

Gauging the Grenfell Campus Community's View on Composting and Potential On-Campus Composting Options

Jason Diamond

Grenfell Campus, Memorial University of Newfoundland

Abstract

The purpose of this paper is to look at the behaviour and attitudes towards composting organic waste among the Grenfell Campus community and to research options to deal with Grenfell's organic waste. With Grenfell's industrial composter no longer in use, due to high costs of operation and budget cuts, there are currently no alternatives to divert the campus' organic waste from ending up in the landfill. Government action plans and Grenfell's vision for the year 2020 push for a more environmentally-friendly and sustainable future. With these plans in place positive outcomes appear to be on the way but concrete actions for moving forward with composting on campus are currently lacking. Through a campus wide survey regarding composting, participants' responses indicate the level of involvement that can happen if composting on-campus returns. Interview responses from faculty and staff on possible composting options that could work for Grenfell help in moving us closer towards this aim. As well, in this research I look at what other campuses are doing to provide ideas. Possible composting options identified for Grenfell include vermicomposting, using backyard composters, and biogas generation. Initial analysis suggests that vermicomposting or the use backyard composters are low hanging fruit that can be easily achievable for our small campus. With a little financial aid and help from interested volunteers, a small pilot project can help divert a small amount of our organic waste from a landfill. Grenfell should support and work towards becoming a more sustainable campus, leaving a positive impact on anyone who visits.

Introduction

Eliot Epstein (1996, xv) explains that, “Composting is the highest form of recycling and the reuse of resources. What greater benefits can be had by mankind to perpetuate the living soil, which provides us with sustenance, food, and life, by returning and utilizing organic matter? What better utilization of organic waste can be had than composting”? This quote has the ability to spark thoughts regarding composting, such as, where is our organic waste going? Organic waste that is not composted in Newfoundland and Labrador goes right into landfills. By reducing our organic waste through composting efforts, we can divert a portion of our organic waste from going into landfills in a sustainable way.

Composting is the “biological decomposition of organic matter... under controlled aerobic conditions... [to produce] a humus-like stable product” (Epstein, 1996, p. 1). Some positive aspects of composting organic waste are as follows: transforming organic matter into a product that improves soil quality; in some cases, composting is economically viable as opposed to other disposal costs; and a considerable amount of domestic waste streams have the ability to be composted (the diversion of waste to landfills) (Epstein, 1996). Composting can also be a tricky

process. For best results there are a few factors that come into play, such as what waste is being added and what maintenance is taking place. Carbon materials (such as shredded paper) and nitrogen materials (such as vegetable debris) are important in the composting process. For best results the carbon: nitrogen ratio is a widely used parameter (Dominguez & Edwards, 2010). Composting organic waste is also a great way to educate and involve the community in environmentally-friendly initiatives.

Memorial University's Grenfell Campus is located in Corner Brook, Newfoundland and Labrador. The campus population is relatively small with around 1,300 undergraduate and graduate students ("Viewbook", 2016). The Grenfell Campus provides many programs and courses related to the environment and sustainability. The 2016 Viewbook states that the Grenfell Campus offers undergraduate and graduate degree programs in: Environmental Studies (BA), Sustainable Resource Management (BRM), Environmental Science [B.Sc., B.Sc. (Hons.)], Environmental Policy (MA), and Boreal Ecosystems and Agriculture Sciences (M.Sc.) (p. 26).

The Environmental Studies program here at Grenfell states that students in this program will gain an understanding of real-world economic, ecological, and social impacts of different environmental problems and solutions. Within the program there are a wide variety of courses with the environment in mind such as environmental ethics, economics, geography, geographical information systems (GIS), environmental impact assessment, research methods, and outdoor pursuits. Using the interdisciplinary grounding provided by these courses required for the Environmental Studies program, these graduating students will be equipped to become stewards of the planet ("Viewbook", 2016).

With over 10 communal kitchens, two food establishments, and nearly 1,500 students attending the Grenfell Campus of Memorial University there is a great amount of compostable waste going to landfills that could be diverted. One means of diverting this waste is through composting processes. According to a member of the Grenfell staff, the campus' industrial composter could process ~100,000 kg of compostable waste a year. This composter received nearly 33,000 kg of compostable waste to process between 2014 and 2015 (Grenfell Campus staff member, personal communication, March 8, 2017). And between 2015 and 2016, the composter received ~28,000 kg even though the campus' major food establishment was not in operation for nearly four months in that year (Grenfell Campus staff member, personal communication, March 21, 2017). Initiatives towards diverting the amount of organic waste that is ending up in nearby landfills will be able to enhance the campus' image of being environmentally-friendly and help increase its sustainability.

The Grenfell Campus of Memorial University had operated an industrial composter, which helped divert compostable waste from local landfills from 2012 to 2016. While the university's web page still states that the "industrial composter operates year round, and has successfully diverted more than 44 tons of organic waste from local landfills" ("Grenfell Composter, Facilities Management"), the composter had stopped operating in the summer of 2016 due to its high annual cost of operation. The cost of running the industrial composter is currently too high for Grenfell's small campus.



Figure 1. A photo of the industrial composter that resides on the Grenfell Campus. Taken from: Cochrane, T. (February 29, 2012). In *Grenfell going greener, launches compost program*. Retrieved from <http://cornerbrooker.com/2012/02/grenfell-going-greener-launches-compost-program/> Copyright 2013 by CornerBrooker.com

Setting up green bins for organic waste around the campus may not pose an issue as these bins have already been here before. The question, however, is where the compostable waste is ultimately disposed. Some on campus composting options mentioned in this paper include the use of backyard composting bins and tumblers, vermicomposters, and biogas generation. Another method includes collecting the waste and transporting it to different waste management corporations for proper disposal, but currently there is no province-wide programs to help achieve this. This research will look at what other small campuses around Canada are doing with their compostable waste, as well as suggestions from the Grenfell community on what to do with our compostable organic waste.

Questioning the Grenfell community on information involving composting, and what one would do if composting on campus were to happen again, can help guide the decision makers on what direction to take in moving forward. Education and teaching by doing are key methods, which can help students on campus get involved to move towards sustainably diverting the campus' waste. While Grenfell does have a small campus, any waste that can be diverted in an environmentally-friendly matter will help make a positive impact on the environment and the ethics of the campus.

The environment and sustainability are growing concerns for many governments, institutions, companies, and people around the world. Baldwin & Dripps (2012) explain that higher education has been at the forefront of the growing sustainable movement over the last few decades. Universities tend to make a significant contribution to the development of our society and therefore have a special societal responsibility to help train youth and push public awareness about sustainability (Alshuwaikhat & Abubakar, 2008). Consistent and comprehensive assessments of campus sustainability initiatives and progress these initiatives are achieving is a great way to connect people with common goals and gaining a sense of what directions to take (Brinkhurst et al., 2011). Initiating small on campus composting projects can connect people together in searching for composting methods to divert more of Grenfell's organic waste. As well, sustainable practices on campus have the ability to attract students. Stafford (2011) explains that with the extent of care about the environment, sustainable practices can help an institution attract like-

minded students and faculty, leading to an increased quality of the institution's teaching and research.

With many courses available at Grenfell involving the environment, encouraging and supporting environmentally-friendly and sustainable initiatives on campus should be at the forefront. While the Grenfell Campus community continues working to explore possible alternative uses for the industrial composter there are alternative options that the campus can partake in towards decreasing its compostable landfill waste and leaving a positive environmental impact. The purpose of this research is to identify and examine possible alternative composting options that can be implemented on campus and to gauge support within the campus community for future composting efforts.

Methods

With the industrial composter that provided for Grenfell Campus out of operation, this leaves the following questions to be answered which are addressed in this research: what are some alternative composting options that can be implemented on campus? What level of support exists within the Grenfell Campus community for composting?

Research methods for this study included:

- looking through articles/journals for peer reviewed information, particularly articles/journals exclusive to campus sustainability, composting on campus, as well as university/government documents and reports relating to issues of composting
- a survey gauging the campus community's view on composting, and
- interviewing members of the campus community on recommendations for composting.

An ethics review was undertaken before for these research processes began. The research proposal for this paper was approved by the Program Level Ethics Review Committee. With approval, the survey and interview processes were able to move forward.

Participants were given a survey about their composting attitudes and behaviours. This survey was released through the campus wide email messenger system on March 16th, 2017. The survey was one of a number of items in the daily email message, which is circulated daily to all members of the campus community (being students, faculty, and staff members). Participants were asked ten questions with room for comments. Questions included how environmentally centred the campus community views Grenfell, how the community views composting, opinions on composting, and what people would be willing to do to contribute to campus composting efforts (see Appendix 1). When implementing the survey, the campus community was given ten days to respond, with one reminder of the survey throughout the allotted time (March 21st, 2017). The survey was finally closed on March 26th, 2017. Participants in survey research included 38 members of the Grenfell Campus community (students, staff, and faculty). The majority of participants who responded to this survey were students. Findings from this survey can help gauge what the campus community's views are on composting and what can happen if on campus composting initiatives are implemented in the future. These results may also have the ability to push decision makers towards working on different options for diverting the campus' waste in the future.

