and Natick. ✓ Use and promote durable bin liners. ✓ Clean out toters with every pick up using on-vehicle power washers. E.g. private hauler CERO ✓ Partner with municipal board of health and inspection services to ensure strong anti-critter operations
Urban Density	➔ Lack of physical space to store toters	<ul style="list-style-type: none"> ✓ Increase frequency of organics collection to allow for smaller toters.
Culture	➔ Community does not prioritize organics diversion	<ul style="list-style-type: none"> ✓ Communicate organics diversion motivation, benefits, and program details through outreach and education to get community buy-in and increase program visibility. ✓ Support systems-change in schools and other institutions to be more waste conscious, e.g. ensure recycling bins are available, promote waste reduction and recycling with advertising campaigns ✓ Encourage and support institutions in partnering with private organics hauler if municipal program is unavailable.

Table 7. Addressing Operations: Barriers and Municipal Solutions to Large-Scale Organics Diversion in the Greater Boston Area

Category	Barrier	Municipal Solutions
Organics Hauling	➔ Some municipalities do not have the trucks, human resources, or capital to provide organics collection and hauling	<ul style="list-style-type: none"> ✓ Contract with a private hauler to provide municipal organics collection. ✓ Partner with a preferred private hauling company to offer subsidized rates for interested participants. ✓ Establish organics drop-off locations for interested participants.
	➔ Drivers have high turnover rate due to nature of the work	<ul style="list-style-type: none"> ✓ Incentivize drivers with greater training, salaries, and/or benefits.
	➔ Private haulers pay additional fees in some municipalities to get permits	<ul style="list-style-type: none"> ✓ Review permitting fees for appropriateness in the context or organics hauling to consider subsidizing or repeal.
Organics Facilities	➔ Facilities have differing and transitory capacities to process packaged foods, compostable bags, compostable dining-ware, contamination, yard waste, etc. in the waste stream	<ul style="list-style-type: none"> ✓ Fund the development and support the sharing of depackaging/sorting equipment and knowledge. ✓ Communicate accepted materials clearly through outreach and education to prevent contamination. ✓ Communicate up-front to participants that accepted items may change depending on processing facility capacities. ✓ Advocate for state-wide standardization (as was done for recycling) to reduce contamination and participant confusion.
	➔ Facilities are not running at full capacity or full efficiency	<ul style="list-style-type: none"> ✓ Increase the supply of diverted organics by achieving economies of scale (refer to Culture section in above table).

Organics Facilities (continued)	➔ Facilities may emit odors and leachate	✓ Develop or support facilities located away from residential and commercial areas.
	➔ High regional land values	<u>Not easily addressable by a municipality</u>
	➔ New England temperatures do not enable full decomposition of some compostable dining-ware	

Cost Table

The table on the following page estimates high-level cost for various diversion methods, and do not necessarily represent actual costs. Estimates are based on 2019 prices. It is likely that organic waste diversion costs will go down in the future as WTE facilities reach capacity and diversion becomes more of a priority in Massachusetts.

Where parentheses are used for dollar amounts, these would be negative costs, or cost savings. Net annual operating cost change indicates how much the city would have to pay in annual costs for waste management, above what it pays now. When this number is in parentheses, this represents a potential reduction in annual waste costs to the city of Medford, due to saving money on trash disposal.

Note: the projected fiscal year 2019 waste budget was \$6.8 million, including trash, recycling, yard waste, white goods, and bulky items. Trash makes up \$4.2 million of that budget.⁴

⁴ Menezes, Mary. "Copy of Waste MGMT 2019.Xls," March 22, 2019.

Table 8: Cost Table							
	Options						
	Drop-Off Sites	DPW	Expand Waste Management Contract	RFQ to Promote Private Hauler	Curbside Pick-up with Bootstrap Compost	Curbside Pick-up with Garbage to Garden	Drop-off Sites with CERO
One-Time Fixed Costs	\$5,000 (5 bins)	\$165,000 (single packer truck)	Unknown	\$5,769 (Labor for one month full-time work)	\$126,000 (18,000 bins)	\$90,000 (18,000 bins)	\$5,000 (5 bins)
Annual Operating Costs (excludes tipping fee)	\$6,000 (hauling)	\$136,765 (Salaries & benefits for 2 DPW workers)	Unknown	\$5,769 (Annual 160 hours of labor spent on advertising & fielding questions)	\$27,000 (\$1.50/HH)	\$250,000 (hauling costs)	\$0
Tipping Fee	\$65/ton	\$65/ton	\$65/ton	\$0	\$65/ton	\$50/ton	\$120/ton
Net Annual Operating Cost change if trash reduced by 5%*	\$92,576	\$223,341	Unknown	(\$58,399)	\$113,576	\$301,791	\$214,121
Net Annual Operating Cost change if trash reduced by 15%*	(\$35,742)	\$95,023	Unknown	(\$186,717)	(\$14,742)	\$173,473	\$85,803

