Island-Wide Organics Feasibility Study
Final Report

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Executive Summary

Background and Study Purpose

The study was conducted between March 2016 and May 2017. The purpose of the yearlong Island-Wide Organics Feasibility Study was to examine issues around food waste recycling on the Island and develop recommendations for local food waste management. The study, funded by the Vision Fellowship, was initiated partly in response to the impending enforcement of the Massachusetts Department of Environmental Protection's (MDEP) commercial food waste ban that targets food operations generating one ton or more of organic waste per week, requiring separation and repurposing or composting this waste. The Island generates an estimated 6,500 tons of food waste annually, but has no public composting facility for food waste and no comprehensive plan for local processing of it. As of the time of this report, neither transfer station is prepared to accept separated food waste for composting. There is no system for addressing the MDEP ban or moving to an Island-wide response.

Study Activities

The study team included a project manager, an assistant, a consulting environmental planner and an active 6-member committee. Staff and committee members visited off-island composting facilities, a food waste extrusion facility and an anaerobic digester. They reviewed literature, conducted a pilot project to collect food waste from a sample of Island restaurants and surveyed farmers and restaurants. The group also developed criteria for assessing potential technologies for managing food waste and ranked these for feasibility on the Island. The team provided public education through community events and the press.

Results and key recommendations for the Island

- Two technologies were ranked highest for Island food waste processing infrastructure: In-vessel composting, which is an odor and pest-free process and extrusion technology, which can turn food waste into an ingredient for livestock feed.

- In-vessel composting emerged as the most feasible. *Recommendation: Pursue funding for in-vessel equipment to be housed at one or both of the transfer stations*

- The pilot project picked up 16 tons of food waste from restaurants. With education restaurant staff are willing and able to separate food waste effectively. *Recommendation: Pursue business possibilities for pick-up service.*

- Processing food waste locally would cost less than the current process of shipping all food waste off-Island and reduces environmental impacts. *Recommendation: Promote Island-wide food recycle, reuse and recover activities.*

- Island farmers, landscaping businesses and homeowners need compost. Large quantities are purchased from off-Island. Composting food waste would increase a local source and business opportunity. *Recommendation: Support and encourage farmers and other businesses to develop licensed composting operations that can accept food waste.*

Massachusetts Commercial Organics Ban

The Massachusetts Department of Environmental Protection (MDEP) instituted a "ban on disposal of commercial organic wastes by businesses and institutions that dispose of one ton or more of these materials per week." [i] On October 1, 2014, this requires any business that meets the threshold to divert food waste from landfills or incineration, either by donating it, or by recycling it, which is usually done through anaerobic digestion or composting. The Island has no composting or anaerobic digestion facility that can take food waste, except for to farms doing so on a small scale. In response to this new law, the MVVF-funded feasibility study emerged.

The research done for this study was the first of its kind on MV. Because of that, our calculations are estimations based on the best resources we could find. Our population numbers came from the Martha's Vineyard Commission and MV Chamber of Commerce, and the numbers used to estimate residential and businesses food waste came from RecyclingWorks and the ReFED roadmap. Primary sources are noted in footnotes and appendices.

Food Waste Challenges

Each year, an estimated 6,500 tons of food are thrown in the trash on Martha's Vineyard Island. Nationwide, at least 40% of food grown in the U.S. is never eaten. Time, money, water, land, and natural resources are used to produce food that is thrown away. Meanwhile, 1 in 6 Americans is food insecure.[ii]

A 2016 study by ICF looked at the economic impact of the 2014 Commercial Food Waste Ban identified key implementation barriers as "lack of space for composting facilities, better source separated wastes in order to prevent contamination, and more stringent enforcement of the ban."[iii] These are the same barriers faced on the Island, but by starting small the organics recycling capacity can be increased along with the amount of source-separated organics that are being diverted from the waste stream.

The IFC study concludes, "the organics waste industry is growing… If the ban normalizes composting or Food Rescue and helps keep food materials out of landfills, it will undoubtedly have a tremendous positive impact on the environment and will change the way people view food and define "waste.""[iv]

Current Municipal Solid Waste (MSW) on the Island

This report will refer to the Island's MSW using both the terms "trash" and "waste" interchangeably. Currently most trash from the Island's 16,500 residents,[v] plus an estimated 98,500 summer residents and visitors,[vi] leaves the Island on the ferries. Each town has a local drop-off location for trash and recycling. Residents, businesses, and institutions also contract with waste haulers – such as Bruno's Rolloff or ABC Disposal - to pick up trash.

Waste from residences, events, and businesses in Tisbury, Oak Bluffs, and from contracted haulers (ABC and Bruno's) is sent to the Oak Bluffs Transfer station. From there, it is sent off-island by ferry to Crapo Hill Landfill in New Bedford, MA, where it is resourced for biogas energy or buried in the landfill. Waste from residences, events, and businesses in Aquinnah, Chilmark, Edgartown, and West Tisbury is sent to the Martha's Vineyard Refuse and Resource Recovery District (MVRD) and then sent off-island by ferry to Covanta SEMASS in West Wareham, MA, where the trash is burned to create energy, and the remaining ash buried in a landfill. Recyclable materials go to E.L. Harvey & Sons in Westborough, MA.

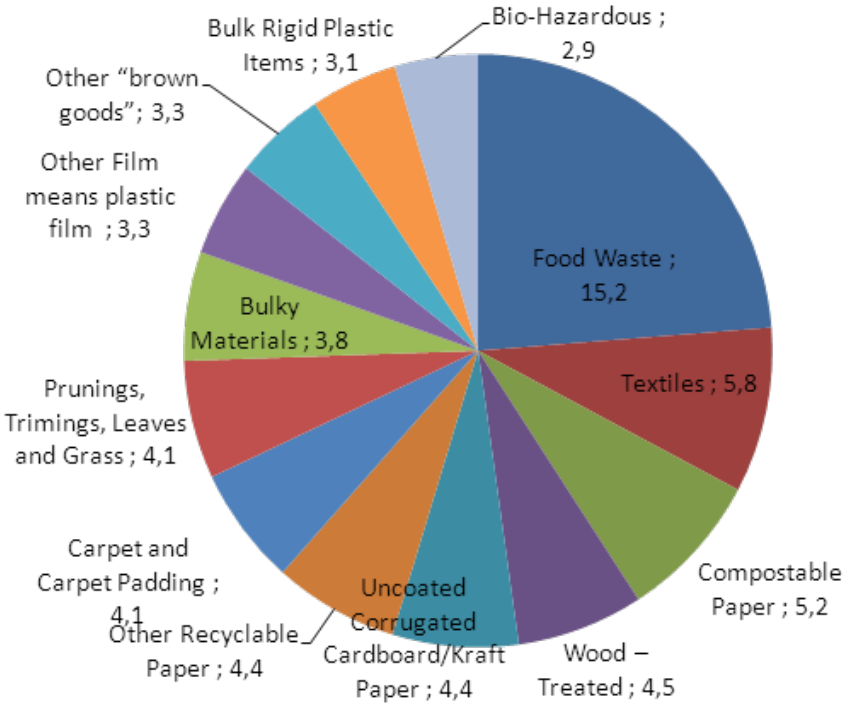
The following map illustrates where our waste goes. It was created by Max King for Slow Foods Martha's Vineyard and showcased at the Living Local Harvest Festival on October 1st, 2016:

Figure 1.

Map of Where Island Waste Goes *Courtesy Max King for Living Local*

The chart below shows the Massachusetts waste stream. Almost 25% of the waste stream is actually compostable material, including food waste, compostable paper, and leaf and yard waste. Nevertheless, in 2014, only 5% of food waste was composted nationwide;[vii] 95% of food waste is ending up in the trash.

Figure 2.



Source: http://slideplayer.com/slide/2857922/

In 2016 the Island's two transfer stations reported a combined total of 19,000 tons of trash sent off-Island for incineration or burial. That's 38 *million* pounds of trash from the Island community. Of that, Don Hatch, Refuse District Director, estimates roughly 45% of that waste, by weight, is food.[viii] This figure is even higher than the chart above. It means approximately 6,500 tons of food waste is being shipped off the Island with the trash each year. Food waste is made up of 70-80% water, and therefore is one of the heavier items in the waste stream, adding to fuel costs.

The value of food waste is lost when it's shipped off-Island. Money is spent on shipping and fuels for hauling, and the value of food for animals, compost, or energy for on-Island use are gone. Animal feed, compost and energy for on-island use were all evaluated in the study.

Island-Wide Waste Economics

What are we spending on food waste disposal? Approximately 19,000 tons of trash is being shipped off the Island each year, along with 3,060 tons of single-stream recycling. To send waste off costs $33.72/ton for shipping and trucking, and another $62 per ton for disposal, or **$95.72** per ton.

To send off single-stream recyclables costs $34.13 per ton in shipping and trucking, and $35 per ton for disposal, or **$69.13** per ton.

Currently, 6,500 tons of trashes are traveling to Rochester, MA- 64 miles round-trip from the Woods Hole Steamship Authority. These trucks are using some 10.67 gallons of diesel per trip ($26.56). Another 12,500 tons of trash are traveling to New Bedford, 104 miles round-trip. At approximately 6 mpg[ix] the trucks are using 17.33 gallons of gas per trip ($43.16).[x]

If food were separated out of the MSW, and processed on the Island, the trucking costs could be $6.88 per ton (See Appendix B). Tipping fees on-Island are currently $45 per ton for disposal, a total of $51.88, a possible savings of $44 per ton of food waste. Using the estimation of 6,500 tons of food waste per year, an annual savings of $286,000 could be realized.

To summarize, based on information from both local transfer stations and the summer Pilot Project, it cost approximately $44 less per ton to process food waste on-island when taking into account shipping, trucking and tipping fees. The table below assumes that 100% of the Island's food waste is being diverted:

Table 1.

Potential Annual Savings from Processing Food Waste Locally				
Dispose Waste Off-Island	**Process Food Waste Locally**	**Total Tons Trash per Year**	**Est. Tons Food Waste**	**Annual Savings**
$96 per ton	$52 per ton	19,000	6,500	**$286,000**

More work is required to determine long-term savings that include labor and costs of constructing an on-Island composting facility.

Food Wasted in the Home

According to the 2016 ReFED Report, 43% of wasted food—approximately 27 million tons per year—occurs in the home.[xi] America wastes enough food to fill the Rose Bowl—a 90,000-seat football stadium—every day.[xii]

The Island's 16,500 year-round residents each waste approximately 238 pounds of food per person per year, or .65 pounds per day. [xiii] Our estimated 98,500 summer visitors and residents do the same. If the summer population spends 3 months (90 days) of the year on the Island, we can estimate the total food waste production on the Island.

Table 2.

Estimated Yearly Residential Food Waste on Martha's Vineyard		
Food waste from year-round population	**16,500 people x 238 lb. year/ 2000 lbs.**	**1963 tons**
Food waste from summer population	**98,500 people x .65 lbs. x 90 days/2000 lbs.**	**2881 tons**
Total yearly food waste		**4844 tons**

Environmental costs: Wasted food consumes 21% of all freshwater, 19% of all fertilizer, 18% of cropland, and 21% of landfill volume.[xiv]

Economic costs: The United States spends over $218 billion—1.3% of GDP—growing, processing, transporting, and disposing of food that is never eaten.[xv]

From a single family of four: Food waste is estimated at $1,350 to $2,275 in annual losses.[xvi]

Hunger: In 2015, 16 million American households were food insecure, lacking reliable access to a sufficient quantity of affordable, nutritious food.[xvii] Reducing wasted food by 20% will recover 1.8 billion meals that could be used to feed hungry people.[xviii]

Waste from businesses on the Island

Forty percent of wasted food in the United States—25 million tons per year—comes from consumer-facing businesses.[xix] On the Island, there are approximately 121 restaurants and takeout spots, 5 grocery stores and 9 smaller markets/fish markets, 7 public schools, over a dozen pre-schools, institutions—the Hospital, the Ice Arena, Martha's Vineyard Community Services, and the YMCA—and various other commercial entities that contribute to food waste. It is difficult to assess every business that serves food on the Island, but from our analysis major restaurants and grocery stores produce **1,746 tons** of food waste each year. To figure out which businesses might be subject to the state ban, formulas were used from RecyclingWorks, a nonprofit working under contract to the Massachusetts Department of Environmental Protection (MDEP), which manages the law. RecyclingWorks helps businesses and institutions maximize recycling, reuse, and food waste diversion opportunities.[xx]

Using the RecyclingWorks formulas, Table 2 on the following page shows the food waste generated by Island businesses that will mostly likely fall under the MDEP food waste ban. There is a discrepancy in the numbers because the State did not take into account the seasonality of some restaurants. Our numbers are based on only the number of months the restaurants are open.

Table 3.

Estimated Tons of Food Waste From Island Businesses Subject to MDEP Ban:				
Business	**Feasibility Study (tons/yr)**	**State List (tons/yr)**	**Weeks open per year**	**Tons per week**
Atlantic	27	150	20	7.50
Nancy's Snack Bar	107	23	20	5.35
S&S Edg	177	198	52	3.81
Homeport	24	60	20	3.00
Beach Plum Inn	8	53	20	2.65
Seafood Shanty	52		20	2.60
S&S VH	81	120	52	2.31
Atria	20	45	20	2.25
Harbor View Hotel	31	113	52	2.17
Lambert's Cove Inn	5	38	20	1.90
Biscuits	32		20	1.60
Chilmark Store		30	20	1.50
Fishbones	10	30	20	1.50
Cronigs VH	65	75	52	1.44
Coop de Ville	7	27	20	1.35
Dairy Queen		23	20	1.15
Farm Neck	21		20	1.05
Chilmark Tavern	20		20	1.00

Other restaurants are very close to the one-ton threshold. The ban applies to businesses generating one ton or more ANY week during the year (not an average), so the following establishments are also subject to the ban:

Table 4.

Estimated Tons of Food Waste From Island Businesses *Possibly* Subject to MDEP Ban				
Business	**Feasibility Study (tons/yr)**	**State List (tons/yr)**	**Weeks open per year**	**Tons per week**
Linda Jeans	50		52	0.96
Square Rigger	22	38	40	0.95
Copper Wok	49		52	0.94
Alchemy	29	45	48	0.94
The Wharf	44	45	48	0.94
Sand Bar	10	18	20	0.90
QuarterDeck		18	20	0.90
Sharky's Cantina (Edg)	44		52	0.85

Current Efforts on the Island

Some Island businesses are already responding to the food waste problem. At the time of this report, Atria Restaurant, Sharky's Cantina, the Harbor View Hotel, and the Square Rigger are participating in the Pilot Project. They are separating wasted food both pre and post-consumer from other trash, and it is being picked up and taken to Morning Glory Farm to be composted. For more on the Pilot Project, see Appendix C. Other restaurants have agreements with pig farmers to take "pre-consumer" waste, which is food that comes from food preparation, not customer plate scrapings.

Cronig's Market has an extensive donation program which involves freezing extra food and giving it to Servings Hands, a food distribution organization. Cronig's also employs food waste reduction strategies, such as preparing only what they think will sell on a given day and using "imperfect" produce for prepared foods and in the salad bar.

For a list of food distribution organizations, see Appendix D.

How much capacity is needed for food waste processing?

We can estimate what capacity would be needed to process food waste on the Island, based on our assessment of business waste generators and what is currently shipped off Island. To accommodate just the businesses that are subject to the commercial organics ban, a system would need to process 22 tons of food waste per week or 3 tons per day. But the system would also need to accommodate our annual fluctuations, meaning four times the average weekly amount in the summer (if not more). Seasonal fluctuations may require processing up to 72 tons per day at times.

These estimates are just for food waste. Wood chips, leaves, soiled paper or cardboard would be required as a source of carbon and bulking agent in most composting systems. These materials are needed at 2-3 times the amount of the food waste (which is the nitrogen source) by volume.

Feasibility Study Activities

The staff, consultant and committee carried out the following activities during the yearlong study:

1. Reviewed literature, previous studies, regulations, and data;
2. Read case studies about what other communities are doing;
3. Toured 7 food waste composting facilities;
4. Toured a food extrusion facility;
5. Toured a food waste anaerobic digester;
6. Conducted residential and commercial surveys;
7. Developed a technology ranking matrix and a site review with the committee;
8. Conducted a wasted food collection Pilot Project to collect primary data;[xxi]
9. Educated the public about the issue of food waste at Island events.[xxii]

Existing research

Information on wasted food, how to reduce food waste, and on different composting, anaerobic digestion, and animal feed methods is plentiful. The documents we referred to most were:

- *A Roadmap to Reduce U.S. Food Waste By 20 Percent*, produced by ReFED in 2016;
- *Wasted: How America is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill,* produced by Dana Gunders for the Natural Resource Defense Council in 2012;
- *Food is Not Trash: Redefining Wellesley's Waste Culture by Composting*, produced by Wellesley College's Environmental Studies program in 2013;

- *Food Waste Diversion and Utilization in Humboldt County,* funded by Humboldt Waste Management Authority, City of Eureka, City of Arcata and Pacific Gas and Electric Company in 2010.

See page 81 Recommended Readings for links to the above resources.

Regulations

Two state agencies regulate food waste recycling operations: Massachusetts Department of Environmental Protection (MDEP) and the Massachusetts Department of Agricultural Resources (MDAR). MDAR focuses on food waste composting sites on farms. Local regulations also apply. In the fall of 2016 the project staff met with the six Board of Health Agents for the Island towns to tell them about the study and the pilot project, and to learn about local regulations. The Board of Health Agents were most concerned with how the restaurants would be separating and storing waste, making sure that the areas are clean and food waste isn't sitting around for long periods of time between pickups. Local Boards of Health may also get involved if there are complaints about the management of composting operations.

The following chart breaks down the regulations relevant to the Study:

Table 5.

Food Waste Regulations				
	Federal	State (MDEP)	State (MDAR)	Local
Facility Permitting		310 CMR 16.04: General Permit for Recycling, Composting or Aerobic and Anaerobic Digestion Operations	330 CMR 25.03: Agricultural Composting Registration. $250 fee.	Notification by email or letter to local BOH with MDEP permit
Facility Siting	1,200 feet from any air traffic operations, or the distance called for by airport design requirements (whichever is greater)	250 ft. from private water source/500 ft. from public water source	Must be located on Agricultural Land	Must comply with local zoning and land-use regulations

Hauling		Training and signage for generators of organic material		Edgartown requires a hauling permit for wasted food transport
Reporting		Accurate records for three years, annual report submitted Feb 15th.	Renewal submitted by Feb 15th each year	
Maintenance		Piles must be monitored for temperature, moisture level, turning/aeration	Piles must be monitored for temperature, moisture level, turning/aeration	Operations must not create nuisance conditions from odor, dust, noise & traffic

For the full text of the MDAR and MDEP regulations, see Appendix E and F.