Along with conducting the survey on the campus community's views on composting I also interviewed a small number of people working at the Grenfell Campus who are knowledgeable of issues on sustainability and the environment. Participants included in the interviewing process were professors, sustainability committee members, and staff members who have been involved in the industrial composting program. Eight members within the campus were interviewed. These members were given a semi-structured interview asking their opinions on alternative composting options that may fit for Grenfell. Questions that these informants were asked include: do they see any possible alternative options for composting at Grenfell, how can the campus community be encouraged to get involved in composting, are there any recommendations for the future, and any comments related to the issue. Interviewing these key members provided knowledge to help further the research and inform decision makers.

Along with the survey to gauge the community's views on composting I researched different composting options that were mentioned in the interviewing process that might be possible to achieve on Grenfell's small campus. Through search engines such as the Memorial University online library and Google Scholar, scholarly articles were identified that provided insight for the campus. Looking at what is offered in the area, such as the Multi-Materials Stewardship Board (MMSB), can help composting efforts on campus more achievable. The MMSB is a crown agency of the Government of Newfoundland and Labrador, "established in 1996, MMSB develops, implements and manages waste diversion and recycling programs on a province-wide basis" (MMSB, "About MMSB"). As well, looking at what other small campuses around Canada are doing for towards composting on or off campus can help give motivation that even though we have a small campus, diverting our organic waste can still be possible.

In the winter of 2017, the MMSB offered a subsidized sale price on a bulk order of backyard composters in increments of 40. The MMSB explains that "through the Compost Bin Distribution Program, MMSB partners with municipalities from across the province to offer compost bins to residents at a reduced cost" (MMSB, "Find a Bin"). The Grenfell community was given this offer through the campus wide email with hopes of ordering at least 40. Results from this offer were gathered through interviews with involved Grenfell members and are outlined in this paper. Feedback on the number of students, staff, and faculty who wanted to be included in this purchase can help show how the campus community has initiative towards composting efforts.

Literature Review

Literature that had been looked at to further this paper included papers and reports related to the areas of campus sustainability, composting, and what the Province of NL offers for support of composting.

Campus sustainability

Institutions such as universities have a growing concern for the environment and sustainability. Universities contribute to the education and awareness in many areas of society (Alshuwaikhat & Abubakar, 2008). Pushing sustainability initiatives such as composting has the ability to make members within a university aware of the benefits that these initiatives have, furthering sustainability and environmentally-friendliness. As previously noted, an environmentally-friendly campus has the ability to attract like-minded students. In doing so, this can increase research and teaching on environmental initiatives (Stafford, 2011). The Grenfell Campus offers many courses related to the environment and sustainability (“Viewbook”, 2016). These courses can help lead the campus community in the right direction towards sustainability and positive environmental impacts.

Composting

Many university campuses around Canada are involved in composting initiatives. While universities have different means of diverting their organic waste, they are all working towards a sustainable and environmentally-friendly future. Composting organic waste has the ability to provide a beneficial product (soil), in some cases it may be economically favorable, and is beneficial for the environment (Epstein, 1996). There are currently no composting options available at the Memorial University, Grenfell Campus at the moment but there are some low cost options that can be easily implemented such as vermicomposting or the use of outdoor 'backyard' compost bins. Any implementation of an on-campus composting project would be a great start to get educate and make people aware of the benefits of composting.

Provincial government reports and resources

Looking through government reports on issues dealing with organic waste management in the province can help show whether the province making steps in the right directions towards sustainability. With the government pushing towards becoming greener (Government of Newfoundland and Labrador, “Greening the Government”), this may make it easier on surrounding institutions to follow. With government plans to implement a solid-waste management plan in the future, this will ease the burden of organic compostable waste ending up in landfills. These plans can benefit Grenfell's campus if there are no means to divert all of its organic waste in the future. These reports mention pilot projects that help provide awareness, education, and data for other future initiatives and collaborations between institutions, which can benefit both parties. The MMSB, a crown agency of the Province provides a lot of information on composting options that are possible to achieve at Grenfell Campus, such as backyard composting and vermicomposting. As well, they have ongoing programs that help composting efforts in the province. Details from these reports are discussed further below.

Compostable Organic Waste at Grenfell

According to a document, the Study of Options for Organic Waste Processing in the Province of Newfoundland and Labrador, released by the Government of Newfoundland and Labrador (2014), out of the waste the Industrial, Commercial, and Institutional (ICI) sector produces, 30% of this is compostable organic material. This is predominantly food wastes from restaurants, food outlets, and kitchens in businesses. This is a relatively large portion of waste that these sectors are producing. With these statistics in mind, upwards of 30% of the waste that Grenfell produces could be diverted from the local landfill.

Currently at the Grenfell Campus there are no programs to divert its organic waste from landfills. In the past the campus had an in-vessel industrial composter that dealt with all of the campus' compostable organic waste. Grenfell's industrial composter was a 5-year pilot project which came into use in the winter of 2012, and shut down in December of 2016. A document released by the Government of Newfoundland and Labrador ("Campus Composting Initiative", November 11, 2011) explained that,

"The Multi-Materials Stewardship Board (MMSB), in partnership with the Grenfell Campus of Memorial University of Newfoundland and College of the North Atlantic, unveiled a new high-tech campus composting initiative in Corner Brook today. This is the first industrial composting application established in Newfoundland and Labrador.

'I commend all of the partners who have helped make this composting project a reality,' said the Honourable Terry French, Minister of Environment and Conservation. 'Keeping organic waste out of landfill sites is imperative to moving forward with a more progressive and environmentally-sound waste management plan for the province, and this is a great example of how the institutional sector can continue to play a role in helping us do just that. We dispose of more than 300 tonnes of organic waste in our landfills on a daily basis, and this is clearly a step in the right direction'" (Campus Composting Initiative, November 2011).

The decision to shut down Grenfell's industrial composter was not an easy one to make. The reason it shut down was because of government budget cuts. The operational cost of running and using the industrial composter was approximately \$105,000 a year. Nearly \$100,000 of this operations cost was allotted to the two union salary positions which helped keep the operation running while only around \$5,000 was needed to keep the industrial composter itself running (Grenfell Campus member, personal communication, March 8, 2017).

When composting was available on campus the Residence Assistants (RAs) were required to speak to students regarding the importance of composting and how the bins should be used. This typically would have been discussed during the first floor meeting. But unfortunately, not all students attend these meetings. RAs may have also posted information on their individual floor Facebook pages regarding composting throughout the semester. Composting was recommended and encouraged in Student Housing. Each floor had a compost bin with appropriate signage. The chalet apartments were also provided with the small bins. Unfortunately, many of the small bins went missing. From 2014 on, chalet students had to contact the student recruitment to receive a small bin. Student housing tried to make it as simple as possible to encourage students to compost. As well, student housing had a slide-show on the importance of being green (composting, water and electrical

conservation, etc.) on the university's website that was available for students. But this had been removed when the composted project ended. Grenfell's student recruitment officer would also come into Student Housing for floor information programs when requested regarding composting. This had helped greatly with getting students on-board with composting. A student housing representative explained that since 2014, there has been a cultural shift within its residences, where these students were really becoming conscious on how to be more environmentally- friendly.

There is hope for a greener future at Grenfell. The Grenfell campus has released a document for its vision in the year 2020. This document's vision explains that “Grenfell Campus is a student-centered and sustainability-driven campus of Memorial University that attracts and retains a diverse and growing community of enthusiastic students, staff and faculty who have made Grenfell their campus of choice for education and employment” (“Vision 20/20”, p.11). As well it states that their mission is “to enrich the personal, economic and cultural lives of the Grenfell community through the highest quality education, the vigorous pursuit of new knowledge, and through a greater engagement with the people of the western region, Newfoundland and Labrador, Canada and beyond” (“Vision 20/20”, p.11).

Grenfell has aspirations towards becoming a more environmentally-friendly and sustainable campus. These initiatives are listed in Grenfell's vision for the year 2020. The document, “Grenfell's strategic plan, Vision 20/20 is realistic and achievable because its foundation is built on the clear and focused imaginings of an entire community” (“Vision 20/20”, p.5). One of the values that Vision 20/20 mentions is environmental care, stating its “commitment to informed and responsible environmental stewardship” (p. 15). Another aim that this document mentions is to “significantly advance Grenfell’s position as an environmentally sustainable campus” (p.33). Diverting Grenfell's compostable organic waste from a landfill will advance the campus in promoting care for the environment and sustainability. But there are financial problems. Fournier (2008) explains that in a financial arena, artificially low trash disposal fees and tight campus budgets hamper these efforts. Grenfell fits the parameters that Fournier explains. Grenfell does not pay high fees for regular trash disposal, and because of a tight campus budget, the campus decided to stop the operation of the industrial composter. Any initiatives towards diverting waste will bring Grenfell a step in the right direction.