Major Recommendations

- 1. Consider the barriers and their solutions.** Tables 5, 6, and 7 present common barriers to large-scale organics diversion programs, focusing on challenges relevant to the Greater Boston Area. We recommend considering the example solutions to these barriers. It could also help to consider, as a first step or complementary process, broader systems and policy changes to create an organics diversion-friendly culture and political environment. Additionally, reviewing the barriers may allow the municipality to avoid common pitfalls.
- 2. Identify the top Medford-specific program alternatives.** Table 9 compares the strengths and challenges of the six program alternatives. We recommend deciding on priority criteria (seen in the table's rows) that reflect municipal goals and constraints. Then, select the top two alternatives that address those criteria.
- 3. Gauge community support to select a final program.** Program visibility and resident buy-in are key to program success. We recommend:
 - Reaching out to residents who have requested organics diversion to create a volunteer organics diversion task force.
 - Including the resident task force in deciding on and implementing community outreach methods and objectives.
 - Conducting community outreach to engage the general public about residents' specific motivations and concerns.
 - Collaboratively developing next steps toward selecting the final program.
- 4. Explore including the commercial sector.** Restaurants, schools, hospitals, and other large food waste generators have been important participants in some municipal organics diversion programs. We recommend that the city consider commercial and institutional organics diversion routes, in addition to residential, to potentially increase efficiency with scale.
- 5. As necessary, evaluate private haulers.** We recommend using the research and comparison tables in Chapter 6 to select an appropriate private hauler, if applicable.
- 6. Implement program gradually.** Most cities phase in municipal organics diversion with a step-by-step combination of community engagement, drop-off sites, and pilot curbside collection. We recommend introducing organics diversion in a step-by-step process. Refer to Chapter 5 for examples.

Note that in Resident Cost and City Operations subcategories, the word ranking reverse in color. Refer to Appendix A for rationale.

Note that in Resident Cost and City Operations subcategories, the word ranking reverse in color. Refer to Appendix A for rationale.

Appendix

Multi-Criteria Analysis Score Rationale

Multi-Criteria Analysis Score Rationale			
Environment	Net GHG Emissions Reduction		
	Option	Ranking	Rationale
	Business as Usual	None	No additional organic waste is being diverted.
	DPW	Minimal	Additional organic waste would be diverted via pick-up by DPW. Organic waste diversion slightly reduces GHG emissions.
	Expand Waste Management Contract	Minimal	Additional organic waste would be diverted via pick-up by WM. Organic waste diversion slightly reduces GHG emissions.
	Curbside Pick-up with Private Hauler	Minimal	Additional organic waste would be diverted via pick-up by private hauler. Organic waste diversion slightly reduces GHG emissions.
	Drop-off Sites	Minimal	Minimal organic waste would be diverted via drop-off sites due to a lower anticipated participation rate than curbside pickup. Organic waste diversion slightly reduces GHG emissions.
	RFQ to Promote Private Hauler	Minimal	Additional organic waste would be diverted via pick-up by private hauler. Organic waste diversion slightly reduces GHG emissions.
	Improvement to Soil Health		
	Option	Ranking	Rationale
	Business as Usual	None	Incineration from Wheelabrator Saugus is not a soil amendment.
	DPW	Some	This is dependent on where DPW hauls organics to. If it is to a compost site with good practice, then it is a high level. If it is to a co-digestion site, depending on the expert, some say that it is equivalent to compost, while others disagree and believe that the byproduct (digestate) of co-digestion may harm soil health.