Communication with Other Organizations, Facility Tours, and Training

Many volunteer hours have gone into studying food waste on the Island. The project staff and committee members communicated with the following organizations about the project: Martha's Vineyard Refuse District, the Martha's Vineyard Commission, the Boards of Health from each town, the Oak Bluffs Planning Board, the Board of Selectmen in Aquinnah, Chilmark and West Tisbury, farmers, restaurants, grocery stores, landscaping companies, Island Grown Schools, the Island Grown Farm Hub, the Martha's Vineyard Shell Recovery Partnership, BiodiversityWorks, Servings Hands Food Distribution, RecyclingWorks Massachusetts, the Cape Cod Composting Network, US EPA, MDEP, and MDAR.

Project staff also attended the Vermont Organics Recycling Summit in Randolph, VT, on April 7, 2016, and the Reduce & Recover: Save Food for People conference at the Harvard Law School Food & Policy Clinic in Boston, MA, on June 28-29, 2016. They also attended a Compost Site Management Workshop hosted by RecyclingWorks Massachusetts, on May 23, 2016, to learn more about current issues and practices in the field.

Tours and interviews were conducted with food waste compost facility operators, and food waste collection companies across the state, and in Vermont, Washington D.C., and California. This was time well spent since it provided useful information on types of facilities and collection systems that are most appropriate for the Island.

Site Visits

The staff and committee visited the following food waste recycling facilities and technologies:

- **Compost with Me**: Turned windrows. Falmouth, MA
- **Green Mountain Compost:** Aerated static pile. Williston, VT
- **Groundscapes Express**: Turned windrows with windrow turning machine. Wrentham, MA
- **Mass Natural Fertilizer** Turned windrows. Westminster, MA
- **Rocky Hill Farm** Three rotary drums and turned windrows. Saugus, MA
- **Sam White & Sons-** Turned windrows with windrow turning machine. Middleborough, MA;
- **Windham Solid Waste Management Distri**ct- Turned windrows. Brattleboro, VT
- **Waste Options**- One large rotary drum and turned windrows. Nantucket Island, MA;
- **Sustainable Alternative Feed Enterprises**- Extrusion technology to manufacture animal feed. Santa Clara, CA
- **Crapo Hill**- Anaerobic digester. New Bedford, MA.

For summaries on facilities, see Appendix H.

Surveys

As part of the study, surveys were sent to the following groups in order to determine interest in composting food waste, and to estimate the demand for compost products on the Island:

1. Residents
2. Restaurants
3. Landscapers and nurseries
4. Farmers

Residential Survey

A survey entitled Residential Compost Survey was distributed at the Living Local Harvest Festival on October 1, 2016 and resulted in 50 responses. That same survey was then constructed through the online survey tool SurveyMonkey and distributed through social media to Island residents, resulting in 41 responses. Of the 91 total respondents, 63 responded that they already compost at home. 28 of 91 would like to bring their food waste to a drop-off location (with an additional 22 "maybe" responses), and 24 out of 91 would pay for curbside pickup (with an additional 25 "maybe" responses). Another 50 out of 91 would attend a workshop on backyard composting.

The survey results show that while two-thirds of responding residents compost at home, there is interest in drop-off or pickup service. Results also showed a desire among residents for more at-home composting knowledge and instruction.

Restaurant Survey

A survey constructed through the online survey tool SurveyMonkey, and titled "Martha's Vineyard Restaurants Rock," was distributed to 31 restaurants. Of the 7 respondents, the

restaurants varied in size from 30-100 seats, and served between 100-300 meals per day. Of the 7, two had pig farmers who picked up some portion of the food waste, but they were interested in potentially utilizing food waste pickup for the balance of their organic waste. The five that do not currently have a diversion program set up were interested in potentially having food waste picked up.

Landscape survey
Informal interviews were conducted in-person, over the phone, and through e-mail with nursery owners and landscapers. Only one nursery (the largest on-Island) does not also have an associated landscaping business. Of the 23 landscapers and nurseries contacted, six responded. They reported buying compost from Coast of Maine in Portland, ME, Vermont Compost in Montpelier, VT, and Bridgewater Farm in Bridgewater, MA. This means compost is being trucked the following distances to the Steamship Authority in (SSA) Woods Hole:

1. Montpelier, Vermont - 261 miles
2. Portland, Maine - 186 miles
3. Bridgewater, MA - 51 miles

Considering the high cost of putting a truck on the ferry to the Island, and the additional driving miles once materials arrive on the Island, we are assuming a significant cost and environmental impact to importing compost to the Island.

Much closer to home, John Keene Excavation in West Tisbury sells island compost and imported chicken manure. The bulk of the material being composted at Keene's is leaves, wood chips, etc. mixed with grass clippings. Food waste would add nitrogen and other nutrients to Keene's compost.

The results were not conclusive enough to estimate the amount of compost being brought onto the Island each year, and it is known that compost from Mass Natural Fertilizer in Westminster, as well as from some other Massachusetts facilities, has been trucked to the Island. However, the survey did confirm that businesses are importing substantial amounts of compost considering just three purchased a combined 3,000 bags of compost, and thousands of yards of bulk compost each year.

Farm Survey
Informal interviews were conducted in-person, over the phone, and through e-mail with Island farmers. Of the 19 farms contacted, 8 farms responded. Farmers (vegetable, meat, and dairy) reported a need for compost to replenish fields and start seeds. All 8 farms reported purchasing compost from off-island sources and expressed a desire to buy Island compost, as well as needing more compost than they can get their hands on. This stems from the sandy quality of the soil on the Island that makes it difficult to garden and farm, further exacerbated by the depletion of minerals in the soil from the continual farming and gardening of the soil. According to Keith Wilda, Farm Hub Director, Island Grown Initiative, soil should contain 4-10% organic matter in order to be productively farmed. However, most of the Island soil contains only 2.5-3% organic matter.

Food Waste Technology Feasibility for the Island

A key goal of the study was to analyze different food waste recycling technologies, for their potential adoption on the Island. Six approaches were identified. The staff combined visits, interviews and extensive discussion in the group to sort through the options. The staff and committee came up with a list of concerns and benefits that can be associated with food waste recycling options.

This study looked at five different technologies for on-Island recycling of food waste.

1. Turned windrow composting
2. Aerated static pile composting
3. In-vessel composting
4. Anaerobic digestion (AD) and
5. Manufacturing animal feed via extrusion technology.
6. Continued off-island transportation model, meaning sending food waste to a recycling facility (whether compost, AD or animal feed) to be processed off-island was reviewed.

The committee rated each technology based on concerns and benefits, and ranked them in order of least concerns and most benefits. Then, the two rankings were added together to get an overall ranking. A SWOT analysis was also done to assess Strengths, Weaknesses, Opportunities and Threats for each technology. The two top-rated options were in-vessel composting, and extrusion to animal feed. These are described in depth below.

The following chart summarizes the top benefits and concerns associated with each technology:

Table 6.

Benefits and Concerns Associated with Food Waste Technologies		
Technology	**Benefits**	**Concerns**
Extrusion	Small space needs. Produces animal feed. Minimal odor, pests, and leachate. Separates inorganic contamination.	High capital and operating costs. Doesn't process leaves, wood chips, and non-recyclable paper. Local markets for animal feed must be developed. Few reference facilities. Contamination causes problems.
Anaerobic digestion	Generates electricity and heat from food waste. Minimal odor, pests, and leachate.	High capital costs. Markets for by-product must be developed. Contamination causes problems.

In-vessel composting	Lower capital costs than extrusion and anaerobic digestion Reduces processing time, and incorporates leaves, wood chips and non-recyclable paper/cardboard. Minimal odor, pests, and leachate. Capacity can be increased with modular units.	Higher capital costs than windrow composting, Contamination causes problems.
Turned windrow composting	Easy to implement. Low-tech and low equipment needs.	Potential for odors, pests, and leachate. Large space needs. Contamination causes problems.
ASP composting	Medium processing time. No need to turn piles.	Contamination causes problems.
Off-Island transport	The concerns with local processing are not present, as waste is shipped away.	Fossil fuel intensive process. Losing valuable resource that could be repurposed.

The committee ranked extrusion as the top technology for having the highest score for many of the criteria, including the creation of a new product for the Island. However the relative newness of the technology, and the uncertainty of where the capital and eventual ownership would fall and whether there was a real market for the product had to be considered. **The conclusion was that in-vessel composting, combined with more conventional outdoor composting at multiple sites would be the most feasible approach to a significant start on managing food waste.**

Variations of Composting Explored

Composting is the biological breakdown of food waste into a nutrient-rich soil amendment. There are three main types of composting technologies:

In-Vessel Composting: Utilize large, slowly rotating cylinders, or other enclosed containers, that blow air into the organic waste to attain optimal temperatures within the container. The rotating drums also provide constant agitation of the organic material. Retention time in the drum varies from a few days to several weeks depending on system design. Usually additional weeks of active composting and curing are required, and can be done in aerated static piles or windrows.

Aerated Static Piles (ASP): Piles of organic waste are constructed with a loader over a series of perforated aeration pipes that blow air through the piles to maintain aerobic conditions and optimal temperatures for degradation. A timer or a temperature probe, with a set temperature range, controls the blower. Typical time in the ASP is 21 days, with no turning of the pile. This is typically followed by additional weeks of ASP or turned windrow curing.

Turned Windrows: Elongated piles of organic waste of varying length, width, and height are constructed and periodically turned with a loader for increased oxygen exposure and porosity. Windrows may also be constructed over aeration pipes to further accelerate the composting process. Piles are typically turned two or three times a week.

In-Vessel Composting in Combination with Turned Windrows and Aerated Static Piles

Despite attractive features of the extrusion process for animal feed, the most feasible approach for the Island seems to be in-vessel composting combined with more conventional composting, such as turned windrows and aerate static piles, some of which are already in operation on Island farms. The in-vessel process takes up a relatively small amount of space, is located inside and could be placed at one or both of the current transfer stations. The product from the in-vessel process is produced relatively quickly, in a few days, and gets through the most objectionable features of composting quickly. The product from the in-vessel process could then be transferred to complete the required curing at a variety of farm or commercial sites around the island to create a compost that could be used on Island farms and gardens and sold to consumers.

Benefits: The benefits to starting the composting process in an in-vessel system are numerous; the active composting time can be as little as three days in a rotary drum, and the enclosed nature of the system helps control odors, pests, and leachate.[xxiii] The system is scalable in the sense that as quantities of food waste increase, additional units can be purchased and installed. An in-vessel composting facility would create local jobs and a limited amount of training is necessary. It could also provide educational opportunities for tours and demonstrations on how to turn food waste into compost. The greatest benefit is that an in-vessel composting system needs carbon sources to mix with the nitrogen-rich food waste, so leaves, yard waste, clean paper and cardboard could also be composted and diverted from the landfill.

Challenges: The equipment needs to be ordered, meaning implementation cannot happen immediately, and there is considerable cost to installation. With more technology comes more moving mechanical parts that will require maintenance. The greatest challenge is that when the materials come out of the in-vessel composting system, they aren't ready to be used. One way to treat the material is to windrow it in an aerated static pile (ASP) system for approximately two weeks. During this time perforated pipes blow air into the pile from underneath. The pile doesn't have to be turned to be aerated. After that it can be brought to a site to be windrowed and cured, usually for 6-8 months. This would require a significant land area (at least 3-5 acres) to ensure the compost is finished and ready to be used to grow new plants.

Environmental Considerations: The ASP and Rotary Drum systems run on electricity. At Rocky Hill Farm, solar panels run the ASP portion of the system on renewable energy.

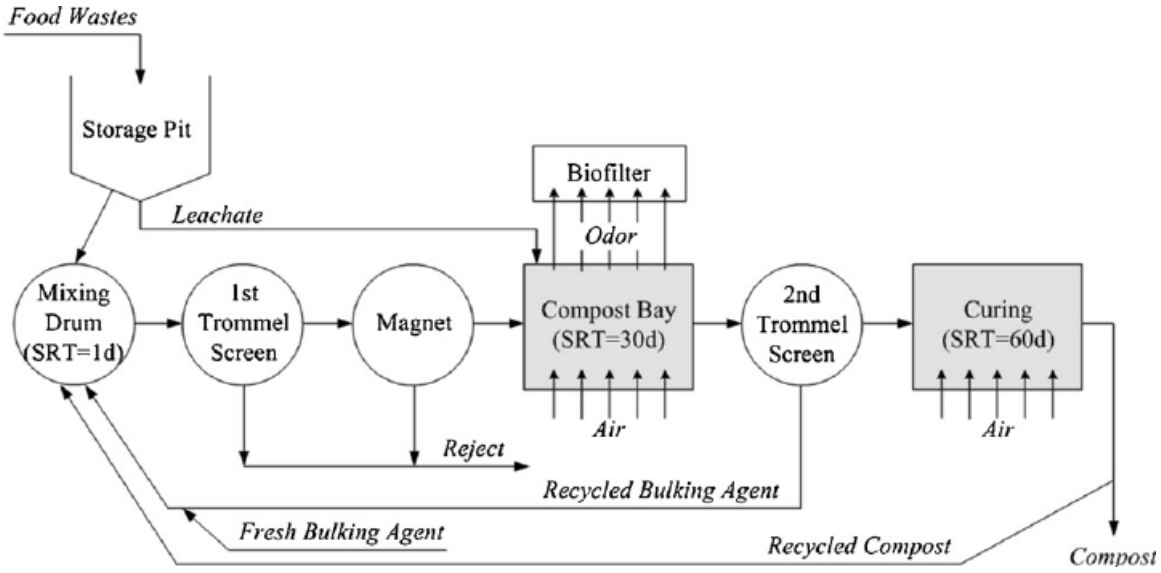
Leachate and groundwater contamination will not be an issue with an in-vessel system, because liquids can be captured in a leachate tank, which can then be used in the composting process, or disposed of at a wastewater treatment plant.

Economic Considerations: Tipping fees at composting facilities across Vermont and Massachusetts are between $45-$65/ton of food waste. A portion of this revenue can be used to pay on a bank loan for the facility. Costs can vary greatly depending on the site, size and type of in-vessel technology. Some examples of in-vessel composting systems sized to handle approximately 6,500 tons of food waste plus per year the necessary organic brown materials to create the correct recipe are as follows:

Capital costs could range from $1.2 to $2 million, including up-front processing mixers, odor control biofilter, and screens for final compost product. Land acquisition, site work, engineering and permitting could add another $500,000 for a total of $1.7 to $2.5 million. Operating costs are typically between $30 and $40 per ton, or $300,000 to $400,000 per year. It is also recommended that a modular composting technology be utilized to phase in the facility, and fund the build-out with operating revenue[xxiv]

There are multiple in-vessel systems for purchase. It is recommended that a request for proposals be prepared and distributed to pre-qualified vendors and developers. The RFP could also be sent to engineering firms that build "turn-key" composting facilities, which would then be operated by MVRD or another qualified company. It's hard to put a timeframe on this process, but after the RFP process, interviews of finalists, and contract negotiations would be needed.

Figure 3: In-Vessel Composting Process



Source: https://www.researchgate.net/figure/5822758_fig1_Fig-1-Schematic-diagram-of-pilot-scale-in-vessel-composting-plant

In the above diagram, food waste comes into the storage area, and then is mixed with carbon materials in the mixing drum. This schematic assumes the mixing drum has a 1 day retention time (SRT=1d) and that is how some facilities operate the rotary drum, rather than as a composting vessel. However, the rotary drum facilities we visited at Rocky Hill Farm and Nantucket have a retention time of at least three days, and then utilize turned windrows and/or aerated piles for additional composting. There is a significant difference in the characteristics of the organic materials from one day to three or four days since the food waste after a longer retention time is no longer recognizable, and actually looks like compost. Another variation is to use a rotary drum with a five day retention time which would allow the material to meet the MDEP requirements for temperature and vector attraction, and therefore the raw compost could be transported to a series of off-site composting sites with reduced chances for vector attraction and odor.

Upon removal from the rotary drum, the material goes through a trommel screen to remove large contaminants (some composting operations might just do this at the end), then passes through a magnet to screen out metals. The Nantucket, and Marlborough facilities utilize trommel screens after the rotary drum, but Rocky Hill does not.

The "compost bay" curing can be ASP, turned windrow, or aerated turned windrow, where the materials compost over a 21–30 day period (SRT=30d).

After the compost bay, the material goes through a smaller screen to remove most remaining inorganic contaminants, then is moved to a location to cure, usually for 6-8 months until it has stopped "actively" composting and can be used in fields, gardens, etc.

There are different types of in-vessel composters: Pictured below is a Rotary Drum.

Source: http://www.southdadeswcd.org/?page_id=91

Another kind is a specially constructed box, such as a shipping container, with an aeration system and screw agitator:

Source: http://www.recyclingproductnews.com/company/3127/green-mountain-technologies

Farms as partners with in-vessel composting

The use of an in-vessel composting system would feed into the expanding number of farms and businesses developing composting operations. Since the Organics Feasibility Study began, an increasing number of Island farms have sought or are seeking permits from MDAR to accept small amounts of food waste (105 tons or less per week). If enough farms were permitted, the Island could have a network of compost sites spread across the Island, which would lessen transportation costs. Farms are currently utilizing turned windrow systems, but Aerated Static Piles could also be considered. A proposal for the Study by SCS Engineers lays out a pilot project for an ASP system utilizing Gore covers. The pilot is proposed to last six months and process 105-135 tons of food waste, plus 200 cubic yards of leaves. The pilot is estimated to cost $76,500, a portion of which ($47,000) could be covered by a MDEP grant. Table 7 lists some of the possibilities.

Once the top two technologies were identified, a site review was conducted. The Martha's Vineyard Commission prepared a map that showed all farm land, conservation land and town owned land that was the appropriate distance from a well (over 250 feet) and over half an acre in size. See Appendix R for map. The following list of favorable criteria were assessed for each site:

- Easily accessible
- 250 + feet from private well/ 400'+ from public well
- Not in close proximity to neighbors
- Ample space for recycling operation
    - Minimum size ½ acre, preferred size 3-5 acres
- Distance from wetlands or other sensitive areas
- Access to water and electricity (if needed)
- Access to necessary equipment
- Knowledge and experience with composting operations by personnel

These potential sites were all contacted and Table 7 summarized the results.

Table 7.

Survey of Sites for Composting Operations				
Name	**Currently accept food waste? Consider accepting food waste?**	**Benefits**	**Concerns**	**Future potential**
Morning Glory Farm	Yes.	MDAR permit, have equipment, and use of compost on the farm.	Limited space.	Would buy semi-finished compost and cure.
MVRD Transfer Station	Yes, but its mixed with trash. Interested.	Already handle waste, centrally located, and can dispose of contaminants.	Flight path for airport.	An in-vessel composter, followed by off-site curing.
OB Transfer Station	Yes, but its mixed with trash. Interested.	Already handle waste, and compost leaf & yard waste.	Requires a public/private partnership, limited space.	In-vessel composter, followed by off-site curing.
Goodales	Yes.	MDAR permit, have equipment and sufficient space.	Current residential zoning would require variance or rezoning.	An in-vessel composter if land can be rezoned.
Keene's	No. Interested.	Already compost leaf & yard waste, have equipment, and compost markets.	Their operation runs smoothly, don't want to cause problems with neighbors.	Windrow composting operation.
IGI-Thimble Farm	No. Interested in AD.	Fits in with IGI's mission.	Space is better used for farming than composting.	Anaerobic digester to heat greenhouse and make fertilizer product.