With an uncertain future for the industrial composter that still resides on the campus grounds, there is a need to look at future alternative options for the Grenfell Campus in case this composter leaves. Improving the diversion of compostable waste on campus will help promote the campus' image of environmentalism and sustainability.

Looking at Universities Similar to Grenfell

The process of this study included searching what similar universities are doing with their compostable waste. The criteria looked at when searching for these universities were a similar amount of students and that these universities were located in different provinces within Canada. Four different universities were included: Bishop's University (Quebec), Mount Allison University (New Brunswick), University of Northern British Columbia (British Columbia), and Acadia University (Nova Scotia). Table 1 below outlines the student population of these universities, what is happening with their organic waste, and problems associated with composting on campus. The research process taken to find out what these universities were doing with their organic waste were searching through their online database for documents they had released regarding sustainability,

audits, and composting. Acknowledging the initiatives that these small universities undertake with their compostable organic waste helped motivate the thought that campus composting can happen here again at Grenfell.

Bishop's University (BU), located in Sherbrooke, Quebec, offers programs and courses in the fine arts, humanities, social sciences, natural sciences, business, and education. BU has 2,400 full-time students (Bishop's University, "BU at a glance"). In a 2009 alumni newsletter, BU explains that over one ton of their waste a week is diverted to a composting site in Bury, Quebec, nearly 40km away from the campus (Bishop's University, "Bishop's University News"). The campus also works with a company called Sodexo (a food services and facilities management company) who helped them implement composting and introduced new waste stations that include recycling, composting, and trash in one convenient structure. From a 2011 sustainability audit, the custodian supervisor estimated their waste yielded 33% recyclable content. Suggested solutions to this problem included locating clear and indicative signs near the waste stations, that all classroom hallways and employee offices have recycling/waste stations installed, and an awareness campaign during each semester (Hamel, 2011). The campus also has an 'eco-floor' in its residence. A 2010-2011 yearend report stated that almost everybody on the floor "enjoyed being part of the Eco-Floor. Some were more interested in learning about sustainable living, while others were more into the idea of living in a community with similar-minded people. While everyone joined for different reasons, this is exactly why the Eco-Floor worked" (Kroeze 2011, p.7). This is a great concept to get people involved. The report also mentioned strategically placing the composting/garbage/recycling bins for easy accessibility and visibility for students and suggested that the campus' environmental club converse with students during busy lunch hours to raise awareness of where the units are placed and what should go in them (Kroeze, 2011).

University/Institution	Student population	What is happening with organic waste	Problems
<u>Bishop's University, Sherbrooke, Quebec</u>	2400	Diverted to a compost site off-campus	Large amount of organic waste being thrown in the trash, need for more awareness and education
Mount Allison University, <u>Sackville, New Brunswick</u>	2300	On-site industrial <u>composter</u>	Improper separation of waste, lack of education
University of Northern British Columbia, Prince George, British Columbia	4020	Small on-site compost pile	Cannot handle all the university's organic waste, underfunded, impacted by seasonal changes
<u>Acadia University, Wolfville, Nova Scotia</u>	3700	Diverted to a compost site off-campus due to provincial regulations	Better waste sorting is needed
Memorial University <u>Grenfell Campus, Corner Brook, Newfoundland and Labrador</u>	1300	No current options to divert waste	N/A

Table 1. Table 1 outlines the university/institution, the student population, what these institutions are doing with their organic waste, and problems associated with their organic waste. Figure created by author from information explained in this section.

Mount Allison University, located in Sackville, New Brunswick, has 2,300 full-time students (Mount Allison University, “The small class difference”). From a 2013 environmental audit, the document states that the campus has an on-site composting machine, the Big Hanna. At full production, the Big Hanna produces 60,000kg of compost each year (Mount Allison University, “Mount Allison Food Audit”, 2013). This compost is used mostly on the campus lawns and field. Before the Big Hanna the campus' organic waste was sent to a composting facility. From their 2014 environmental audit, the document explains that even though efforts are made by staff and students to properly separate waste it has proved to be difficult to convey these messages to the campus community and lack of education ultimately leads to poor sorting of the waste (Mount Allison University, “Environmental Audit 2014”).

University of Northern British Columbia, located in Prince George, British Columbia, had a total of 3,290 full-time students in 2015/2016 (University of Northern British Columbia, “Facts and Statistics”). Composting on-campus began as a joint action between two interest groups. Green bins are located around the campus and diverted to a compost site on-campus that is only accessible to workers and volunteers (Tumblr, “PGPIRG Compost and Garden”). The soil made from their on-campus composting process is used in the campus' compost garden. The schools website explains that these operations are underfunded and unable to handle all the organic waste that the

campus produces (University of Northern British Columbia, “Completing Key Organic Waste Audits”, 2014). They explain that an in-vessel composter would be able to decompose their waste through all seasons. And creating an audit for their organic waste generation is required to properly scale a composting system that can handle their campus' volume. In a waste audit project conducted by a student, the document exclaimed that the campus' administration must take responsibility for waste diversion programs as opposed to viewing these as optional and/or volunteer activities (Smyth, 2008). The document also stated that even though the campus is at a disadvantage because of how small it is, a single sustainability coordinator can have the ability to facilitate education and encourage the campus community on proper collection and processing of wastes (Smyth, 2008).

Acadia University, located in Wolfville, Nova Scotia, has ~3,700 full-time students (Acadia University, “At a glance”). From a 2006-2009 sustainability assessment, the document stated that while efforts to recycle and compost are commendable, more attention is needed for waste sorting to minimize the waste on campus (Arthur Irving Academy for the Environment). This university is located in an area where a waste management corporation (Valley Waste Resource Management, VWRM) oversees the garbage and recycling collection and diversion for the campus (Acadia University, “Recycling and Garbage 101”). The VWRM explains that they are mandated under the Nova Scotia provincial waste resource management regulation. This regulation keeps banned materials (e.g. Recyclables and compostable) out of landfills (Valley Waste Resource Management, “Overview”).

Four of these universities have a student population of less than 5,000. These universities see similar problems with their organic waste being it is not separated properly and the need for more education (refer to table 1). Some problems associated with composting in Bishop’s University are a large amount of their organic waste is going into the trash, and there is a need for more awareness and education. Mount Allison’s organic waste is processed in an in-vessel system on campus. Problems with their campus include the improper separation of waste and a lack of education. University of Northern British Columbia’s organic waste is diverted to an on-site compost pile. Problems associated with this include the pile not being able to handle all of the university's waste, the program is underfunded, and the pile is impacted by seasonal change. Because of Nova Scotia's provincial regulations, Acadia’s organic waste is diverted to an off-campus compost site. One problem that this university has is a need for better sorting. While the Grenfell Campus currently has no means to divert its organic waste on campus, any initiatives to do so will be a step in the right direction.

Initiatives and Strategies Towards Greening and Composting in Newfoundland and Labrador

MMSB Partnered Projects

The MMSB has been involved in some pilot projects in Newfoundland and Labrador in hopes of diverting organic wastes from landfills. One of the MMSB partnered pilot projects was the industrial composter that Grenfell had. Another pilot project that that MMSB is involved in is a curbside composting pilot project in the Northern Peninsula. This project began in September 2016. It involved the curbside collection of compostable organic waste among 900 households in

a sub-region in the Northern Peninsula. Mike Samson, Chief Executive Officer of MMSB, explained that the “MMSB has established long-term partnerships and made strategic investments in a range of new programs and technologies with the goal to better understand best practices and options for managing organic waste in Newfoundland and Labrador” (Investing in Sustainable Communities, September 8, 2016). Results from pilot projects like these can push government action towards the collection and treatment of organic waste in the province.

Greening Government Action Plan

The Greening Government 2015 Action Plan, was a document released by Government of Newfoundland and Labrador. In it was an action plan to push the government towards a more 'green' and sustainable future. The document states that

“Creating a culture of environmental sustainability within government’s operations and realizing these benefits will require a sustained commitment over the long-term. The release of this action plan is an important step in that direction and government is committed to show leadership now and in the future” (“Greening Government”, p.2).

A greener government can lead to more green initiatives in other areas of the province. The document mentions that it will take steps towards increased efforts of recycling and composting by encouraging and supporting composting pilot projects. If the operation of the industrial composter is too costly to warrant support from the government, then a cheaper means of diverting Grenfell's organic waste could be supported by the government instead.

