Closed-Loop Composting At Haverford College: Proposal and Implementation Plan

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as part of an Environmental Studies Capstone in Spring ‘22;
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Introduction

On-campus composting has long been a project wanted by Haverford's students, staff, and administrators, but it was last seriously considered seven years ago. Since that time, we have established and grown the Haverfarm, implemented the use of an anaerobic digester in the Dining Center, and started a composting system within the Haverford College Apartments. Since these developments, Haverford College is now more equipped than ever to tackle the challenge of implementing a new, closed-loop composting system on campus and turn this long-term goal into a reality.

A closed-loop composting system on Haverford's campus would provide numerous educational opportunities inside and outside the classroom. The composting system could be incorporated into the curriculum and overall student life in a variety of ways. Students would have the opportunity to receive first-hand experience turning their food scraps into nutrient-rich soil. Examples of engagement with the system include:

- Conducting research on food waste using compost to collect data;
- Taking soil samples to analyze factors contributing to soil health;
- Comparing the rate of decomposition of various food items;
- Volunteering at the Haverfarm to assist with processing and using the compost to grow food;
- Incorporating the on-site composter into Haverfarm/Arboretum tours to give visitors a hands-on introduction to composting.

The joining of Haverford student life with the on-campus composting system would create a plethora of interactive educational opportunities for students, faculty and staff, and visitors, as well as serve as a model for peer institutions.

Before 2019, Haverford College exported any food waste that was not going directly to the landfill to a New Jersey pig farm, which is the current food waste system that Bryn Mawr College implements. There are currently three areas in which Haverford composts: the dining center, the Haverford College apartments, and the Haverfarm. In 2019, Haverford started composting pre-consumer food waste in the Dining Center using an anaerobic digester called "Munchy Crunchy." Although there was an attempt at digesting post-consumer waste, the tight restrictions upon what the digester can accept made this process difficult to implement on a large scale. Haverford also started collaborating with Mother Compost in the fall of 2021 to compost food scraps (anything besides meat, meat by-products such as bones, pet waste, or large yard waste items) from students living in the Haverford College Apartments. Mother Compost comes weekly to empty food waste from two large dumpsters to transport to Linvilla Orchards in Media, PA for processing. Prior to collaborating with Mother Compost, food waste was transported from the Haverford College Apartments to the Dining Center and "Munchy Crunchy" by Carousel Connections and later student workers from the Committee for Environmental Responsibility (CER). Additionally, the Arboretum composts dead leaves collected from the campus in large piles, and the Haverfarm composts agricultural waste using a small windrow system.

The overall mission of this project is to redirect food waste from landfills to be used on our own campus while creating numerous educational opportunities in and out of the classroom. Instead of transporting food waste to be processed off campus, which emits carbon dioxide and is expensive, a closed-loop composting system on campus would allow us to reduce our carbon footprint while saving money in the long run by producing all the compost the Haverfarm and Arboretum needs. Implementing a closed-loop composting system would allow Haverford College to have control over our food waste systems, push us towards our goal of zero waste and carbon neutrality, and serve as a model for peer institutions. It would also help expand the Haverfarm, provide students with interactive composting experience, provide student jobs, and serve as a pathway to connect further with the outside community (i.e., Bethel AME Church, Victory Farm). A new composting system on Haverford's campus would serve as a living laboratory for experiential learning and exploration of food waste and what it has the power to become if diverted from the landfill.

Proposed Plan

Our proposed plan for closed-loop composting at Haverford College consists of two main composting machines. The primary system is a Rotating Drum Composter designed by Compost for Good. The easily customizable design is outlined in rich detail in their Design Guide and Operation Manual. We can either build the drum ourselves, ideally doubling the length of the

drum (Pingry School built their system longer by adding an additional section), or have the company's contractors build it in New York and then transport it to us.

Compost for Good: Rotating Drum Composter

Size	4' diameter, 20+' depending on construction
Intake	50,000 lbs/year of food waste Can run well at a low capacity
Necessary Support	One 220V/20A circuit Weather protectant housing

Supplies for the Rotating Drum cost about $15,000. The general quote we received from Compost for Good was $30,000 for them to build and install the Rotating Drum Composter. The original 20 ft drum is designed to be housed in a 40 ft shipping container, which costs on average $4,000, although other housing options are possible. Additional costs associated with this system are running one 220V/20A circuit to the site and any necessary clearing of the site.

