UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Community Business Project: UBC SEEDS

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University of British Columbia

BA 511

Finance, Waste

May 4, 2018

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CBP: UBC SEEDS

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EXECUTIVE SUMMARY

The University of British Columbia (UBC) has been one of the leaders in sustainable practices on university campuses across Canada. Over the past few years, UBC has been working towards becoming a zero waste campus. One of the most limiting factors that is working against the overarching goal of becoming zero waste, is the fee structure that is currently in use for ancillary buildings hosted on campus. The fee structure charges ancillary buildings less for disposing of their garbage waste stream, than their organics waste stream. This provides an internal incentive for buildings to dispose of more garbage than organics to minimize their bottom line. In order to eliminate this disincentive program, the fee structure needs to be reevaluated. It is essential to focus on industry best practices before introducing a new fee structure on UBC campus, because ancillary buildings are able to opt out of UBC waste management in order to use a private waste disposal company.

There are a number of cities and university campuses who have set applicable precedent when it comes to waste management practices, including the fee structures used in specific jurisdictions. San Francisco, Seattle, City of Vancouver, University of Western Ontario and the University of Victoria were all investigated in order to establish some industry best practices for achieving zero waste. Within the municipalities, residential waste collection rates were analyzed for trends that would incentivize zero waste practices. San Francisco has in place a discounting model that offers a decrease in rates for customers with a higher waste diversion rate, which has proven to be effective. Seattle offers discounts for bulk waste disposal of each of their waste streams, with the exception of recycling which is free pickups for residents. The City of Vancouver – including Burnaby – has limited garbage disposal to a biweekly pickup schedule, while maintaining their weekly organics and recycling pickups. Universities have introduced a number of educational programs on campuses to encourage students to take an active role in waste management on campus.

The new model proposes offering a discount to buildings that have higher waste diversion rates, based on the size of the bins of different streams of waste. In order to effectively introduce this strategy, more metrics should be measured in monthly waste audits. The introduction of barcodes on waste disposal bins should allow for measures of each waste stream to be simple and inexpensive, as only scanning and tracking technology would need to be purchased. As well, there will be an immediate decrease in garbage pickups, inspired by Vancouver and Burnaby reducing the garbage pickups to a biweekly manner. Thirdly, fines for high rates of contamination should be introduced, especially for that of contaminated organics bins. The combination of the above three processes should advance the movement of UBC campus towards zero waste.

Moving forwards, it is essential to recognize that the industrial composting machinery is reaching the end of its life. In order to replace the machine, research must be conducted to ensure that UBC purchases the most efficient industrial composter. As well, more educational programming should be rolled out to the primary waste sorters on campus – the students – in order to increase the waste diversion rate and decrease the contamination in all the waste streams.

INTRODUCTION

UBC SEEDS

UBC SEEDS is a sustainability program centered on the University of British Columbia (UBC) campus, responsible for advancing sustainability on campus (University of British Columbia, 2018). There are a number of faculty members, students, community partners and staff who are engaged with SEEDS projects. There are numerous projects that take place across UBC campus each year run supported by the SEEDS program, and it is essential to the introduction of the Zero Waste Action Plan on UBC campus. UBC SEEDS has partnered with Building Operations for this project in order to effectively incentivize buildings on campus to reduce their garbage waste stream by reducing their bottom line if there is an overall reduction of waste. The success of this project relies on the ability to justify the changes in the waste fee structure used on campus, without increasing the bottom line of ancillary buildings. UBC SEEDS is providing support for this project by facilitating the meetings that are essential to communicating progress, as well as providing essential resources for the background information on waste management practices on UBC campus.

