UBC Social Ecological Economic Development Studies (SEEDS) Student Report

AN INVESTIGATION INTO WATER BOTTLES AND WATERFILLZ UNITS

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Submitted to Dr. Carla Paterson

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1.0 INTRODUCTION

The usage of bottled water has significantly increased over the last decade. Consequently, the amount of waste, harmful gases, and pollutants produced by the making and demolishing of this product are escalating. Such rise in harmful substance can have negative impacts on the environment, economy, and social life of the society. As a result, finding alternatives to bottled water is an issue at stake now. In the case of construction of the new SUB at UBC, replacement of bottled water with WaterFillz is a major concern.

This report describes the environmental, economics, and social aspects of water bottles and WaterFillz and draws a conclusion on which technology is more suitable to qualify the new SUB on Leadership in Energy and Environmental Design (LEED) criteria. The environmental aspect of these technologies focuses on emission of gases, production of pollutants, and their effects on the environment. The economics aspect of water bottles and WaterFillz provides commendable information on cost breakdown, including production, usage, and demolition of the two products to facilitate choosing the reasonable option. The social aspect of the two mentioned technologies, [bottles and WaterFillz], focuses on health concerns, business partnership chances, and social impacts namely, job creation and community involvement. In this report, water bottles are compared to WaterFillz along with their negative and positive outlooks. This analysis is important because UBC strives to be a Platinum+* facility, and the construction of the new SUB is a major step to help this cause.

* This term and all subsequent terms marked with an asterisk will be found in the glossary on p.vii-ix

2.0 WATER BOTTLES

In order to determine whether water bottles are advantageous over WaterFillz, environmental, economic, and social effects of these technologies are analysed. This section highlights the major issues involved with water bottle usage.

2.1 Environmental Aspects

This section is mainly dedicated to provide a reasonable exhibition of the ecological*, carbon footprints*, and recycling of the bottled water. Focusing on these factors can help one to rate the environmentally-friendliness of the bottles. Drinking tap water can be beneficial to the environment by reducing the emission of greenhouse gases and smaller ecological footprints. A study done in 2009 showed that the ecological and carbon footprints of tap water are approximately 300 times lower than that of bottled water. This research revealed that drinking about 1.5 L of tap water can prevent up to 260 CO_2 eq g of greenhouse gases to be released.[12]

Many people believe that the water bottles are environmentally-friendly and fully recyclable. However, the film, “Addicted to Plastic” shows otherwise. This video shows the steps of production to destruction of plastic and unveils that only a small percentage of water containers are recycled.[8] The un-recycled discarded bottles are either buried or burned.[13] Both methods are harmful for the environment. The bottles buried in the landfills remain there for a long time as plastic is not biodegradable*. This effect is aggravated if the plastic is not exposed to sunlight. Plastic buried in the landfills can penetrate into the groundwater and pollute it by releasing “phthalates and other toxic additives,” defeating the very reason of its existence, namely providing a “healthier and purer” water.[13]Burning plastic bottles releases toxic chemicals such as nitrogen, sulfur, and carbon dioxide into the air.[13] These pollutants are the primary chemicals associated with global warming* and climate change. Further producers of such pollutants are the production plants of bottles. The main components of plastic water bottles are

fossil fuels* which in turn, release substantial amount of carbon dioxide. [13] In addition, sulfur dioxide and nitrogen oxides generated in plastic bottle production play a significant role in the formation of acid rain*.[13]

According to the Container Recycling Institute (CRI), plastic-bottle waste has tripled since 1995. In its study, CRI declares that the rate of recycling of plastic bottles is now at half of the rate of 1995.[13] This reduction is due to the type of plastic used by bottle companies but use of recyclable plastic is expensive. For instance, in 1990, Coca-Cola and Pepsi decided to use 25% recycled material in their bottles, a promise on which both failed to deliver. Later Coke guaranteed to use 10% recycled content in its products, but in only 25% of their bottles. This fraction equates to 2.5%, or a fraction of the 25% they used in 1993, claims CRI.[13] Information of this kind is not represented to customers on regular basis. Instead, the logo much similar to the recycling logo is shown on every bottle. This logo which consists of three chasing arrows is provided by the Society of the Plastics Industry (SPI) as only a sorting measure and is completely independent from recycling. Due to its similarity to the recycling logo, this symbol is deceptive and often mistaken for an authentic recycling logo.[13] Despite their confusing logo, SPI refuses to remove it and continues to promote the sales of plastic bottles. All these claims are proven right when the SPI guidelines for manufacturers are looked into: “1. Make the code inconspicuous at the point of purchase so it does not influence the consumer’s purchase decision. 2. Do not make recycling claims in close proximity to the code”.[13]