Whippoor will Farm	No. Interested.	Have equipment.	Limited space and close proximity to neighbors.	Windrow composting.
The Farm Institute	No. Interested.	Already making compost on a small scale.	Not centrally located.	Windrow Composting.
Beetlebung Farm	No. Interested.	Only potential site in Chilmark. Have equipment.	Not centrally located.	Windrow composting.

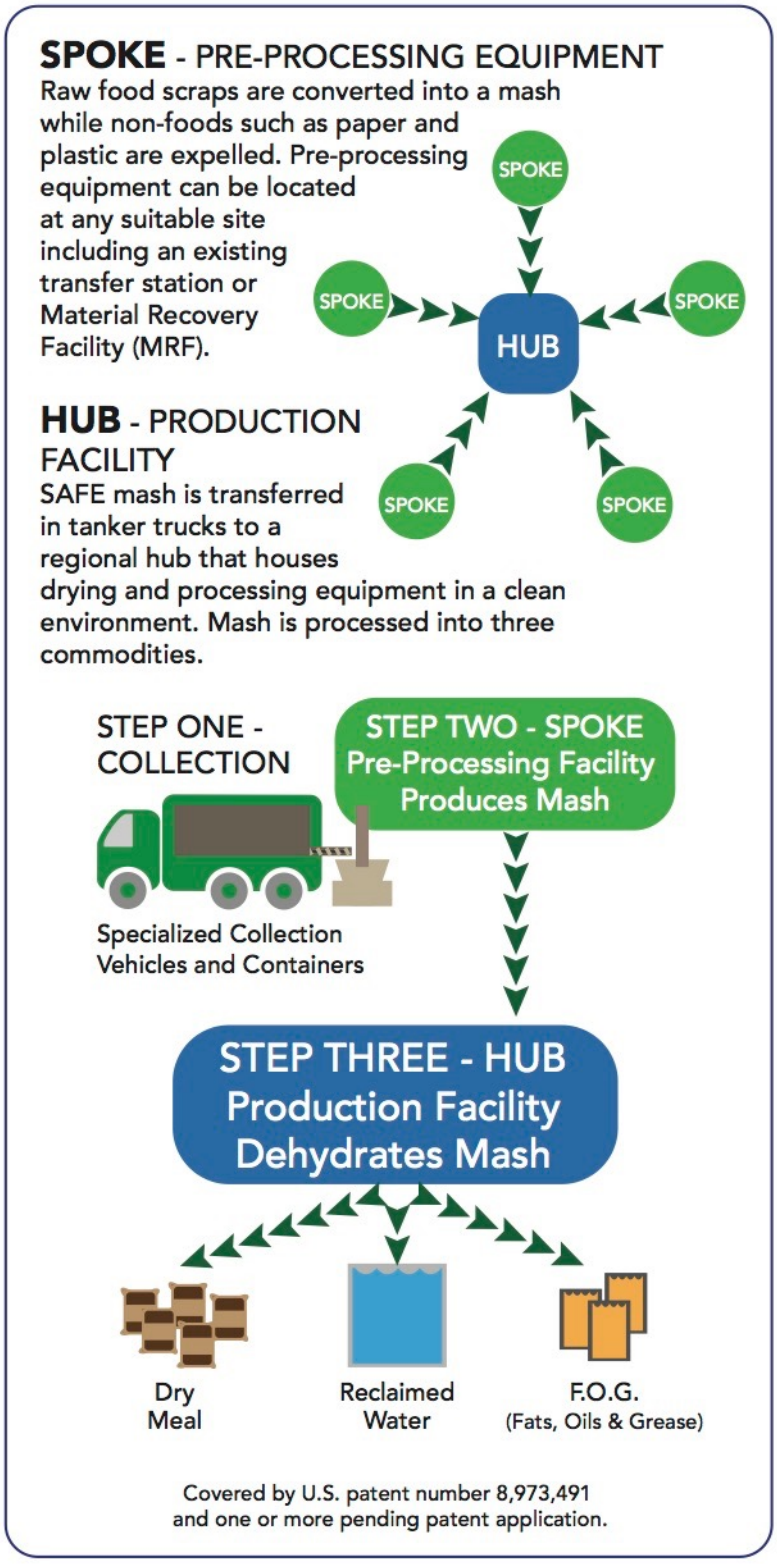
Extrusion process to create an additive for animal feed

Staff and the Study committee were intrigued by the extrusion technology that is being used to take food waste and process it into a high quality additive for animal feed. While for a variety of reasons it was not recommended as the most feasible for the Island, it is worth keeping on our radar. As the technology advances it may become more feasible financially and a business interest might see it as an opportunity.

Making animal feed via extrusion technology is a process where waste is fed into an extruder, mixed and melted by a rotating screw, and then dried to be shaped into a compact meal and used as animal feed.

In March 2016, Abrams visited the Sustainable Alternative Feed Enterprises (SAFE) plant in Santa Clara, CA. The process starts at the nearby transfer station with pre-processing food scraps into a mash. It is then trucked over to the "hub" where it is dehydrated and extruded to remove excess water and oil. The product is a meal that can be combined with other materials to make animal food for pigs, goats, dogs, and other domestic animals. Figure 4 demonstrates the process.

Figure 4.


SPOKE - PRE-PROCESSING EQUIPMENT
Raw food scraps are converted into a mash while non-foods such as paper and plastic are expelled. Pre-processing equipment can be located at any suitable site including an existing transfer station or Material Recovery Facility (MRF).
SPOKE
SPOKE
SPOKE
HUB
SPOKE
SPOKE
HUB - PRODUCTION FACILITY
SAFE mash is transferred in tanker trucks to a regional hub that houses drying and processing equipment in a clean environment. Mash is processed into three commodities.
STEP ONE - COLLECTION
STEP TWO - SPOKE Pre-Processing Facility Produces Mash
Specialized Collection Vehicles and Containers
STEP THREE - HUB Production Facility Dehydrates Mash
Dry Meal
Reclaimed Water
F.O.G. (Fats, Oils & Grease)
Covered by U.S. patent number 8,973,491 and one or more pending patent application.

Benefits:
There are many benefits to this technology. The greatest benefits are:

- The operation is enclosed, and food waste never hits the ground during the processing, so this minimizes the chance of attracting pests or predator species, minimizes outside noise (it is contained in a building), odors, and potential for leachate. The facility could handle all the food waste on the Island if sized correctly, and would be able to handle seasonal fluctuations by sizing equipment for off-peak loads, then running the machines 7 days/week during peak times. The food waste is quickly converted into animal feed, which is the only edible product created by any of the recycling technologies.

- Contamination is sorted out in the process, making it very easy for consumers to sort their food waste without worrying about the occasional trash getting mixed in.

- The permitting could be minimal if the process were to be installed at an existing transfer station. There would be more state and local permit requirements if it were proposed as a new facility in an industrial zone.

- Composting facilities require large amounts of land, something we're short of on the Island. The Santa Clara, CA extrusion facility is in a 10,000 sq. ft. building, and utilizes another 5,000 sq. ft. at a nearby transfer station. If this process were replicated on the Island the operation could potentially be 1/3 of this size based on the amount of food waste to be processed.

- The finished product is a meal used to make dog food, dog treats, pig food, and fish food. The technology also produces reclaimed water (that is used in the facility) and FOG (fat, oil, grease) that can be turned into biofuel.

- An extrusion facility would provide several good quality jobs to operate the facility, and provide an exciting educational opportunity for the community to tour the facility and see locally produced animal feed being made.

Challenges

- The amount of startup capital and continued capital needed to meet operating costs (see *Economic Considerations* below); The SAFE facility in CA cost $6 million (including all equipment), plus $600,000 to install processing equipment in the transfer station. They also retrofitted garbage trucks to collect food simultaneously with trash at a cost of $40,000-$50,000 per truck. These costs are up to 3x as much as we would need to spend here (since the CA location is 3x the size needed on MV). If a SAFE facility were going to be opened on Martha's Vineyard, it could be through a partnership between the landowner and SAFE.

- Water vapor captured during the dehydrating process is reused in the facility. Other environmental benefits are the minimal land requirements, and the low rate of emissions (resulting only from transporting waste from the transfer station to the facility).

- Only food waste would be processed. The technology does not process other organics like leaf & yard waste, cardboard or soiled paper, meaning a missed opportunity to recycle these materials locally, or a separate composting facility.

- There is a significant lead-time on ordering equipment (approx. 8 months) and a new building would need to be constructed, or an existing building renovated, meaning that the timeline for implementation is over a year.

- The market for local animal feed has yet to be evaluated, and therefore the revenue, or cost associated with a final product is unknown.

Off-Island Transport

One of the options for managing food waste is to continue our current system. Food waste would be loaded onto transfer trailers at the two transfer stations, put on the ferry, and driven to a composting or AD facility off-Island. This is what the island is basically doing now, except food waste is not going to a recycling facility.

Benefits
Shipping waste off-island means there is minimal risk for the potential hazards of noise, odor, feeding predator species and attracting pests, and leachate. It's easy to scale if the amount of waste increases- more trucks must be added. No land is needed for composting, storing or curing. It's out of sight, out of mind.

Challenges
The problem with this is that when food waste is shipped off-island, the community is missing out on valuable resources. Whether compost or animal feed is the finished product, these are two things that are imported from off-island to feed livestock and grow crops. Waste is shipped off, and compost and animal feed are shipped on. By keeping the food waste local, this valuable resource is captured and turned into a usable product. Time, space on the boats, and fuel needed to ship materials far distances are all saved.

With the off-island transport model, no local jobs are created and the educational experience of being able to see waste turned into usable products again is missing.

Economic Considerations
To haul wasted food off island it costs approximately $41.19, all variables considered. This same amount hauled to a site on-island is $6.88. Tipping fees off-island range from $45-$65 per ton at composting sites. On-Island compost sites are currently $45-$50 per ton, and

MSW is $162 per ton if dropped off. See the transportation model in Appendix N for more information.

Possible sites:
Currently our food is a major portion of our trash, and is shipped by boat to the mainland, then trucked to the Crapo Hill landfill in New Bedford, MA, or the SEMASS waste-to-energy plant in Rochester, MA.

There are only two compost sites on Cape Cod: Compost with Me in Falmouth, and Watts Family Farm in Sandwich. Compost with Me doesn't have the infrastructure to accept our food waste at this time, and we have been trying unsuccessfully for over six months to get in touch with Watts. Two more distant sites with larger capacity are Mass Natural Fertilizer Co. in Westminster, MA, and Rocky Hill Farm in Saugus, MA.

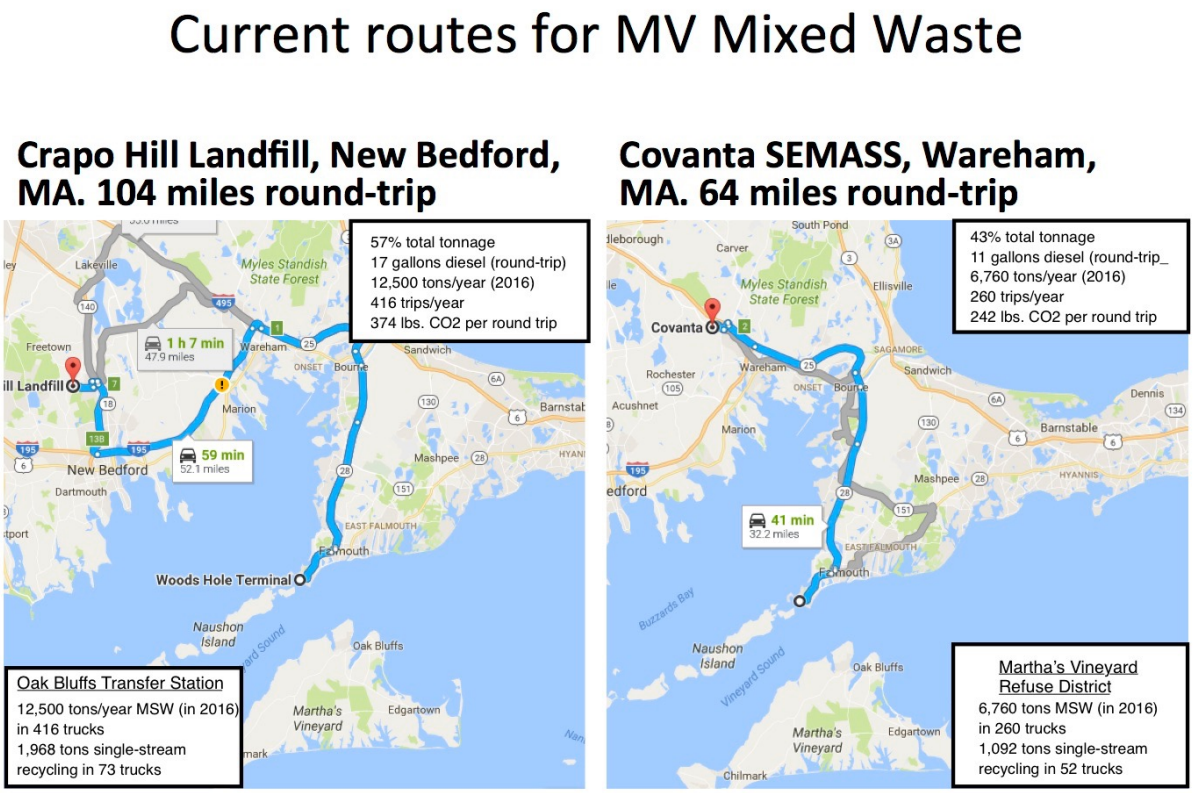
Environmental Considerations:
Crapo Hill is 52 miles from Woods Hole (104 miles round trip), and SEMASS is 32 miles (64 miles round trip).

To ship to composting sites, Mass Natural is 120 miles one way, and Rocky Hill is 92 miles one way. The garbage trucks leaving the Island get approximately 6mpg and run on diesel fuel. They also release metric tons of CO_2 ($MTCO_2$) into the air (22.38 lbs. of CO_2 are released with each gallon of diesel fuel combusted).[xxv] To transport waste to these sites uses the following resources:

- Crapo Hill- 17.33 gallons gas per round trip, .19 $MTCO_2$
- SEMASS- 10.67 gallons gas per round trip, .12 $MTCO_2$
- Mass Natural- 40 gallons gas per round trip, .45 $MTCO_2$
- Rocky Hill Farm- 30.67 gallons gas per round trip, .34 $MTCO_2$

The diagram on the following page summarizes the current hauling routes and resources used to transport Island waste:

Figure 5.



Another environmental consideration of keeping food waste out of the landfill is reduced methane generation. "The EPA states that methane from landfills accounts for 34% of all national methane emissions."[xxvi] By taking food out of the waste stream that goes to the landfill, the percent of methane emissions is greatly reduced.

Challenges Associated with Implementing New Food Waste Recycling Systems

One major factor of the wasted food-recycling puzzle is successful and economic separation and collection of organic materials from trash and recycling. The pilot project demonstrated successful separation at restaurants and events. The next phase of the pilot will work with grocery stores, schools, hospitals and residences (see Appendix C for more information).

The greatest lesson from the Pilot Project separation of food waste at restaurants is that the restaurants were able to separate waste with minimal contamination (glass, plastic, metal, etc.). The separation was made easier since all food including meat and bones, and paper towels and napkins were allowed in the food waste. In the instances where contamination was present, a picture and a text message were sent to the restaurant

owner/manager, and the issue was cleared up by the next pickup. This demonstrates the importance of constant communication with customers.

Separation of food waste at events can be a challenge since each presents different variables, including untrained event staff and attendees, and the existing waste disposal system. At the MV Ag Fair, for instance, there are so many trashcans throughout the property that people just dispose of waste in the easiest manner. It doesn't matter if it's trash, a plastic bottle, or a corncob. People see a trash can and throw whatever it is in there. Successful recycling at "Zero Waste" events can be achieved when recycling stations are provided next to each trash container, and signs show acceptable materials for each container. It is also useful to have volunteers at the stations to reinforce proper sorting.

During the pilot project we did not pick up waste from grocery stores. This can be tricky in terms of separation because some portion of grocery store food needs to be separated from packaging. If done manually this is very labor intensive, but there is equipment that can do this job. Separators come in different forms and sizes. One that we looked at was the Scott Equipment Company Model T30 Turbo Separator. This system can process roughly 6-10 tons per hour of organic food waste and costs $182,000. If located at a transfer station where non-organic waste could be easily disposed of, equipment like this could make separating organics very easy for grocery stores and other commercial entities.

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Scott Equipment Company Turbo Separator

Other companies offer similar and different kinds of depackaging materials. RecyclingWorks Massachusetts did a review on nine different types of depackaging technologies. See Appendix O for more information.

There are two new depackaging/separators operating in Massachusetts- at Save That Stuff in Charlestown, and at E.L. Harvey in Westborough. These facilities are being utilized to mechanically depackage the food, and then liquefy the food for shipment to AD facilities, as well as make a drier product suitable for animal feed, or composting. Given the high capital costs of this technology it is likely that a separator would not be justified since there is no AD facility on the Island, and it would be costly to ship to AD facilities on the mainland.

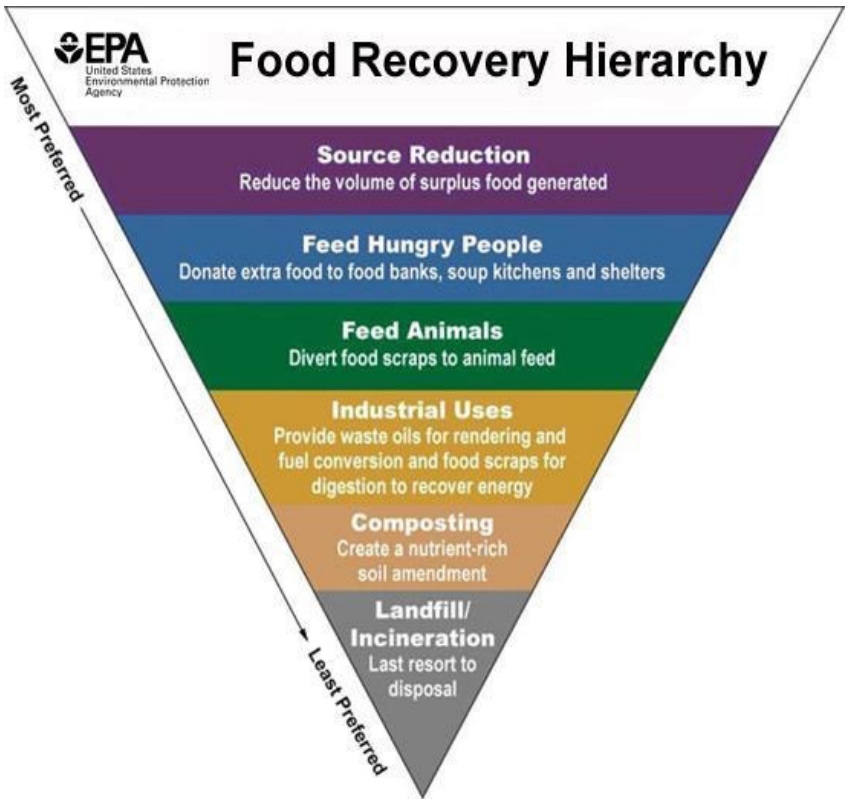
Solutions and Recommendations from Existing Sources for Reducing, Recovering and Recycling Food Waste on the Island

While this study was focused specifically on assessing options for helping the Island deal with the immediate need to address the upcoming ban on commercial food waste, there are many other private and public activities can help with this problem.

