University of Michigan Composting Proposal

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Executive Summary

We are proposing that the University of Michigan begin a composting program to manage its organic waste. This university has the potential to produce 4.9 tons of compost every day, but is instead paying to have the ingredients disposed of in landfills. Full-scale implementation of this program would contribute to climate change mitigation, effectively reducing greenhouse gas emissions by the equivalent of taking 100 cars off the road. This number does not include the additional reduction in the embedded emissions associated with the transportation of waste and the production of chemical fertilizers. The nutrient-rich compost would furthermore contribute to local soil quality.

Implementation of this program would cost approximately $1 million, an amount feasible to obtain through various environmental protection grants. This report provides examples of universities that have received comparable amounts of money for similar composting programs in the recent past. Costs will be further offset by the reduction of waste disposal fees, as well as the reduction or elimination of purchased soil, fertilizer, and insecticides. In the future, the university may also wish to consider commercialization of their compost.

At this time, we advise the purchase of two 2.5 tons per day Hot Rot brand composters to be situated at Matthaei Botanical Gardens. Startup costs can be reduced by purchasing just one composter, which will be sufficient to accomodate the university's dining halls and takeout restaurants.

This program will additionally provide research and employment oportunity for university students, and can be further utilized as public outreach to educate local secondary schools.

A composting program at the University of Michigan would aid the environment and the university by turning a costly matter of waste dispoal into an oppotunity to regularly generate a unique and valuable resource.

Introduction

Composting can take on many forms, but is in simplest terms the process of taking organic material and placing it under optimal conditions to accelerate its natural decomposition. Composting requires little in the way of labor and upkeep and acts as a cleaner and potentially cheaper option for managing organic wastes. Compost brings with it a large variety of environmental benefits associated with its production and distribution relative to the typical alternatives. This report discusses the advantages, feasibility, and associated costs of implementing a composting program at the University of Michigan.

Climate Change Mitigation

Human influence has slowed the replenishment of eroded topsoil by sealing the necessary nutrients within landfills. Organic material trapped within the low-oxygen environment of landfills undergoes anaerobic decomposition, a process which releases a significant amount of methane gas. Landfills are the second largest source of methane in the United States, accounting for approximately 23% of the methane emissions in 2008[1] As a greenhouse gas (GHG), methane has a Global Warming Potential (GWP) 25 times stronger than carbon dioxide over a 100 year time-span.[2] In 2008, the United States produced the methane equivalent to 117.5 Teragrams of CO_2 from landfills alone.[3]

To compensate for nutrient deprivation, agricultural practices employ increasing amounts of chemical fertilizers. In 2008, the United States produced the NO_2 equivalent of 210.7 Teragrams of CO_2 [4] for agricultural soil management. There is additionally a heavy embedded emission of greenhouse gases related to the Haber-Bosch process of fertilizer production that has been estimated to contribute 1.2% of the total GHG emissions worldwide.[5] For comparison, 224.2 Teragrams of CO_2 were released in the commercial combustion of fossil fuels, roughly comparable to the greenhouse gas emissions of agricultural soil management and less than double of the emissions

[1] "2011 U.S. Greenhouse Gas Inventory Report — Climate Change - Greenhouse Gas Emissions — U.S. EPA." US Environmental Protection Agency. Web. 26 Apr. 2011. http://epa.gov/climatechange/emissions/usinventoryreport.html

[2] Working Group 1. "Climate Change 2007 - The Physical Science Basis." IPCC Fourth Assessment Report (2007). Web. http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-errata.pdf.

[3] "2011 U.S. Greenhouse Gas Inventory Report — Climate Change - Greenhouse Gas Emissions — U.S. EPA." US Environmental Protection Agency. Web. 26 Apr. 2011. http://epa.gov/climatechange/emissions/usinventoryreport.html

[4] *ibid.*.

