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An Investigation into Implementing a Campus-Wide Styrofoam Recycling Program

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SUSTAINABILITY PROJECT REPORT

AN INVESTIGATION INTO IMPLEMENTING A CAMPUS-WIDE STYROFOAM RECYCLING PROGRAM

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ABSTRACT

"An Investigation into Implementing a Campus-Wide Styrofoam Recycling Program"

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This report examines options available to launch a campus-wide Styrofoam recycling program at UBC. A pilot project on Styrofoam (a.k.a. expanded polystyrene foam) recycling has been running at the Brain Research Lab (BRC) located in the UBC Hospital. The pilot program has lasted for four months in nine of their labs. This pilot program uses services provided by a recycling material transporting company named Pacific Mobile Depots (PMD) to transport the Styrofoam to a recycling plant by the name of AquaPak situated in Surrey, BC. As part of the UBC Waste Management target of 55% per capita waste reduction for 2015, UBC is in need of a campus-wide Styrofoam recycling program to completely remove Styrofoam from going to landfills. The goal of this report is to closely examine options available for initiating and continuing a Styrofoam recycling program throughout the whole campus. The scope of this report extends only to the logistics of the recycling program, which consists of three main categories: the Recyclable Materials, Collection and Storage, and Pick-up and Drop-off of Styrofoam. A sister report for this project is being written by another group, to analyze the recycling process itself.

Each section was evaluated using a triple-bottom-line analysis to recommend the best available solutions for each category. Research on all options was limited to available resources around campus and surrounding cities. The report's economic analysis is limited to preliminary numbers as it was not feasible to capture all hidden costs associated with the options.

Upon a triple-bottom-line analysis, it was evident that many Styrofoam products on campus could be recycled; the existing recycling bin infrastructure on campus could be utilized in the campus-wide Styrofoam recycling project. Furthermore, it was evident that utilizing a UBC owned truck to transport the Styrofoam to the recycler is economically, socially and environmentally favored over other options available. This report recommends that buildings manage Styrofoam collection bins and store collected Styrofoam at a designated location in the building until the UBC owned pick-up truck collects the Styrofoam to transport to the recycler.

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LIST OF ABBREVIATIONS

UBC: University of British Columbia

BRC: Brain Research Center

SUB: Student Union Building

EPS: Expanded Polystyrene

PMD: Pacific Mobile Depots

1.0 INTRODUCTION

Styrofoam use is often overlooked at the University of British Columbia (UBC). Recently, however, the campus community has become more aware of recycling this type of material. In addition, recycling Styrofoam has *also* become quite an obstacle to overcome.

This report explains an implementation for a Styrofoam recycling process at UBC. This recycling process is crucial since UBC's Styrofoam waste is a large contributor to the Vancouver's landfills. By adding modifications to our present recycling program, Styrofoam recycling is possible. The process to recycle Styrofoam will involve an investigation into three factors: Recyclable Materials, Collection and Storage, and Pick up and Drop off.

* Abbreviations will be found in the List of Abbreviations on p.vi

2.0 RECYCLABLE MATERIALS

2.1 Background

Styrofoam is a light, plastic foam that is made out of polystyrene. It is used as packing, peanuts, food trays, and variety of other products. Unfortunately, it seems the full negative impact of Styrofoam is current overlooked at UBC. Styrofoam is applied and used throughout UBC and there is currently no program to recycle it on campus in a large scale.

2.1.1 Environmental Impact

Despite its number of uses, Styrofoam is a harmful factor to the environment. Given that Styrofoam is a type of plastic, it is not biodegradable. This is due to dangerous chemicals like benzene that are used to create this type of foam (Ho, 2010). Therefore, once thrown away, Styrofoam does not deteriorate. Not only does this cause harm to the environment, it also contributes to landfill pileup. In fact, according to UBC Waste Management's Annual Report of 2003/2004, two thousand nine-hundred thirty two tonnes of waste were sent to the landfill. Unfortunately, the waste contained Styrofoam. An estimated forty percent of the waste amount from this time period was from polystyrene (UBC Waste Management, 2004).