The Massachusetts ReFED Road Map offers 27 solutions for reducing wasted food. These are divided into three categories: Prevention, Recovery, and Recycling, which are estimated to potentially reduce the amount of food wasted in this country by 20%. The benefits from doing so include financial savings, diversion from landfills, reduced air emissions, water saved, jobs created, and food recovered to feed people and animals.

When looking at solutions for handling wasted food, it's important to be aware of the U.S. Environmental Protection Agency's (EPA) Food Recovery Hierarchy[xxvii]. Starting at the top, and working our way down, the EPA recommends to first reduce food waste at the source, then feed wasted food to people, then to animals, and once that's been done use wasted food for industrial purposes such as converting fats to products, or for an anaerobic digestion to generate electricity, and then to composting. The bottom, the last resort, is to landfill or incinerate wasted food.

To lay out solutions for the Island, we will categorize them similarly: Reduction, Recovery and Recycling.



Reduction Solutions

Called "Prevention Solutions" in the ReFED Report and Source Reduction in the EPA Food Recovery Hierarchy, this top tier of the pyramid is the best solution when handling wasted food, because the most efficient thing one can do with wasted food is to not waste it in the first place. When food is wasted everything that went into growing, packing, transporting and selling that food is also wasted. That means land, fertilizer, water, fuel used in transportation, materials used for packaging, labor and love that went into that food are all wasted. Food waste consumes 21% of fresh water, 19% of all fertilizer, 18% of cropland, and 21% of landfill volume.[xxviii]

40% of food waste in America occurs in the home- that's 25 million tons.[xxix] There are many resources available for homeowners, as well as businesses and manufacturers for ideas on how to reduce wasted food. See Appendix P for tips on how to reduce wasted food in the home and the *For Further Reading* on page 81 for a list of materials.

The following recommendations are things that can be done on an Island-wide scale to reduce wasted food:

1. Sell imperfect produce: Grocery Stores, markets and farmers markets can all sell "Imperfect Produce"- things like potatoes that are too small or carrots that have two heads. Imperfect produce is often wasted because there is no market for it, even though the taste and nutritional value is the same as its "perfect" counterparts. Cronig's Market makes use of imperfect produce by cutting it up for the salad bar and using imperfect produce in

prepared foods like soups and casseroles. For more on imperfect produce, see the *Recommended Reading* section on page 81.

2. Smaller plate options at restaurants: A lot of post-consumer waste (aka plate scrapings) that occurs at restaurants is because of large portion sizes. Project staff rode with a Bruno's commercial trash truck on a fall Saturday morning to visually inspect the trash from restaurants, and documented huge quantities of French fries and other plate scrapings. Some people take home leftovers, but many don't, especially when traveling. Restaurants can offer smaller sizes of entrees, half portions, or a la carte options so people can order an amount that they are more likely to eat. Post-consumer waste cannot be fed to pigs without being heat-treated.

3. Consumer awareness campaigns: the Environmental Protection Agency (EPA) launched the Food: Too Good to Waste (FTGTW) campaign to reduce wasted food in the home. They have an implementation guide and toolkit on their website[xxx] and the campaign has been used in various communities across the country. King County, Washington, Iowa City, Iowa and the nonprofit Rhode Island Food Policy Council have launched successful FTGTW campaigns. Launching a similar campaign on the Island could start to reduce the amount of wasted food being generated in homes.

4. Education: Island Grown Schools (IGS) and the Vineyard Conservation Society (VCS) already have great programs within the public schools focusing on environmental and food system issues. Partnering on food waste-specific education projects and campaigns could bring more awareness to the Island's youth, which can have a trickle-up effect in their homes and the community.

5. Composting Workshops and Instruction: A residential composting survey distributed at the Living Local Harvest Festival and on Facebook revealed that almost 25% of residents who said they do not compost at home do not do so because they don't know how. Workshops are a way to teach the skills that people need to have their own backyard compost, which cuts down on food scraps in residential trash. Partnering with an organization to make them free for residents increases participation and accessibility of the workshops. In Vermont, Chittenden Solid Waste District (CSWD) has been doing incredible work with reducing food waste since Vermont passed Act 148, the Universal Recycling Law.[xxxi] This law includes food waste being completely banned from landfills by 2020, phased in with larger producers being required to divert materials first. CSWD offers instructions for backyard composters on their website and hosts free composting workshops.[xxxii]

6. Zero Waste Events: The City of San Francisco requires that all events offer recycling and composting. They offer zero waste event trainings and resources for event producers.[xxxiii]

There are many events on Island, especially in the summer, including hundreds of weddings each year. Organizations like Sail MV and Farm.Field.Sea are already hosting zero waste events. Materials separation at events is easy to implement and could be overseen by the sponsoring towns or organizations. Shared recycling stations could be owned by the towns, the MVRD, or other organizations, and make this even more efficient.

Recovery Solutions

Many options for food recovery exist already, allowing for edible food to be eaten instead of discarded. According to ReFED, $218 billion a year is spent by consumers, businesses, and farms on growing, processing, transporting, and disposing of food that is not eaten.[xxxiv] Meanwhile, 1 in 6 people in America face hunger. [xxxv]

Despite these statistics, last year, "the Feeding America network and [their] partners diverted over 2 billion pounds of safe, edible food that might otherwise have gone to waste, to Americans facing hunger."[xxxvi] There are two things that encourage donations: tax incentives and the Good Samaritan Law. There is a federal tax incentive that ALL food donors can take when donating food, whether they are large or small, grower, packer, rancher, food manufacturer, retailer or restaurant. The federal food donation tax deduction provides an enhanced tax deduction when food is donated to a 501c3 nonprofit for the care of the ill, needy, or infants.[xxxvii]

In addition, the Bill Emerson Good Samaritan Food Donation Act[xxxviii] enacted in 1996 protects businesses donating food in good faith to food recovery organizations if for some reason the food ended up causing harm to an individual. It makes it more safe and appealing to donate food and grocery products.

There are also various initiatives working on recovery of food on Martha's Vineyard that help feed the Island's underserved community members.

Each year 16% of wasted food nationally—10 million tons per year—occurs on the farm. To be clear, food wasted on the fields does not cause the same problems as food sent to the landfill. Farmers till the food under to add nutrients to the soil for next year's crop. But, looking at hunger issues, better uses exist for this food. One way to avoid food going to waste in the fields is through gleaning, the act of collecting leftover crops from the farmers' fields after they have been commercially harvested or on fields where it is not economically profitable to harvest.

The only program on the Island that recovers food from the fields is Island Grown Gleaning, a program of the nonprofit organization Island Grown Initiative. The program, initiated in 2009, recovers an average of 25,000 lbs. of produce annually from local farms and residences and delivers the produce to 23 local organizations, including all the Island's public schools, each town's' Council on Aging, low-income housing units, elderly housing units, and addiction recovery centers. The program is volunteer-based, and run by Program Leader Jamie O'Gorman. The program is reliant upon the availability of crops, with the majority available from June to December with some winter donations from a local farm greenhouse. A handful of local farms and residents supply the program with gleaned food and a steady core group of volunteers help harvest and deliver produce. The program also organizes a recovery of day-old baked goods from a local restaurant.

Recovery can also come in the form of donations from restaurants and businesses that donate unused product to food collection agencies that distribute food to marginalized community members.

On the Island, four organizations provide food distribution services, including The Food Pantry and Serving Hands, who focus on recovering uneaten food for distribution. Access to these programs can be improved upon, especially to the undocumented worker population according to Serving Hands' Betty Burton. For a list of the organizations see Appendix D.

The progress that has been made in recent years to recover wasted food to feed hungry people is tremendous, but there is much more to be done. The following recommendations can be used Island-wide to recover more wasted food:

1. Create value-added food products with recovered produce: There are several commercial kitchens on the Island that could be used to turn tomatoes into sauce, pickle beets and cucumbers, and make apple preserves and jams. This would create an extended shelf life for produce that comes in abundance and cannot be eaten within its sell by date.

2. Expand the existing gleaning program: With more donations and volunteers, and by creating value-added product with gleaned produce, the gleaning program could expand its operations. The program finds that the community they are serving may not have the time or knowledge to process uncommon vegetables. The infrastructure for processing would increase the recovery of farm produce.

3. Feeding wasted food to animals: According to the EPA Food Diversion Hierarchy, feeding wasted food to pigs is the third best solution. There is potential for greater utilization of this diversion method on the Island, but it can be problematic when getting into post-consumer food waste (like plate scrapings from restaurants). After a 2001 outbreak of foot and mouth disease in the United Kingdom linked to pigs who were being fed food scraps,[xxxix] regulations were put into place requiring food scraps to be sterilized through heating before being fed to swine. When done correctly, it is an efficient way to divert food scraps. Pig farmers already spend a considerable amount of time collecting pre-consumer food scraps. To have a shared infrastructure in place where food waste could be turned into pig feed could have positive effects on the Island in terms of more sustainable pork production.

The country of Japan produces 40% of its own food and 20% of their livestock feed by using food waste to make animal feed. They've identified three ways to do this safely: dehydration, silage, and liquid feeding. Many use the dehydrating method and do this with conventional dehydration by heat, fermentation dehydration or a newer method called fry cooking. They've found this to be a great step forward in self-sufficiency and sustainability of raising livestock in Japan,[xl] and these same practices could be used on the Island.

Restaurants on the Island are already partnering with pig farmers to separate their pre-consumer food waste to be fed to pigs. Some reported consistent relationships with the farmer and others had inconsistent relationships. Food scraps can also be fed to chickens, and several composting facilities in Vermont use this approach to "preprocess" the food, then add manure that is then built into a composting windrow. Creating a network that pairs Island livestock farms and homeowners who keep animals, with restaurants,

businesses, and residents would increase the recovery level of using food waste to feed animals.

4. Date label education: Date labels are generally intended as indicators of quality, not safety, but confusion about these labels leads to massive quantities of waste. About 37% of Americans report always or usually throwing away food that is close to or past the date on the package, and 84% report doing so at least occasionally. However, there is no federally mandated system for date labeling from the USDA or FDA, leaving regulations to vary state by state.[xli] It is more than likely that much of the food that is thrown away by grocers based upon their date-label is salvageable. This food could be donated instead of discarded. The Food Donation Act protects organizations from donating to a nonprofit in case a product donated in good faith later causes harm to a recipient.[xlii]

5. Donation matching software: Companies like Spoiler Alert have created technology platforms that connect businesses with organizations that can accept donated food. These can be very beneficial for increasing efficiency of small-scale donations. When seasonal restaurants close down, for example, they might have leftover food that could be donated to Island organizations. If food recovery organizations utilized the Spoiler Alert software it could benefit businesses and food recovery organizations on the Island.

6. Donation transportation, storage and handling: With different organizations working to provide hunger relief and a large network of small businesses on the Island, coordinated transportation, storage and handling of donated food could go a long way towards creating a more efficient food recovery system on the Island. Food Hubs serve this purpose across the U.S., but we don't have one on the Island. Island Grown Initiative (IGI) is conducting a feasibility study to see whether a Food Hub would be beneficial to the Island food system. IGI has a refrigerated truck and storage space at the Thimble Farm that is used for the Gleaning program. If these items could be used to their full capacity they could provide additional transportation, storage and handling of donated food. Supporting IGI's Food Hub research could get us closer to this being a reality on the Island.

Recycling Solutions

Recycling food waste can be accomplished through: composting, anaerobic digestion (AD) and animal feed. Regardless of method, important considerations include hauling, separation, and ownership. The following recommendations can be used Island-wide to process food scraps locally:

1. Support a central compost or animal feed production operation: The estimated 6,500 tons of food scraps thrown away on the island annually can easily be turned into usable compost or animal feed instead of being shipped to a landfill or incineration plant. For more details on the technologies, potential sites, and other logistics, see the *Technologies* section starting on p. 19. An example of a successful composting operation is in Prince George's County, MD. For almost 25 years, Prince George's County Organics Composting Facility has been making a high quality compost product from leaves and grass clippings. The facility is located on a 200-acre site, of which 52-acres is paved asphalt. It receives between 55,000-60,000 tons/year of yard trimmings. In 2014 they hired an engineering

firm to conduct a waste sort of residential and commercial waste streams. The findings: "Food waste comprised 22.8% of the residential loads (yard trimmings were 7.3%) — the largest category by weight residentially. In the commercial stream, paper was 26.7 percent, and food was 26.1 percent by weight."[xliii] They started a food waste composting pilot project receiving up to 45 tons/week and composting in three 80' x 25' positively aerated heaps covered with GORE covers. The compost is of high quality, sold in the area and used to grow food. The compost has an active time of 8 weeks, 6 of which it is covered, and then it's cured for an additional 10-12 weeks. The demand keeps growing, making this a success story.

2. Establish a food scrap drop-off program at the Island's six Local Drop-offs (LDOs):
In Thompkins County, NY, residents can bring up to 10 gallons of food waste (including paper towels) to one of eight food waste drop-off sites.[xliv] The County's Solid Waste Division provides information, containers, and compostable bags). The food waste is picked up and processed with yard waste at Cayuga Compost.

Four of the Island's six towns now have funding for food waste containers at the LDOs. The MVRD was concerned about having enough volume to justify a collection program, but routes that collect from the LDOs could be expanded to other food waste generators, providing "route density" that can financially support a collection program.

3. Establish a curbside food scrap pickup program:
The Town of Brattleboro, VT, has weekly curbside collection of recyclable materials as well as food scraps using side-loading trucks to collect all three materials at the same time (commingled containers, paper/cardboard and food waste). The trucks drive to the Windham Solid Waste Management District (WSWMD) facility in Brattleboro, weigh in at the scale, dump the organics on the composting pad, weigh again, then dump the paper/cardboard in the MRF, weigh again, then dump the bottles and cans in the MRF.

The town has Pay As You Throw (PAYT) at $3/bag of trash, with every-other-week trash collection and weekly recycling collection. There is no separate charge for recyclables and organics, and approximately 2,000 households out of 3,000 participate. Approximately 12 tons per week is generated, with the average household putting out 12 lbs. of organics each week. Leaves and yard trimmings are not allowed in the weekly curbside program but are collected separately on two days in the spring, and two days in the fall, and taken to the WSWMD composting operation.

Compost is managed by WSWMD in turned outdoor windrows, and after 6 months, screened to 3/8 inch, and marketed locally.

In April 2014, the city of Cambridge started a pilot project to offer curbside food waste pickup to 600 homes. In the first year, they collected 170,000 lbs. of wasted food.[xlv] In October 2015, another 5,000 homes were added to the pilot. For residents that cannot participate, drop-off sites are available throughout the city. The food waste goes to Rocky Hill Farm in Saugus, MA, where it is composted in in-vessel rotary drums and sold in bulk for a variety of commercial uses.

The Pilot Project on MV has focused solely on restaurants, but many residents cannot compost at home for various reasons, and could benefit from food scrap pickup or drop-off. This will be one of the goals of the Pilot Project in 2017.

4. Determine whether there is a need for a boutique hauling company, or if the existing commercial haulers can fill the need for food scrap hauling:

There are two main commercial waste haulers on Martha's Vineyard: Bruno's Rolloff, Inc. and ABC Disposal Services, Inc. Both collect trash and send it to the Crapo Hill Landfill in New Bedford, MA., and collect single stream recyclables and send them to E.L. Harvey's in Westborough.

There are two main barriers currently inhibiting haulers from picking up food scraps: lack of a commercial-scale composting facility, and an insufficient number of food scrap generators separating organics. In order to establish a viable organics collection program, there has to be sufficient "route density" of organic waste generators, i.e. enough material to fill a truck. A representative from ABC said the company would be interested in picking up organics if there was a site available on-island that could handle enough volume to make it worth purchasing a water tight truck, and hiring an additional employee. Bruno's had similar hesitations. They want to be able to offer food waste pickup, but with labor shortages and insufficient volume to start out, it doesn't appear feasible at this time.

Enter Island Food Rescue. This Pilot Project is continuing to provide food waste pickup on Martha's Vineyard. But it's not a new idea.

Around the country, entrepreneurs are turning food waste collection into successful businesses. An article in Biocycle Magazine's April 2014 edition highlighted four such companies, ranging from a 9-year old's bike-powered collection business and backyard "shared piles" in Traverse City, MI, to a company in New Orleans, LA, servicing large universities and businesses that has its own composting site.[xlvi]

These "boutique haulers" are small, private companies picking up wasted food via bicycle or truck that specialize in setting up food scrap separation for mostly residential and small business pickup, but are branching out into colleges and universities and larger commercial establishments. They vary in size and organizational structure, but share many aspects, including thorough communication with customers to insure minimum contamination of organic waste.

Compost with Me in Falmouth, and Bootstrap Compost in Boston, have provided insight into the world of food waste hauling as Island Food Rescue has moved forward with the collection pilot project as part of the Study. One reason these boutique haulers have been successful is that they are able to bring a clean product to composting facilities, which is greatly needed on the Island since both of the currently permitted sites are small farms that have no way of handling excessive contamination.

There are a number of larger haulers in Massachusetts and Vermont providing organics collection, including EL Harvey, Triple T Trucking, and Save That Stuff. They utilize

conventional rear-load and front-load packer trucks to collect organics from varying sizes of dumpsters, typically four and six cubic yard capacity. Since many of the compost sites accept soiled paper and cardboard, there are minimal problems with liquid leaking from trucks as the fiber absorbs most of the liquid.

There are also haulers that collect food scraps in toters, wheeled carts of varying capacity, which are mechanically lifted into trucks. The type of truck and truck bodies also vary, including packer trucks, side-load recycling trucks, and rendering trucks with a lift gate on the back. Some trucks are equipped with a spray wash system so that the toters can be rinsed out into the bed of the truck. Bruno's utilizes a spray wash system on some of its rear-load trucks to rinse toters used to collect trash, and therefore their existing equipment could probably be utilized for organics collection routes.