2.2 Economic Aspects

Bottled waters are distilled*, filtered water packaged in plastic bottles. They are ready available to all the students all over the UBC campus and that is why an immense number of theses bottles are consumed annually [in UBC]. All bottled waters are generally packaged in Polyethylene terephthalate (PET)*, a derivative of crude oil. This commonly used polyester used in beverage containers, is a thermoplastic polymer resin of the polyester family. [17] This section provides an analysis on cost and usage of water bottles.

In order to obtain a better understanding of bottled water it is important to consider the economic aspects of this product and compare them with those of the WaterFillz to draw a conclusion of which one is the better choice on UBC campus. Between the years 2002 and 2007,

world consumption of bottled water increased by 7.6 % per year, and from 130.95 billion litres to 188.8 billion litres. As United States tops the list on this category by having an astonishing figure of 259.7 litres of water per person, Canada has a low ground in this category, as they only consume sixty litres per person as of 2005.[6] (See figure 1)

It is noted that in 2008 only three in ten Canadian citizens consumed bottled waters in Canada. This number is not quite the same amongst the university students in Canada, as only 25% of students consume bottled waters.[6] One of the major issues with bottled water is the plastic used so as to supply the water to the consumers. It is reported that a mind blowing 2.7 million tons of plastic are used annually in order to produce bottled waters in America. The price of tap water is about $0.0015/gallon in comparison with the price of bottled water which is around $10/gallon. These figures show that the price of bottled water is an astonishing ten thousand times of the price of tap water. Forty percent of bottled water is directly taken from tap water, which questions why many people still purchase bottled water. On a side note, around twenty two percent of bottled water tested contains chemical contaminants which are a risk to an individual's health.[9]

For the issues regarding wasted energy in the process of making bottled waters, it should also be mentioned that it takes about "three times the amount of water to produce the water as it does to actually fill it". However, by looking at this matter in a completely new perspective, we see that around seventeen million barrels of oil are used annually to produce bottled water in the United States, which could in fact fuel approximately one million cars. These two facts show that an enormous amount of energy is wasted by production of bottled water in North America. In general, bottled water is overpriced; in fact, they cost ten thousand times the price of tap water. Water bottles are an easier choice for UBC students; hence, they are still being purchased frequently all over campus and the numbers of these purchases are glooming daily.

Leading countries' consumption and compound annual growth rates (CAGR), 2002-2007				
		Millions of Litres		Compound Annual Growth Rates
2007 Rank	**Countries**	**2002**	**2007**	**2002/07**
1	United States	21,938.7	33,398.7	8.8%
2	Mexico	14,757.8	22,277.9	8.6%
3	China	8,094.7	18,123.8	17.5%
4	Brazil	9,621.8	13,707.4	7.3%
5	Italy	9,683.8	11,738.2	3.9%
6	Germany	8,674.3	10,384.1	3.7%
7	Indonesia	6,141.8	9,087.3	8.2%
8	France	8,424.8	8,642.9	0.5%
9	Thailand	4,833.9	5,803.4	3.7%
10	Spain	4,509.9	4,860.5	1.5%
	Top 10 Subtotal	96,682.1	138,024.4	7.4%
	All others	34,273.9	50,752.2	8.2%
	World Total	130,956	188,776.6	7.6%

Figure 1. Leading Countries in Compound Annual Growth Rates

Source: Beverage Marketing Corporation, 2008, <http://www.cbc.ca/news/background/consumers/bottled-water.html>