The Way Forward: A Vision for Sustainability and Growth in Newfoundland and Labrador

This document was released in November 2016. The document states that this is a “roadmap guiding the future for Newfoundland and Labrador. It clearly outlines the policy decisions the Government of Newfoundland and Labrador will take to realize our vision. The role of this plan is to inform the public about what to expect and to guide public servants in their duties to ensure Provincial Government activity has a clear focus. This document serves as a record of our commitments, and as a standard of conduct to which we will hold ourselves accountable” (Government of Newfoundland and Labrador, “The Way Forward”, p.2).

One of the actions brought up in the document is increasing collaboration between the Memorial University and the College of the North Atlantic. Partners of Grenfell's industrial composter included the College of the North Atlantic here in Corner Brook. When Grenfell’s industrial composter was active, College of North Atlantic's organic waste was brought to the site. The action plan states that the provincial government will work with both institutions to increase the amount of research programs and initiatives taking place in both institutions (“The Way Forward”, p.27). A positive move in the future would be re-opening the campus' composter for use. This could be achieved through increased funding from the government. This would reinstate some collaboration between both institutions. This would also help with the government’s initiative towards a more sustainable province, keeping these institutions volume organic waste out of the provinces landfills.

This document also states that, “by 2025, Newfoundland and Labrador residents will increase their rate of vegetable and fruit consumption by five per cent. The current provincial rate is 25.7 per

cent, while the national rate is 39 per cent” (“The Way Forward”, p.43). Fruit and vegetable waste are great sources in the composting process. If the government aims towards higher consumption of these organic materials, then this will also mean that more organic wastes will end up in landfills. This action plan further pushes the need for a reliable way to compost organic waste in the province.

Implementation of a Province-wide Solid-waste Management Plan

The government has a solid-waste management implementation plan for the province. In 2014, the provincial government released the Study of Options for Organic Waste Processing in the Province of Newfoundland and Labrador. But in May of 2015, the government released a document that explained their plan to extend the implementation of this solid-waste management plan. The document states that “a plan for full-scale organic waste management is in development and will include a combination of services and technologies to best manage the volume of organic waste generated on a regional basis” (Government of Newfoundland and Labrador, “Provincial Government Extends”, May 25, 2015). And “the Provincial Government will continue to invest in the Provincial Solid Waste Management Strategy with a plan to complete a province-wide network of transfer stations and waste recovery facilities by 2020 and develop full-scale organic waste management infrastructure by 2025” (“Provincial Government Extends”, May 25, 2015). These facilities will the province become more sustainable. If there are no means to divert all of Grenfell's compostable organic waste by 2025, then these facilities may be favorable in helping the current situation.

Pilot projects from the MMSB help look for successful outcomes of diverting organic waste in Newfoundland and Labrador. These projects get the ball moving and help provide some baseline data for implementation and involvement. Grenfell's vision for the year 2020 is a great document with a list of objective to make the campus better in the following years. It pushes for a more sustainable future so hopefully these objectives are completed. The Greening Government Action Plan is the provincial governments plan for a greener future within their sector. Working towards a greener government will benefit the province and provide information and ideas for other sectors to follow in the greening process. The provincial government's document envisioning sustainability and growth in the province mentions more collaboration with the College of the North Atlantic and Memorial University. In the past these two institutions diverted their organic waste to the industrial composter at Grenfell. These institutions can increase more collaboration in becoming more sustainable if the industrial composter were to begin operations again. As well this document explains that in the future there will be an increased consumption of fruits and vegetables. This will lead to more compostable waste going into landfills, which could be diverted in a better way. And there are plans to work towards the implementation of a province-wide solid-waste management plan. This is a positive push towards sustainability for the province and these plans may also help Grenfell with diverting their organic waste in the future if there are no initiatives already in place. The government is slowly working towards becoming more environmentally-friendly and sustainable and the Grenfell Campus should follow as well.

Grenfell Campus Organic Waste Survey Results

After approval from the ethics board a survey regarding the campus community's views and behaviours toward composting organic waste was released. The survey was open to the university community (students, staff, and faculty members) for 10 days and it received 38 responses. Response rate for the survey may have been low because people were uninterested, or because people did not read their emails that had the survey attached. Even through this is a small number, the responses have the potential to shed light on composting behaviours and initiatives for future use. Refer to Appendix 1 to see the questions asked and responses available. The majority of participants who completed this survey were students, at 74 percent, followed by staff members, 16 percent, and faculty members, 10 percent. So when viewing these results, the majority of the responses were from the Grenfell student population.

When asked if it is important that Grenfell strives to be an environmentally-friendly campus, the majority of participants, at 58 percent, believed that it is very important. 37 percent of participants believed that it is somewhat important, and while two and a half percent chose neutral, and two and a half chose that it was not very important. These statistics help reiterate the fact that there is a growing concern for the environment and sustainability in students of higher education.

Eight percent of participants chose strongly agree when asked if they see Grenfell as an environmentally-friendly campus, while 47 percent chose somewhat agree, 31.5 percent chose neutral, 11 percent chose somewhat disagree, and two and a half percent chose strongly disagree. With mixed statistics like these, some of the Grenfell population can see that the campus has some environmentally-friendly efforts taking place, but more can be done.

Forty-two and a half percent of participants chose that composting organic waste on campus was very important, while 45 percent chose somewhat important, five percent chose neutral, five percent chose not very important, and two and a half percent chose that it was not important at all. These are great statistics to show that the Grenfell community are interested in being able to compost their organic waste on campus.

Fifty-two and a half percent of participants strongly agreed that the Grenfell Campus would benefit from on campus composting, while 34 percent chose somewhat agree, 11 percent chose neutral, and two and a half percent chose strongly disagree. These statistics help show that the Grenfell community (at least those responding to the survey) are knowledgeable about the fact that the campus will be able to benefit from being able to composting on campus. As well, in this question participants were asked to list any possible benefits they see from being able to compost on-campus. 13 participants responded to this part and some of these responses are as follows: reduced waste, increase green image of school, create quality soil for the school and community gardens, encourage education within in the school and city community, reduce unnecessary waste, decrease waste from going to landfills, and hopefully make people more conscious of how they dispose of their waste, on and off campus. With a transparency of known benefits of on-campus composting, this may have the ability for more of the campus community to take part in efforts towards composting.

When participants were asked if they compost their organic waste at home the responses were mixed. 24 percent chose always, eight percent chose most times, 26 percent chose sometimes, 24 percent chose rarely, and 18 percent chose never. Being able to compost organic waste on-campus

may have the ability for participants to be more consciously aware of how they dispose of their organic waste off-campus.

When asked if participants disposed their organic waste in the green bins provided around campus when the industrial composter when it was in use (2012-2016) results were as followed: 13 percent chose always, 37 percent chose most times, 11 percent chose sometimes, five percent chose rarely, 13 percent chose never, and 21 percent of participants were not here during that time. Even though 21 percent of participants were not here during that time, 50 percent of participants chose they used the green bins provided always or most times. These results help show that the campus community had participated in the composting efforts and that if initiatives were to begin on-campus there can be positive results.

If composting were to start up on campus again 53 percent of participants would dispose of their organic waste in the green bins provided chose always, while 26 percent would most times, 13 percent would sometimes, and eight percent would never. Again, this helps to show that if composting were to start on-campus there is some willingness to participate. Thirty-seven percent of participants would be interested in volunteering in any on campus composting efforts in the future while 63 percent would not. A comment box was provided for participants to leave their school email addresses for possible composting efforts in the future and nine participants responded. These responses show that there is interest in future efforts for composting on campus.

When asked how many hours participants would be willing to contribute to composting efforts on-campus, eight percent chose less than an hour (~one and a half hours a week between three participants), 19 percent chose one to two hours (7-14 hours a week between seven participants), eight percent chose two to four hours (6-12 hours a week between three participants), and 65 percent (25 participants at zero hours) indicated that this question was not applicable to them. With possible future pilot projects or initiatives involving on-campus composting these numbers help show that some of the campus community are willing to give their time and take part in future efforts.

This survey shows positive results for the involvement, education, and awareness regarding composting on campus. Many of the participants believed that Grenfell should be striving towards becoming more environmentally-friendly. Many participants saw that it is important to be able to compost organic waste on campus and were able to list some of the benefits of doing so. When composting was available on campus in the past, the majority of the participants stated that they put their organic waste in the compost bins provided at least 'most times'. If any composting initiatives were to happen in the future, there are volunteers that are willing to help. From the survey findings there were 13 volunteers interested. The results from this survey help show that there is interest in seeing Grenfell become a more environmentally-friendly and sustainable campus with interest in volunteering to work towards this goal.