[5] Kongshaug, G. 1998. Energy Consumption and Greenhouse Gas Emissions in Fertilizer Production. IFA Technical Conference, Marrakech, Morocco, 28 September-1 October, 1998, 18pp.

produced by organic waste decomposition in landfills.[6]

Compounded upon this is the more situational emission of GHG associated with the transportation of organic materials to landfills. Compostable material tends to be wet, heavy, and dense, and hence requiring tremendous effort to transport over large distances. The environmental and financial costs are highly variable and thus difficult to estimate, but become another consideration in the waste-management process of large organizations.

Proposed Action

Current composting efforts by the university are limited primarily to yard-waste, and further restricted to a maximum of 5% by volume by spatial limitations at the City of Ann Arbor composting facility. Even without these restrictions, third-party composting programs do not accept post-consumer waste such as fruit peels or the biodegradable containers used by campus takeout dining. We are proposing that the University of Michigan start a full-scale composting program that will allow the university to create compost out of its organic waste.

The project is aiming for a budget of approximate $1 million, the majority of which we can expect to obtain through various grants that will be discussed later in this paper. The university currently sends approximately 1,725 tons of compostable material (31% of its waste stream) to landfills every year.[7] By processing this organic waste into compost, the university can generate about 4.9 tons of compost each day. The resulting reduction in greenhouse gas emissions from aerobic decomposition in a composter instead of anaerobic decomposition in landfills is functionally similar to taking 100 cars off the road.[8] This value does not include the additional reduction in greenhouse gas emissions associated with shorter transportation routes or the reduction in fertilizer demands, further enhancing its contributions to climate change mitigation.

Since the university would own the composting facility, it would also own the nutrient-rich compost that is the end result of this endeavor. This compost can be used to offset or eliminate the university's need to purchase soil, fertilizer, and insecticides, as well as reduce waste management fees. As the University of Michigan is unlikely to use all 4.9 tons of compost produced each day, the university has further options available for consideration regarding either potential commercialization or free distribution of compost to help the agricultural community. This project seeks to create an environmentally and financially beneficial program from what is currently

[6] "2011 U.S. Greenhouse Gas Inventory Report — Climate Change - Greenhouse Gas Emissions — U.S. EPA." US Environmental Protection Agency. Web. 26 Apr. 2011. http://epa.gov/climatechange/emissions/usinventoryreport.html

[7] Resource Recycling Systems. UM-Ann Arbor Compost Feasibility Study. Rep. 2011.

[8] ibid.

a liability of waste management, simultaneously improving local soil quality and reducing the University of Michigan's contribution to global climate change.

Additional Environmental Benefits

In addition to the reduction of greenhouse gas emissions that are generated through the transportation of organic waste, anaerobic decomposition in landfills, and the production of chemical fertilizers, the application of compost itself is tremendously beneficial to the environment.

Compost foremost enriches soil by returning nutrients that would otherwise have been trapped within landfills. Compost furthermore acts as a carbon sink, sequestering 6 to 40 tons more carbon per hectare out of the atmosphere and back into the soil.[9] Compost is similarly used to cleanse contaminated soils by treating volatile organic compounds including heating fuels, polyaromatic hydrocarbons, and explosives, while simultaneously diminishing migration of VOCs by resisting the transport of pollutants to water resources.[10] The natural, nutrient rich compost reduces the need for irrigation by 30-70% (and thus the associated agricultural energy demands), while suppressing plant diseases and harmful pests more efficiently than chemical substitutes.[11] Finally, coming full circle, compost strengthens soil structure making it more resistant to topsoil erosion.[12]

Pilot Programs/Locations

The University of Michigan is not new to composting. In July 1997, the Grounds & Waste Management Services started a food waste and composting pilot project with the city of Ann Arbor. In this program, pre-consumer vegetative food waste was collected by the university and transported to the city's composting facilities.[13] The collection was taken at three residence

[9] Sharma, Girja, and Angus Campbell. Life Cycle Inventory and Life Cycle Assessment for Windrow Composting Systems. NSW Department of Environment and Conservation and The University of New South Wales. Sydney, Australia, 2003. http://www.recycledorganics.com/publications/reports/lca/lca.htm.