2.3 Social Aspects

Social aspects of water bottles can be investigated through different indicators such as human rights and well-being implications on the end user. This section mainly focuses on the health, consumer awareness, and regulations associated with water bottles. A study conducted at the University of Tuskegee in Alabama, focused on the quality of bottled water in terms of presence of toxic chemicals. In this research, 25 brands of bottled water were analyzed. The arsenic concentration in 11 samples of five bottled water brands - Aquafina, Crystal Springs, Dasani, Fountainhead, and Poland Springs – was rated higher than maximum safe limit of 10 micrograms per Liter for drinking water. It must be noted that exposure to arsenic in water can increase risks of skin, bladder, lung, liver, colon and kidney cancer.[13] In 2010, the data released by Statistics Canada showed that about 91% of Canadians have measurable levels of Bisphenol A (BPA) in their bodies.[5] BPA is a chemical used in plastic bottles and can leach into the water it contains. This toxic water can cause breast cancer in females, prostate cancer in males, and behavioral problems in children.[9] Statistics Canada also revealed that most of the people that showed BPA were between the ages of 12 to 19.[5] This means many people are exposed to cancer causing substances at an early age.

The International Bottled Water Association (IBWA), in the United States, upholds that the quality of bottled water is superior to that of tap water as it must comply with three regulation levels, namely, federal, state, and their own association's code of conduct.[13] Similar claims are made by their Canadian counterparts. The Canadian Bottled Water Association (CBWA) claims "bottled water is extensively and strictly regulated as a food product at the federal, provincial and association levels".[13] According to a food specialist at the Canadian Food Inspection Agency (CFIA), 125 bottling plants were inspected each year between 2002 and 2003.[13] This number corresponds to two-thirds of all bottling plants in Canada and denotes that all Canadian water bottling plants are inspected once every three years.[13] The number of inspections in the U.S. is even less impressive, with only one inspection "every five to six years" according to the Natural

Resource Defense Council (NRDC).[13] These figures indicate that the bottled water industry requires much more quality control.

It is important to point out that the marketing schemes used by the bottled water companies create public fear of tap water. Through different advertising campaigns and slogans such as Pepsi's Aquafina "So pure we promise nothing", bottled water companies manipulate the public to question the health and safety of tap water. These companies have associated their products to a trendy and fashionable lifestyle.[13] The irony is that Coke and Pepsi, two of the largest producers of dehydration-producing soft drinks, try to boost their market shares of the bottled water industry by "Get-Hydrated or Die" marketing slogans. It can be concluded that the bottled water industry benefits from an imaginary concept of purity and safety, a "perceived social value" which they have worked so hard to build. [13] Studies show that there is no evidence that bottled water is any healthier, safer or purer than tap water. In fact, it is the tap water that often outshines bottled water as it is subject to more inspections and follows stricter regulations.[13]

3.0 WATERFILLZ

3.1 Environmental Aspects

The use of WaterFillz units instead of water bottles helps lowering the carbon emissions and lightens the load at landfill sites in terms of wastes. WaterFillz filtration system is a known as a major step towards a greener planet.[4] The WaterFillz™ Kiosk uses the latest purification technology to remove undesired elements while leaving beneficial minerals and salts behind[4]. Furthermore, these units can run on solar power or 12W of electricity. This electricity is used to power the ultraviolet purification stage.[4] The demand of electricity of these units also lies within their water cooling system. When the custom designed refrigeration unit is running to cool the water to 38F, only 46w of power is required. On the other hand, the vending machines can suck over 1500W of power.[4]

The WaterFillz kiosk efficiently distributes portions of water to people. This even distribution prevents the unnecessary waste created by bottled water, which reduces the carbon

footprint that is created by the manufacturing, delivery, and waste disposal of plastic "PET" bottles.[4] The WaterFillz units maximize sustainability profile by using only 46 watts of electricity at peak. In comparison, the average pop machine draws as much as 1500w plus.[4] The WaterFillz are easy to use and maintain. For example, they do not have motors or breakable parts.[4]

In terms of maintenance of the WaterFillz, the consumable and replaceable parts are replace filters, UV bulb, and standard disinfection protocol of all tanks. These replacements take 30 to 60 minutes.[4] This short amount of time is advantageous over vending machines which take a while to not only refill but also to unload change and other associated tasks. The WaterFillz are also beneficial to the environment since their body is made of steel. This material can be recycled an unlimited number of times, causing the energy to be recovered back into the product. Moreover, Steel structures have low embodied energy levels and relatively longer life spans than some of the other materials.[2]