Composting Options for Grenfell

Members of the campus community stressed that regardless of the type of composting system used education and awareness are important. An interviewee explained that composting efforts on campus all depend on help from volunteers, which can lead to success in any project. To encourage

the campus community to get involved, education, awareness, and in particular the concept of an 'open house' day and participation of separate departments were all brought up in discussions. Some options to encourage participation included actively promoting compost bins and where they are located, providing articles on how composting works and its process, setting target weights, providing incentives to those who compost their organic waste, inviting presenters to talk about the composting process, and encouraging composting on an individual level. The concept of an 'open house' day involved the hopeful future of the industrial composter staying on campus and in-use. This concept involved members of the community and the campus bringing a bucket or two to take some of the soil for their own use, which would be created from the industrial composter. During this day, education and awareness activities could be undertaken to help show how the composting process takes place and the positive impacts that come with composting. This can lead to more people being interested in composting their organic waste. As well, department initiatives can take place where a department purchases a composter (whether a backyard composter or vermicomposter, for example), puts it in an approved location and the department contributes to and maintains the composter. These options could also work with the campus residences. Floors can help contribute to and maintain their own bin. All of these ways to encourage composting on campus involve educating others on the composting process, and making people aware when/if these initiatives take place and of the need for people to be involved. Volunteers can be a great help in successfully moving forward with any future effort.

Recommendations for the future provided throughout the research included:

- seeking financial help from outside sources in these initiatives, being able to bring down expenditures when possible, and looking for feasible options on a limited budget;
- strategically placing bins in good locations if available;
- looking for a commonly agreed solution between the city of Corner Brook, the Multi-Materials Stewardship Board, and the Western Regional Service Board for a positive outcome regarding the fate of the industrial composter; and
- if the industrial composter comes back into use, involving students in working with the composter.

Comments that were raised regarding composting on campus involved hoping the industrial composter stays on campus, as it is a great educational tool and a way to boost Grenfell's image of sustainability as a showpiece for the campus. When the industrial composter was in use, there was positive involvement and awareness. Residence assistants did a good job with awareness and education with the on-campus composter. One interviewee is hoping to see a residential compost pick up service happen in the future as this can help divert Grenfell's organic waste. Asking the whole campus community for ideas in diverting its organic waste would also help involve people and identify further possible options. There is also a need to push for financial help and for student volunteers for composting to begin on campus again. If the industrial composter does not re-open, composting options raised during interviews with campus representatives included vermicomposting, using backyard compost bins, and biogas generation through anaerobic digestion.

Vermicomposting

While some interviewees believed that there are currently no options available for Grenfell, one interviewee explained that the use of vermicomposting helps speed up the composting process. Vermicomposting has been recognized as an eco-friendly technology in which organic waste can be converted into reusable high-value organic material (Jeyabal & Kuppuswamy, 2001). Certain species of earthworms (such as Red Wigglers) have the ability to consume organic material at a rapid pace and fragment them into finer particles (Ndegwa & Thompson, 2001). On average, the vermicomposting process produces harvestable material in three to four months (Ellis, 2015). Munroe (2007) explains that in ideal conditions these worms are able to consume in excess their body weight of organic waste each day, but a general rule of thumb is that these worms will consume half of their body weight each day. So as an example, 5 lbs. of worms will generally be able to consume 2.5 to ~5 lbs. of waste per day. Some common problems associated with vermicomposting are a bad smelling bin (due to overfeeding, bin too wet, or not enough air), its attracting flies (rotten food, or food scraps exposed), and the worms dying (due to temperature, bin too wet/dry, or not enough food or air). Solutions for a bad smelling bin include stop feeding for two weeks, bury food waste completely, mix in new dry bedding, or fluff the bedding. Solutions for if a bin is attracting flies include burying the food waste completely, cover with clean bedding, and not overfeeding the worms. If the worms are dying, keeping the bedding at optimal conditions (good mixture of wet/dry) will help as well as keeping temperatures near 21°C to 26°C (Selden et al., 2005). Vermicomposting inside will help keep an optimal temperature for these worms.

The MMSB suggests organic waste to add to vermicomposters such as fruit and vegetable scraps, coffee grounds and filters, plant trimmings, stale bread, leftover pasta, and shredded toilet paper, paper, napkins, egg cartons, and boxboard (MMSB, “Feeding Time”). Organic waste suggested not to add include meat, fish, bones, dairy products, fats, oils, and sauces (“Feeding Time”). Table 2 below lists the advantages, disadvantages, and general notes regarding the organic waste that are added to the vermicompost bins. These materials will all contribute to the success or failure of the vermicompost bin.

Organic Waste

Advantages

Disadvantages

General Notes

Fresh food scraps (e.g., peels, other food prep waste, leftovers, commercial food processing wastes)	Excellent nutrition, good moisture content, possibility of revenues from waste tipping fees	Extremely variable (depending on source); high N can result in overheating; meat & high-fat wastes can create anaerobic conditions and odours, attract pests, so should NOT be included without pre-composting (see below)	Some food wastes are much better than others: coffee grounds are excellent, as they are high in N, not greasy or smelly, and are attractive to worms; alternatively, root vegetables (e.g., potato culls) resist degradation and require a long time to be consumed.
Pre-composted food wastes	Good nutrition; partial decomposition makes digestion by worms easier and faster; can include meat and other greasy wastes; less tendency to overheat.	Nutrition less than with fresh food wastes (Frederickson et al, 1997).	Vermicomposting can speed the curing process for conventional composting operations while increasing value of end product (GEORG, 2004; Frederickson, op. cit.)
Corrugated cardboard (including waxed)	Excellent nutrition (due to high-protein glue used to hold layers together); worms like this material; possible revenue source from WM fees	Must be shredded (waxed variety) and/or soaked (non-waxed) prior to feeding	Some worm growers claim that corrugated cardboard stimulates worm reproduction

Table 2. The advantages, disadvantages, and general notes for adding certain organic waste to vermicompost bins. Figure created by author from data in Munroe, G. (2007). Manual of on-farm vermicomposting and vermiculture. *Organic Agriculture Centre of Canada*, 39, 40.

In 2015, the Texas State University, located in the United States, conducted a vermicomposting project over the course of a semester. Of the four months, 100 lbs. of food waste a month was collected from one of the cafeterias on campus. The purpose of their study was to establish vermicomposting using red wiggler worms with cafeteria food waste as their primary source, to determine potential economic benefits of vermicomposting on campus, and to determine the educational potential and opportunity for its students to get involved. The campus' environmental committee funded the initial project which involved building a shed for the composting to take place (\$650), 6 lbs. of red wiggler worms (\$120), electricity and air conditioning (\$620 initial cost, and ~\$15 a month for electricity), and paying a student worker \$9 an hour, two and a half hours a week. Out of the 400 lbs. of organic waste that was collected over the semester, a total of 30 five gallon zip-lock bags of vermicompost were harvested during the semester. The harvest was sold to the university community at \$10 a bag, totaling to \$300 in the initial semester. The university offered demonstrations of their vermicomposting system during orientation campus tours and in elementary/high-school tours. In addition, students learned how to make home vermicomposting systems. One of the university students reported, "I not only learned how to build a proper vermicomposting environment, but also how the different factors associated with the environment worked together to form a symbiotic relationship to amplify and maintain the biodiversity of microbes in the soil. Tangible, real world projects like the worm shed really bring the information forward much more than a book ever could and I'm thrilled to have had the hands-on opportunity to learn about vermicomposting and its benefits to the soil" (Montoya et al., 2016). Projects such

as this have the ability to advance learning about the benefits of composting and encourage people further to divert their waste in a fun, environmentally-friendly, and sustainable way.

If Grenfell were to start a pilot programs involving vermicomposters, Troutor's Special Worm Farm, located in Bay Bull's, Newfoundland & Labrador, would be a great help in initiating the project. Troutor's is a year-round, family owned and operated business. Throughout its development stage it had worked closely with different universities and institutions in Canada and the United States to develop and provide the best products with education and technology in mind (Troutor's Special, 2017). This worm farm sells Red Wigglers at \$50.00 a pound, and \$30.00 at half a pound. As well they sell Vermicompost start up kits. These kits include 1 pound of worms, a 15 litre bag of premixed bedding, a 38 litre Rubbermaid container (24" x 16" x 8.75"), and a three page pamphlet on helpful tips with the process. These kits sell for \$69.99 (Troutor's Special, Products and Pricing, 2017). Purchasing these kits or the materials needed will help get these composting projects started.

Backyard Composting

Backyard composting involves the use of bins outside which do not take up much space. Some interviewees explained that the use of backyard composters are possible due to the fact that they do not cost much, but there will be a need for people to look after these. The MMSB explains that there should be a 50/50 ratio of carbon (such as paper, woodchips, or dried leaves) and nitrogen (such as fruit/vegetable debris and coffee grounds) in composter bins to help produce good soil in the composting process (MMSB, Maintaining Your Bin). With winter dropping temperatures below zero degrees Celsius for many months, outdoor composting year round can be troublesome, working against backyard composting options. But the MMSB explains that composting does not have to stop when the weather gets cold. Although the decomposition process of organic waste will slow down (or even stop) during the winter months decomposition will speed up again in the spring so there is no need to stop adding to the compost bins (MMSB, Maintaining Your Bin). With the provinces climate, MMSB states that "the composting process in Newfoundland and Labrador can take anywhere from one to two years. The amount of time it takes your compost pile to produce rich compost, or humus, will depend on the material you add and the effort you put in" (MMSB, Maintaining Your Bin). Having a good carbon/nitrogen material and properly maintaining the bin will have positive results in a faster time.