Zero Waste

Zero waste is becoming an ever more popular initiative worldwide, focusing on resources end-life so that all resources could become reused (Recycling Council of British Columbia, 2018). This philosophy focuses on actions to be taken in order to prevent waste, in order to reach the goal of zero waste (Recycling Council of British Columbia, 2018). The implementation of zero waste practices benefits the recycling industry, as well as raises awareness of the waste produced during the entirety of a products life cycle. Zero waste is becoming increasingly important because it promotes the sustainability of the environment, ensuring that resources are utilized to their fullest extents and encourages individuals and organizations to be responsible for their actions and consumption.

UBC Zero Waste Action Plan

Many countries and universities have zero waste plans set in place, including University of British Columbia (UBC). UBC had set a goal of reaching 80% waste diversion away from the garbage stream by 2020 on its Vancouver Campus, according to the 2014 Action Plan. The major stakeholders here consist of academic buildings (core buildings), Ancillary Buildings (student housing, UBC Recreation, Food Services, etc.) on campus. UBC has an in-vessel composter in place for transforming food waste into compost, which is then used for landscaping on campus. Operational waste is mainly divided into organics, paper, plastic and non-recyclables. Currently, there is no recorded data of up-to-date waste diversion rate as UBC does not have the infrastructure in place to collect this data frequently. Estimations by front line employees assess the contamination rates – especially of organics waste – are remarkably high as will later be discussed, especially in student housing areas, which make up a large percentage of the total collection. This is effectively slowing down the action plan, and increasing incremental costs due to the dual-processing required of certain contaminated waste streams. For example, if an organics bin is flagged by employees as too contaminated to be processed it will not be identified until it has already been transported to the organics facility. The contaminated bin will then have to be transported to the garbage waste facility – effectively being processed for two different waste streams, adding unnecessary transportation and processing costs to certain waste streams.

Project Scope

This project collaborated with SEEDS Sustainability Program, who are responsible for supporting sustainable issues on UBC campus including the Zero Waste Action Plan. The overarching goal of this Community Business Project (CBP) is to come up with an implementable new pricing model that incentivizes the zero waste strategies on campus, along with other feasible recommendations for further encouraging zero waste practices. The current fee structure has a

disincentive thus not promoting zero waste practices; conversely, it encourages the garbage stream to be utilized because it is the least expensive waste stream to dispose of for the ancillary buildings. On campus, profits are not the priority: instead, a cost recovery structure is used and should be emphasized when the new fee structure is designed. For this CBP project, the focus is on producing a fee structure for the ancillary buildings: student housing, food services, athletics center, etc.

Action Plan

In order to meet the targets mentioned above, secondary research regarding zero waste it was necessary to conduct in order to establish successful industry practices used to motivate zero waste practices. By reaching out to waste management organizations in cities and universities across North America, industry best practices were determined. Biweekly meetings with the SEEDS program and meetings with the faculty supervisor were organized for deliverables updates and sharing progress. Internal meetings are also planned and recorded. Program management course have helped establish the general action plan and clear goals for restructuring the current fee plans. Based on research results and calculations, a new pricing model has been designed and will be illustrated in the following section. Due to the lack of real data, the pricing model might be subject to external factors. The fee structure post achieving zero waste have also been taken into considerations by future break-even analysis.

INDUSTRY BEST PRACTICES

There are a number of cities and campuses across North America that are renowned for their waste management strategies, in working towards incentivizing zero waste practices. It is important to recognize that the best practices found within Canada are most relevant for UBC, it is imperative to also analyze the practices followed in the United States. Both cities and university campuses were researched in order to determine best practices that UBC could incorporate on

campus in order to incentivize zero waste practices by focusing on fee structures, and other policies.

UBC Campus Waste Management Practices

To begin, it is important to recognize that UBC already has a number of waste management practices that are working towards moving the campus towards the zero waste goal established in 2014. Before the 2014 '20-year Sustainability Strategy' was developed, UBC had been recognized in 2011 its first Gold rating on the STARS university rating system (University of British Columbia, 2017). UBC has successfully reduced their greenhouse gases emissions by 30% since 2007, thus approaching the goal of reducing greenhouse gas emissions by 67% compared to 2007 levels by 2020 (University of British Columbia, 2018). The issue most relevant to the focus of this project was that there was also a recorded 67% waste diversion rate recorded on UBC Vancouver campus (University of British Columbia, 2017). Although this is significant, the Welcome Back Staff BBQ on UBC campus resulted in only one 20-litre bag of garbage of the 200kg of waste produced from the day (University of British Columbia, 2017). This was a prime example of how 99% of waste can be diverted away from the garbage stream given the right direction.