The current plan is to maintain the use of the Dining Center's anaerobic digester, Munchy Crunchy, to deal with pre-consumer food waste. The proposed system would step in to deal with post-consumer food waste from the Dining Center, the Coop, and eventually the whole campus. Rotating drum composters also require the use of bulking agents, which are carbon-rich material that adds structure, or bulk, to the compost. This includes wood chips, wood shavings, sawdust, dry leaves, shredded landscape waste, shredded paper, shredded cardboard, and animal bedding. With this system, we would also be able to compost waste from other parts of campus, such as sawdust from the Foundry, leaf waste from the Arboretum, garden waste from the Haverfarm, and shredded paper from the library and offices.

As we implement a more expansive compost system on campus with the eventual goal of collecting and composting all post-consumer food waste, we might want to invest in a three-stream system for organizing waste. This would be an additional investment that could be undertaken once a reliable on-campus compost system is established.

The general proposed location of the compost system is the Haverfarm. The system would go along the fence on the right side of the garden in an area that local contractors currently use for illegal dumping. By placing the system here, compost from the Dining Center, the Coop, and the Library Cafe can be driven along roads to the composter. Additionally, this location is near the existing location where agricultural and leaf waste from the campus is collected. It will be easy for Haverfarm workers to mix the food waste and bulking agents daily.

Picture of proposed composter site

Although the day-to-day management of the compost systems will fall under the purview of the Haverfarm Manager, Haverfarm Fellow, and Haverfarm Student Workers, we will need two additional student workers with golf cart certification, working for about 5 hours per a week each on the transportation of food scraps to the compost system. We believe that the work will be about an hour a day and best split between two workers for schedule flexibility. The cost for these two workers is estimated to be about $4,000 per year. There are possible additional maintenance costs that could arise, but they are not expected to be of any significant cost.

Recommended Expansion

The additional optional component that could be added to Haverford's compost system is the Actium Batch Composter.

Actium: Actium Batch Composter

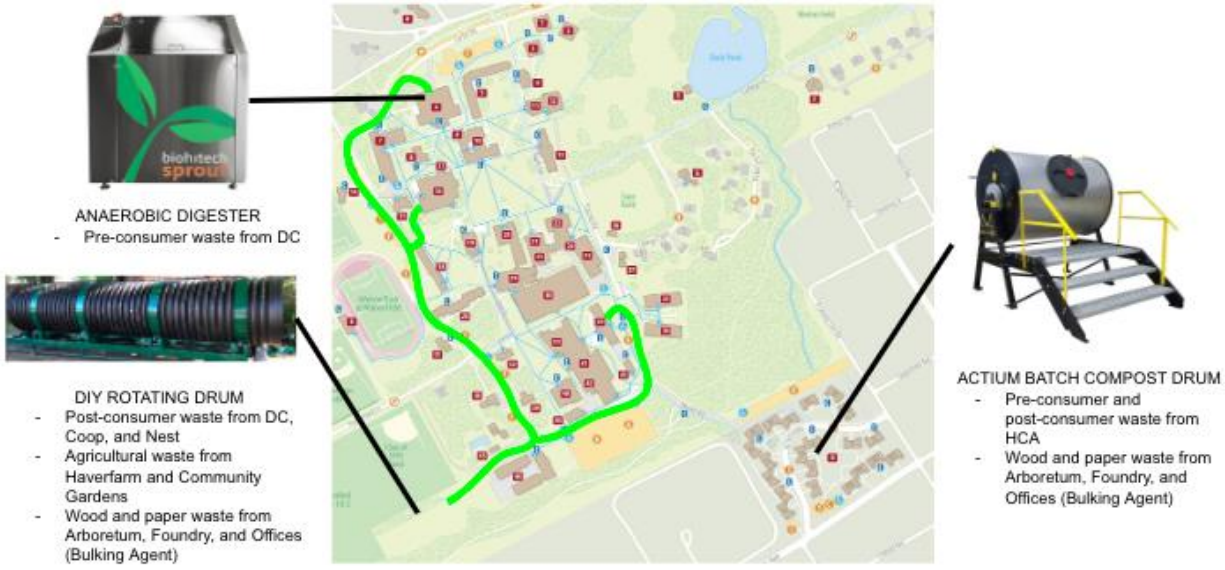
Size	4' diameter, 5' long
Intake	350 lbs/week of food waste Hand-spun rotating drum
Necessary Support	8' x 10' concrete pad