From MMSB's compost bin offer (refer to Figure 2), Grenfell's Facilities Management purchased 80 tumbler style composter bins for members of the campus community to purchase if interested (refer to Figure 3 for compost bin styles). As of March 30th, 2017, 49 of these compost bins have been sold; 26 percent of these bins were purchased by students, 34 percent purchased by staff, and 40 percent purchased by faculty. These compost bins help advance individual efforts within the campus community to reduce organic waste that ends up in landfills. With a portion of the Grenfell community purchasing these bins there is an option to collect organic waste on campus to bring home to personal compost bins. Grenfell will continue to sell these remaining compost bins until all 80 are gone. While none of these bins were purchased for the campus' general use, purchasing some of these bins is an option for the future. For the success of these bins, they will have to be strategically placed around campus, along with information on what organic waste should and

should not be added. Distribution of the bins also helps provide an option for people to take organics home from their own offices in personal bins.

Figure 2. MMSB's composter bin offer (MMSB, “MMSB 2017 Backyard Composting Program”, January 30, 2017).

The Multi-Materials Stewardship Board (MMSB) is researching the feasibility of once again procuring a bulk order of compost bins on behalf of communities in the province and would like to invite your town to participate. If sufficient demand is received, this program will involve the sale of subsidized compost bins directly to communities partnered with an education program for residents.

One third of the waste your residents place at the curbside is organic. Promoting backyard composting of organic waste over landfilling will reduce greenhouse gas emissions, create healthy soil and save landfill space – all while saving your community money.

This year, MMSB is exploring the feasibility of procuring **two different types of composters**. There are dozens of different models of backyard composters, but the main two types are **bins** (those that sit on the ground) and **tumblers** (those that are raised above ground). Understanding the features and benefits of these two types will make it easier to choose the right composter for your community's needs. More information on the two types of composters is included in this package.

Figure 3. Composter options provided by MMSB (MMSB, “MMSB 2017 Backyard Composting Program”, January 30, 2017).

Composter Options

Option 1: Compost Bin



Regardless of the tender price, this program will involve the sale of subsidized bins to communities at a rate of **\$21.99 per bin** plus HST (inclusive of shipping and handling). In order to participate there will be a minimum order size of 40 units (orders will be accepted in increments of 40). The average compost bin retails for \$70 dollars, meaning a 40 bin order would normally cost \$2,800 plus HST. With this offer, your community can receive the same order for only \$880. If your municipality sells all composters to residents for the unit price of \$21.99, this program will cost very little to implement.

Option 2: Compost Tumbler



Regardless of the tender price, this program will involve the sale of subsidized tumblers to communities at a rate of **\$34.99 per bin** plus HST (inclusive of shipping and handling). In order to participate there will be a minimum order size of 40 units (orders will be accepted in increments of 40). The average compost tumbler retails for over \$100 dollars, meaning a 40 bin order would normally cost over \$4,000 plus HST. With this offer, your community can receive the same order for only \$1,400. If your municipality sells all composters to residents for the unit price of \$34.99, this program will cost very little to implement.

At a small-scale, there are many variables that will impact the composting process in the use of compost bins/tumblers outdoors. Some of these variables include what is going into the bin, the management of the organic waste involved, and the location of the bin (temperature). It is hard to determine concrete results due to the lack of scientific studies (Karnchanawong & Suriyanon,

2011). In Table 3, the MMSB explains some pros and cons of the compost bins and tumblers that they offer. The tumblers have a ~37 gallon capacity (~140 litres), while the bins have a ~82 gallon capacity (~310 litres) (Home Depot, 2017). According to the EPA (2016), one gallon of university food waste is equivalent to ~3.8 lbs (p.3). With these statistics in mind, the tumbler bins have the capacity of ~140.6 lbs., while the bins have a capacity of ~311 lbs.. The compost bins are able to hold more waste but aerating the pile can be harder while the tumblers hold less waste but aerating the pile is easily done.

Both composters take up the same footprint (4-6 square feet) and should be placed in direct sunlight. The following are some important considerations when choosing the right bin for your community.

Compost Bin:	Compost Tumbler:
<ul style="list-style-type: none"> • lower cost • minimal assembly • larger capacity – bins can handle 2-3 times the volume of a tumbler (important for large family sizes or if residents want to compost large quantities of leaves) • aerated using a pitch fork or shovel • bins drain excess moisture more readily • harvesting finished compost with a shovel can be a slower process 	<ul style="list-style-type: none"> • higher cost • assembly required (approximately one hour) • smaller capacity • sealed drum speeds up composting process • aerated by spinning • easy to access finished compost by inverting the drum over a wheelbarrow or garden cart • dual compartment models keep newly added organics separate from finishing compost • can be difficult to spin when over 2/3 full • no accessibility for wildlife • can be difficult to slide the lid open below 0°

Table 3, compost bin vs. compost tumbler from MMSB's subsidized compost bin offer (MMSB Representative, personal communication, January 20, 2017).

Creating usable soil via compost bins and tumblers can be a long process to accomplish. But with offers through the MMSB, the use of these bin as an option represents 'low hanging fruit' that the Grenfell campus can become involved in. These two composters are simple options that do not need a lot of maintenance. Some general maintenance includes adding the right organic waste into the bin, moving the contents (for aeration to help the process) when needed, and extracting the usable soil when the process is complete. Strategically placing these bins/tumblers in areas around the campus where people will be compelled to take part in this initiative would need to be considered. These areas would need to be accessible year round, have access to direct sunlight, and be in an area where drainage of excess moisture can happen for positive outcomes in using these bins. Some possible areas for these bins can include near the entrance of the campus' cafeteria, around chalet buildings, or any entrance where optimal conditions (easy access, sunlight, and drainage) are available. The usage of these simple outdoor compost bins has the ability to enhance the schools image of working towards being environmentally-friendly and sustainable.

The continued use of compost bin options on campus is questionable. Information regarding backyard composting is scarce, even though many institutions take part in it ("Campus Food Waste Composting," 2002). A study done at the University of Waterloo, in Ontario, Canada, explained that backyard composters have the ability to cause odours and attract rodents if not properly

maintained. Further, interest is often lost in maintaining these composters or the initiators leave campus (“Campus Food Waste Composting,” 2001). This study had also looked at the results of using compost bins on two other campuses affiliated with the University of Waterloo (St. Jerome’s and St. Paul’s) and found the same results. Improper maintenance, lack of education, and loss of interest all contribute to poor outcomes from using outdoor compost bins (“Campus Food Waste Composting,” 2001). Although limited studies on the usage of on-campus compost bins do not show promising results, Grenfell may have the ability to provide positive results with using these bins. Initiative in wanting these bins to succeed and actively educating the campus would need to happen. With no other means to divert organic waste on campus, these compost bins are relatively easy solutions to begin composting organic waste on-campus again.

Biogas Generation

A third option that was brought up in the interviewing process was biogas generation through the anaerobic digestion (AD) process. Li et al. (2011) explain that anaerobic digestion is a “method engineered to decompose organic matter by a variety of anaerobic microorganisms under oxygen-free conditions. The end product of AD includes biogas (60–70% methane) and an organic residue rich in nitrogen”. This organic residue can be used as fertilizer or help in the organic waste composting process. They go on to state that this technology has been successfully implemented in the treatment of agriculture and food waste (Li et al., 2011). By containing the decomposition process in a closed, oxygen-free environment, this diverts potentially damaging methane from entering the atmosphere (Ward et al., 2008). The energy gained from the combustion of the contained methane will help displace fossil fuels (Ward et al, 2008). The EPA (2016) explains the process of biogas generation through AD in figure 6.

Some of the factors that impact the success of producing biogas include the reactors design (where the anaerobic digestion process happens), the mixing of its contents, the wastes that are being used (different waste yield different methane outputs), temperature (optimal between 35-55° C), and keeping a narrow pH range (between 6.8-7.2) (Ward et al., 2008). In an efficient anaerobic digestion process, contents stay in the reactor for 17 to 50 days, staying longer in less efficient systems (Gell, 2008). Gell (2008) explains that financial economics are the biggest barrier towards development. Even with subsidies and renewable energy incentives, the cost-benefit analysis of operating a small-scale anaerobic digester is unfavourable (Gell, 2008). In the future the campus could look at doing a full cost-benefit analysis of implementing this option to help towards waste diversion.