Often, on campus it is observed that all of the waste streams are contaminated, which stems from the fact that consumers – students, faculty, administration, staff, and visitors – are responsible for the sorting of their own waste. According to front line employees working in the on-campus composting facility, almost 50% of organics bins have to be sent to the landfill because their contamination rates are so high. The current recorded contamination rate is 7%, which is a gross underrepresentation of how contaminated waste is on campus (University of British Columbia, 2017).

All aforementioned factors considered, UBC is progressing in the right direction with their sustainable waste management practices. In order to remain on track to achieve the goals set out

in the Zero Waste Action Plan, it is essential that all areas of UBC make changes that allow for the improvement of the waste diversion rates as a whole.

Best Practices on University Campuses

Some of the most significant universities in Canada for their waste management practices include the University of Western Ontario and the University of Victoria, alongside the University of British Columbia itself. It was essential that the research completed on these universities go beyond the data posted online about their waste management practices. Though numerous universities in Canada operate using private waste management systems, none who were contacted were willing to provide our team with specific fee structures from their campus. However, a number of valuable insights into practices taking place on campus to incentivize correct waste stream sorting behaviour were recognized after speaking with representatives from each of the mentioned universities.

The University of Western Ontario sorts garbage on campus in a manner similar to UBC, with four different waste streams: organics, paper, plastics, and garbage. The University of Western Ontario has implemented a volunteer system during orientation week, where the sustainability club on campus – EnviroWestern – positions trained volunteers at busy waste disposal locations on campus in order to educate the students on correct waste sorting procedures (University of Western Ontario, 2017). This system, although not fee structure related, has reduced the amount of contamination within the waste streams on campus. The president of EnviroWestern noted that the first year this practice was put into place the amount of contamination in the organics stream decreased by 20% from the previous year (University of Western Ontario, 2017). The University of Western Ontario was unable to provide any information on their fee structure for waste management purposes, but it is important to notice the impact of the educational programming on the waste management practices taking place on campus. It is important to note

that there was no incentive program highlighted from any of the contacts at the University of Western Ontario.

The University of Victoria has a similar goal to UBC of becoming a zero waste campus, by implementing a Sustainability Action Plan in 2009. The University of Victoria was one of the first universities to implement centralized waste sorting bins, by removing individual waste bins from lecture halls and classrooms (University of Victoria, 2017). This practice has since become industry standard on university and college campuses across Canada. Another relevant sustainable practice that the University of Victoria currently has in place is periodic waste audits, that determine waste stream composition (University of Victoria, 2017). The basis of how the frequent waste audits were conducted while keeping costs low was not something that the key informants from the University of Victoria were able to disclose in the timeframe of this project. Understanding the waste streams and their composition is essential to increasing waste diversion rate, overall working towards a zero waste goal.

Best Practices in North American Cities

Some of the most noteworthy cities in North America for their waste management practices include San Francisco, Seattle, and Vancouver – including Burnaby. Residential disposal practices and fees were analyzed to determine what practices could be transferable onto UBC campus. Cities on the West Coast were selected to analyze, because the culture is very similar to what is found on the campus of UBC, thus the transition of some of the practices should have been straightforward. It is important to recognize some of the practices will not be transferrable because residential practices may not be implementable on UBC campus because it is a private waste management organization.