Another collection option that has been considered are heavy-duty compostable bags such as those produced by Organix Solutions. The bags are made from a biodegradable starch material at a thickness that allows them to be co-collected with trash, and can withstand a certain amount of compression in the packer truck. Once the contents of the truck are dumped on a tipping floor, the blue or green color bags of organics can be separated from the trash using a grapple, and sent to a composting facility. Since the bags are thicker than most biodegradable bags, they require high temperature composting to break them down, and perhaps more time than less thick biodegradable bags. Such bags might be a way for Bruno's and ABC to start collection of organics at generators required by the MDEP waste ban since the few organics generators would not have to be served by a special collection route. It is recommended that both haulers try the bags to see if they can withstand the compaction in the packer trucks.

On a visit to Rocky Hill Farm, the difference between the waste brought in from large commercial haulers and the small boutique haulers was apparent. Scaling up can be a challenge for boutique haulers, creating a market for both boutique and commercial haulers. It's unclear whether the Island can support both collection models, but the Pilot Project continuing through 2017 will shed more light on this issue.

Funding Options

MDEP Sustainable Materials Recovery Program (SMRP)
MDEP has put a considerable amount of money into helping communities develop wasted food collection, and recycling infrastructure. The SMRP has the following nine grant programs available each year:

Table 8.

Name	Summary	Amounts	Notes
Curbside Recycling/Organics Collection Carts	To assist municipalities with the purchase of wheeled carts for the implementation or expansion of a curbside wheeled cart program	$20 per cart for organics. Maximum award is $100,000.	
Drop-off Recycling/Organics Collection Equipment	To assist municipalities with establishing or expanding diversion programs for targeted materials at a municipal transfer station. This includes purchase of containers, compactors, sheds, and structures.	Carts/dumpsters- $1,500, with $2,500 in initial startup funding available. 40 CY Open top roll-off- $5,500. Compactor- $7,500. Shed- $3,000. Swap Shop Shed- $6,000.	Funds can also be used for educational materials.
Waste Reduction and Organics Capacity Projects	To expand management capacity for source separated food waste through reuse (donation/animal feed), composting or anaerobic digestion.	$10,000-$500,000	Projects can be located at a municipal or public site, or a private facility which has entered into a long-term contract with the host municipality.
Targeted Small Scale Investments	To purchase materials to sustain existing waste reduction programs or facilitate new, low-cost initiatives	$500-$2,000 depending on population size	Aquinnah, Chilmark, West Tisbury and the MVRD were awarded this grant in 2016
Recycling Dividends Program	Payments to municipalities that have implemented specific programs and policies that maximize reuse, recycling and waste reduction.	Points are earned by population size. For an example, West Tisbury was awarded $2,100 in 2016. Down Island towns could earn more.	Aquinnah, Chilmark and West Tisbury were awarded this grant in 2016

These funds can be very useful in increasing our organics diversion programs and infrastructure. For more details, see the MDEP website at http://www.mass.gov/eea/agencies/massdep/recycle/grants/smrp-grants.html

EPA Healthy Communities Grant:
This grant is broader, but can be used for creating healthy outdoor environments, which includes pounds of waste diverted from municipal solid waste disposal. It was used in Rhode Island for a food waste reduction program aimed at households that taught strategies for reducing food waste.

https://www3.epa.gov/region1/eco/uep/grants_2016hc.html

Company grants:
Companies like Patagonia and Clif Bar offer grants for organizations doing environmental work. See more information on their websites:
http://www.patagonia.com/grant-guidelines.html
http://clifbarfamilyfoundation.org/Grants-Programs/Small-Grants

Closed Loop Fund and Claneil Foundation:
Larger foundations are looking at food waste as a current critical issue, and offering sizeable grants of around $50,000 to programs employing creative solutions to combat food waste.
http://www.closedloopfund.com
http://www.claneilfoundation.org

Local Grants:
Local organizations like The Edey Foundation offer grants to organizations on the Island who are doing conservation and environmental work.

Results and Key Recommendations for the Island

- Two technologies were ranked highest for Island food waste processing infrastructure: In-vessel composting, which is an odor and pest-free process and extrusion technology, which can turn food waste into an ingredient for livestock feed.

- In-vessel composting emerged as the most feasible. *Recommendation: Pursue funding for in-vessel equipment to be housed at one or both of the transfer stations*

- The pilot project picked up 16 tons of food waste from restaurants. With education restaurant staff are willing and able to separate food waste effectively. *Recommendation: Pursue business possibilities for pick-up service.*

- Processing food waste locally would cost less than the current process of shipping all food waste off-Island and reduces environmental impacts. *Recommendation: Promote Island-wide food recycle, reuse and recover activities.* \

- Island farmers, landscaping businesses and homeowners need compost. Large quantities are purchased from off-Island. Composting food waste would increase a local source and business opportunity. *Recommendation: Support and encourage farmers and other businesses to develop licensed composting operations that can accept food waste.*

Beyond the explicit goals of the feasibility study, additional activities and generated by the study activities produced a variety of important advances.

Extended Pilot through IGI

The pilot project was originally slated to run for four months (from mid-June through mid-October). There was leftover money in the budget so it was agreed to run the project through the end of the year. As the end of the year neared it was clear that there was a desire by the restaurants to continue the pilot since that had made such great strides in changing their behavior, and to have them go back to throwing food in the trash would be a major step backwards.

The Island Grown Initiative (IGI) offered a home to the pilot collection program for 2017-18. The project will receive in-kind financial management, marketing, and office support from IGI, as well as help with fundraising. After the two years are over there should be sufficient data to decide whether the project could be a viable stand-alone business, a viable part of IGI, or if there is another home for this service, like with commercial waste haulers. One of the Feasibility Study employees will be staying on to work on the project.

New Compost Sites

When the project started, only one site—Morning Glory Farm—was registered to take off-site food waste on the Island. During the project, a second farm became permitted. Other farms and a commercial business are interested in becoming registered, and have received materials from the Feasibility Staff to help them do so.[xlvii]

Expansion at existing compost sites

Before the Pilot Project, Morning Glory Farm was permitted by MDAR and was accepting materials like leaves and grass clippings, but was only composting the food from their own farm stand. According to Morning Glory Farm staff, adding the food from the pilot project gave them further practice at managing their compost site so that odors, pests, and other issues were under control. They made better compost and now know what it takes to incorporate accepting food waste from off-site at their compost operation.

The businesses required by law to divert food waste from the trash generate an estimated 44 tons per week, combined. According to the operators of the two current compost sites, a combined 31 tons per week of food waste can be handled. That means without expanding composting infrastructure, 70% of the food waste that is required to be diverted by the Commercial Organics Ban could be recycled locally.

Town grants for food waste containers

The MDEP has many grant opportunities for communities looking to expand food waste recycling operations. Don Hatch and Abrams attended Selectmen's meetings in three Island towns to put into place an official Buy-Recycled Policy, which states that town offices will buy paper products with recycled content when price is similar to virgin paper. Once the Buy-Recycled Policy is in place, towns can apply for annual Small-Scale Initiatives and Recycled Dividend Program grants from the state. This grant money can be used to purchase food waste collection containers, signage, and educational materials. Chilmark, Aquinnah, and West Tisbury were awarded both types of funding, and the MVRD in Edgartown was awarded a Small-Scale Initiatives grant. Now the towns can easily apply for these grants each year. Once further collection and composting facility logistics are worked

out, the MVRD will put into place food waste collection at the Local Drop-offs (LDO's) in each of the above towns.

Martha's Vineyard Refuse District Expansion Plans

The MVRD has been seeking expansion of its operations for the past two years. This year those plans were amended to include a potential future in-vessel composting facility. Engineered plans have been drafted, and as of May 9th, 2017, the expansion was voted on at four town meetings and passed in all four towns. The MVRD can move forward with their proposal, and the Study staff hopes to work with the MVRD to secure financing for an in-vessel composting facility.

Partnerships

The **Martha's Vineyard Shellfish Group** was instrumental in getting the Pilot Project off the ground. Their truck was used for pickup, which has a lift on the back to pick up heavy food waste toters, and driver Sakiko Isomichi split pickup days with Shell Recycling intern, Zach Gordon. This allowed for food waste pickup six days a week, which is important in the hot summer so food doesn't start to smell and attract flies and pests. The Shell Recycling Partnership and the food waste collection fit well together, and will continue to collaborate in the future.

The **Island Grown Initiative** was helpful throughout the project in many ways, including volunteering staff time and materials to help the efforts at the MV Ag Fair. Moving forward, they will be vital to the Pilot Project as they are the current home of the Pilot Project.

The **Martha's Vineyard Commission** had a food waste intern in the summer of 2017, Jessica Wey, who helped tremendously on the study by putting together the Food Scrap Generators list that produced a list of businesses that are subject to the state ban.

The Trustees of Reservation (TTOR) acted as the fiscal sponsor for the study by virtue of its acquisition of **The Farm Institute**, which originally served in that role.

Don Hatch at the **Martha's Vineyard Refuse District** was invaluable to this study. His knowledge of the waste industry and the waste landscape on MV made it possible to work towards viable regional solutions.

Next Steps and Action Plans for Island Food Waste Management

- Survey pig farmers to determine current recovery rates and potential recovery rates.
- Survey grocery stores to determine current recovery rates and potential recovery rates.
- Research the markets for local animal feed to determine the feasibility of an extrusion facility, or a depackaging/separator

- Support the development of an in-vessel composting facility at the MVRD, to process 6,500 tons per year of food waste, plus carbon sources like leaves, yard waste, soiled paper and cardboard.
- Further evaluate each potential site, including total usable area, zoning requirements, state permit requirements, parcel map, topographic map, distances to abutters, access roads, and estimated purchase costs.
- Obtain agreements with the potential site landowners to develop a facility.
- MVRD should prepare and release an RFP for in-vessel food waste composting technology to be constructed at the transfer station.
- Complete research on quantity of compost shipped on-Island.
- Visit Watts Family Farm to determine if that is an option for off-island transport of food waste.
- Work with Peter Goodale to amend Oak Bluffs zoning to allow for development of a composting facility on his property.
- Utilize MDEP and other funding opportunities. Towns can apply for the SMRP grants each year. The up-island towns; Aquinnah, Chilmark, West Tisbury, plus the Martha's Vineyard Refuse District, received grants in 2016. Edgartown, Oak Bluffs and Tisbury could also apply in the future. These grants are annual so towns can apply each year.
- Create a food waste drop-off program at the LDO's, and a collection program to transport the food waste to a composting facility. Provide educational materials for the public about this service. With the SMRP grants, all six towns can be awarded state funds to set up a program for residents and small businesses to drop off food waste at the town drop-off centers.
- Create a curbside residential food waste collection program, as has been successfully done in towns like Brattleboro, VT, and in large cities like San Francisco, CA. This could be operated by the municipalities, or by commercial haulers.
- Encourage event recycling. Event organizers can add a food waste recycling clause to their rental contracts. Large events like the MV Ag Fair should use waste stations manned with volunteers instead of scattered bins.
- Support the extended pilot project through Island Grown Initiative.

Conclusion

If the recommendations in this report are implemented, they would facilitate compliance with the MDEP commercial food waste ban. The recommendations could also result in a resilient food recycling system with a smaller carbon footprint, while creating jobs and saving money on trash disposal for individuals, businesses and towns. Recycling organic waste locally means less time, money, labor, and fuel to ship wasted food off-Island in the trash. It also reduces the need and environmental impacts of shipping compost and animal feed onto the Island. It creates the opportunity to keep this valuable resource on Island while beginning to close the loop on the Island's food system

Appendices:

A. Feasibility Study Team
B. Calculations from RecyclingWorks
C. Pilot Project: Composting on the Coast
D. Food Distribution Organizations
E. MDAR Regulations
F. MDEP Regulations
G. Food Separation at Events
H. Food Waste Recycling Site Visit Summaries
I. Resident Compost Survey Questions
J. Landscaping and Farm Survey Questions
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L. Technology matrix
M. SWOT Analysis
N. Transportation Model
O. RecyclingWorks De-packaging technologies summary
P. Tips for reducing wasted food in the home
Q. Wildlife and Farming on Martha's Vineyard
R. Land Use Map from the Martha's Vineyard Commission
S. Descriptions of Food Recycling Technologies

Appendix A: Feasibility Study Team

Oversight Committee

Chris Murphy, Committee Chair-
Chris Murphy is a Chilmark resident and a retired commercial fisherman. He has volunteered as a Big Brother, was an EMT for many years, and worked as a dock builder, caretaker, and ran a family clambake business. He has served on many town boards and committees including the Martha's Vineyard Museum, Chilmark Conservation Commission, Chilmark Zoning Board of Appeals, Chilmark Finance Committee, Chilmark Board of Health, and the Martha's Vineyard Commission.

Jon Previant, Executive Director, The Farm Institute
Jon earned a BA from the University of Wisconsin and went on to earn an MBA from the University of Minnesota. He has 40+ years in agriculture, both domestic and international, from farming through sales and management. He has been Executive Director at The FARM Institute on Martha's Vineyard for eight years.

Richard J. Toole, Concerned Citizen
Richard graduated from U.R.I. in 1971 with a B.S. in Forestry, Wildlife Mgt. and Resource Development. He's worked as a self-employed carpenter and caretaker with a stint as the manager of Vineyard Pine Lumber, thinning pine stands in the M.V. State Forest. He serves on many volunteer boards including the Oak Bluffs Land Bank Advisory Board, Oak Bluffs Rep. for Cape Light Compact, and Oak Bluffs Rep. for Cape and Vineyard Electric Coop. He is a member of the M.V. Commission. He participates in Water Alliance and Joint Affordable Housing discussion groups on a regular basis. He has served on the Oak Bluffs Conservation Commission, the Oak Bluffs Zoning Board of Appeals, the Oak Bluffs Wastewater Planning, and was a Former Board member and President of Vineyard Conservation Society.

Don Hatch, District Manager, Martha's Vineyard Refuse District (MVRD)
Don has been in the waste business for over 40 years. He's worked in New York, Pennsylvania and all over Massachusetts. He started working on the Island in 2001, at the Oak Bluffs Transfer Station and BFI hauling. He has been the District Manager of the MVRD since 2005.

Keith Wilda, Farm Hub Program Leader, Island Grown Initiative
Over the past 20 years Keith has worked as an educator and researcher, through extension work at the University of Massachusetts, as general manager of two of the largest aquaculture and aquaponics facilities in the country and as a consultant. Keith lives with his wife Reagan and has three daughters, Ella and twins Morgan and Addison.

Michael D. Loberg, PhD in Nuclear Chemistry
Michael currently serves as President of Vineyard Medical Care, LLC and as Chairman of the Vineyard Center for Clinical Research. He serves on the Tisbury Board of Health as an

elected health commissioner, is on the board of Vineyard Village at Home and has previously served on the Duke's County Health Council and the board of Hospice of Martha's Vineyard. He currently serves on the boards of three biotech companies: ArQule, Kereos and IGM Biosciences.

Sundy Smith, Committee Clerk
Sundy earned a BA in English and American Literature from Brown University, followed by an MS in Educational Psychology from Southern Illinois University. She is the sole proprietor of SchoolMeds.com LLC, providing customized website development, online training and other resources to support safe medication management in the school setting. She has also been consulting for over 40 years offering freelance writing, social marketing and grant writing throughout the U.S.

Staff

Sophie Abrams, Project Manager
Sophie was born and raised on Martha's Vineyard. After graduating from the University of Vermont with a BA in Sociology and Environmental Studies, she lived in Colorado, Wyoming, California, and Costa Rica. She returned to the east coast to attend Marlboro Graduate School where she earned an MBA in Managing for Sustainability. Since moving back to the Island in 2011 she has worked in renewable energy, affordable housing, and is now the Project Manager of the Island-Wide Organics Feasibility Study. Building on her graduate school thesis project studying carbon resources for composting animal wastes from the proposed meat processing facility at Thimble Farm, this project has allowed her to live out her dream of making the Island more self-sufficient by processing food waste locally.

Robert Spencer, Environmental Planning Consultant
Bob Spencer has a wide range of solid waste composting experience over the past 25 years, serving as the plant manager for the 150 ton/day co-composting facility in Marlboro, Massachusetts from 1999 to 2006. While at the Marlboro facility he started the supermarket composting program for 15 stores.

From 2007 through 2014 Bob worked part-time for Mass Natural Fertilizer Co., a large food waste composting company in Westminster, Massachusetts.

In September 2011, Bob was hired as the part-time Executive Director of Windham Solid Waste Management District in Brattleboro, Vermont, which operates a 5,000 ton per year materials recycling facility for 20 member communities. Bob permitted and operates Vermont's second largest food waste composting facility on the district's property, serving the Town of Brattleboro's residential curbside food waste collection program, as well as schools, restaurants, and supermarkets.

Since 1989, Bob has been a Contributing Editor to BioCycle magazine. He provides consulting services on recycling of organic wastes to communities, states, and companies.

Bob is on the Board of Directors for the Composting Association of Vermont, and is chairman of the Town of Vernon Planning Commission,. Bob has a BS from Allegheny College, Meadville, PA, and an MS from SUNY College of Environmental Science and Forestry, Syracuse, NY.

Wendi Goldfarb, Project Intern
Wendi was born and raised in the suburbs of New York City. After graduating from American University with an MA in Special Education, she taught as a first grade teacher in Washington, DC. After a year of teaching she moved to Northern Thailand to teach kindergarten. She returned to Martha's Vineyard and began working for the Island Grown Gleaning program. This project allows her to work on understanding how to close the loop on food waste, which she believes can in turn lead to a happier, creative, and more productive society.

Sakiko Isomichi, Pilot Project Driver/Intern
Sakiko is a food worker, trained piano technician and student concentrating in International Relations. She has worked on a certified organic farm and engaged with the island community through good food and a series of exciting dialogues for almost a decade. Her interests include waste management, Arabic language, lichens and mosses.

Jessica Wey, Summer Intern, Martha's Vineyard Commission
Jessica is from Sugar Land, Texas. She is a junior environmental engineering major at Worcester Polytechnic Institute in Worcester, MA, where she is on the varsity swim team and in the sorority Alpha Xi Delta. She is passionate about the environment and enjoyed interning with the Martha's Vineyard Commission working towards a more sustainable waste management system on Martha's Vineyard.

Appendix B: Calculations from RecyclingWorks

Restaurants

You can use this fill-in threshold estimation guide to identify if your facility may be subject to the Commercial Food Waste Disposal Ban. If you have any questions, please contact RecyclingWorks in Massachusetts by email (info@recyclingworksma.com) or by calling 1-888-254-5525.