Environment (Continued)	Expand Waste Management Contract	Some	Depending on the expert, some say that it is equivalent to compost, while others disagree and believe that the byproduct (digestate) of co-digestion may harm soil health.
	Curbside Pick-up with Private Hauler	Some	This is dependent on where the company hauls organics to. If it is to a compost site with good practice, then it is a high level. If it is to a co-digestion site, depending on the expert, some say that it is equivalent to compost, while others disagree and believe that the byproduct (digestate) of co-digestion may harm soil health.
	Drop-off Sites	Some	This is dependent on where the company hauls organics to. If it is to a compost site with good practice, then it is a high level. If it is to a co-digestion site, depending on the expert, some say that it is equivalent to compost, while others disagree and believe that the byproduct of co-digestion (digestate) may harm soil health.
	RFQ to Promote Private Hauler	Some	This is dependent on where the company hauls organics to. If it is to a compost site with good practice, then it is a high level. If it is to a co-digestion site, depending on the expert, some say that it is equivalent to compost, while others disagree and believe that the byproduct (digestate) of co-digestion may harm soil health.
Processing	Co-digestion or Compost		
	Option	Ranking	Rationale
	Business as Usual	None	There is currently no municipally-endorsed or municipally-provided organics diversion.
	DPW	Unknown	There are no current or proposed operations; would depend on city plans.
	Expand Waste Management Contract	Co-Digestion	Waste Management, Inc. hauls organics to the CORE facility where they are slurried and sent to the Greater Lawrence Sanitary District.
	Curbside Pick-up with Private Hauler	Dependent	It depends on the organics hauler. If Agri-Cycle hauls, is co-digestion with dairy manure, and others are compost.

Processing (Continued)	Drop-off Sites	Dependent	It depends on the organics hauler. If Agri-Cycle hauls, is co-digestion with dairy manure, and others are compost.
	RFQ to Promote Private Hauler	Dependent	It depends on the organics hauler. If Agri-Cycle hauls, is co-digestion with dairy manure, and others are compost.
	Items Diverted		
	Option	Ranking	Rationale
	Business as Usual	Nothing	There is currently no municipally-endorsed or municipally-provided organics diversion.
	DPW	Unknown	There are no current or proposed operations; would depend on city plans.
	Expand Waste Management Contract	Food, meat/ dairy, some bioplastics	Can accept all organic food items and some bioplastics.
	Curbside Pick-up with Private Hauler	Food, meat/ dairy, some bioplastics	Can accept all organic food items and some bioplastics, dependent on hauler.
	Drop-off Sites	Food, some bioplastics	Would not accept meat/dairy to prevent risk of animal attraction in public spaces.
	RFQ to Promote Private Hauler	Food, meat/ dairy, some bioplastics	Can accept all organic food items and some bioplastics, dependent on hauler.
Residents	Ease to Divert Organics		
	Option	Ranking	Rationale
	Business as Usual	None	Residents need to figure out how to divert organics on their own.
	DPW	Some	DPW would collect organics on the curb and would seek to match pick-up to current routes.
	Expand Waste Management Contract	Some	Waste Management would collect organics on the curb and contract could be set so pick-up matches current routes.
	Curbside Pick-up with Private Hauler	Some	Private Hauler would collect organics on the curb and contract could be set so pickup matches current routes.
	Drop-off Sites	Minimal	Residents would need to travel to drop-off site which could or could not be conveniently placed in relation to their residence and/or current travel routes.

Residents (Continued)	RFQ to Promote Private Hauler	Minimal	Residents would need to privately create contract with private hauler but could go to city for support.
	Resident Cost		
	Option	Ranking	Rationale
	Business as Usual	High	There is currently no municipally-endorsed or municipally-provided organics diversion, so residents currently pay for materials to backyard compost or subscribe with a private hauler .
	DPW	Some	In order to pay for operations, it is likely that the cost would go into municipal taxes.
	Expand Waste Management Contract	Some	In order to pay for operations, it is likely that the cost would go into municipal taxes.
	Curbside Pick-up with Private Hauler	Some	In order to pay for operations, it is likely that the cost would go into municipal taxes.
	Drop-off Sites	Some	In order to pay for operations, it is likely that the cost would go into municipal taxes, though this would likely be lower.
	RFQ to Promote Private Hauler	High	Residents would have to pay full cost of subscription.
	Receive Compost		
	Option	Ranking	Rationale
	Business as Usual	No	There is currently no municipally-endorsed or municipally-provided organics diversion.
	DPW	Unknown	No current or proposed operations; would depend on city plans.
	Expand Waste Management Contract	No	Compost is not created as an output of Waste Management, Inc.'s processing.
	Curbside Pick-up with Private Hauler	Possible	Would depend on the contract between the hauler and the city.
	Drop-off Sites	Possible	Would depend on the contract between the hauler and the city.
	RFQ to Promote Private Hauler	Possible	Would depend on the contract between the hauler and the city.