[10] "Environmental Benefits — Composting — US EPA." US Environmental Protection Agency. 7 Oct. 2008. Web. 26 Apr. 2011. http://www.epa.gov/osw/conserve/rrr/composting/benefits.htm.

[11] "Composting: A Greenhouse Gas Mitigation Measure." Californians Against Waste. 2010. Web. 24 Apr. 2011. http://www.cawrecycles.org/issues/ghg/compost.

[12] Washington State University. "Compost Fundamentals: Benefits & Uses." Compost Fundamentals. Web. 22 Apr. 2011. http://whatcom.wsu.edu/ag/compost/fundamentals/benefits_benefits.htm.

[13] University of Michigan Occupational Safety and Environmental Health. "Food Waste Collection and Composting Pilot Program." P2000: Pollution Prevention Program. 09 July 2008. Web. 4 Apr. 2011. http://www.p2000.umich.edu/grounds_waste/gw4.htm.

hall kitchens for 8 months, during which time over 30 tons of food waste was collected. In 2008, the project moved out of the pilot stage and into the beginning of its current form under the University of Michigan Recycling Program. In fiscal year 2010, 63.05 tons of pre-consumer waste was composted from five residence halls, the Hill Dining Center, Pierpont Commons cafeteria, the University Catering Services, and Palmer Commons.[14]

There is also a current procedure in place for composting yard waste. Leaves, small branches and other organic wastes are taken to a facility on the North Campus Grounds for composting. The university is missing some pieces of composting equipment, making the process much more labor-intensive and less efficient. In autumn, the amount of leaf debris is too great in volume for the North Campus facility to handle, so the leaves are taken off-site to the Matthaei Botanical Gardens for land application. The current grounds being used are on Draper Dr. by the Arborcrest Cemetery and the Naval Architecture and Marine Engineering building on North Campus.[15]

In order for a location to be considered for a larger-scale composting operation by the UM-Ann Arbor Compost Feasibility Study, it needed to meet some basic qualifications. These included an area of at least 2 acres, no surface waters or wetlands within 200 feet, and 480 volts of electrical service. The current grounds were ruled "not likely suitable" for expanded composting, due to small size and planned repurposing of some of the area that would reduce the area available even further. A nearby location, between Fuller Road and Huron Parkway was also considered for this expansion. It also fell into the "not likely suitable" category because of the presence of surface waters, expected difficulty in obtaining composting permits, and likely relocation of the operations if located there. On Plymouth Road, the North Campus Research Center has plenty of space available and is easily accessible. However, the Feasibility Study concluded that out of all four sites it investigated, this was the most likely to be used for another purpose in the future, requiring relocation of the facilities. For that reason, this location was labeled as "not likely suitable." The fourth and final location is the Matthaei Botanical Gardens. This is the furthest away from the current grounds site, requiring more travel time for university operators, or for Matthaei staff to operate the facility. There is again plenty of space for operations to be set up, and room for the additional equipment necessary. The Study concluded that this site "may be suitable to house compost

[14]University of Michigan Plant Operations. "Food Waste Compost Program — Recycling — Plant Operations, UofM." Plant Operations — U of M. 14 Mar. 2011. Web. 4 Apr. 2011. http://www.plantops.umich.edu/grounds/recycle/food_composting.php.

[15]University of Michigan Occupational Safety and Environmental Health. "Yard Waste Composting." P2000: Pollution Prevention Program. 9 July 2008. Web. 4 Apr. 2011. http://www.p2000.umich.edu/grounds_waste/gw5.htm.

operations," but also that more research is necessary.[16]

Equipment

In a recent study performed to evaluate the feasibility of composting at the University of Michigan, requests were sent to ten vendors asking for information on their products. Of these, seven responded with information and costs estimates. Of the seven that responded, two offered products other than aerobic decomposters, and one vendor was outside the desired price range.