2.1.2 Current Methods of Recycling

The Brain Research Center (BRC) was selected for a Styrofoam recycling pilot program in hopes that the rest of UBC Campus would be able to follow in their pursuit. The BRC is located at the UBC Hospital and has nine labs under the four month pilot program (Bertrand, Melanie (2009). The UBC Farm also takes part in re-using Styrofoam egg cartons too. By encouraging students and faculty to give their egg cartons to the farm, they avoid adding more Styrofoam to UBC's waste. The majority of all egg cartons used by the UBC Farm are donated by students and faculty. They are used over and over again until weakened (UBC Recycling, 2007).

As of now though, there is no campus-wide program at UBC to recycle Styrofoam. Instead, Styrofoam is simply thrown in the trash to take to the Vancouver landfill.

2.2 Options Considered

2.2.1 Styrofoam Cups/Containers

Styrofoam cups and containers are used from UBC Food Services. They are used at the Student Union Building (SUB), and other areas that handle food.

* Abbreviations will be found in the List of Abbreviations on p.vi

Figure 1. Styrofoam Cups.

Source: Moon Battery (2008), Retrieved on April 2nd, 2010, < http://www.moonbattery.com/styrofoam_cups.jpg>

2.2.2 Insulation Materials

Styrofoam insulation is used in the buildings throughout UBC campus. Due to Styrofoam's strength and water-resistance, it is a good insulator.

2.2.3 Packing Blocks

In its lightness, Styrofoam is used to protect items during transit; it acts like a "cushion." At UBC, items that are shipped and received need Styrofoam packing blocks to prevent damage.

Figure 2. Packing Block.

Source: Bureau of Environmental Services (2007), Retrieved on April 2nd, 2010, < http://www.co.ho.md.us/DPW/DPWIMAGES/styrofoam%20block.jpg>

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2.2.4 Packing Peanuts

Packing peanuts are usually S-shaped and are found in packaging of delicate items for protection. They are light and inexpensive.

Figure 3. Packing Peanuts.

Source: Foto S.A. (2009), Retrieved on April 2nd, 2010, < http://fotosa.ru/stock_photo/Corbis_RF/p_2581573.jpg>

2.3 Barriers

Recycling Styrofoam is seldom a simple idea. At UBC, implementing a recycling program for Styrofoam involves many obstacles.

2.3.1 Low Cost

Styrofoam is a sanitary product and costs less than biodegradable products. UBC Food Services is assumed to spend a lot on Styrofoam annually. Due to Styrofoam's inexpensiveness, this is estimated to be a lesser amount than it would be with other materials for their services. Despite its lack of biodegradability, Styrofoam is economical for UBC campus. Therefore, substituting or decreasing the use of Styrofoam at UBC is inconvenient.

2.3.2 Social Ignorance

Moreover, members of the UBC community are unaware of the negative impacts of Styrofoam waste. Frequently, Styrofoam is littered or thrown aimlessly around trash cans throughout campus. Not only does this show lack of community care, but this also shows the lack of knowledge of Styrofoam's negative impacts. If the UBC community became more cautious of Styrofoam's environmental harm, more pilot programs and more action would take place to implement a Styrofoam Recycling Process.

* Abbreviations will be found in the List of Abbreviations on p.vi

2.4 Recommendations

During the process of putting Styrofoam recycling into action, the campus community may be hesitant to adjust themselves to new changes. However, through seminars, posters, and word-of-mouth, the campus community will become educated in the importance of Styrofoam recycling. By providing more awareness to the members of UBC campus of Styrofoam recycling, they will approve sooner than later the new plan.

Styrofoam is a necessity throughout UBC campus. Therefore it would be unrealistic to assume this type of plastic could ultimately be avoided for the university. Through investigation, it is found that UBC's Styrofoam use is consisted of cups and containers from UBC's Food Services, as well as insulation materials, packing blocks, and packing peanuts. With new renovations and machines on campus, insulation and packing Styrofoam is common at UBC too. With a monthly recycling depot and a new pick-up process, these Styrofoam materials can be recyclable.

* Abbreviations will be found in the List of Abbreviations on p.vi

3.0 COLLECTION AND STORAGE

This section of the report details the analysis of collection strategies. Once the end user has finished with the polystyrene foam product, there must be procedures in place to discard the product and then consolidate all the foam so that it can be recycled. Three individual alternatives to collect the foam have been identified and evaluated here. Due to the unique needs of the individual end users as discussed in the previous section, these alternatives are evaluated on a triple bottom line stance considering laboratories, academic buildings and offices, vendors, and food consumers. For the purposes of this report, our estimates indicate that the campus will produce the equivalent of 80 large bags of Styrofoam per month.