San Francisco has in place a discount system, that offers a discount on waste disposal rates based on waste diversion rates. This program has a base diversion rate that customers must be

above in order to be eligible for the discount on their waste disposal (San Francisco Environment, 2018). In San Francisco, there is three streams of residential waste: garbage, recycling and organics. The recycling stream is processes further downstream between plastics and paper products. Though this is an added expense to San Francisco's waste management organizations, it ensures much cleaner waste streams, because the sorting is completed by their employees. In order to implement a strategy such as this one, individual household diversion rates must be calculated. In order to collect this data, different sizes of bins are used according to the necessities of the individual household. Waste diversion rates are calculated based on pick-up frequency and size of organics, recycling and garbage bins.

Seattle has also set some industry standards for implementing sustainable waste management practices. Seattle uses a different strategy than San Francisco, instead by offering discounts for increased amounts of organics disposal, but instead charging more per unit of garbage waste. Seattle does not charge recycling pickups to their residents. The larger organics bins cost less per liter, whereas the garbage bins cost more per liter as the size of the bin increases. The frequency of pickups is constant in Seattle; waste, and recycling are picked up weekly, whereas organics are picked up biweekly (Seattle Public Utilities, 2017). This is counter-intuitive for Seattle working towards becoming zero waste because it allows for more garbage waste to be deposited, even with the discounted organics disposal. Seattle does not charge residents independently – there are no garbage bag-tags required – instead, the fees are charged monthly to households, in a similar manner to how utilities are charged to households.

Finally, Greater Vancouver is one of Canada's leaders in waste management practices. Burnaby was the first of the outer communities to introduce biweekly garbage pickups in 2017, while maintaining weekly organics and recycling pickups for residents (City of Burnaby, 2017).

The introduction of this practice is beginning to be become more common outside of Greater Vancouver, seeping into not only interior B.C. but also into other provinces as well. Disallowing garbage pickup weekly encourages consumers to correctly sort their waste, while simultaneously enhancing the other services provided by the waste management organization. The resources that were once allocated to the garbage pickups, can now be reallocated towards other services such as litter collection or large item collection from households.

There are a number of practices from each of the above-mentioned municipalities that are implementable on UBC campus, especially those being performed in Burnaby. It would be easy to convince building managers on campus that these changes are common-place if the changes are already implemented in their residences off-campus. The discounting model used in San Francisco could also be implemented, if enough data could be collected on UBC campus about their waste management practices.

Limitations of Industry Best Practices

As mentioned throughout, it is essential to recognize that unlike residential waste management, the ancillary buildings on UBC campus have the option to employ a private waste management organization. The implementation of practices used across North America must be smooth, and should cause little to no turmoil during the transition from the currently used practices. Some of the best practices used in industry require infrastructure that UBC would be unable to support, given the current standards used on campus. For example, UBC uses standardized bin-sizes for recycling and organics disposal, which eliminates the eligibility for Seattle's bulk waste disposal to be an easy transition. Although there are a number of practices that may not be immediately implementable, these standards should be considered a good benchmark for UBC in the future. It should also be noted that UBC can justify changes being made to the current strategies

by proving that said practices are used elsewhere successfully, and thus industry best practices can be referenced by waste management on campus easily.

COST RECOVERY FINANCIAL MODEL DETAILS

Current Fee Structure of UBC Waste Management

The University of British Columbia maintains a cost recovery waste management plan in place in order to achieve long term sustainability in campus waste management (University of British Columbia, 2017). The existing fee structure of UBC Waste Management was analyzed to determine insights on how to approach and implement the goal of a cost recovery strategy while simultaneously incentivizing zero waste practices on campus. The current UBC fee structure incentivizes exploiting the garbage stream compared to that of recycling or organics, which add more comparatively to the bottom line of the ancillary buildings on campus. The details of UBC Waste Management funds and expenses are shown in the Figure 1. The data in Figure 1 shows the cost recovery surplus is 0.62%, indicating that the Waste Management fee structure in 2016 was marginally recovering the costs incurred.