TABLE 6: RFI RESPONSES AND BASELINE DATA

Company Name	Type of Equipment	Responded to RFI?	Equipment Capital for Full Program Rollout ($000)	Building/Site Capital ($000)	Total Cost ($000)	Scalable?
EcoDrum	Continuous In-Vessel Compost	Yes	$497.7	$425.7	$ 923.4	Yes
Gaia Recycle	Batch Dehydrator, Sterilizer	Yes	$1,120.0	$342.0	$1,462.0	Yes
Harvest	Batch Dry Anaerobic Digester	No	NA	NA	NA	NA
Hot Rot	Continuous In-Vessel Compost	Yes	$890.6	$247.5	$1,138.1	Yes
Green Mountain Technologies	Continuous In-Vessel Compost	No	NA	NA	NA	NA
Engineered Compost Systems, Inc.	Batch In-Vessel Compost	Yes	$892.5	$247.5	$1,140.0	Yes
OnSite Power Systems, Inc.	Batch Dry Anaerobic Digester	No	NA	NA	NA	NA
BioFerm Energy Solutions	Batch Dry Anaerobic Digester	Yes	$3,292.1	$50.0	$3,342.1	No
Wright Environmental	Continuous In-Vessel Compost	Yes	$848.9	$425.7	$1,274.6	Yes
Vertal Inc.	Continuous In-Vessel Compost	Yes	$1,500.0	$247.5	$1,747.5	Yes

[16] Resource Recycling Systems.

Source: Resource Recycling Systems

Of the four choices that remained for consideration, EcoDrum offers small, 0.5 ton composting units. Though the cheapest option, this would have required additional equipment and facility management during later phases of implementation.

Wright Environmental, by contrast, offered a large 5 ton unit that required at least 2.5 tons per day to operate. Not only does this option offer less flexibility and scalability, it is also less spatially efficient.

Hot Rot offers a continuous in-vessel composter that can process 2.5 tons per day. A single unit can support the university's dining halls and takeout facilities before a second unit is brought it to support administrative and research buildings. The Hot Rot units fit in Matthaei Botanical Gardens and are readily scalable to project specifications, while offering more flexibility than the batch composters sold by Engineered Compost Systems, Inc. Total cost for full university support keeps to the estimated budget of about $1 million. Hence, due to scalability, flexibility, and cost, the Hot Rot brand 2.5 ton composter is the preferred choice for university implementation.

Financial Feasibility

Capital Costs

Based upon the Resource Recycling Systems Final Report, the proposed phases for a scalable University of Michigan composting facility should be as follows:

- Current: .3 T/Day
- Phase I: 1.5 T/Day
- Phase II: 2.2 T/Day
- Phase III: 4.0 T/Day
- Phase IV: 4.9 T/Day

Due to the nature of the equipment we are selecting and in the interest of implementing as much composting as possible as quickly as possible, scalability is key and therefore it is paramount that for economic feasibility, that the cost be similarly scalable. The capital costs of a Hot Rot equipment implementation at Phase I & II as well as Phase IV are shown in the following figure, with the total cost at each stage representing the cost of each previous stage plus additional costs. The Phase IV implementation is the ultimate goal of a UM composting facility and as such, the ultimate total of $1,153,206 total capital cost or $133,489 annual capital cost should be anticipated and used as an estimated projected capital cost.

Phase I & II Capital Cost			
		Years	Annual cost
Site and Building Costs	$ 247,500	20	$ 19,027
Equipment Costs	$ 583,680	10	$ 73,765
Carts	$ 3,510	10	$ 444
Total	**$ 834,690**		**$ 93,235**

Phase IV Total Capital Cost			
		Years	Annual cost
Site and Building Costs	$ 247,500	20	$ 19,027
Equipment Costs	$ 890,640	10	$112,558
Carts	$ 15,066	10	$ 1,904
Total	**$1,153,206**		**$ 133,489**

Source: Resource Recycling Systems

The first column of numbers represents the total upfront costs, while the 'Annual cost' column is the total cost of each item divided by its life-expectancy - shown in the 'Years' column - and can be interpreted as the cost per year of the operation if not paid upfront but rather incrementally with interest.