City Operations	Municipal Cost		
	Option	Ranking	Rationale
	Business as Usual	None	There would be no additional city expenditure because there is currently no municipally-endorsed or municipally-provided organics diversion.
	DPW	Substantial	The city would need to invest in trucks, waste hauler salaries, and educational and outreach material.
	Expand Waste Management Contract	Some	The city would have to pay additional costs for the added organics collection contract with Waste Management, Inc., and educational and outreach material.
	Curbside Pick-up with Private Hauler	Some	The city would have to pay additional for the added organics collection contract with any private hauler, and educational and outreach material.
	Drop-off Sites	Minimal	The city would need to invest in drop-off bins, a smaller contract with a private hauler, and educational and outreach materials.
	RFQ to Promote Private Hauler	Minimal	The city would need to pay for educational and outreach materials.
	Equipment Required		
	Option	Ranking	Rationale
	Business as Usual	None	There is currently no municipally-endorsed or municipally-provided organics diversion.
	DPW	Substantial	Would need to procure at least one additional truck.
	Expand Waste Management Contract	Minimal	Need to order residential bins and toters.
	Curbside Pick-up with Private Hauler	Minimal	Need to order residential bins and toters.
	Drop-off Sites	Some	Need to order drop-off bins.
	RFQ to Promote Private Hauler	None	No large equipment needed.
	Logistics of Establishing Partnership		
	Option	Ranking	Rationale
	Business as Usual	None	There is currently no municipally-endorsed or municipally-provided organics diversion, so no partnership is necessary.

City Operations (Continued)	DPW	Substantial	Medford would need to develop a partnership with wherever they haul organics to.
	Expand Waste Management Contract	Minimal	Medford would add to their current Waste Management contract.
	Curbside Pick-up with Private Hauler	Substantial	Medford would need to develop a new partnership with a private hauler, at a scale of 18,000 households, with a municipal contract.
	Drop-off Sites	Some	Medford would need to develop a new partnership with a private hauler, at a smaller scale, based on number of drop-off sites.
	RFQ to Promote Private Hauler	Minimal	Medford would need to develop a new partnership with a private hauler, at a smaller scale than a curbside or drop-off program, with no municipal contract.
	Longterm Program Management		
	Option	Ranking	Rationale
	Business as Usual	None	There is currently no municipally-endorsed or municipally-provided organics diversion, so no partnership is necessary.
	DPW	Substantial	Medford staff would need to continue maintaining a partnership with wherever they haul organics to.
	Expand Waste Management Contract	Minimal	Medford staff would continue their Waste Management partnership. This would not add much to longterm management as long as Waste Management, Inc. continues to pick up trash and recycling, and continue education.
	Curbside Pick-up with Private Hauler	Minimal	Medford staff would continue the new partnership with the private hauler and communicate about changes or concerns in pickup of organics and continue education.
	Drop-off Sites	Some	Medford staff would need to monitor drop off sites, continue partnership with the private hauler, and continue education.
	RFQ to Promote Private Hauler	Some	Medford staff would need to advertise, conduct outreach for the private hauler, and continue education.

City Operations (Continued)	Potential Additional Traffic from Organics Diversion Vehicles		
	Option	Ranking	Rationale
	Business as Usual	None	Currently, residents can privately sign up with any private hauler, which means several different companies are driving in Medford and are likely adding to traffic.
	DPW	Minimal	DPW would add an additional truck to cover the route.
	Expand Waste Management Contract	Minimal	Waste Management, Inc. would add an additional truck to cover the route.
	Curbside Pick-up with Private Hauler	Minimal	The private hauler would add additional vehicles to cover the route.
	Drop-off Sites	Minimal	Residents could drive to the drop-off site and this would increase traffic around the drop-off site.
	RFQ to Promote Private Hauler	Minimal	The private hauler would add additional vehicles to cover the route.

Note that in Resident Cost and City Operations subcategories, the word ranking reverse in color.

Please refer to full report for bibliography.