2016 Actuals for Waste Management		
UBC Funding	$	1,303,137.00
Revenues and Charging Fees	$	726,536.00
Total Fund Available	$	2,029,673.00
Salaries and Benefits	$	1,131,313.00
Operating Expense and Fees	$	885,782.00
Total Expense	$	2,017,095.00
Over/Under Recovery	$	12,578.00

Figure 1. Waste management funding and expenses provided by UBC

To maintain a sustainable cost recovery fee structure, there are four key variables should be considered in order to effectively determine the cost recovery ratio:

1. UBC Funding: UBC funding is considered a fixed input. The amount of funding from UBC is determined by the long term strategy on waste management at UBC. It is determined by UBC financial and budgeting departments but not by the UBC waste management team. As such, despite the fact that UBC Waste Management team can send a request to UBC and ask for more funding, it is something that out of the team's control and it should not be the focus of the future strategy.
2. Revenues and Fees: Waste Management Team generate revenue and income streams from providing recycling services to subscribing customers. According to UBC Zero Waste Action Plan in 2014, the fees for tipping service in the Lower Mainland have been steadily increasing and are expected to continue to increase further. Per-ton waste disposal fees are also able to cover the per-ton costs for recycling for most materials. However, the current UBC composting facility is not able to cover its cost of composting, as it is higher than the cost of waste disposal on a per-ton basis.
3. Salaries and Benefits: The labour cost of the Waste Management team is determined by the workload of campus waste management service such as garbage bin pick-ups, waste composting and campus maintenance, etc. This is treated as a variable cost, but it is considered a fixed cost in the short run under the assumption that no significant human resource changes will be made. As such, labour costs are set as constant.
4. Operating Expense: This is the variable that deserves the most focus for this project, as it is highly associated with the zero waste management plan of UBC. By shifting materials from waste to recycling or organics, the UBC Waste Management team can achieve a

higher waste diversion rate while reducing operational expenses. In order to maintain a cost recovery fee structure, the operating expenses need to be redistributed across the waste, recycling and organics operational streams.

Current Waste Management Situation Analysis

The sorting stations on UBC campus have four different bins for waste separation: organics, recyclable plastics, paper/cardboard and garbage. Each of the four bins are the same size, but the utilization of each bin is different. According to the waste audit conducted in 2010 on UBC campus, 54.7% of disposed materials in UBC campus are organics and only 9.3% are non-recyclables (UBC Waste Audit Report, 2010). In 2013, UBC generated 3000 tons of garbage that was directed to the landfill, of which 48% was compostable or recyclable materials. Furthermore, 78% of the garbage waste stream gathered from the Nest were recyclable or organics materials that were disposed of incorrectly, or absentmindedly (University of British Columbia, 2017).

Cost Structure Model Proposal

Based on the situational analysis above, it is necessary for the future fee structure to not only recover the costs from waste management, but also increase the waste diversion rate on UBC campus. Figure 2 displays the current fee structure used for UBC Waste Management. In order to produce the new model, the emphasis needs to remain on cost-recovery while the model incentivizes zero waste practices.

2017 UBC Waste Management Price List (Approximate Cost)

Construction Waste Disposal			
1	cubic yard	$ 16.07	per unit
Concrete Waste Disposal			
1	cubic yard	$ 10.71	per unit
Scrap Metal Recycling/Disposal			
1	cubic yard	$ 10.71	per unit
Gypsum Waste Disposal			
1	yard	$	30.60

Garbage Dumpster Monthly Fees			
6	cubic yard	$ 78.80	per tip
4	cubic yard	$ 49.11	per tip
3	cubic yard	$ 27.85	per tip
1	bag	$ 2.50	

Organic Bins			
35	gallon	$ 23.50	per tip

OCC-Cardboard			
4 or 6	cubic yard	$ 21.42	per tip

Recyclables/Cans and Bottles			
35	gallon	$ 4.81	per tip
65	gallon	$ 7.65	per tip
95	gallon	$ 9.45	per tip