3.1 Styrofoam Consumers

3.1.1 Laboratories

Expanded Polystyrene usage in laboratories is almost exclusively through Styrofoam packaging. Continuously incoming goods such as chemical or biological materials that require refrigeration almost always come in Styrofoam vessels for its insulating qualities.

3.1.2 Building and Offices

The Styrofoam usage in most buildings and offices is found from packing materials such as the foam padding in computer boxes or the foam peanuts that new furniture is packed in.

3.1.3 Food Consumers

The Styrofoam production from food consumers can be tracked to key locations around campus such as the Student Union Building, where the Styrofoam to be recycled consists of small clamshell type containers that meals are served in.

* Abbreviations will be found in the List of Abbreviations on p.vi

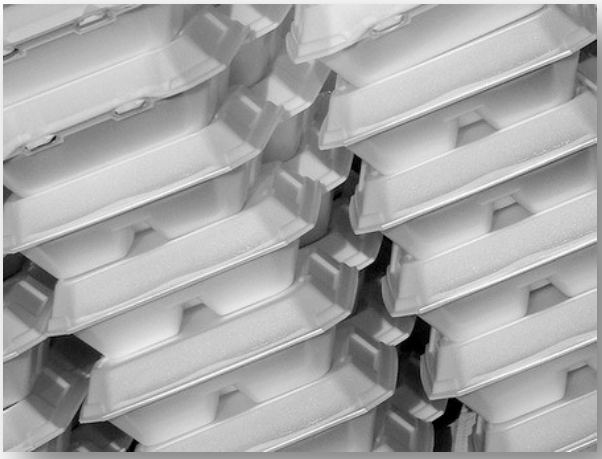

Figure 4. Styrofoam Clamshell

Styrofoam clamshell container used for many on campus food services (Source: blog.ecolect.net)

3.1.4 Vendors (Goods/Food)

Vendors receive much of their raw products packed in Styrofoam blocks or peanuts.

3.2 Alternatives

Three main alternatives were considered and are examined here:

3.2.1 Recycling Bins

This collection method involves using the current recycling bins that can be found throughout much of campus (see Figure 5 – Existing Paper Recycling Bins. Source: UBC waste management). Bins would be dedicated specifically to expanded polystyrene products and would be bagged, collected, and inspected by the existing custodial staff.

* Abbreviations will be found in the List of Abbreviations on p.vi

Figure 5. Existing Paper and Can/Bottle Recycling Bins

(Source: UBC waste management)

3.2.2 Consumer Recycling

Through consumer based recycling strategies, consumers would request recycling bags from waste services and fill them at their discretion. They would also be responsible for taking out the filled foam containers to their designated monthly collection location. This alternative is inspired by the Styrofoam recycling strategy that is taken by the University of Victoria.

3.2.3 Central Recycling

Consumers would be entirely in control of bringing their foam waste to a central place on campus where it would be collected and sorted for recycling.

3.3 Triple Bottom Line Analysis

This section breaks down each of the alternatives and comparatively analyzes them using the triple bottom line criteria: economic, social, and environmental impacts.

3.3.1 Economic Analysis

3.3.1.1 Recycling Bins

For every large bag (0.313 m^3) worth of Styrofoam collected (details of bags outlined in the Pick-Up & Drop-Off section of the analysis), two recycling bins (0.189 m^3) are required to hold the volume of the foam. At a cost of approximately $30 per container when bought in bulk:

* Abbreviations will be found in the List of Abbreviations on p.vi

- 80 large bags per month* 2 bins per large bag = 160 bins
- 160 bins * $30 per bin = $4800 upfront capital investment

Assuming it takes custodial staff 5 minutes to remove, inspect, bag each bin weekly and transport the foam to the building's collection location:

- 5 minutes per bin per week x 160 bins * 4 weeks per month /60 min per hour = 53.3 hours of labour
- 53.3 hours * $20 per hour (includes wages plus added overhead) = $1066 per month for collection

3.3.1.2 Consumer Recycling

As the consumer bags their own waste in this alternative, there are no costs associated with physical collection; however, an infrastructure would have to be set up for distribution of bags. This would likely correspond to one full time employee in the waste management department who would take requests and deliver the collection bags to the consumers.