3.2 Economic Aspects

There are different purchase and maintenance pricings available for the big water-filtering systems collection on websites like Costco and Amazon (see figure 2). Some of these water filtering systems are reverse osmosis, two stage filtration system, and water dispensers. The only manufacturer of the WaterFillz units (same one the ones available at UBC Kelowna), is SafeStar (www.safestar.ca). Due to lack of price breakdown on the SafeStar website, the president of Safestar Company, Mr. Paul S. Wilson was contacted via a phone call. According to Mr.Wilson, each WaterFillz unit costs around $7500. The Sediment filtration* costs $20 and need to be replaced every 6 months. The Carbon block filtration is $122 and needs to be replaced every 6 months as well. The ultra-violet light bulb is $66 and is expected to work for 12.5 months. In addition, the maintenance and cleaning labours have to be considered every 6-12 months.

Although the WaterFillz may seem very expensive, it is important to note that these units installs quickly, easily, and takes up very little floor space. They offer unlimited supply of water without any coinage equipment, making them easy to maintain and simple for customers to use. [4]

The filtration used in WaterFillz, is exceptionally efficient and provides the healthiest water in comparison with other water-filtering systems such as reverse osmosis, two stage, and water dispensers. For instance, reverse osmosis system removes all the minerals in water. This method, unlike the WaterFillz, filters all the harmful minerals in addition to the ones beneficial to human health.[1] An excel sheet is included in our report which calculates all the costs (including installation, maintenance, and consumable filters) of each water-filtering method up to 5 years of purchasing time. Models selected to be compared to WaterFillz are: A) Watts premier filter pure 2 stage water filtration system.[7] B) Countertop Reverse Osmosis Units.[10] C) Polar Tri-temperature Stainless Steel Water Dispenser.[3]Note that each WaterFillz unit costs 9925.11$ in a 5 year span. These units are very expensive compared to the A, B, and C method. In September 2010, two WaterFillz units were installed in the current SUB. The total cost of a 5 year span of these units is predicted to be 19850.22 $.

Figure 2. WaterFillz Units

Source: SafeStar Products 2009, < http://www.waterfillz.com/water-purification-kiosk.php>

3.3 Social Aspects

In order to investigate the WaterFillz's social aspects factors like health and well-being, maintenance and budget, and social attributes are analysed. This section mainly focuses on health concerns, business partners, and social impacts.

The WaterFillz units use four major steps to supply clean, safe, and mineralized drinking water. Three of these steps are filtering steps. The units use the city water as their major source. This water travels around the city and enters the UBC WaterFillz with the possibility of contaminations from dislodges of the pipes. In order to eliminate these impurities, a filter called the Sediment Filter is installed as the first step filtration. This filter is almost as thin as a human hair and separates the minerals from the contaminants in the water. At this point, although contaminates are removed, some harmful elements such as manganese, copper, lead and mercury may escape the filter and remain in the water.[11] Such impurities can cause high blood pressure, renal insufficiency*, and even damages to the nervous system.[14] The WaterFillz use an Activated Charcoal Filter (ACF) to avoid presence of these impurities in the final product. The ACF also filters the chlorine added by the city for protection. The last filter is the Ultra-Violet Light filter (UVLF). This filter removes any micro-organisms missed in the previous steps and keeps the valuable salts and minerals.[4] It is important to note that the WaterFillz provide the UVLF as their final "insurance Policy" to gain customer's assurance.[4] The WaterFillz guarantee their costumers of healthy drinkable water that is "Green" to the environment.[4]

The ethical issues involved with WaterFillz mostly revolve around maintenance and advertisement. Every WaterFillz machine requires inspection and service once or twice a year. However, the filter examination should happen more often depending on the quality of the intake water.[4] The UVLF requires a light bulb change almost every year. Each bulb can last about 9000 hours depending on the quality of the bulb. The second stage of filtering, ACF, also requires maintenance each 6-12 months. This maintenance includes basic cleaning and chlorine bleach

flushes of the system. This fundamental cleaning does not require a lot of time and can be done in maximum an hour. In order to save budget and time, working with the same company all along from purchase to maintenance can be beneficial. The WaterFillz company guarantees their product and is helpful with filtration, cleaning, light bulb change, and other issues.