Potential Savings

Based on the organic nature of compost and its versatile use as among others, a topsoil additive and fertilizer, many cost reductions can be anticipated from activities such as: reduced pumping of grease traps, use of compost as fertilizer, replacing topsoil, waste tip fees, compost tip fees, and waste collection savings. Savings simply from use of compost total nearly an estimated $49,500 per year with a Phase IV implementation with the additional cost saving measures adding up to bring the possible savings to around $102,332 per year with a Phase IV implementation.[17]

Compost Use Savings:

Phase	Replace Topsoil	Compost Tea	Compost Topdressing
Phase I	$5,200	$26,600	$1,900
Phase II	$7,500	$26,600	$2,800
Phase III	$13,800	$26,600	$5,100
Phase IV	$16,700	$26,600	$6,200

Source: Resource Recycling Systems Final Report

[17] Resource Recycling Systems

Total Costs

	Current	Phase I	Phase II	Phase III	Phase IV
Operating Costs					
Site Operation/Tip Fees	$ 2,693	$ 25,431	$ 31,193	$ 52,681	$ 62,483
Operational $/ton	$ 40.00	$ 56.95	$ 49.28	$ 45.66	$ 45.09
Collection	$ 16,190	$ 37,170	$ 62,216	$ 142,593	$ 156,028
Bags	$ -	$ 6,488	$ 15,365	$ 40,163	$ 51,210
Total Operating Costs	**$ 18,882**	**$ 69,089**	**$ 108,774**	**$ 235,436**	**$ 269,721**
Cost Savings					
Reduced pumping of grease traps		$ 14,508	$ 14,508	$ 14,508	$ 14,508
Use of Compost		$ 5,182	$ 7,503	$ 13,772	$ 16,695
Waste Tip Fees		$ 8,038	$ 13,631	$ 24,567	$ 31,527
Compost Tip Fees		$ 2,693	$ 2,693	$ 2,693	$ 2,693
Waste Collection Savings		$ -	$ -	$ 18,455	$ 36,910
Total Cost Savings		**$ 30,420**	**$ 38,334**	**$ 73,994**	**$ 102,332**
Net Cost No Capital	**$ 18,882**	**$ 38,668**	**$ 70,440**	**$ 161,442**	**$ 167,390**
$/ton	$ 280.50	$ 86.59	$ 111.28	$ 139.93	$ 120.80
Ammortized Capital Costs					
Annual Capital	**$ 8,500**	**$ 101,411**	**$ 101,668**	**$ 149,753**	**$ 150,116**
Net Cost W/Capital	**$ 27,382**	**$ 140,079**	**$ 172,107**	**$ 311,196**	**$ 317,506**
$/ton	$ 406.77	$ 313.69	$ 271.90	$ 269.73	$ 229.13
Cost per Cart Tip	$ 4.21	$ 2.70	$ 2.86	$ 2.50	$ 2.04

Source: Resource Recycling Systems Final Report

Taking into consideration yearly savings, total operating costs per year excluding amortized capital costs range from $18,882 with our current facility to $167,390 with a Phase IV implementation. When adding in the amortized capital costs, the costs jump to $27,382 for the current configuration to $317,506 for a full implementation of Phase IV. This is however, not an accurate indicator of the true cost of the program, as the initial capital can be expected to be covered either partially or fully by local or federal government grants. The more realistic yearly cost would then be $167,390 + AC, where AC represents any amortized capital costs not covered by grants or other sources of funding.[18]

These costs are also only the facility costs and are not inclusive of transportation or dining services costs. Despite the conclusion of Smith, Mosley,

[18]Note: Minor discrepancies and typographical mistakes in the consultants report were ignored in order to simplify analysis of the costs and utilize their final numbers. Important to note, is that any discrepancies erred on the side of caution: numbers may be higher in the final total cost analysis than in previous charts.