- $20 wages and overhead *40 hours a week * 4 weeks per month = $ 3200 infrastructure per month

3.3.1.3 Central Recycling

Central recycling, like consumer recycling, also relies on the consumer to collect the recycling, but has infrastructural costs associated with it to have someone maintain the central collection facility and the costs of running the collection center itself:

- $20 wages and overhead *40 hours a week * 4 weeks per month = $ 3200 infrastructure per month
- 500 square foot facility = ~$1000 per month operating and land opportunity cost
- Total = $4200 per month

3.3.2 Environmental Analysis

The section details the environmental impacts of each strategy. Although not quantified, they will each be considered qualitatively for their potential impacts.

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3.3.2.1 Recycling Bins

As the bins could be made from plastics derived from refined petroleum products, there are environmental impacts associated with their manufacture and recycling. Chemicals would perhaps also be needed to clean these bins.

3.3.2.2 Consumer Recycling

Delivery of the bags to each consumer would produce greenhouse gas emissions from transportation and maintenance of the vehicle.

3.3.2.3 Central Recycling

Consumers would likely use a fossil fuel based method to transport the Styrofoam waste to the central location. In addition, the overhead of running a central facility would require products and energy that could involve GHG emissions or the use of other chemicals that could be polluting.

3.3.3 Social Analysis

3.3.3.1 Recycling Bins

Bins provide an easy fixed location for the recycling, but take up space in buildings and can add to repetitive stress injuries to custodians who are constantly emptying these bins daily anyway.

3.3.3.2 Consumer Recycling

The social benefit to consumer recycling is that it allows each user to customize their recycling plan, which may encourage more efficient usage, but this alternative would also require consumers to take initiative which could discourage usage in the first place. As well, it may not work well for a multiuser building, as each consumer would have to coordinate with others to combine their foam waste.

3.3.3.3 Central Recycling

Having central recycling reduces the convenience of the onsite collection strategies which may also discourage recycling.

3.4 Recommendations

From this analysis, it seems that a recycling bin based system provides an economical long term solution that derives its relative inexpensiveness from building on the existing recycling

* Abbreviations will be found in the List of Abbreviations on p.vi

infrastructure. It is the most convenient of the three alternatives and is comparable qualitatively in terms of its environmental impacts.

For further research, the analysis of these collection strategies was considered mutually exclusive from the options available for recycling. If for example the sister report of this project, dealing with the recycling process itself, determines that UBC should have its own Styrofoam recycling equipment, the criteria for analysis may change. Areas where food containers are used also currently require thorough cleaning in order for processing by AquaPak and therefore merit more analysis for economic feasibility.

Further research can also be done into a hybridization of these strategies based on individual consumer needs and perhaps implementing a pay per usage type system to offset the program expenses would be possible, depending on the cost tolerances of the parties involved.

A marketing strategy will also likely be necessary when a new program like this is rolled out, to educate consumers.

* Abbreviations will be found in the List of Abbreviations on p.vi

4.0 PICK-UP AND DROP-OFF

Pick-up and drop-off of the collected Styrofoam is one of the main elements of the campus-wide Styrofoam recycling program. The collected and stored Styrofoam on campus should be picked up and transported to the recycling plant. Transportation of Styrofoam plays a major role in the recycling project as it determines whether recycling Styrofoam on site or at a recycling plant will be the most favourable, economically, socially and environmentally. UBC's current pilot project on Styrofoam recycling utilises a recyclable-material transporting company called Pacific Mobile Depots (PMD), which collects the Styrofoam from campus and transport it to the recycling plant. PMD transports all Styrofoam to 'AquaPak' which is a Styrofoam recycling plant situated in Surrey BC. UBC's current pilot project on recycling Styrofoam mainly utilizes AquaPak's services. Collection of Styrofoam and transportation to the recycler should happen on a weekly or a monthly schedule which will depend on the amount of Styrofoam produced on campus within a given period of time. In this section, our goal was to come up with a set of options available for the pick-up and drop-off portion of the program, and analyse these options according to a triple-bottom-line assessment. Furthermore, this triple-bottom-line analysis will enable us to recommend the best and most feasible method for the transportation part of the program.

The sections below, describe in detail, the three main options that were available for the campus-wide Styrofoam recycling program. It also provides a triple-bottom-line analysis of the considered options in order to recommend the best solution available.