The WaterFillz allow the buyers to customize the exterior walls of the unit. There are always sponsors that welcome a chance to advertise in a major public place such UBC. Moreover, re-selling the WaterFillz space annually or semi-annually can enhance the earnings from these units.[4] Permitting different companies to advertise at UBC can help to build a budget for more WaterFillz units not only at the SUB but possibly around the UBC campus. A part of this budget can be used to encouraging students to use these units by providing them with free reusable water bottles, posting poster around the campus, and hosting related activities. In addition, the WaterFillz units can be used to support causes [i.e. cancer, children hospital, and etc.] by advertisements printed on their body. The money earned from these advertisements could also partly go towards either the mentioned causes. Another section of the budget could go towards maintaining student designed clubs, leading to more student involvement around UBC campus. The WaterFillz can create new jobs for students as someone needs to design these advertisements and blueprints to be printed on the units. The designs on the WaterFillz tend to grab the user's attention for at least 10 seconds.[4] While filling up their water bottles, the users habitually read what they see, which in this case could be the advertisements printed on the WaterFillz unit.[4] Using this myth, the WaterFillz units can potentially self promote themselves by having "green" images printed on them.

4.0 CONCLUSION AND RECOMMENDATIONS

Based on our research, obtained data and survey, it is evident that WaterFillz are a more sustainable, environmental friendly and a better choice for the UBC Student Union Building to use. Our survey's results show that only a merely 12% of students knew about the existence of WaterFillz at the SUB which should cause a huge concern for the UBC staff. By using many key facts regarding the negative aspects of bottled waters in our report, we tried to open the eyes of many consumers concerning this topic. Such facts include the astonishing price of bottled water, which are about 10,000 times the price of regular tap water. Also, it should be noted that nearly forty percent of all bottled water are tap water in a plastic container, which brings up a valid argument, as of why there are still many students purchasing bottled waters. One major answer to this question could be that many students are unaware of the truth behind bottled waters, and are also unaware of the existence of the WaterFillz units in the SUB. Moreover, by looking at the social aspects of this issue, the staff of UBC should try and raise the awareness of students of such product, so more students could get to use this great facility. Our survey showed that only 13% of the randomly chosen UBC students knew about the existence of WaterFillz units, which is a very low and disappointing figure. On the contrary, most of the students (82%) surveyed noted that after knowing about such units, they would start using it, instead of spending their money on bottled waters. All in all, based on all economic, social, and environmental aspects of this issue, it could be said that WaterFillz units are the better choice and more sustainable choice of facility for the students to use at the Student Union Building. However with that said, it is up to the UBC staff to raise the awareness of students regarding the existence of such units, and also up to the students to take advantage of this facility and help the environment and UBC in the long run.

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APPENDIX A: “Expenses of Different Water Filtration Systems For 5 Years o Ownership”

System A: two stage filtration	Initial Capital	Year 1	Year 2	Year 3	Year 4	Year 5
System Cost ($)	69.99					
Accessories: microbiological carbon block ($)	15.5	31	32.86	34.8316	36.92	39.1
Supplies/ Consumable filters (done every 6 months) ($)	9.95	19.9	21.094	22.3596	23.701	25.1
Maintenance- for installers' labour($)		39.9	42.294	44.8316	47.521	50.3
Installation labour ($)	100					
Total ($)	195.44	190.8	196.25	202.02	208.14	214.6
PV of $1 with annual investment rate of return at 6%	1	0.94339	0.8899	0.83961	0.792	0.747
PV ($)	195.44	85.35	85.66	85.66	85.4	85.6
Total PV ($)	**623.11**					