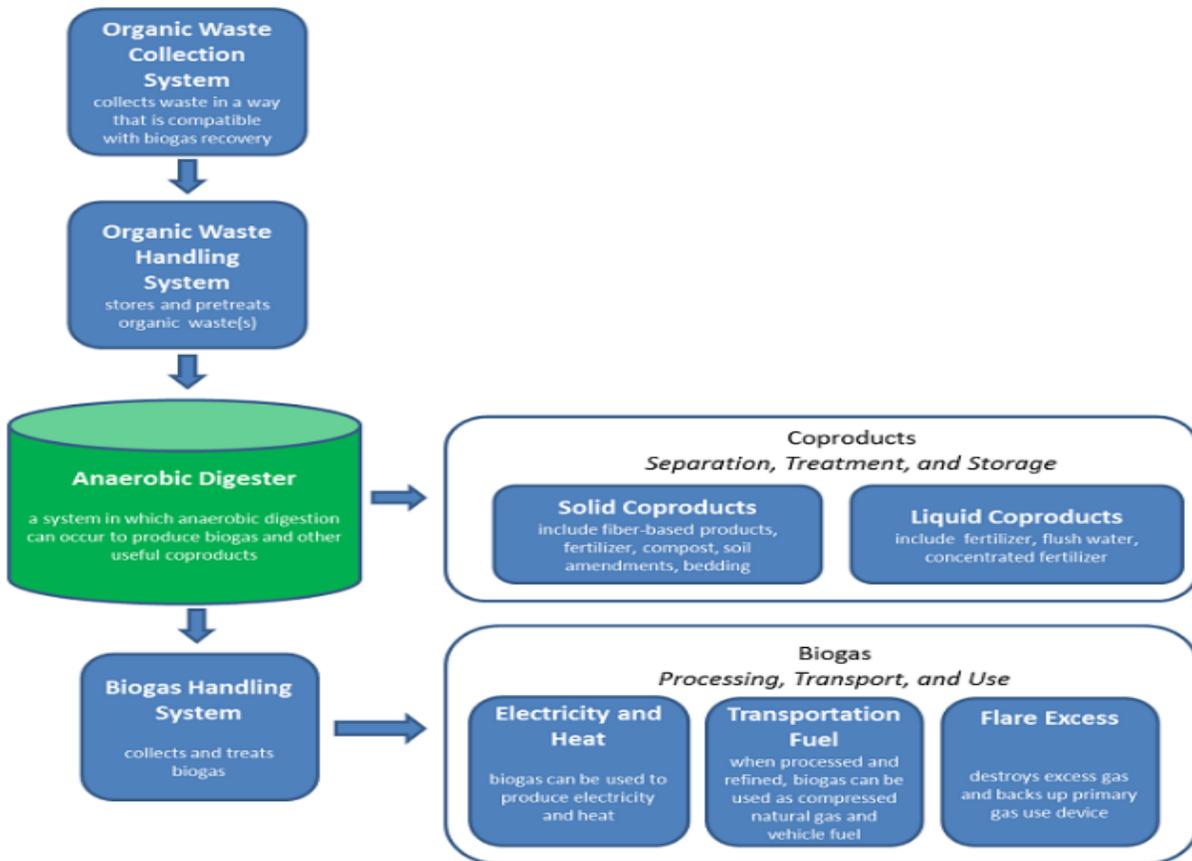


Figure 6. Anaerobic digestion, the biogas recovery system. Taken from: Environmental Protection Agency. (June 15, 2016). *Learn about Biogas Recovery*. Retrieved from <https://www.epa.gov/agstar/learn-about-biogas-recovery#adwork> Copyright 2016 by the Environmental Protection Agency.

Through interviewing key informants on campus of the environment and sustainability composting alternatives raised for the Grenfell Campus included vermicomposting, the use of backyard composters, and biogas generation through the anaerobic digestion process. Biogas generation was brought up and it was explained that the process does not require any energy to use and it produces usable energy. But one problem with this process is the need for financial input for the start-up of this option, something that Grenfell may not have at this time. For this reason, financial problems, some interviewees explained that they did not see any composting alternatives for the campus at this time. In reviewing each of these options funding as well as available space and a site for composting to take place, together with the province’s seasonal weather conditions all hinder composting options for Grenfell.

Recommendations for the Future

The most favourable future regarding composting organic waste on-campus would be the restart of the industrial composter, but this would have to be achieved through financial aid. In the absence of an industrial composter, future recommendations include introducing a vermicomposting or backyard composting project to the campus. Vermicomposting should be the first project to consider as it does not have a high cost to implement, space for these bins is not an issue as one can use the small bins available from the vermicompost kits or construct a bin that fits the size available, the compost process takes 3-4 months, and it is a great hands-on educational tool to get people involved. The use of backyard composters would be the second option as it does not have a high cost to implement but the composting process takes longer to complete and information on the use of these on other campuses have shown limited success. Based on my research, biogas generation through the anaerobic process would be the last option for Grenfell at this time as there is a high implementation cost, more space is needed, and there are more variables that need to be taken into consideration during the process.

To encourage the campus community to get involved there would need to be more education and awareness on the benefits of composting at the campus. As well, letting separate departments or resident floors within the campus could manage their organic waste, working with the incentive of one department/floor wanting to do better than the other. Shriberg & Harris (2012) explain that facilitating student internships, work-study positions, requiring students to complete independent projects, and continuing projects over multiple semesters can be combined to aid in a project's probability of success. As well, they say that success in these projects lead to a deeper understanding for students, more professional development opportunities, and can lead to a greater partnership between students, staff, and faculty (Shriberg & Harris, 2012). Initiating small projects on campus has the ability to bring the campus community closer as we become a better, more sustainable campus.

References

- Acadia University. (2017). At a Glance. Retrieved from <http://www2.acadiau.ca/about-acadia/at-a-glance.html>
- Acadia University. (2017). Recycling and Garbage 101. Retrieved from <http://www2.acadiau.ca/international/recycling-guide.html>
- Alshuwaikhat, & Abubakar. (2008). An integrated approach to achieving campus sustainability: Assessment of the current campus environmental management practices. *Journal of Cleaner Production*, 16(16), 1777-1785
- Arthur Irving Academy for the Environment. (2009, June). Acadia University Sustainability Assessment 2006-2009. Retrieved from http://sustainability.acadiau.ca/tl_files/sites/aiae/PDF%20Files/Acadia%20Sustainability%20Assessment%20-%20Final.pdf
- Baldwin, E., & Dripps, W. (2012). Spatial characterization and analysis of the campus residential waste stream at a small private Liberal Arts Institution. *Resources, Conservation and Recycling*, 65, 107-115.

- Bishop's University. (2009). Bishop's University News. Retrieved from <http://www.ubishops.ca/wp-content/uploads/alumni-magazine/bu-newsletter-winter09.pdf>
- Bishop's University. (2017). BU at a glance. Retrieved from <http://www.ubishops.ca/about-bu/bu-at-a-glance/>
- Brinkhurst, M., Rose, P., Maurice, G., & Ackerman, J. D. (2011). Achieving campus sustainability: top-down, bottom-up, or neither?. *International Journal of Sustainability in Higher Education*, 12(4), 338-354.
- Campus Food Waste Composting: Past Failures and Future Possibilities (2001). Retrieved from <http://www.adm.uwaterloo.ca/infowast/watgreen/projects/library/s01composting/composting.html>
- Dominguez, J., & Edwards, C. A. (2010). Relationships between composting and vermicomposting. *Vermiculture Technology Earthworms, Organic Wastes, and Environmental Management*, 11-26.
- Ellis, M. D. (2015). Assessing the feasibility of composting food waste at Ball State University.
- Environmental Protection Agency. (2016). *Volume-to-weight Conversion Factors*. Retrieved from https://www.epa.gov/sites/production/files/201604/documents/volume_to_weight_conversion_factors_memo_randum_04192016_508fnl.pdf
- Environmental Protection Agency. (June 15, 2016). *Learn about Biogas Recovery*. Retrieved from <https://www.epa.gov/agstar/learn-about-biogas-recovery#adwork>
- Epstein, E. (1996). *The science of composting*. CRC press.
- Fournier, M. (2008). Recycle this. *Facilities Manager*, 1, 48-53.
- Gell, K. (2008). Review of small scale, community biogas in the industrialized world. *Wageningen University, Netherlands: Community Composting Network*.
- Government of Newfoundland and Labrador. (January 21, 2015). Greening Government 2015 Action Plan. Retrieved from http://www.ecc.gov.nl.ca/publications/climate_change/greening_government_action.pdf
- Government of Newfoundland and Labrador. (November 9, 2016). The Way Forward: A Vision for Sustainability and Growth in Newfoundland and Labrador. Retrieved from http://www.gov.nl.ca/pdf/the_way_forward.pdf
- Government of Newfoundland and Labrador. (May 25, 2015). Provincial Government Extends Timeline for Implementation of Solid Waste Management Strategy. Retrieved from <http://www.releases.gov.nl.ca/releases/2015/ma/0525n01.aspx>