	Average Measurement		Material
Meals Served	0.5	lbs/meal	Food waste
Full-Time Employees	1,500	lbs/employee/year	Food waste
Disposed Waste [Full Service]	66	% of disposed waste by weight	Food waste
Disposed Waste [Fast Food]	51	% of disposed waste by weight	Food waste

	# Meals Served Weekly	Average Food Waste Measurement	TOTAL Estimated Food Waste Disposed Weekly (lbs)
Meals Served		× 0.5 lbs/meal	

	# of Full-Time Employees	Average Food Waste Measurement	Average Annual Food Waste Disposed (lbs)	1 Week Divisor	TOTAL Estimated Food Waste Disposed Weekly (lbs)
Full-Time Employees		× 1,500 lbs/employee/year		÷ 52	

	Amount of Disposed Waste Weekly (yd^3)	Average Weight of 1 yd^3 Disposed Waste (1 yd^3 = ~450 lbs)	Average Amount of Disposed Waste Weekly (lbs)	% Food Waste Disposed Weekly	TOTAL Estimated Food Waste Disposed Weekly (lbs)
Disposed Waste [Full Service]		× 450 lbs		× 66% of disposed waste by weight	
Disposed Waste [Fast Food]		× 450 lbs		× 51% of disposed waste by weight	

If the "TOTAL Estimated Food Waste Disposed Weekly" in the final column is greater than 2,000 lbs, then your facility may be subject to the Commercial Food Waste Disposal Ban. If you do not have a food waste diversion program in place, contact RecyclingWorks in Massachusetts by email or by calling (888) 254-5525, or visit the RecyclingWorks website to learn how to begin a program today!

If you serve **4,000 meals** in one week, then:

0.5 lbs/meal * 4,000 meals served/week = 2,000 lbs/week = 1 ton of food waste in one week

If you have **70 full-time employees**, then:

1,500 lbs/employee/year * 70 full-time employees = 105,000 lbs food waste generated/year

105,000 lbs/year ÷ 52 weeks/year = 2,019 lbs/week = 1 ton of food waste per week

If you are a full-service restaurant [1] and fill **1 trash dumpster at 4 cubic yards 2 times per week**, then:

450 lbs * (1 trash dumpster * 4 yd^3 * 2 pickups/week) = 3,600 lbs of total disposed waste/week

3,600 lbs * 66% of total waste = 2,376 lbs/week = 1.2 tons of food waste in one week

If you are a fast-food restaurant [2] and fill **1 trash dumpster at 4 cubic yards 3 times per week**, then:

450 lbs * (1 trash dumpster * 4 yd^3 * 3 pickups/week) = 5,400 lbs of total disposed waste/week

5,400 lbs * 51% of total waste = 2,754 lbs/week = 1.4 tons of food waste in one week

***Note**: The equation based on weight of disposed waste (above) assumes a weight of 450 lbs/yd^3 for mixed commercial waste materials. It was derived using the median value of EPA's standard conversion factor: 1yd^3 of commercial-industrial waste = 300 to 600 lbs. You may choose to change this number to best represent your operations.*

[1] *Full-service restaurants are defined as restaurants in which the customer orders and is served at a table.*

[2] *Fast-food restaurants are defined as restaurants in which the customer orders and picks up food at a counter.*

Supermarkets and Grocery Stores

You can use this fill-in threshold estimation guide to identify if your facility may be subject to the Commercial Food Waste Disposal Ban. If you have any questions, please contact RecyclingWorks in Massachusetts by email (info@recyclingworksma.com) or by calling 1-888-254-5525.

	Average Measurement		Material
Full Time Employees	3,000	lbs/employee/yr	Food waste
Disposed Waste	63	% of disposed waste by weight	Food waste

	# of Full-Time Employees	Average Food Waste Measurement	Average Annual Food Waste Disposed (lbs)	1 Week Divisor	TOTAL Estimated Food Waste Disposed Weekly (lbs)
Full-Time Employees		× 3,000 lbs/employee/year		÷ 52	

	Amount of Disposed Waste/Week (yd^3)	Average Weight of 1 yd^3 Disposed Waste (1 yd^3 = ~450 lbs)	Average Amount of Disposed Waste/Week (lbs)	% Food Waste Disposed Weekly	TOTAL Estimated Food Waste Disposed Weekly (lbs)
Disposed Waste		× 450 lbs		× 63% of disposed waste by weight	

If the "TOTAL Estimated Food Waste Disposed Weekly" in the final column is greater than 2,000 lbs, then your facility may be subject to the Commercial Food Waste Disposal Ban. If you do not have a food waste diversion program in place, contact RecyclingWorks in Massachusetts by email or by calling (888) 254-5525, or visit the RecyclingWorks website to learn how to begin a program today!

If you have **35 full-time employees**, then:

3,000 lbs/employee/year * 35 full-time employees = 105,000 lbs food waste generated/year

105,000 lbs/year ÷ 52 weeks/year = 2,019 lbs/week = 1 ton of food waste per week

If you fill **1 trash dumpster at 4 cubic yards 2 times per week**, then:

450 lbs * (1 trash dumpster * 4 yd^3 * 2 pickups/week) = 3,600 lbs of total disposed waste/week

3,600 lbs * 63% of total waste = 2,268 lbs/week = 1.1 tons of food waste in one week

***Note**: The equation based on weight of disposed waste (above) assumes a weight of 450 lbs/yd^3 for mixed commercial waste materials. It was derived using the median value of EPA's standard conversion factor: 1yd^3 of commercial-industrial waste = 300 to 600 lbs. You may choose to change this number to best represent your operations.*

Tip: Large supermarkets with a comprehensive recycling program in place should consider applying to MassDEP's Supermarket Recycling Program Certification, in which members qualify for certain waste ban regulatory relief. Learn more here.

Hospitals

You can use this fill-in threshold estimation guide to identify if your facility may be subject to the Commercial Food Waste Disposal Ban. If you have any questions, please contact RecyclingWorks in Massachusetts by email (info@recyclingworksma.com) or by calling 1-888-254-5525.

	Average Measurement		Material
Meals Served	0.6	lbs/meal	Food waste
Food Served	30	% of food served by weight	Food waste
Beds [1]	3.42	lbs/bed/day	Food waste

	# Meals Served Weekly	Average Food Waste Measurement	TOTAL Estimated Food Waste Disposed Weekly (lbs)
Meals Served		× 0.6 lbs/meal	

	Food Served Weekly (lbs)	Average Food Waste Measurement	TOTAL Estimated Food Waste Disposed Weekly (lbs)
Food Served		× 30% of food served by weight	

	# of Beds	Average Food Waste Measurement	Average Daily Food Waste Disposed (lbs)	1 Week Multiplier	TOTAL Estimated Food Waste Disposed Weekly (lbs)
Beds [1]		× 3.42 lbs/bed/day		× 7	

If the "TOTAL Estimated Food Waste Disposed Weekly" in the final column is greater than 2,000 lbs, then your facility may be subject to the Commercial Food Waste Disposal Ban. If you do not have a food waste diversion program in place, contact RecyclingWorks in Massachusetts by email or by calling (888) 254-5525, or visit the RecyclingWorks website to learn how to begin a program today!

If you serve **3,334 meals** in one week, then:
0.6 lbs/meal * 3,334 meals served/week = 2,000 lbs/week = 1 ton of food waste in one week

If you serve **6,667 lbs of food** in one week, then:
30% of food served * 6,667 lbs served/week = 2,000 lbs/week = 1 ton of food waste in one week

If you have **84 beds**, then:
3.42 lbs/bed/day * 84 beds = 287 lbs/day
287 lbs/day * 7 days/week = 2,009 lbs/week = 1 ton of food waste per week

[1] *This metric uses beds as a proxy to account for all food waste generated across the hospital by patients, staff, and visitors.*

Visit: http://recyclingworksma.com/food-waste-estimation-guide/#Jump06 for calculations for additional industries.

Appendix C: Pilot Project- Composting on the Coast

As part of the study, a pilot project - Composting on the Coast - was launched to better understand the practicalities of food waste collection and processing from the significant restaurant sector on the Island. The pilot started with six participating restaurants from Oak Bluffs and Edgartown: Isola, the Port Hunter, Park Corner Bistro, the Lookout Tavern, Atria, and the Square Rigger. The restaurants were given 32-gallon toters to store food waste outside, and 4-gallon buckets for inside use. Food scraps (including meat, bones, dairy, fruits and vegetables, grains, coffee grounds, filters, tea bags) and paper towels/napkins were separated from the rest of their trash. The containers were picked up six days per week from June-October, weighed, and taken to the on-farm composting facility at Morning Glory Farm in Edgartown.

The goals of the study were to:

- Collect data to estimate the amount of restaurant food waste on the Island (average statistics are available but this provided a local "check");
- Assess the practical issues involved in collecting food waste on a small scale;
- Gain restaurant buy-in by demonstrating the benefits and ease of separating food waste from trash; even for small restaurants that might not fall under the state mandate.

RecyclingWorks, a nonprofit funded by the Massachusetts Department of Environmental Protection, provided the pilot project with free technical assistance, training and educational materials at no cost. RecyclingWorks staff came to the Island to train Project Manager Abrams so she would be able to train participating businesses.

The Pilot Project was originally scheduled to run from mid-June to mid-October, but restaurants were enthusiastic and the process was smooth, so it was decided to extend the pilot through 2017 to get a better sense of the seasonal cycle of restaurant waste and test the viability of turning the hauling project into a future business.

Results to Date
From June 20th-December 31st the Pilot Project collected **33,000 pounds** of food waste, or **16.5 tons**. There was additional food waste collected from events including the MV Ag Fair and the Living Local Harvest Festival totaling approximately **2 tons**.

The pilot project depended on a partnership with the MV Shellfish Group's Shell Recycling program. Their truck was used and Island-Wide Organics drivers split shifts with their intern. The partnership was very successful for both organizations and will hopefully be part of continuation plans.

Funding from a gofundme campaign supplemented $6,000 in funding from the Vision Fellowship. The whole pilot cost approximately $8,000. The funds were used to purchase

the necessary containers and equipment, pay for gas and maintenance of the MV Shellfish Group's truck, pay a tipping fee to Morning Glory Farm, and pay a part-time driver.

Overall, the pilot project provided useful information and experience. The restaurants expressed satisfaction with how it worked on their end, and are looking forward to doing an even better job next year. Some restaurants never got around to training front of house staff to separate plate scrapings, so those restaurants will have an opportunity to divert even more food from the trash in the future.

Contamination in the food waste was minimal, and when it was present, our driver would speak directly with the restaurants about the specific materials, and the matter was always handled by the next pickup. Pilot project staff found it to be very important to communicate often and directly with restaurant staff about contamination, which can be a big issue. Two composting sites on Cape Cod tried to work with commercial haulers bringing them food waste, and found the contamination to be so overwhelming that they had to do their own hauling. A small hauling program that has the ability to communicate with each and every customer may actually be beneficial.

One issue surfaced when seagulls became interested by all the high-end restaurant food showing up at the Morning Glory compost site. The solution was to have the driver cover the food waste with leaves and other yard waste immediately at the Morning Glory site, which minimized the problem, according to anecdotal reporting from Daniel Athearn.

Conclusion

The pilot project provided valuable data and experience needed for evaluating a food waste collection program. This data has been used to continue and expand the project, while pointing out inefficiencies in picking up food waste on a small scale. It helped test the formulas used to estimate the amount of food waste on MV. The project provided extra nitrogen materials to Morning Glory Farm for their composting operations, and an income stream for both Morning Glory Farm (through tipping fees) and the Shell Recovery Partnership through rental use of their truck.

Appendix D: Food Distribution Organizations

The following chart shows the organizations providing food distribution services on Martha's Vineyard:

Name	Use	Funding	Run by	Schedule
Vineyard Committee on Hunger	3,654 visitors (2016/2017) Goal of 70% fresh produce	Receive food from the Greater Boston Food Bank, federal and state funds, from gleaning and from local businesses (grocery stores, etc.)	Betty Burton. Staffed by volunteers.	Serving hands: Year-round, monthly. Weekly produce in the summer. Family-to-family distributes holiday meals before Christmas, Thanksgiving and Easter
Island Food Pantry	2,405 visitors, 505 families fed (2014)	No government subsidies used. Receive food through donation only (organizations, families, gleaning)	Volunteer based, coordinated by Margaret Hannemann	Oct-April, 3x per week, afternoons. Weekly in the summer.
Senior Centers	Each have their own small food pantries		Senior Center Staff	Varies by town
Meals on Wheels	Distributes food to homes, open to those 60+ years old		Michelle Dupon	Year-round, Monday-Friday

330 CMR 25.00: AGRICULTURAL COMPOSTING PROGRAM

Section

25.01: Purpose

330 CMR 25.00 establishes criteria whereby the Department of Food and Agriculture may register and provide education and technical assistance to agricultural composting operations. Agricultural compost operations registered by the Department of Food and Agriculture are conditionally exempt from site assignment pursuant to the Department of Environmental Protection regulations (310 CMR 16.05(3)(g) and (h)).

25.02: Definitions

Agricultural Composting: the composting of agricultural wastes and other compostable materials on an agricultural unit resulting in stabilized compost products for agricultural and horticultural uses.

Agricultural Unit: land which conducts activities listed in M.G.L. c. 128, § 1A.

Agricultural Waste: discarded organic materials produced from the raising of plants and animals as part of agronomic, horticultural or silvicultural operations, including but not limited to animal manure, bedding materials, plant stalks, leaves, other vegetative matter and discarded by-products from the on-farm processing of fruits and vegetables.

Compostable Material: an organic material that has the potential to be composted, excluding wastewater treatment residuals, which is not co-mingled or contaminated by significant amounts of toxic substances.

Composting: a process of accelerated biodegradation and stabilization of organic material under controlled conditions yielding a product which can safely be used.

Department: the Department of Food and Agriculture.

DEP: the Department of Environmental Protection.

Disposal: the final dumping, landfilling or placement of solid waste materials into or on land or water or the incineration of solid waste.

Physical Contaminants: any non-biodegradable material such as plastic, metal, glass, stones, or masonry debris.

Registration: approval by the Department as an agricultural composting operation.

25.03: Agricultural Composting Registration

The Department may register agricultural composting operations if the Department determines that:

(1) the compost operation is located on agricultural unit;

(2) the applicant has submitted a completed application;

(3) the applicant agrees to a site visit and to comply with the Department's Agricultural Compost

Guidelines;

25.03: continued

(4) the applicant demonstrates knowledge and capability to conduct the agricultural composting operation to produce a stabilized compost product.

25.04: Composting Materials

(1) Registered agricultural compost operations can only use defined agricultural wastes and other compostable material allowed by DEP regulation pursuant to 310 CMR 16.05(g) and (h) whether those materials are generated on-site or off-site.

(2) Physical contaminants must be removed from the raw materials prior to mixing at the compost site. Separated physical contaminants must be appropriately disposed. Materials received from off-site locations must be source separated.

25.05: Operation of Composting Facilities

(1) Agricultural composting facilities must be secure from illegal dumping of waste materials.

(2) Composting operations shall comply with all state and local regulations governing agricultural composting including those which relate to siting requirements (310 CMR 16.00) and the Department's Agricultural Compost Guidelines.

(3) The operation of the composting facility must be done in a manner to minimize odors, noise, drift of materials, and risk to humans or the environment.

(4) All demonstration composting facilities must be available to the Department for educational purposes on such terms as the Department may require, for the purpose of complying with M.G.L. c. 21H, § 7B.

(5) If an agricultural compost operator makes nutrient claims of their finished compost material, then such operators are subject to M.G.L. c. 128, §§ 64 through 83 and, 310 CMR 15.00.

25.06: Revocation of Agricultural Composting Registrations

If the Department finds that any portion of the Agricultural Composting Registration application includes false or misleading information, or the operation of a registered composting facility is in violation of the regulations or guidelines, or is acting not in the best interest of Massachusetts agriculture, the Department may suspend or revoke the registration which will also revoke the exemption status and thereby the operator must comply with DEP Regulations for Determination of Need for Site Assignment as set forth in 310 CMR 16.05(4).

REGULATORY AUTHORITY

330 CMR 25.00: M.G.L. c. 21H, § 7.

Appendix F: MDEP Regulations

The Massachusetts Department of Environmental Protection regulations, 310 CMR 16, can be found online at:

http://www.mass.gov/eea/docs/dep/service/regulations/310cmr16.pdf

Appendix G: Food Separation at Events

As part of the study we separated food waste at the following events: the Martha's Vineyard Agricultural Fair, the Living Local Harvest Festival, a private wedding in Katama, two Gather events, a Standing Rock Benefit, and a Potluck Jam at the Chilmark Community Center.

Martha's Vineyard Ag Fair:
As part of the Island-Wide Organics Feasibility Study a test run food waste separation was conducted at the Martha's Vineyard Agricultural Society (MVAS) Fair. The inspiration was the Marshfield Fair which has been increasing their recycling and composting efforts over the past few years (watch their video at http://www.e-awakening.com/www.e-awakening.com/Other_Videos_2.html).

Separation efforts started as soon as the gates opened on Thursday. Staff and volunteers collected 382 lbs. of wasted food, followed by 501 lbs. on Friday, 878 lbs. on Saturday, 814 lbs. on Sunday, and 421 lbs. from the hall. The total over the course of the four-day Fair was 2,996 lbs. (approximately 1.5 tons) of food and organic materials (including flowers and paper napkins).

Twenty-four volunteers and three staff from the Island-Wide Organics Feasibility Study manned six food waste stations over the course of the long weekend. They helped people sort their waste into the proper place, talked to people about composting and about the study, weighed and emptied full buckets, kept food waste buckets washed and cleaned, and sorted out food from the rest of the trash bins. There are a lot of trash bins scattered throughout the fairgrounds so there wasn't a food waste bin at every trash can, but the most populated eating areas were supplied.

The vendors also had the option to participate, and eight chose to do so. They were given buckets, they'd sort the food waste from prep activities (ends of peppers, banana peels, coffee grounds etc.) then Organics staff would pick it up and leave them empty, clean buckets.

While there was a steady amount of post-consumer wasted food (uneaten french fries, for instance), the largest amount of waste came from prep or from inedible parts of food that are served whole at the fair. The most common things thrown out were corncobs, followed by watermelon rinds and fruit cores and peels from smoothies.

Project staff also composted the flowers, veggies and baked goods from the hall (included in the total pounds above).

Two hundred pounds of food was used to feed nearby pigs and the rest was composted on site at the Ag Hall. It is assumed the MVAS board will find good use for the finished compost, or that it can be offered to fairgoers next year, as they do in Marshfield.

The efforts would not have been possible without Eleanor Neubert and Tim Mavro from the MVAS, or without the help of the MV Shellfish Group, Island Grown Initiative, and our many volunteers. This program looks to continue at future fairs.