4.1 Options Considered

The three main solutions considered for the transportation of the collected Styrofoam from campus to the recycler are:

- Utilising PMD's services
- Use of UBC owned trucks
- Utilising general garbage removal services available

4.1.1 Pacific Mobile Depots

UBC's current pilot program on Styrofoam recycling uses PMD services to transport the Styrofoam to the recycling plant located in Surrey. PMD is a company that provides plastic

* Abbreviations will be found in the List of Abbreviations on p.vi

related recycling services to the greater Vancouver area. PMD was founded in 2000 and has since been the only company in Vancouver that provides services of pick-up and transport of recyclable material to various recyclers. PMD has five tonne trucks that are used as mobile Styrofoam collectors. The company has established rates for pick up charges depending on the type of material being collected (see Table 1).

4.1.2 UBC Owned Trucks

Transportation of the collected Styrofoam could be done by the use of a UBC owned truck. UBC Plant Operations Management and UBC Waste Management own trucks that are of the right capacity to haul the collected Styrofoam to the recycling plant.

Figure 6. Garbage Truck Owned by the UBC Waste Management Office

Source: UBC Waste Management, 2010 <http://www.recycle.ubc.ca/services.htm>

4.1.3 Other Garbage Removal Services

There are many companies within Vancouver that provide junk removal services. 'City Haul Rubbish removal' and 'Junk Removal Vancouver' are a few of many such companies. Pacific Mobile Depots differ from these companies as it has established rates and charges specifically for the Styrofoam recycling services.

4.2 Triple-Bottom-Line Analysis of Pick-up and Drop-off Methods

In order to provide the best solution for the transportation of the collected Styrofoam to the recycling plant, a triple-bottom-line analysis is performed on all three options discussed in Section 4.1. For the purpose of analysis and comparison, time required to collect Styrofoam throughout the campus by one 5 tonne truck is assumed to be one working day. This section provides detailed discussion of Economical, Social and Environmental analysis of all three solutions considered.

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4.2.1 Economical Analysis

4.2.1.1 Utilising Pacific Mobile Depots' Services

PMD's charges are categorized per bag of material being transported. The size of a regular bag is 18"x24" and large bag is 36"x48". Pacific Mobile Depot's charges include all costs involved in the transportation process, such as, storage and fuel costs. PMD is able to go to every building or storage place on campus to collect Styrofoam and there will be no extra cost for the frequent stops they have to make at each building. Table 1 shows Pacific Mobile Depots' charges for various Styrofoam products to be recycled. For the purpose of comparing each option, assume the following quantities are produced throughout the campus per month:

- 50 large bags of foam containers
- 25 large bags of foam peanuts
- 25 small bags or foam packing blocks

The total cost to transport the above quantities to the recycler through Pacific Mobile Depots is $487.50.

Category	Regular	Large
Foam Peanuts	$2.25	$4.50
Foam Packing Blocks	$2.50	$5.00
Foam Containers/Insulation	$2.50	$5.00

Table 1. Pick-Up Fee Chart for Pacific Mobile Depot

.Table contains charges per bag of material. Regular bag size: 18"x24", large bag size: 38"x48".

4.2.1.2 Utilising a UBC-Owned Truck

If a UBC owned 5 Tonne truck is used to transport the Styrofoam to the recycler in Surrey, the cost will include the wage for the driver and the collector and the cost for the fuel for the truck. Since Styrofoam is not a heavy material, the amount of gas burnt for transportation will be less compared to other garbage materials. Styrofoam could be collected from storages around all around campus within a day. The wage for the driver and the collector could be calculated to be $24/hr x 8 hr = $192.00. The amount of gas burnt by a 5 tonne truck per 100km is about 13.5L. The total distance to travel around the campus along with the drive to the recycler and back is

estimated to be 88.9km. Therefore, the total fuel cost for the transportation and pick-up of Styrofoam per month will be, 12L x $1.00 + tax ≈ $15.00.

- The overall cost assessment per month for the use of a UBC's truck option is as follows:
- Fuel cost: $15.00
- Crew cost: $192.00
- Total: $207.00

4.2.1.3 Utilising Other Junk-Removal Companies

Junk removal companies' pick-up and drop-off fees are based on the distance the truck has to travel from the company to the pick-up location and the amount of material being transported. As the storage of collected Styrofoam is at every building on campus, the truck will have to visit each building and collect Styrofoam and transport it all the way to Surrey. The monthly estimated cost for this service is $550.00.