Extra Services			
Paper Shredding		$ 5.00	per box
Hauling fees are applicable on minimum charge of $51.00			

Figure 2. Current waste management prices on UBC campus

The new model was developed using the basic principles learned from the San Francisco residential waste management fee structure, offering a discount to ancillary on their waste pickup service fees to ancillary buildings for increased waste diversion rates. This model – found in Appendix A and B – introduces an incentive program for buildings to encourage the correct sorting of waste. While this model has proven to be effective in San Francisco, implementing it alone is not predicted to be effective on UBC campus, because there is a misalignment between those who see the bottom line and those who are responsible for sorting the waste. The discount will only be offered to those who are above a base diversion rate, which can be determined using the results of the most recent waste audit conducted on UBC campus. In order to provide an accurate discount for those who have a higher waste diversion rate, a method of collecting this information is required. The new model that was produced can be found in Appendix A and B, and defines the waste diversion rate as the sum mass of recyclables and organics divided by the total mass of all waste streams.

To complement the discount model proposed above, an increase in the price of garbage disposal is required. Although this is a straightforward approach to the issue, the cost of establishing a relationship with a new private waste management organization is steeper than maintaining the existing partnership with UBC Waste Management, even with an increase in cost of garbage tips.

Limitations of Proposed Model

There are several limitations to the aforementioned model that arise due to the lack of established infrastructure at UBC. The discount model requires a significant number of inputs, that are currently unavailable for the ancillary buildings. A good example of this, is the number of bins – for each individual waste stream – removed from the individual buildings monthly. In order for the proposed model to be effective, this information is essential; but, as of right now is not audited frequently enough to be accurate.

Another limitation is that the increase in garbage fees are estimated for appropriateness based on secondary research, and informal discussions with decision-makers on the UBC campus. Before the new pricing model is implemented, concrete research must be conducted in order to value the established partnership between the ancillary buildings and UBC Waste Management.

RECOMMENDATIONS FOR IMPLEMENTATION

There are several recommendations that will begin to move the University of British Columbia towards the zero waste plan. In order to implement the proposed cost recovery model, more frequent data collection is required, as well as a change in the frequency of waste pickups, and the rollout of fees for contaminated waste streams to individual buildings.

Increased Waste Auditing

In order to ease the process of implementation of the discounting model on UBC campus, there are a number of measures that will need to be determined each month for the ancillary

buildings. The accuracy of the estimation for the model will increase significantly if a monthly waste audit can be conducted. The rollout of this method could be a barcode scanning system for all the waste bins being removed from each of the ancillary buildings. A barcode system would not require new or different physical bins, but instead would be a minor investment in barcode scanning technology that would be inexpensive to introduce. This method of waste auditing would allow for the operators picking up the organics bins to determine exactly where each bin was coming from, while simultaneously determining waste diversion rate. In order to determine the value of this project, it could first be rolled out in a pilot program to exclusively student athletics, in order to establish how effective said measures would be. The waste diversion rate would be calculated based on the bin sizes, using the formula previously mentioned –the sum mass of recyclables and organics divided by the total mass of all waste streams.

The model produced would calculate waste diversion rate based on the inputs can be seen in Appendix A. Only by accurately tracing the waste diversion rate can improvements be made on the model that was piloted. The rollout of the new fee structure should not be introduced until the data collection from continuous waste auditing has been streamlined.

Frequency of Waste Pickups

While establishing a more thorough waste auditing system will not introduce an immediate change on UBC campus for waste management, a change in frequency of standard waste pickups offers an instantaneous impact on campus waste management. Decreasing the frequency of garbage pickups, while simultaneously increasing the price of tipping garbage incentivizes zero waste practices. This method was adapted from the City of Burnaby introducing biweekly garbage pickups, and reallocating the resources towards other services for its customers. It is recommended that the expenses that will be eliminated by reducing the frequency of garbage pickups be reallocated towards reducing the cost of organics disposals per tip for ancillary buildings. By

introducing this new standard of frequency to the buildings, there will be a limitation on the amount of garbage that can be held in each of these buildings. This limitation will persuade buildings to encourage those who are sorting the waste to sort it correctly in order to remove the ~50% of recyclables and organics from the garbage waste stream, as to not fill the garbage containers as quickly.