Varadharajan and Tripuraneni in their report entitled, "Sustainable University of Michigan Dining Hall Waste Management," that sorting more compostables and waste is not economically feasible, it is in fact feasible. The two problems with the equations used by the group are with the amount of sorting required and the estimated labor. With the increased simplicity of single stream recycling and a UM composting facility that can accommodate pre- and post-consumer compostables, sorting would be drastically reduced. The amount of labor, estimated by Smith, et al. to be 6 workers working 8 hours a day at a pay rate of $15 an hour, would be reduced both due to the increased simplicity of sorting but also by patron involvement. Patron sorting was dismissed by Smith, et al. as a possibility but based on the example of Ohio University, it must be considered viable. Ohio University found that with Patrons sorting their own compostables only minimal contamination was detected; this would further cut the need for labor down from 6 workers for 8 hours to possibly 1 worker sporadically during mealtimes.[19]

Ohio University

As a comparably sized, Midwest university, Ohio University's existing compost facility makes for a good comparison with a projected UM facility. Ohio University started its composting facility in 2009 with a capacity of 2 T/day. The initial capital costs were $800,000 with $335,000 in funding coming from the Ohio Department of Natural Resources and the Division of Recycling and Litter Prevention.[20]

In 2010, Ohio University received $1,088,571 in funding as part of a roughly $10 Million block grant to various institutions in the state of Ohio from the American Recovery and Reinvestment Act's Energy Efficiency and Conservation Block Grant: Local Governments and State Energy Program. This funding was used to roughly double their composting capacity.[21][22]

Given the amount of funding and the comparable size of Ohio University's composting project with that of UM's prospective program, funding to cover all initial capital costs seems very likely.

Funding Sources

Possible sources of funding include:

[19] Resource Recycling Systems Final Report Appendix 4, pg. 2

[20] NWF campus ecology paper: http://www.nwf.org/campusEcology/docs/Ohio%20University%20Case%20Study-Composting%20FINAL.pdf

[21] Ohio Compass article: http://www.ohio.edu/compass/stories/09-10/6/ARRA-grants-682.cfm

[22] Ohio University 2007 grant: http://www.ohio.edu/sustainability/documents/Ohio_U_Solar_Compost_proposal.pdf

- American Recovery and Reinvestment Act: Energy Efficiency and Conservation Block Grant: Local Governments and State Energy Program
- Michigan Department of Environmental Quality's $200,000 Community Pollution Prevention Grant Program[23]
- EPA:
  - Pollution Prevention (P2) Grant[24]
  - nvironmental Education Grant[25]
- Grants.gov: A portal for federal grants

Education

Integrating the University of Michigan compost site into existing education curriculum at the university and K-12 levels is beneficial to both students and the compost program itself. Students at the university can learn more about what composting does to improve the environment, and also work at the site to gain valuable experience for the future. Grade school students could take what they learn from field trips to the site and bring that knowledge home, and perhaps start a family composting site. Even small scale home composting will help improve the environment one piece at a time.

Getting the word out in the community about the compost program at Michigan will bring more interest and investment to the program. More visitors will come to the site, and this will further promote the program and composting in general. This will help our community by both decreasing our greenhouse gas emissions and the amount of trash that goes to landfills. More job applications will come in, allowing the site to choose from a greater pool of highly qualified students and managers.

Educational outreach at Ohio University has been very successful. There have been news articles, and awareness groups at campus eating areas. Faculty here have expressed interest in including the composting site as part of their classes. Tables were manned to inform students about the existence of the compost program and why it was being done. In fact, starting in January, 2007, students were instructed to separate their compostable waste a full year before the composting machine began operating so they would be well familiar with the process.[26] An early test of how well students are able to sort out their compostables was done at Ohio University and although

[23] http://www.michigan.gov/deq/0,1607,7-135-3585-252884–,00.html
[24] http://www.epa.gov/p2/pubs/grants/
[25] http://www.epa.gov/education/grants.html
[26] http://www.nwf.org/campusEcology/docs/Ohio%20University%20Case%20Study-Composting%20FINAL.pdf

about 50% of all waste was put in the compost bin, about 1/4th of that was not actually compostable. This was termed an acceptable level for this early in the program however.[27]