Other Events:
Besides the Ag Fair, the pilot project tested out food scrap separation at other events and collected a total of **821 lbs.** of food scraps:

- Living Local Harvest Festival: approximately **110 lbs.** were collected from the October day-long fair as festival-goers separated scraps into the bins made for the Ag Fair;
- Katama Wedding: A private wedding yielded **423 lbs.** of food waste and tested out source separation from the caterers perspective;
- Gather events: Nevette Previd's Farm.Field.Sea hosted two local food-based events; Food & Oceans and Food & Waste. Food & Oceans produced **129 lbs.** of food waste and **37 lbs**. of shells. Food & Waste produced **39 lbs.** of food waste. The food was taken to Morning Glory Farm and composted;
- Standing Rock Benefit: Approximately 500 people attended a potluck at the Chilmark Community Center with music and a silent auction. Pilot Project staff manned the waste station and helped people sort their food scraps and recycling into the appropriate bins. **70 lbs.** of wasted food was collected.
- Potluck Jam: Another event at the Chilmark Community Center resulted in **13 lbs.** of food waste. Pilot Project staff dropped off food waste bins and picked them up at the end of the night. In between, we learned later that one of our volunteers from the Ag Fair was there helping people sort their waste.

Workshop:
In July, Abrams and Goldfarb taught a workshop on composting at home at the Farm Institute (TFI). Three participants as well as TFI staff learned about composting basics, troubleshooting, and available at-home composting bins. Our residential surveys showed that many people are interested in doing this, so annual or twice yearly workshops might prove beneficial.

Appendix H: Food Waste Recycling Facility Site Visit Summaries

Compost With Me: Falmouth, MA. Visited May 3, 2016. Owned and operated by Mary Ryther, CWM is also a food waste hauling company picking up residential and commercial food waste. Residential customers get a free 5-gallon bucket of compost four times per year. Mary uses homemade pallet/chicken wire compost "bins," then moves food waste into small windrows. Sometimes she will cover piles with a tarp to keep critters out.

Crapo Hill Landfill Anaerobic Digester (AD): New Bedford, MA. Visited November 14, 2016. The AD is a 100,000 gallon digester that accepts pumpable liquid food waste. A pumping station and underground holding tank feeds to a processing tank inside the building. The liquid food waste is processed and pumped into its final holding tank outside the building where methane gas is collected at the top of the tank and added to the methane gas from the landfill to run the electric power plant Filters are used in the underground tank and in the second holding tank to screen out contaminates and is cleaned daily. The food waste has an average 30-day retention time in the digester (but can take anywhere from 18-40 days depending on the material). The AD holds 12 tons of food waste and receives 3,000 gallons a day of liquid food waste from ice cream retailers, a compost company's extra liquid compost tea, and food waste leftovers from a Biogas company that collects fat, oil and grease for fuel. It produces enough energy to power about 5,000 homes.

Green Mountain Compost: Williston, VT. Visited April 8, 2016. Owned and operated by Chittenden Solid Waste District, the facility uses concrete bunkers with aeration trenches operated by timers to accelerate the composting process. After 3 weeks, compost is moved out of the bunkers, and further processed in turned windrows. After 6-8 months it is screened and sold in bulk and in bags. Approximately 5,000 tons of food scraps are processed each year, along with another 5,000 tons of leaf and yard waste.

Groundscapes: Wrentham, MA. Visited May 3, 2016. Owned and operated by John Engwer, leaves, woodchips, seafood products, cranberries and food waste from a nearby state school are composted at Groundscapes in turned windrows. They use a windrow turner that can move 300 yards of material per hour. They specialize in manufacturing compost-based erosion control products such as filter socks, and have a blower truck to install compost filter berms and seeded compost blankets.

Mass Natural Fertilizer Co.: Westminster, Mass., Visited April 6, 2016. The largest food waste processing operation in Massachusetts, approximately 50,000 tons per year food waste and paper mill sludge are composted on 20 acres. They use turned windrows on concrete pads. Compost piles are turned with a front-end loader and after a year material is screened and sold, primarily as a blend of compost and loam

Rocky Hill Farm: Saugus, Mass., Visited June 14, 2016. 70-90 tons of material per week is composted in two in-vessel rotary drums. A mix of food waste, leaves, and wood chips are processed in slowly rotating, and aerated metal drums for three days, producing a compost product that is equivalent to material that has been in turned windrows for 2-3 weeks. The rotary drums were installed to control odor, and to increase the processing capacity of the facility. The immature compost is then moved to turned windrows for two weeks, run

through a trommel screen to sort out plastics and other contamination, then cured in windrows for 6-8 months.

SAFE: Santa Clara, CA. Visited March 18, 2016. Food waste (including meat and bones) is made into a high protein animal feed at the SAFE facility. Approximately 120 tons per day of food waste received at a nearby transfer station is mechanically sorted to remove plastic, metals and other contaminants, then processed into a mash which is trucked down the road to the SAFE facility. The mash is dehydrated, oils are expelled and then the material is refined through an extruder, where it comes out as a meal that can be mixed with other ingredients to make food for dogs, pigs, goats, or other animals.

Sam White & Sons: Middleboro, MA. Visited May 3, 2016. SCS Engineering runs this operation under contract to Sam White & Sons, a regional manufacturer of compost and mulch. The facility composts carbon materials, fish waste, and crab shells.. A special mixing truck blends wood chips and yard waste with the food waste, and constructs the windrows through a side discharge chute while it's driving. Then, an 18' wide windrow turner is used to mix and turn the piles, followed by 6 months of curing, then screening to make the final compost product.

Windham Solid Waste Management District: Brattleboro, VT. Visited April 6, 2016. The Town of Brattleboro offers residents curbside food waste pickup, including meat, bones, pet waste, garden weeds, and non-recyclable paper and cardboard which is delivered by its contract hauler to WSWMD. The food waste is mixed with wood chips and leaves where it's composted in turned windrows. Several haulers also bring loads of commercial food waste to the facility. After 6-12 months the compost is screened to 3/8 inch with a trommel screen in order to remove inorganic contaminants. The final product is sold in bulk to several garden centers.

Appendix I: Residential Survey Questions

1. Do you compost at home? _____Yes _____No

2. If you answered "No," why not? (Circle all that apply) I don't know how to compost

I'm afraid it will attract animals My landlord won't let me I don't have space for a compost pile

Composting is gross Other (please specify) _____

3. If you had the choice to bring your food scraps to the dump, would you do it?

   ____Yes ____No ____ Maybe

4. Would you consider joining a residential food scrap pickup service for a fee?

   ____Yes ____No ____Maybe

5. Would you be interested in attending a composting workshop?

   ____Yes ____No ____Maybe

6. Put your name below to be entered in the raffle. If you'd like additional information as services become available on MV, please also leave your contact info below:

Name _____Email _____Phone _____

Appendix J: Landscaping and Farm Survey Questions

Farm and landscaping surveys were conducted via phone, in-person and email. Conversations varied but these were the questions conversations were based upon.

Farms:
1. Do you compost on the farm? What materials are you composting?
2. Do you make enough compost on site for your operations? Or do you supplement with purchased compost?
3. Would you be permitted to accept food waste from restaurants or residences to create compost?
4. How much compost do you buy from off island?
5. Where do you purchase your compost?

Landscapers:
1. Where are you getting your compost?
2. How much do you import?
3. Would you feel comfortable sharing how much you pay per yard?
4. Would you be open to purchasing locally produced compost?
5. How are you purchasing compost from Coast of Maine, by the yard or by the bag?
6.How much are you paying per unit?
7. How much are you purchasing annually?

Appendix K: Restaurant Survey Questions

Restaurant name:_____

Operational Questions

Circle all that apply:

1. **seasonal** or **year round**
2. Serving:
    a. **breakfast**
    b. **lunch**
    c. **Dinner**

3. If food waste collection were offered by your trash hauler would you be interested in that service?
   Yes _____ No _____

Capacity Questions

1. How many meals are served on average per day during the summer season? _____
2. (If applicable) How many meals are served on average per day during the off- season? __
3. How many seats are in your restaurant? _____

Product Questions

1. Where do you purchase your food products? (Circle all that apply)
   Sysco Sid Wainer Doyle Perkins Nassif Island Food Products Other_____

2. How often do you receive a shipment? _____

3. What are your shipment costs? _____

4. Do you purchase any local food products? Yes _____ No _____

If yes, what products are you purchasing and from where? _____

_____

If no, what are the challenges or barriers preventing you from purchasing local food products?

_____

Thank you so much for your time!

Appendix L: Technology Matrix

Technology Matrix- Concerns

Ratings

Technologies

Scale 1 - 5
1= highly likely to create this problem
5 = not likely to create this problem

Rate scale 1 - 5 1 = least important 5 = most important	Concerns	Description of Concerns	**Turned Windrows - long piles of layered organic waste and bulking material that are open to the air and periodically turned with a front loader for increased oxygen exposure and porosity.**	Weighted Rating for Turned Windrows	**Aerated Static Pile - thinner and shorter (about 2m high) piles of organic waste and bulking material that contain perforated pipes that run through the pile and bring oxygen to the waste.**	Weighted Rating for Aerated Static Pile	**In-Vessel - involve large, slowly rotating cylinders that process organic waste and bulking material at high temperatures within the cylinder.**	Weighted Ranking for In-Vessel	**Anaerobic Digestor- involving the breakdown of waste by microorganisms in the absence of oxygen. Materials are usually contained within a tank and the process produces digestate made up of Nitrogen, Potassium and Biogas that can be harnessed and used for energy.**	Weighted Ranking for Anaerobic Digestor	**Extrusion - A process where waste is fed into an extruder, mixed and melted by a rotating screw, and then dried to be shaped into a compact meal which can be used to make animal feed.**	Weighted Ranking for Extrusion
5	**Pests**	Attracts and subsidizes pest species that are a risk to human health and safety	1	5	3	15	5	25	5	25	5	25
5	**Biodiversity**	Subsidizes generalist predator species that impact endangered or threatened species	1	5	4	20	5	25	5	25	5	25
5	**Env. Impact**	Environmental issues associated with the technology including water use, energy needed, land use, emissions,etc.	4	20	4	20	4	20	4	20	3	15
5	**Noise**	Sounds the technology produces that may be bothersome to neighbors.	5	25	4	20	3	15	5	25	4	20
5	**Time**	Time needed to implement technology	5	25	3	15	4	20	3	15	3	15
5	**Contamination**	Capability of the technology to handle contamination present in food waste.	2	10	2	10	4	20	1	5	5	25
5	**Scalability**	Ability to build upon the technology's actual size or install separate units in different locations.	5	25	5	25	4	20	2	10	5	25
5	**Legal Permitting**	Legal Regulations required to implement technology, or that the technology may violate.	5	25	4	20	4	20	3	15	4	20
5	**Political**	Favorability among political groups and decision-makers.	4	20	5	25	3	15	3	15	4	20
4	**Odor**	The amount of unpleasant smells gernerated by the technology.	3	12	4	16	5	20	5	20	5	20
4	**Access**	Location- ability of the technology to be installed in a convenient place on the island for people to bring their food waste and organics.	4	16	4	16	4	16	4	16	4	16
4	**Unit Cost**	Cost per metric ton of food waste processed- the cost that residents may incur to process food waste.	4	16	3	12	3	12	4	16	3	12
4	**Traffic**	Any additional vehicle congestion caused by the location of the technology.	3	12	3	12	3	12	3	12	3	12
4	**Rate to Process**	Rate at which the technology produces the finished product.	1	4	2	8	3	12	4	16	5	20
4	**Labor/Jobs**	Ease of staffing with available workers with the necessary skills to operate the technology.	5	20	5	20	5	20	5	20	5	20
3	**Leachate**	The potential for leaking of contaminants or nutrients from the compost operation into the ground and potentially into the ground water.	1	3	3	9	4	12	5	15	5	15
3	**Operational Cost**	The cost of running, maintaining, and operating the technology (including labor cost).	5	15	4	12	3	9	5	15	2	6
3	**Capital Cost**	The startup costs of the technology and all necessary equipment.	4	12	4	12	3	9	2	6	2	6
3	**Volume**	The measurable amount of organics that the technology can process.	5	15	5	15	5	15	4	12	5	15
3	**Aesthetic**	The aesthetic aspect of the technology- what will it look like to island residents and tourists.	3	9	3	9	3	9	4	12	4	12
2	**Footprint**	The amount of space needed for the particular technology and finished product for storing.	1	2	1	2	1	2	4	8	3	6
Total			**71**	**296**	**75**	**313**	**78**	**328**	**80**	**323**	**84**	**350**
Average			3.38	14.10	3.57	14.90	3.71	15.62	3.81	15.38	4.00	16.67

Technology Ranking		
1	Extrusion	350
2	In-Vessel	328
3	Off-Island Transport	325
4	AD	323
5	ASP	313
6	Turned Windrows	296

1= least amount of harmful concerns

Technology Matrix- Desired Benefits

Ratings			Technologies	Scale 1 - 5 1= least likely to produce this benefit 5 = most likely to produce this benefit											
Rate scale 1 - 5 1 = least important 5 = most important	Desired Benefits	Description of Benefits	**Turned Windrows - long piles of layered organic waste and bulking material that are open to the air and periodically turned with a front loader for increased oxygen exposure and porosity.**	Weighted Rating for Turned Windrows	**Aerated Static Pile - thinner and shorter (about 2m high) piles of organic waste and bulking material that contain perforated pipes that run through the pile and bring oxygen to the waste.**	Weighted Rating for Aerated Static Pile	**In-Vessel - involve large, slowly rotating cylinders that process organic waste and bulking material at high temperatures within the cylinder.**	Weighted Ranking for In-Vessel	**Anaerobic Digestor- involving the breakdown of waste by microorganisms in the absence of oxygen. Materials are usually contained within a tank and the process produces digestate made up of Nitrogen, Potassium and Biogas that can be harnessed and used for energy.**	Weighted Ranking for Anaerobic Digestor	**Extrusion - A process where waste is fed into an extruder, mixed and melted by a rotating screw, and then dried to be shaped into a compact meal which can be used to make animal feed.**	Weighted Ranking for Extrusion	**Off-Island Transport - Unprocessed food waste is brought to a processing facility off-island, either to a landfill, waste-to-energy facility or composting site.**	Weighted Ranking for Off-Island Transport
5	**Waste Reuse/Recapture**	Capability of the technology to process or reuse all of our organic materials.	5	25	5	25	5	25	3	15	3	15	1	5
5	**Finished Product**	The compost, energy, or animal feed produced by the technology.	5	25	5	25	5	25	4	20	5	25	1	5
4	**Education**	Community value provided by educational experiences via public awareness, tours of the facility, etc.	5	20	5	20	5	20	5	20	5	20	1	4
3	**Job Creation**	The number of employment opportunities produced by the facility.	2	6	2	6	3	9	2	6	4	12	1	3
3	**Env. Considerations**	Reduction of greenhouse gases, water conservation and soil health	5	15	5	15	5	15	5	15	5	15	2	6
4	**Cost avoidance**		5	20	5	20	5	20	4	16	4	16	2	8
Total			**27**	111	**27**	111	**28**	114	**23**	**92**	**26**	**103**	**8**	**31**
Average														

Technology Ranking		
1	In-Vessel	114
2	Turned Windrows	111
2	ASP	111
4	Extrusion	103
5	Anaerobic Digestion	92
6	Off-Island Transport	31

1= delivers the most desireable benefits

Appendix M: SWOT Analysis

In-Vessel

STRENGTHS	WEAKNESSES

• Containerized
  • No pests, odors, noise, or emissions
  • No leachate groundwater intrusion
• Process Cycle
  • Short cycle ~3 days
  • Able to accommodate seasonal volume fluctuations
• Final product readily marketable with income stream
• Contamination capabilities
  • Readily sorts out contaminate materials such as plastic and glass
• Input material:
  • Can process all organic waste
• Capital costs:
  • Readily scalable once facility is built
	• Capital costs:
	  • Relatively high
	• Footprint
	  • Large facility footprint
	  • Large associated land costs
	• Significant operational costs
	  • Powered by fossil fuels
	  • Equipment maintenance

OPPORTUNITIES	**THREATS**

• Economic:
  • Creates year-round jobs
  • Ability to attract industrial and civic sponsor and capital to manufacture, market and provide relatively low cost animal feed
• Educational
• Will participate in MVC review
	• Inability to acquire capital (~?M)
	• Long lead time on technology (>? year)
	• Needs appropriate zoning and permitting

Extrusion

STRENGTHS	WEAKNESSES

• Containerized
  • No pests, odors, noise or emissions
  • No leachate or groundwater intrusion
• Footprint
  • Small facility footprint
  • Small associated land costs
• Process cycle:
  • Short
  • Able to accommodate seasonal volume fluctuations
• Final product readily marketable with income stream
• Input material:
  • Able to process all food waste
  • No carbon required to support composting
• Water recycled in facility operations
• Readily sorts out contaminate materials such as plastic and glass
	• Capital costs:
	  • Relatively high
	  • Not readily scalable once facility is built
	• Significant operational costs
	  • Powered by electricity
	• Input material:
	  • Limited to organic food waste
	  • Alternate composting process required for leaves, etc.