- Government of Newfoundland and Labrador. (November 11, 2011). Campus Composting Initiative a First for Newfoundland and Labrador. Retrieved from <http://www.releases.gov.nl.ca/releases/2011/env/1116n02.htm>
- Government of Newfoundland and Labrador. (September 8, 2016). Investing in Sustainable Communities. Retrieved from <http://www.releases.gov.nl.ca/releases/2016/ecc/0908n02.aspx>
- Hamel, A. (2011). Sustainability Audit for Bishop's University Campus. *Bishop's University*. Retrieved from http://www3.ubishops.ca/fileadmin/bishops_documents/services/SDLU/files/2011-Sustainability-Audit-Bishops-University.pdf
- Home Depot. (2017). [compost bin and tumbler capacity]. Retrieved from http://www.homedepot.com/p/FreeGarden-EARTH-82-gal-Enviro-World-Compost-Bin-EWC-30/204841192?MERCH=REC-_rv_homepage_rr-_NA-_204841192-_N and http://www.homedepot.com/p/Tumbling-Composter-with-Two-Chambers-for-Efficient-Batch-Composting-IM-4000/202672114?MERCH=REC-_rv_gm_pip_rr-_204841192-_202672114-_N
- Jeyabal, A., & Kuppaswamy, G. (2001). Recycling of organic wastes for the production of vermicompost and its response in rice–legume cropping system and soil fertility. *European Journal of Agronomy*, 15(3), 153-170.
- Karnchanawong, S., & Suriyanon, N. (2011). Household organic waste composting using bins with different types of passive aeration. *Resources, Conservation and Recycling*, 55(5), 548-553.
- Kroeze, K. (2011, April 30). Elizabeth Harvey Memorial Sustainable Development Intern Year End Report for the Academic Year 2010 – 2011. *Bishop's University*. Retrieved from http://www3.ubishops.ca/fileadmin/bishops_documents/services/SDLU/files/Intern-Report-2010-2011.pdf
- Li, Y., Park, S. Y., & Zhu, J. (2011). Solid-state anaerobic digestion for methane production from organic waste. *Renewable and sustainable energy reviews*, 15(1), 821-826.
- Memorial University, Grenfell Campus. (n.d.) Grenfell Composter, Facilities Management. Retrieved from <http://www.grenfell.mun.ca/Faculty-and-Staff/Pages/Facilities-Management/Grenfell-Compost.aspx>
- Memorial University, Grenfell Campus. (2016). Viewbook, Thinking of Applying. Retrieved from <http://www.grenfell.mun.ca/future-students/Pages/Thinking-of-Applying/viewbook.aspx>

- Memorial University, Grenfell Campus. (n.d.) Vision 20/20, Strategic Plan 2015-2020. Retrieved from <http://www.grenfell.mun.ca/Faculty-and-Staff/Documents/Administration-and-Governance/Vision-2020.pdf#search=vision%202020>
- Montoya, J. E., Cade, T. M. W., & Gandonou, J. M. A. (2016). An Economic Analysis of the Development and Management of a University Vermicomposting System: A Self-Sustaining Environmental and Waste Management Educational Tool. *Texas Journal of Agriculture and Natural Resources*, 29, 1-11.
- Mount Allison University. (2013, August 26). Mount Allison Food Audit. Retrieved from https://www.mta.ca/uploadedFiles/Community/Campus_life/Environment_Mount_Allison/Documents_and_reports/2013%20Environmental%20Audit%20-%20Water%20and%20Food.pdf
- Mount Allison University. (2014). Environmental Audit 2014. Retrieved from https://www.mta.ca/uploadedFiles/Community/Campus_life/Environment_Mount_Allison/Documents_and_reports/2014%20Environmental%20Audit%20-%20Waste.pdf
- Mount Allison University. (2017). The small class difference. Retrieved from <https://www.mta.ca/smallclass/>
- Multi-Materials Stewardship Board. (n.d.). About MMSB. Retrieved from <http://mmsb.nl.ca/about-mmsb/>
- Multi-Materials Stewardship Board. (n.d.). Feeding Time. Retrieved from <http://mmsb.nl.ca/waste-diversion-programs/organic-waste/vermicomposting/worm-feeding/>
- Multi-Materials Stewardship Board. (n.d.). Find a Bin. Retrieved from <http://mmsb.nl.ca/waste-diversion-programs/organic-waste/backyard-composting/find-a-bin/>
- Multi-Materials Stewardship Board. (n.d.). Maintaining Your Bin. Retrieved from <http://mmsb.nl.ca/waste-diversion-programs/organic-waste/backyard-composting/backyard-compost-bin-maintenance/>
- Munroe, G. (2007). Manual of on-farm vermicomposting and vermiculture. *Organic Agriculture Centre of Canada*, 39, 40.
- Selden, P., DuPont, M., Sipes, B., & Dinges, K. (2005). Small-scale vermicomposting.
- Shriberg, M., & Harris, K. (2012). Building sustainability change management and leadership skills in students: lessons learned from “Sustainability and the Campus” at the University of Michigan. *Journal of Environmental Studies and Sciences*, 2(2), 154-164.
- Smyth, A. (2008, September). 2008 University of Northern British Columbia Waste Audit Report. Retrieved from <http://www.unbc.ca/assets/green/wasteauditreport.pdf>

- Stafford, S. L. (2011). How green is your campus? An analysis of the factors that drive universities to embrace sustainability. *Contemporary Economic Policy*, 29(3), 337-356.
- Tiew, K. G., Watanabe, K., Basri, N. E. A., & Basri, H. (2011). Composition of Solid Waste in a University Campus and its Potential for Composting. *International Journal on Advanced Science, Engineering and Information Technology*, 1(6), 675-678.
- Trouter's Special. (2017). Retrieved from <http://www.trouterspecial.ca/>
- Trouter's Special. (2017). Products and Pricing. Retrieved from <http://www.trouterspecial.ca/products-and-pricing>
- Tumblr. (n.d.). PGPIRG Compost and Garden [Blog post]. Retrieved at <https://pgpirg.tumblr.com/compostingandgardening>
- University of Northern British Columbia. (2014). Completing Key Organic Waste Audits for UNBC Prince George Campus. Retrieved from <http://www.unbc.ca/green/green-fund/past-projects>
- University of Northern British Columbia. (2017). Facts and Statistics. Retrieved from <http://www.unbc.ca/about-unbc/facts>
- Valley Waste Resource Management. (2010). Overview. Retrieved from http://www.vwrm.com/AboutUs_Overview.html
- Ward, A. J., Hobbs, P. J., Holliman, P. J., & Jones, D. L. (2008). Optimisation of the anaerobic digestion of agricultural resources. *Bioresource technology*, 99(17), 7928-7940.

Appendix 1

Survey Questions

- 1) Are you:
 - A) A Student
 - B) A Staff Member
 - C) A Faculty Member
 - D) A Campus Visitor

- 2) How important is it to you that Grenfell strives to be an environmentally-friendly campus?
 - A) Very Important
 - B) Somewhat Important

- C) Neutral
- D) Not Very Important
- E) Not Important At All

3) Do you see Grenfell as an Environmentally-friendly Campus?

- A) Strongly Agree
- B) Somewhat Agree
- C) Neutral
- D) Somewhat Disagree
- E) Strongly Disagree

4) How important, in your view, is being able to compost organic waste (E.g. Vegetable and fruit debris) on campus?

- A) Very Important
- B) Somewhat Important
- C) Neutral
- D) Not Very Important
- E) Not Important At All

5) Do you think that the Grenfell campus would benefit from composting organic waste on-campus? (This question had a comment box to list any benefits that participants see for Grenfell)

- A) Strongly Agree
- B) Somewhat Agree
- C) Neutral
- D) Somewhat Disagreement
- E) Strongly Disagree

6) Do you compost your organic waste at home?

- A) Always
- B) Most Times
- C) Sometimes
- D) Rarely
- E) Never

7) When Grenfell had an operational industrial composter in the past (2012-2016), how often did you discard your organic waste in the green bins that were provided?

- A) Always
- B) Most Times
- C) Sometimes
- D) Rarely
- E) Never
- F) I Was Not Here During That Time

8) If composting were to start up again on campus how often would you compost your waste if compost bins were provided?

- A) Always

- B) Most Times
- C) Sometimes
- D) Rarely
- E) Never

9) Would you be interested in volunteering in a campus composting program? (This question had a comment box for participants to leave their school emails if they were interested in volunteering)

- A) Yes
- B) No

10) If yes, how much time per week would you put into composting waste efforts on campus?

- A) Less Than An Hour
- B) 1-2 Hours
- C) 2-4 Hours
- D) 6-8 Hours
- E) Question Not Applicable To Me