The university may want to partner with a non-profit organization such as the U.S. Composting Council to help with the educational process. The USCC has Compost Operations Training Courses in 2011 and 2012 in Raleigh, NC, Davis, CA, and Houston, TX. Ann Arbor may be able to attract one of these courses in the future.[28]

Logistics

Workers

The compost site would be able to employ student workers from the university under work study. Interested students would likely come from Natural Resources, Biology, Chemistry, Engineering, and Geography. This would allow the program to keep labor costs low. Only one or two skilled supervisors would need to be hired. One or two people per shift need to be present at the site for monitoring, and it could be left for several days unattended in the cases of illness or holiday breaks, etc.[29]

Transportation

One potential negative with the program is the need to transport the food waste from campus dining halls to the Matthaei Botanical Gardens. It would be best to keep transportation to a minimum so there is little added carbon to the overall program, but this is not possible. There is very little open land in the Central Campus, so the closest feasible University-owned location has to be used. It is six miles one way from the Botanical Gardens to either the Palmer Field dining hall or the North Quad dining hall. The distance from Central Campus to the Ann Arbor Recycling Center on Ellsworth Rd is five miles one way. This one mile savings would not be enough to override the benefits of keeping the program entirely "in house." North Campus is even closer to the Botanical Gardens (4.5 miles) than Central Campus, and Pierpont Commons is one of the largest generators of food waste at the university, so the Botanical Gardens are a great choice for that reason as well.

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[27] Olivares, Cristina. BioCycle. 2007. http://www.jgpress.com/archives/_free/001357.html

[28] U.S. Composting Council, 2011. http://compostingcouncil.org/education/

[29] Ohio University Sustainability. 2007.
http://www.ohio.edu/sustainability/documents/OU_Compost_proposal.pdf

Storage

Storage of compost can be more difficult than most people imagine. The decomposition of food products creates heat, which has both pros and cons for compost storage. The benefit of heat generation is that it helps inhibit growth of bacteria, insect larvae, and weed seeds. This maintains the compost at a high quality that is safe for human interaction and easy to transport. The negative side is that if the compost is not periodically mixed or turned over, the inner temperature can reach a level over 150 degrees F, and this could create spontaneous combustion. This mixing is even more imperative when dealing with a large collection of compost, as this project plans to be. Combustion has never been reported from piles less than seven feet high. In general, this is not likely to happen even under poor conditions. Another way to keep temperatures from getting this high is to add moisture.[30]

Moisture is a necessary factor for good composting. Again, like temperature, it has to be monitored periodically, and if neglected can slow down decomposition. Some water is needed to help the process, but if there is too much it will fill many of the pores and keep air out, which is also needed. Furthermore, issues can arise with attracting both insects and mammals to the compost site. Keeping meats and dairy out of the compost should eliminate this issue. This is more of an issue for home-based composting, as the university site would be indoors and attended by employees most of the time.[31]

According to balconycompost.com, the minimum temperature to work against microorganisms is 131 degrees. Thus there is a small temperature range that is necessary for high-quality compost. The right amount of aeration and water will keep the compost at the best temperature and improve the efficiency of decomposition.[32]

Distribution System

University dining halls and cafes should be supplied with a composting collection bin for compostable waste to be kept temporarily in the kitchen. These bins could be lined with compostable bags, as done at Seattle University, so the entire bag can be taken along with everything inside of it. Collection personnel would not need to do any dumping of the bins into their own larger size bag. Bins should be kept either in a closet or with a lockable lid to limit odors getting around the kitchen.