Contamination Fines

Though the financial model proposed in Appendix A and B introduces an incentive program for proper waste sorting practices, studies have proven that disincentives tend to be more beneficial at influencing behaviour. The data collection proposed above introduces the possibility of initiating fines for high rates of contamination in organics waste. Currently, close to 50% of organics bins are sent from the composting facilities to the landfill because of the prohibitive amount of contamination – both recyclables and garbage. The operators of the composting facilities have a good idea of where the highest rates of contamination on campus are coming from, but in order to quantify how many bins are being double-processed, more auditing is necessary. If contamination fees are implemented along with the model that offers a discount for improved waste diversion, there should be a strong incentive for buildings to promote proper waste sorting. This contamination fine could be put into place immediately, because the trucks collecting organics bring only eight organics bins at a time, thus the operators can mark where the contaminated bins were collected from. Justifying this fine to the customers is straightforward, because of the necessary dual-processing fees, and should have a relatively fast impact on the buildings who are charged great numbers of fines.

FUTURE PROPOSALS

Efficient Industrial Organics Programs

Essential to the success of implementing a new fee structure that will progress UBC campus towards their zero waste goal is the efficiency of the organics processing facilities. The current composting facilities have already exceeded their expected lifetime, and are consistently not functioning at full capacity due to necessary shutdowns for repairs. The cost of shutting down the organics composting facilities for repairs is increasing every year, and will continue to negatively impact the bottom line of UBC Building Operations. Furthermore, the decrease in amount of compost being produced from the increased number of weeks that the facilities are shut-down each year could increase the costs for UBC maintenance who use the free compost produced for landscaping UBC campus.

UBC Waste Management will face the important decision of what to replace the current organics processing system with, within the next 5 years according to the current operator of the composting system. In order to choose the best industrial composting process replacement, intensive research must be conducted. The investment will be significant for UBC, and thus should be investigated further in the upcoming years. Prospective facilities that are already in place in other industrial composting facilities should be evaluated on efficiency and longevity, in order to reinforce the decision that UBC Waste Management will make.

Waste Management Education

The education of primary waste producers is also essential to the success of becoming zero waste. Based on the practices employed at the University of Western Ontario, educating students on correct waste sorting processes is a key factor in the success of waste diversion. Some programs that are currently employed on the campus of the University of Western Ontario could easily be implemented on UBC campus, such as student volunteers trained in assisting their peers on proper waste sorting. The posters that are present on the waste sorting stations currently are somewhat

effective, but based on discussions with current students, there are many waste articles that are not displayed which leads to improper disposal.

The University of British Columbia could also consider implementing a program similar to what is found in Cadillac Fairview Malls in the Greater Vancouver Area. In the highest traffic areas for waste disposal in the malls – the food courts – there are employees who collect the waste and sort it correctly, thus guaranteeing that the waste diversion rate is maximized because the contamination rates are minimized. Implementing a similar program on UBC campus would be an additional expense for waste management, but would assist in guiding the University in the direction of zero waste at a faster rate. More research should be conducted on the feasibility of implementing this, if only in the NEST and Student Union Buildings as there is high traffic and high waste disposal.