The drum costs $8,500; there are optional steps and handrails (that could be helpful if the system is used for learning and teaching purposes) for an additional $1,250. The delivery price is also $1,250. Additional expenses for this system include pouring the concrete pad and smaller buckets necessary for collection from the Haverford College Apartments. The proposed location

for this system is next to HCA Gardens. This location is easily accessible for all apartment dwellers to collect their food waste in large holding bins - very similar to the current system of food waste collection with Mother Compost, and accessible along the paved road by golf cart for the movement of any necessary bulking agents. This location will also allow the compost to be easily used on the HCA Gardens. Management of the Batch composter can fall under the purview of Haverfarm Student Workers and/or members of CER. Once the Batch Composter is full, it composts for a week without additional food waste; in the interim, food waste can be collected in the large holding bins.

If the proposed expansion were not implemented, the waste could be collected in a similar collection system or holding bins. This food waste would have to be transported to the rotating drum, most likely increasing the number of hours for the student workers. Additionally, there is some concern that the waste could overwhelm the rotating drum because of the variability of food waste produced in HCA. All of this considered, we highly recommend the complete food waste management system.

Food Waste Management System Map



Possible Concerns

We have tried to identify possible concerns and obstacles in implementing our proposed closed-loop composting system. In some states in the US, local ordinances regarding how much one can compost on-site without a permit have been issued, but Haverford Township has no ordinances so far. The amount we have estimated Haverford would be composting (50,000 lbs a year) is well below the number of pounds of compost produced per year that would require a governmental permit.

Other obstacles that we might encounter will most likely have to do with the setup and operation of the system. The proximity to electricity at the proposed site was a concern at first since the rotating drums system needs electricity to operate. After talking with Claudia Kent, we do not think this will pose any issues since the Arboretum recently installed trash compactors close to the proposed site; bringing electricity to the site will be a simple extension of the current system.

Like any machine, the operation of the rotating drum system will not always be smooth, and thus obstacles will come up. One area that we believe could pose potential issues would be the amount of bulking agents needed in order for the system to produce useful compost. The Arboretum and other places on campus have a surplus of wood chips, sawdust, and leaves that can be used as bulking agents. However, we have heard from the Pingry School – who use the same rotating drum system we are proposing – that their wood chips, sawdust, and leaves would become damp during the year since they sat uncovered outside, which made them not suitable as bulking agents. While the Arboretum's piles of wood chips and leaves sit outside, there is a possibility that the piles can be covered with a tarp for them to be able to stay dry.

The suggested ratio of bulking agents to food waste in the rotating drum system is 1 pound to 5 pounds; the Pingry School told us that, in their experience, the ratio has varied depending on season and weather. In warmer months, the system creates a lot more steam, so fewer bulking agents are needed, while in winter months, more bulking agents are usually required to produce the same quality of compost. Due to the lack of dry bulking agents available to them, the Pingry School was forced to start buying compressed sawdust pellets to use as their bulking agents. We believe that, between using a tarp to keep the bulking agents dry and being able to control the size of the wood chips using a wood chipper we have on campus, Haverford will be able to use its surplus of wood chips, sawdust, and dry leaves as bulking agents and will not need to purchase additional pellets.

Another concern that was voiced throughout our research was how the hauling and transporting of food waste to the proposed site would be handled. As we outlined earlier in the proposal, the human-required operations of the rotating drum system will be done by the Haverfarm Manager and Fellow, and two newly hired student workers. We know that proposing funding new jobs, even student worker positions, can pose difficulties in management and budgeting, but we hope the college can prioritize these jobs as it would support a college-wide effort. During the summer and school breaks, due to the significantly reduced food waste produced on campus, the system will run at a low capacity and can still be managed by the Haverfarm Manager, the Haverfarm Fellow, and two student summer workers.