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[30] University of Minnesota Extension. 2000. http://www.extension.umn.edu/distribution/horticulture/components/3296-03.html

[31] Christensen, Dick. Colorado State University Cooperative Extension. 2002. http://www.colostate.edu/Depts/CoopExt/LARIMER/mg020921.htm

[32] http://www.balconycompost.com/general/university-compost-spotlight-seattle-university

A truck with two people would be sent around on a loop to all food service locations on campus. One person would drive the truck and a second would go inside and pickup each sites compostable waste. These individuals could be employed student drivers similar to the program the U-M Blue Bus System currently uses. The Blue Bus System trains students for 50 hours in the classroom and on the road in safe and efficient use of university buses. All training is paid, and students gain a commercial drivers license that they can go on to use in other employment if desired. This same program could simply be extended to cover compost pickup trucks. The same trucks could be used for both pickup from campus sites and distribution of ready compost back to campus landscaping.[33]

Production and distribution of compost in Michigan is not highly regulated. On-site composting facilities do not need permits to operate, and compost can be sold to others without any oversight as long as there is no performance guarantee attached.[34]

Sorting Compostable vs. Non-Compostable

The equipment we are proposing can accept both pre- and post-consumer compostable waste, so there is very little dining hall waste that cannot be composted. Furthermore, unless the university wants to sell compost to others, there is no need for permitting. This makes it very easy to put most kitchen waste that would otherwise go to a landfill into a composting collection bin. Seattle University has amongst their extensive "green" portfolio a successful composting facility, creating 26 tons of compost annually from just pre-consumer waste (local regulations do not allow for collection of post-consumer waste). With around 6,000 students, this is a respectable total for a small school. This ended the need for a truck to make a 46 mile roundtrip to the compost facility they used before 2003. Their website lists many things that are compostable: fruits and vegetables, grains, meat, dairy, even bones and eggshells. Shredded paper and paper plates are good additions because these help the food decomposition process.[35][36]

Used coffee grounds, coffee filters, and tea bags are another group of compostable items that are usually thrown away. These can make up a significant percentage by weight of the waste from dining halls and cafes. Starbucks Coffee for example found that over 1/3rd of their waste was from coffee grounds alone. Therefore, the company decided to start a program where those who wanted to could come to any Starbucks and pickup a bag of used coffee grounds for their garden at no charge.[37] The University of

[33] University of Michigan, 2011. http://pts.umich.edu/taking_the_bus/student_driver.php

[34] McEntee Media Corporation, http://www.recycle.cc/compostregs.htm#Michigan

[35] http://www.seattleu.edu/sustainability/compost/, 2008.

[36] http://www.seattleu.edu/sustainability/compostfacility.aspx, 2008.

[37] Tolliver-Nigro, Heidi. http://inspiredeconomist.com/2010/12/08/starbucks-grounds-

Michigan program should have collector bins at all campus locations serving coffee, so this can be diverted from unnecessary landfill dumping.

What is not compostable? For one thing, paper that has any sort of lining, such as a wax lining on many commercial coffee cups. Any plastic kitchen waste needs to either be recycled or put in the trash. Seattle University has changed all their plastic utensils over to a compostable plant-based material.[38] Paper that is not shredded is not nearly as beneficial to compost production as shredded paper, so intact paper should be shredded or recycled. Some would prefer that paper is not composted, because if it is not recycled than that is more paper that has to be made originally from trees.[39] However, the costs and benefits of that are up to the individual to decide.

Conclusion/Recommendation

Based upon our research, we find that a University of Michigan composting program is not simply feasible, but recommended, carrying with it long-term environmental and social benefits. The best option in terms of equipment is the Hot Rot Continuous In-Vessel Composter, as outlined in the 'Equipment section, due to its scalability and cost. In this case, scalability is key, as a composting facility can still be put in place even if a full-Phase IV implementation is not chosen.

The composting facility itself should be placed at Matthaei Botanical Gardens, providing the most space, nearest proximity and best infrastructure for a campus-wide implementation. While start-up costs will be substantial, net costs will be offset by the lifetime expectancy of the program, various grants, and educational values. The initial capital cost of a Phase IV implementation is $1,153,206 and would be competitive with that of other schools with an annual operation cost of $167,390. As outlined in the 'Financial Feasibility section, most, if not all, of the initial capital costs can be covered with federal and state grants. This would lead to a University of Michigan composting facility that more than pays for itself.

for-your-garden-program-greenwashing-or-worse/, 2010.

[38] http://www.seattleu.edu/sustainability/compost/

[39] U.S. Composting Council. http://compostingcouncil.org/faq/