APPENDICES

Appendix A: Inputs for produced financial model

Garbages when compost is not diverted					
Container Type	Quantity	Number of pickup (days/week	Utility (%)	Weight (lbs)	Notes:
30 cubic yard debris box	0	0	0	0	
25 cubic yard debris box	0	0	0	0	
20 cubic yard debris box	0	0	0	0	
6 cubic yard dumpster	0	0	0	0	
3 cubic yard dumpster	0	0	0	0	
1 cubic yard dumpster	0	0	0	0	
96 gallon toter	0	0	0	0	
64 gallon toter	0	0	0	0	
32 gallon toter	0	0	0	0	
			Total Weight	0	

Waste when compost is diverted					
Container Type	Quantity	Number of pickup (days/week	Utility (%)	Weight (lbs)	Notes:
30 cubic yard debris box	1	0.5	50	1125	
25 cubic yard debris box	0	0	0	0	
20 cubic yard debris box	0	0	0	0	
6 cubic yard dumpster	0	0	0	0	
3 cubic yard dumpster	0	0	0	0	
1 cubic yard dumpster	0	0	0	0	
96 gallon toter	0	0	0	0	
64 gallon toter	0	0	0	0	
32 gallon toter	0	0	0	0	
			Total Weight	1125	

Recyclable Paper, Bottle & Can					
Container Type	Quantity	Number of pickup (days/week	Utility (%)	Weight (lbs)	Notes:
6 cubic yard dumpster	1	1	50	1005	
4 cubic yard dumpster	0	0	0	0	
3 cubic yard dumpster	0	0	0	0	
2 cubic yard dumpster	0	0	0	0	
1 cubic yard dumpster	0	0	0	0	
96 gallon toter	0	0	0	0	
64 gallon toter	0	0	0	0	
32 gallon toter	0	0	0	0	
			Total Weight	1005	

Recyclable Cardboard					
Container Type	Quantity	Number of pickup (days/week	Utility (%)	Weight (lbs)	Notes:
6 cubic yard dumpster	1	1	50	300	
4 cubic yard dumpster	0	0	0	0	
3 cubic yard dumpster	0	0	0	0	
2 cubic yard dumpster	0	0	0	0	
1 cubic yard dumpster	0	0	0	0	
96 gallon toter	0	0	0	0	
64 gallon toter	0	0	0	0	
32 gallon toter	0	0	0	0	
			Total Weight	300	

Office Compostables					
Container Type	Quantity	Number of pickup (days/week	Utility (%)	Weight (lbs)	Notes:
6 cubic yard dumpster	1	1	50	540	
4 cubic yard dumpster	0	0	0	0	
3 cubic yard dumpster	0	0	0	0	
2 cubic yard dumpster	0	0	0	0	
1 cubic yard dumpster	0	0	0	0	
96 gallon toter	0	0	0	0	
64 gallon toter	0	0	0	0	
32 gallon toter	0	0	0	0	
			Total	540	

Food Scraps					
Container Type	Quantity	Number of pickup (days/week	Utility (%)	Weight (lbs)	Notes:
6 cubic yard dumpster	1	1	50	1902	
4 cubic yard dumpster	0	0	0	0	
3 cubic yard dumpster	0	0	0	0	
2 cubic yard dumpster	0	0	0	0	
1 cubic yard dumpster	0	0	0	0	
96 gallon toter	0	0	0	0	
64 gallon toter	0	0	0	0	
32 gallon toter	0	0	0	0	
			Total	1902	

Appendix B: Waste Diversion Rate Calculation

Conversion factors	
Material Type	**Density (lb/cu yd)**
Waste when compost is not diverted	400
Waste when compost is diverted	150
Recyclable Paper, Bottle & Can	335
Recyclable Cardboard	100
Office Compostables	180
Food Scraps	634

Container	**Gallons to cubic yards**
96-gallon toter	0.48
64-gallon toter	0.32
32-gallon toter	0.16

Diversion Rate Calculation	Weight generated in pounds/month	tons/month
Total Garbages:	4871.25	2.174665179
Total Recycled:	5650.65	2.522611607
Total Composted:	10573.86	4.720473214
Total Generation (Garbage, Recycling, Composting):	21095.76	9.41775
Diversion Rate:	**76.91%**	**76.91%**

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