4.2.2 Social Analysis

4.2.2.3 Utilising Pacific Mobile Depots' Services

PMD is able to drive to each building to pick-up collected Styrofoam. This enables each building to have its own storage for Styrofoam, thus making it convenient for the building users to collect Styrofoam for recycling. Pick-up of Styrofoam may block the entrance of the building for a while, making access to the building inconvenient to the users.

4.2.2.4 Utilising a UBC- owned Truck

UBC owned trucks are operated by UBC's employees and their health and safely is the priority of their employing office at UBC for that particular staff. Just as in PMD's social impacts, this service makes it convenient for the users to collect Styrofoam for recycling as the trucks are able to go to each building to collect the Styrofoam from the storage location.

4.2.2.5 Utilising Other Junk Removal Companies

The only social impact of utilising a junk removal company for the pick-up and transportation of the Styrofoam is the company's willingness to drive around the campus to all buildings to collect Styrofoam. If the junk removal company requires all Styrofoam products to be transported be stored at one location, the building users will find it difficult to collect

Styrofoam, as the storage for the Styrofoam will be at different or far away locations from the building.

4.2.3 Environmental Analysis

4.2.3.1 Utilising Pacific Mobile Depots' Services

PMD uses 5 tonne trucks as their main mobile depots for Styrofoam collection. Each of these trucks are able to carry 200 of large size bags (see Section 4.2.1). The amount of CO2 released to air per 1L of Diesel is 2.68kg. The total amount of CO2 released to the air per month by a 5 tonne truck for collection and transportation of Styrofoam to the recycler is calculated to be: 32.16 kg (people.exeter.ac.uk). PMD is situated in Metro Vancouver which is 23.3 km away from UBC. The amount of CO2 released to the air by one 5 tonne truck for traveling between Metro Vancouver and UBC is (13.5x43.6/100)x 2.68 = 15.77kg. Therefore, the total carbon footprint of PMD for pick-up and drop-off of Styrofoam per month is 32.16+15.77 = 47.93kg. Furthermore, the idling time between the loading of the truck with collected Styrofoam and the amount of noise generated by the engine also impacts the environment.

4.2.3.2 Utilising a UBC- owned truck

The amount of CO2 released by a UBC owned 5 tonne truck for transporting the Styrofoam to the recycler is 15.77kg less than that of PMD's carbon foot print. This is because; UBC's truck starts and ends its journey right in campus which will not include any traveling distance to campus from an outside location. The noise pollution and the idling times for this option do not significantly differ from the other two options**.**

4.2.3.3 Utilising Other Junk-Removal Companies

Environmental impact of a normal junk removal truck closely relates to that of PMD's truck since they both are outside sources which will travel the same distance within campus and outside. Therefore, the carbon foot print calculated for PMD's truck could be assumed for 'other junk removal truck' option as well.

4.3 Recommendations

Following the triple-bottom-line analysis done in Section 4.2, the recommended option for the pick-up and drop-off portion of the campus-wide Styrofoam recycling program is the use of a UBC owned truck. Economically, UBC's truck option is favoured over the other two since the estimated total cost per month is less than the other options. The social impacts for all three

* Abbreviations will be found in the List of Abbreviations on p.vi

options are not very different. Environmentally, UBC's truck leaves less amount of a carbon footprint compared with the other two options. Since, the use of a UBC owned truck to transport Styrofoam has a positive impact on all three areas of the triple-bottom-line analysis, this option is highly recommended.

* Abbreviations will be found in the List of Abbreviations on p.vi

5.0 CONCLUSION

In this report, we hope to have shown that there are feasible options for UBC to implement a campus wide recycling strategy for Styrofoam products. Through a triple bottom line analysis, strategies for recyclable materials, its collection/storage, and pick-up/drop-off were indentified and evaluated.

These products such as cups and containers from UBC's Food Services, as well as insulation materials, packing blocks, and packing peanuts can be found across the campus in various locations. By utilising and growing on the existing UBC recycling infrastructure, a cost effective, socially acceptable, and environmentally responsible method to recycle these can be implemented.

Although the research in this report is useful for making recommendations, the assumptions and estimates detailed should be thoroughly investigated, as the program is rolled out in stages to ensure its success in all location across campus.

* Abbreviations will be found in the List of Abbreviations on p.vi

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