Budget and Funding Opportunities

Currently, in order to support the Haverfarm and the Arboretum, we purchase large amounts of compost, fertilizers, and pesticides. The Haverfarm currently purchases 4-8 tons of compost per year from the Fairmount Park Organic Recycling Center at about $600/year. The farm also spends about $400/year on soil amendments like blood meal, alfalfa meal, feather meal, and potash. The Arboretum does not currently purchase any compost; instead, they purchase approximately 10 tons of fertilizers (organic composted chicken manure) at about $18,000/year. Additionally, they purchase pesticides at $3,000-$5,000/year. CER also pays

Mother Compost $1,500/year to transport food waste from the Haverford College Apartments to Linvilla Orchards, where it is composted. The current total yearly expenses total about $24,500.

High-quality compost, which is what is produced through a well-maintained rotating drum system, can reduce or even eliminate the need for fertilizer and pesticides. We project a conservative reduction of costs to be $13,500/year by eliminating the Haverfarm and Mother Compost expenses and reducing by half of the Arboretum expenses for a new yearly expenses cost of $11,000.

We conservatively estimate the costs of building ourselves and implementing the Rotating Drum Composter from Compost for Good to be $30,000; if we were to purchase the pre-constructed system, this cost would be increased. The possible additional cost of purchasing and implementing the Actium Batch Composter is about $15,000. The cost for these two workers is estimated to be about $4,000 per year.

Cost Analysis

Yearly Savings: $13,500	Initial Costs: $30,000 or $45,000 Yearly Costs: $4,000

The smaller system can pay for itself in 3.5 - 4 years depending upon DIY or purchase, and the more expansive system can pay for itself in less than 5 years.

Opportunities

Haverford would benefit from implementing a closed-loop composting system on campus in four major areas of the college's goals and values: educational opportunities, community engagement, net-zero carbon emissions, and overall monetary savings.

As we have learned from other institutions, like Lafayette College and the University of Maine who we consulted during our research process, each closed-loop composting system had an even-larger-than anticipated educational impact on the school. Classes from all different departments can use the observational and experiential opportunities that will come from on-campus composting facilities. Haverfarm volunteers and student workers will also have the opportunity for hands-on experience in creating compost. In addition to the opportunities for students on campus, the closed-loop composting will also offer invaluable education to the broader community. School groups of all levels, which often visit the Haverfarm and Arboretum, can come to see the system to learn about composting, creating unique and memorable educational opportunities.

The closed-loop composting system presents multiple ways for Haverford to further existing relationships and build new relationships with communities in Haverford and Ardmore. The Haverfarm community gardeners can use the compost produced from the system on their plots, and extra compost can be used by the Admore Victory Gardens, which would strengthen the already existing partnership between Haverford College and Bethel AME Church. Additionally, depending on how much compost is produced and used on campus, there could be

an opportunity for the Haverfarm to sell the compost to nearby community members to use in their backyards and gardens. Through our research project, we also connected with the Haverford Boys School. Although at this time they are unable to consider composting, in the future they would be open to collaborating and taking their compost to the rotating drum system on Haverford's campus.

The cost of implementing the rotating drum system we have proposed will be substantial upfront, but as we calculated, the DIY rotating drum system should pay for itself in about four years, with the more expansive system paying for itself in five years. The Haverfarm will no longer need to purchase compost and soil amendments, and the Arboretum can reduce purchases for fertilizer and pesticides. The only significant annual budget considerations will be the compensation for student workers transporting the compost.

One of Haverford's greatest sustainability goals is to achieve net-zero emissions by 2035 (ideally, 2033, the bi-centennial of the college's founding). Implementing a closed-loop composting system would help advance progress towards this goal. With the reduction in transportation emissions and the continued use of the anaerobic digester in the Dining Center, the system would contribute daily to lowering our emission levels on campus. Although Haverford still needs to implement many changes to reach its target goal of net-zero emissions, installing a closed-loop composting system on campus will help further that goal faster.

Haverford has often been seen as a leader among our peer institutions, but this does not ring true for sustainability. Implementing on-campus closed-loop composting is an accessible and worthwhile project that can help propel Haverford to a leading example of stewardship towards the environment that peer institutions and community groups can aspire to. We strongly feel that this project would positively impact students and the community, and we thank everyone for taking the time to consider our proposal.