OPPORTUNITIES	**THREATS**

• Economic:
  • Creates year-round jobs
  • No competition in the local market
  • Ability to attract industrial and civic sponsor and capital to manufacture, market and provide relatively low cost animal feed
• Educational
• Will participate in MVC review
	• Inability to acquire capital (~6M)
	• Long lead time on technology (>1 year)
	• Needs industrial zoning and permitting
	• Emerging technology; not widely tested

Off-Island Transport

STRENGTHS	WEAKNESSES

• Not Containerized
  • No pests, odors, noise or emissions
  • No leachate or groundwater intrusion
• Footprint
  • No facility footprint
  • No associated land costs
• Process Cycle:
  • Able to accommodate seasonal volume fluctuations
• Input materials
  • Able to process all organic waste
• Capital costs
  • Readily scalable
	• Capital costs
	  • Relatively high
	• Significant operational costs
	  • Powered by fossil fuels
	• Not containerized
	  • Emissions from transport of materials

OPPORTUNITIES	**THREATS**

• Economic:
  • Creates year-round jobs
• Short lead time on technology (already doing this)
• Easily zoned and permitted
	• Ability to acquire capital (~?M)
	  • High disposal disposal and transportation costs
	• Short lead time on technology (<1 month)
	• Distance to available facilities
	• Competition with trash haulers and for space on boats
	• No educational value

Appendix N: Transportation Model

Jon Previant and Keith Wilda developed the following model for the Study. It shows hauling costs when transporting off-island versus on-island:

OFF ISLAND TRANSPORT TO PLANT	Unit	amount	TOTAL costs		VARIABLES			ON ISLAND TRANSPORT TO PLANT	Unit	amount	TOTAL costs	
pickup/load time	hours	1.00	$25.00					pickup/load time	hours	1	$25.00	
Miles to ferry	miles	7.00	$8.75		tons hauled	20.00						
drive time	hours	0.25	$6.25		hours charge	$25.00		-				
wait time	hours	0.50	$12.50		mile charge	$1.25		-				
ferry charge off	dollars	100.00	$100.00					-				
transit time	hours	0.75	$18.75					-				
drive miles	miles	137.00	$171.25					drive miles	miles	20	$ 25.00	
drive time	hours	3.00	$75.00					drive time	hours	1	$ 25.00	
wait time at plant	hours	0.50	$12.50					wait time	hours	0.5	$ 12.50	
return miles	miles	137.00	$171.25					return miles	miles	20	$ 25.00	
return time	hours	3.00	$75.00					return time	hours	1	$ 25.00	
wait time	hours	0.50	$12.50									
ferry charge on	dollars	100.00	$100.00									
transit time	hours	0.75	$18.75									
drive miles	miles	7.00	$8.75									
drive time	hours	0.30	$7.50									
TOTAL $$ per ton hauled			$41.19					TOTAL $$ per ton hauled			$6.88	
TOTAL COST			$823.75					TOTAL COST			$137.50	
total hours		9.55	$238.75	29%				total hours		2.5	$62.50	45%
total miles		288.00	$360.00	44%				total miles		40.0	50.00	36%
total ferry			$200.00	24%				NO FERRY				

Appendix O: RecyclingWorks De-packaging technologies summary

Overview of listed on-site food depackaging technologies
(Listed alphabetically by company name)

	Company Name	Model Name	Food Material Types	Packaging Types	Capacity	Separation Efficiency (%)	Price Range (USD)
1	**Brask Enterprises**	High Density Extruder	Wet food waste and liquids	Paper, plastic, aluminum, tin, steel, etc.	Varies	Liquid extraction rates up to 98% and volume & weight reductions up to 90%	Varies
2	**Brask Enterprises**	Xcycler	All	Varies	Varies	Varies	Varies
3	**Brask Enterprises**	Xtractor	Liquids	Plastic, tin & aluminum cans, and paper based containers	Up to 8 yd^3/hour (Over 12 yd^3/hour of aluminum cans)	Weight reduction up to 97% & volume reduction up to 95%	Varies
4	**Ecoverse (Doppstadt US)**	Tiger HS 640	Post consumer food waste, packaged foods, cafeteria waste, industrial food production rejects.	Cans, metal, plastic, paper, tetra pack, cardboard, plastic wrap, bags, etc.	9 tons/hour	98%	460,000
5	**JWCE**	ZWM (ZWM40xx/ ZWM30xx)	Liquids, dairy (i.e. milk, yogurt), canned foods, boxed foods	Cardboard, plastic bottles, metal cans	205 ft^3/hr (5.8 m^3/hr)	Varies	$100,000 – 125,000+
6	**Scott Equipment Company**	Turbo Separator	All	All	0 to 25 tons/hour	90% or greater	$125,000 - $245,000 (typical)
7	**Sebright Products, Inc.**	High Density Extruder	Wet food waste and liquids	All	Up to 28 yd^3/hour	See literature online	$70,000 - $500,000
8	**Sebright Products, Inc.**	X3Cycler	Liquid products	Aluminum cans and plastic bottles	Up to 30 yd^3/hour (Up to 1,200 lbs of PET per hour)	Volume reduction up to 95%	$70,000 - $500,000
9	**Sebright Products, Inc.**	Xtractor	Liquid products	Aluminum cans, plastic bottles and other liquid containers ranging from 0.5 to 4 liters	10 yd^3/hour (7.5 m^3/hour)	Weight reduction up to 93% & volume reduction up to 90%	$70,000 - $500,000

Appendix P: Tips for reducing wasted food in the home

The best resource we found for reducing food waste in the home is Dana Gunders' The Waste Free Kitchen Handbook. This easy-to-read guide is full of tips and tricks including storage techniques to prolong the life of food and recipes to use up spoiled or often discarded parts of food (think Sour Milk Pancakes or Broccoli Stem Salad).

The following infographic from Sustainabletable.org does a great job at summarizingsome doable actions to start reducing food waste at home:

Source: http://www.gracelinks.org/2244/food-waste

Appendix Q: Wildlife and Farming on Martha's Vineyard

BiodiversityWorks
wildlife research, monitoring & mentoring

Wildlife and Farming on Martha's Vineyard

Local food and sustainability are issues that many Vineyard residents embrace, and farming (agriculture and aquaculture) is a vital part of our community. While green living, growing food sustainably, reducing carbon footprints, reducing consumption and waste, and 'living local' are common themes in Island sustainability discussions, the Island's biodiversity, our flora and fauna, is often overlooked. Many of our local farmers and shellfish growers are avid naturalists who enjoy the diversity of birds, mammals, reptiles, amphibians, wildflowers, trees and want their grandchildren's grandchildren to be able to enjoy them too. With this in mind, we created this handout to bring to light some unintended negative impacts of farming, composting, and aquaculture on the Island's wildlife with hopes of reducing these impacts and preserving biodiversity amidst the growing local food movement.

Wildlife Populations

Generalist species can live in a variety of habitats, eat almost anything, and find shelter almost anywhere. They are often called 'human commensals' because generalists live among us. On the Vineyard, generalist species include American crows, gulls, striped skunks, raccoon, and white tailed deer. Several of these generalist species are predator on the eggs, young and adults of many specialist species. Specialist species occupy particular habitats and have narrow diets. Examples of Vineyard specialists include American woodcock, grasshopper sparrow, piping plover, American oystercatcher, terns, eastern spadefoot toads, smooth green snakes, spotted turtle, barrens buck moth, and monarch butterflies.

Many factors influence wildlife populations, but a primary factor is food availability. While generalists can exploit many different food sources, specialists cannot. Thus, food subsidies play an important role in artificially increasing populations of generalists and increasing their activity near subsidies. Many wildlife species can track subsidies over time and incorporate them into their food search images. Crows are particularly skilled at exploiting food subsidies and are a primary predator for many specialist species.

Predictable **A**nthropogenic **F**ood **S**ubsidies (PAFS)

PAFS are food subsidies that wildlife can readily locate and exploit with regularity. While unintentional, agricultural, shellfishing, and composting practices provide PAFS across the Vineyard and they contribute to abundant crow, skunk, raccoons, and gull populations. PAFS currently available include:

- shellfish discard piles
- compost piles
- pasture manure and associated insects

- spilled grain on farms - manure piles and associated insects/small mammals
- water sources in otherwise dry landscapes

These PAFS draw generalists to the area, concentrate their activity, and boost their survival. If the subsidy is abutting conservation land, songbirds, turtles, snakes, frogs, and small mammals moving through the area or between habitats are exposed to higher predation risk because the predators loaf, linger, and forage near PAFS. Introducing livestock or compost to a new area will attract generalist predators and increase predation risk for specialist species in that area within a month.

Best Practices for Reducing Subsidies

1. Contain or Cover Compost and Shellfish Discard Piles – to reduce the number of crows, gulls, skunks, raccoons, and rats you are feeding. This will reduce their activity on the farm and their populations across the Island. If you cannot contain your compost, a tarp or cover will at least keep crows and gulls from accessing the compost easily. The predators subsidized on a farm roam several miles out from the farm and impact wildlife elsewhere

2. Cover/Contain/Biochar manure piles – while it may not seem attractive to humans, manure is very attractive to crows, gulls, skunks, raccoons and rats because of the insects living in the manure. Biochar could be a win-win on the farm. Is it feasible?

3. If grazing livestock on conservation lands, remove manure when moving livestock – this will require extra effort, but will reduce the attractive subsidy, particularly during the summer breeding season for so many species. Could volunteers be mobilized to help?

4. Feed only as much grain as necessary – livestock spill grain, but sometimes they are given more than they really need. Are your livestock eating all of their grain within a few minutes? If not, try giving them less.

Appendix R: Land Use Map from the Martha's Vineyard Commission

Town	Farmed Field	Cleared Fields	Town Owned (not Conserved)*	Conservation Land/Open Space
Aquinnah	0	0	28	394
Chilmark	394	128	39	2,396
Edgartown	489	197	105	6,595
Oak Bluffs	40	17	105	918
Tisbury	107	24	23	889
West Tisbury	638	247	24	5,310
MV Total	1,667	613	323	16,503

Appendix S: Descriptions of Food Recycling Technologies

Aerated Static Piles- forced aeration method of composting in which a composting pile is aerated by a blower moving air through perforated pipes located beneath the pile.

Anaerobic Digestion- a processing technology involving the breakdown of organic waste by microorganisms in the absence of oxygen, thereby generating methane which can be used to generate electricity and heat for reuse. Materials are usually contained within a tank and the process produces a liquid or solid digestate product for land application.

Extrusion- a process where food waste is fed into an extruder, mixed and melted by a rotating screw, and then dried to be shaped into a compact meal, which can be used to make animal feed.

Feed manufacturing- the process of turning organic waste into food for animals, usually done through a process of grinding and mixing of foodstuffs with careful attention to potential contaminants.

In-vessel composting- composting materials are contained in a building, reactor or vessel.

Rotary Drum- an in-vessel composting technology involving large, slowly rotating cylinders that process organic waste and bulking material at high temperatures within the cylinder.

Turned windrows- a composting method where long piles of layered organic waste and bulking material are open to the air and periodically turned with a front loader or windrow turner for increased oxygen exposure and porosity.

Recommended reading

There is an abundance of information about food waste and composting found online. Below are some favorite resources that were used by the Feasibility Study staff:

General Food Waste resources

ReFED Report: A Roadmap to Reduce U.S. Food Waste by 20 Percent
https://www.refed.com/?sort=economic-value-per-ton
Then click on download the roadmap

NRDC Study: Wasted: How America Is Losing Up to 40 Percent of It Food from Farm to Fork to Landfill by Dana Gunders https://www.nrdc.org/sites/default/files/wasted-food-IP.pdf

Technical composting and feasibility study reports

Food Is Not Trash: Redefining Wellesley's Waste Culture by Composting
http://www.mass.gov/eea/docs/dep/recycle/reduce/06-thru-l/food-is-not-trash.pdf

Food Waste Diversion and Utilization in Humboldt County
http://www.hwma.net/sites/default/files/humboldt_regional_food_waste_digester_feasibility_study_0.pdf

Consumer food waste reduction

The Waste Free Kitchen Handbook: A guide to eating well and saving money by wasting less food by Dana Gunders.

Ugly Fruit and Veg campaign http://www.endfoodwaste.org/ugly-fruit---veg.html

Food: Too Good to Waste (FTGTW) implementation guide and toolkit
https://www.epa.gov/sustainable-management-food/food-too-good-waste-implementation-guide-and-toolkit
Examples of Food: Too Good to Waste campaigns:

- King County, Washington FTGTW campaign: https://your.kingcounty.gov/solidwaste/wasteprevention/too-good-to-waste.asp
- Palo Alto, CA FTGTW campaign: http://www.cityofpaloalto.org/gov/depts/pwd/zerowaste/resources/foodwaste.asp
- Rhode Island Resource Recovery Center FTGTW campaign: http://www.rirrc.org/resident/food-too-good-to-waste/

The Dating Game: How Confusing Food Date Labels Lead to Food Waste In America
http://blogs.harvard.edu/foodpolicyinitiative/files/2013/09/dating-game-report.pdf

Recovery resources

Leftovers for Livestock: A Legal Guide for Using Food Scraps as Animal Feed
http://www.chlpi.org/wp-content/uploads/2013/12/Leftovers-for-Livestock_A-Legal-Guide_August-2016.pdf

Comprehensive Guidelines for Food Recovery Programs
http://recyclingworksma.com/wp-content/uploads/2015/07/food-recovery-final2007.pdf

ENDNOTES

[i] "Commercial Food Waste Disposal Ban." Mass.gov. http://www.mass.gov/eea/agencies/massdep/recycle/reduce/food-waste-ban.html. Accessed November 16, 2016.

[ii] Dana Gunders. "Wasted: How America Is Losing Up to 40 Percent of its Food from Farm to Fork to Landfill." Natural Resource Defense Council. August 2012. Page 1.

[iii] ICF. *Massachusetts Commercial Food Waste Ban Economic Impact Analysis.* December 2016. Page 4.

[iv] *Ibid*, page 20.

[v] Martha's Vineyard Commission. "DRAFT Seasonal Population Estimates for Martha's Vineyard." December 6, 2011.

[vi] Mike Benjamin. "Martha's Vineyard, Off Season." Nov 14, 2016. https://www.nytimes.com/2016/11/20/travel/marthas-vineyard-off-season.html?_r=1

[vii] "Advancing Sustainable Materials Management: 2014 Fact Sheet." *U.S. Environmental Protection Agency.* November 2016. *https://www.epa.gov/sites/production/files/2016-11/documents/2014_smmfactsheet_508.pdf.* Accessed April 5, 2017.

[viii] Noli Taylor. "Where the Waste Goes, I Will Follow." *Vineyard Gazette*. June 2, 2016. Accessed December 8, 2016. https://vineyardgazette.com/news/2016/06/02/where-waste-goes-i-will-follow

[ix] At the time this report was published, Brunos Rolloff was in the process of switching over to Clean Air Emissions vehicles with better efficiency of 6.8 mpg. Patrick Medeiros, March 28, 2017.

[x] Shipping, trucking and disposal costs as according to Don Hatch, on October 31, 2016

[xi] ReFED homepage. http://refed.com. Accessed November 17, 2016.

[xii] Jonathan Bloom. "Americans Waste Enough Food to Fill a 90,000-Seat Football Stadium Every Day-- What Can We Do About It?" September 15, 2011. AlterNet, accessed November 17, 2016. http://www.alternet.org/story/152429/americans_waste_enough_food_to_fill_a_90,000-seat_football_stadium_every_day_--_what_can_we_do_about_it

[xiii] ReFED: A Roadmap to Reduce US Food Waste by 20%. Technical Appendix, last revised March, 2016. Page 14. https://www.refed.com/downloads/ReFED_Technical_Appendix.pdf

[xiv] ReFED homepage. http://refed.com. Accessed November 17, 2016.

[xv] ReFED: A Roadmap to Reduce US Food Waste by 20%. 2016. Page 10.

[xvi] Dana Gunders. "Wasted: How America is Losing up to 40 Percent of Its Food from Farm to Fork to Landfill," Natural Resource Defense Council. August 2012. Accessed November 2016. Page 12. https://www.nrdc.org/sites/default/files/wasted-food-IP.pdf.

[xvii] "Hunger and Poverty Facts and Statistics," Feeding America. Accessed November 2016. http://www.feedingamerica.org/hunger-in-america/impact-of-hunger/hunger-and-poverty/hunger-and-poverty-fact-sheet.html

[xviii] ReFED, page 7.

[xix] ReFED homepage. http://refed.com. Accessed November 2016.

[xx] For more on RecyclingWorks, visit their website at http://recyclingworksma.com

[xxi] For more information on the Pilot Project, see Appendix C.

[xxii] For more information on food waste separation at events, see Appendix G.

[xxiii] For more information on the problems with pests and compost, se Appendix H.

[xxiv] DSM Environmental Services and Robert Spencer. Systems Analysis of the Impact of Act 148 on Solid Waste Management in Vermont. October 21, 2013. Appendix C.

[xxv] Juliette P. Bohn *et al.* "Food Waste Diversion and Utilization in Humboldt County." May 2010. Page 10.

[xxvi] Juliette P. Bohn *et al.* "Food Waste Diversion and Utilization in Humboldt County." May 2010. page 8.

[xxvii] EPA website. "Sustainable Management of Food," accessed December 2016. https://www.epa.gov/sustainable-management-food

[xxviii] ReFED, accessed December 2016. http://refed.com/?sort=economic-value-per-ton

[xxix] *Ibid.*

[xxx] EPA website. "Food: Too Good to Waste Implementation Guide and Toolkit", accessed December 2016. https://www.epa.gov/sustainable-management-food/food-too-good-waste-implementation-guide-and-toolkit

[xxxi] "Vermont's Universal Recycling Law," Vermont Official State Website, accessed December 2016. http://dec.vermont.gov/waste-management/solid/universal-recycling

[xxxii] "Backyard Composting," Chittenden Solid Waste District, accessed December 2016. http://cswd.net/composting/backyard-composting/

[xxxiii] "Event Recycling and Composting," SF Environment, accessed December 2016. http://sfenvironment.org/zero-waste/recycling-and-composting/event-recycling-and-composting

[xxxiv] ReFED report. Page 5.

[xxxv] "11 Facts About Hunger in the U.S." Dosomething.org, accessed January 18, 2017. https://www.dosomething.org/facts/11-facts-about-hunger-us

[xxxvi] "Food Waste In America," Feeding America website, accessed January 18, 2017. http://www.feedingamerica.org/about-us/how-we-work/securing-meals/reducing-food-waste.html

[xxxvii] *Ibid.*

[xxxviii] "Protecting Our Food Partners," Feeding America website, accessed January 18, 2017. http://www.feedingamerica.org/ways-to-give/give-food/become-a-product-partner/protecting-our-food-partners.html

[xxxix] Carly Chynoweth, "The Pig Idea: use food waste as pig feed rather than crops, says celebrity chefs," *The Guardian,* November 26, 2013. Accessed November 2016. "https://www.theguardian.com/sustainable-business/food-blog/pig-idea-food-waste-feed-tristram-stuart-thomasina-miers

[xl] Tomoyuki Kawashima, "The use of food waste as a protein source for animal feed - current status and technological development in Japan," *National Institute of Livestock and Grassland Science Japan.* Accessed November 2016. http://www.fao.org/docrep/007/y5019e/y5019e0i.htm

[xli] Emily Broad Leib, *et al*. "Keeping Food Out of the Landfill: Policy Ideas for States and Localities," *Harvard Food Law and Policy Clinic.* October 2016. Accessed November 2016. http://www.chlpi.org/wp-content/uploads/2013/12/Food-Waste-Toolkit_Oct-2016.pdf

[xlii] "Protecting Our Food Partners," Feeding America website. Accessed November 2016. http://www.feedingamerica.org/ways-to-give/give-food/become-a-product-partner/protecting-our-food-partners.html

[xliii] Nora Goldstein, "Food Scraps Composting at County Yard Trimming Site," *BioCycle,* May 2015, Vol. 56, No. 4, p. 21. Accessed November 2016. https://www.biocycle.net/2015/05/13/food-scraps-composting-at-county-yard-trimmings-site/

[xliv] Tompkins County Department of Recycling and Materials Management website. Accessed November 2016. https://recycletompkins.org/Recycling/Food-Scraps-Recycling

[xlv] "Curbside Compost Pilot," *The Cambridge Department of Public Works website.* Accessed November 2016. http://www.cambridgema.gov/theworks/ourservices/recyclingandtrash/curbsidecollections/compostingquestions/curbsidecompostpilot

[xlvi] Nate Clark. "Entrepreneurs See Opportunity in Food Scraps Collection," *BioCycle,* March/April 2014, Vol. 55, No. 3, p. 71. Accessed November 2016. https://www.biocycle.net/2014/03/28/entrepreneurs-see-opportunity-in-food-scraps-collection/

[xlvii] At the time this study was published, this information was still in the planning stages and therefore asked to remain confidential. Information regarding farms permitted by MDAR is also kept confidential by the state.