System B: Reverse Osmosis	Initial Capital	Year 1	Year 2	Year 3	Year 4	Year 5
System Cost ($)	197					
Accessories: membrane($)	55	110	116.6	123.596	131.0	138.9
Supplies/Consumable filters (done every 6 months) ($)	40	80	84.8	95.2812	100.9	107.0
Maintenance-for installers' labour ($)		39.9	42.294	44.8316	47.5	50.3
Installation labour ($)	100					
Total ($)	292	229.9	243.69	263.7	279.53	296.2
PV of $1 with annual investment rate of return at 6%	1	0.94339	0.8899	0.83961	0.7920	0.747
PV ($)	392	216.89	216.89	221.4	220.8	221.3
Total PV ($)	**1489.31**					

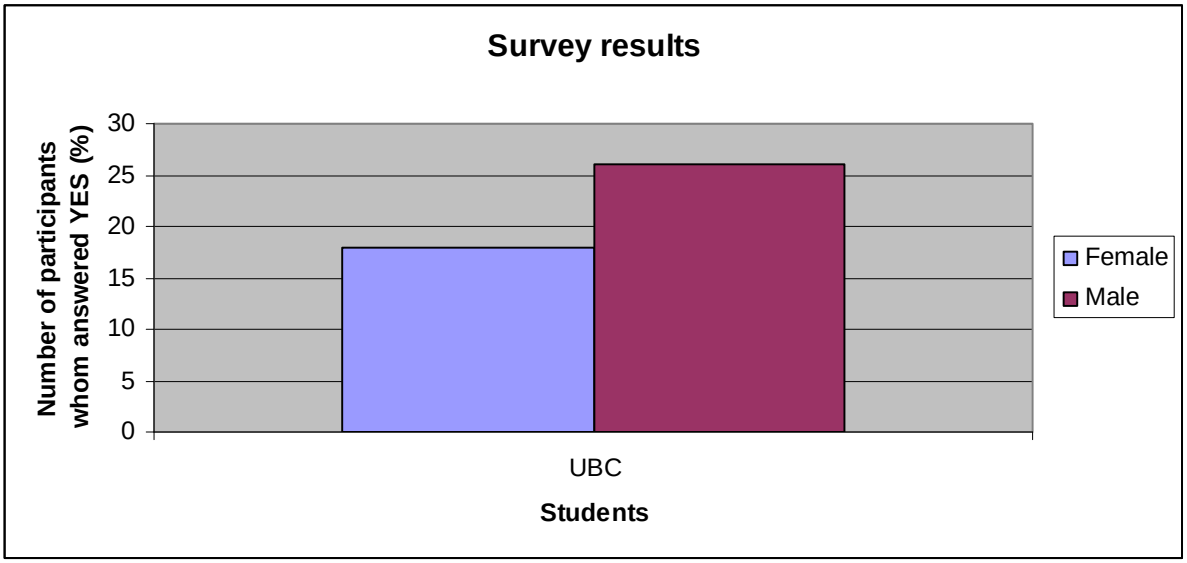
System C: Bottled Water Dispenser	Initial Capital	Year 1	Year 2	Year 3	Year 4	Year 5
System Cost ($)	199.99					
Accessories: plastic glasses ($)	4 (Daily-use)	1250	1325	1404.5	1488.7	1578
Suppliers/Consumable tank (weekly change) ($)	10	480	508.8	539.328	571.68	605.9
Maintenance-for installers' labour ($)		39.9	42.294	44.83	47.52	50.37
Installation labour ($)	100					
Total ($)	314	1770	1876.09	1988.66	2107.9	2234
PV of $1 with annual investment rate of return at 6%	1	0.943396	0.889996	0.83961	0.7920	0.747
PV ($)	314	1663.7	1669.7	1669.68	1665.3	1669
Total PV ($)	**8652.09**					

System D: WaterFillz Unit	Initial Capital	Year 1	Year 2	Year 3	Year 4	Year 5
System Cost ($)	7500					
Installation labour ($)	140					
Consumable(sediment/carbon block filter and UV bulb)	210	354	373.13	399.21	431.02	466.1
Maintenance, cleaning, and chlorine bleach flush		80	84.8	95.28	100.99	107.0
Total ($)	78.5	434	457.93	494.49	532.01	573.1
PV of $1 with annual investment rate of return at 6%	1	0.943396	0.8899	0.83961	0.7920936 6	0.747258 7
PV ($)	78.5	407.96	407.55	415.18	420.28	424.1
Total PV ($)	**9925.11**					

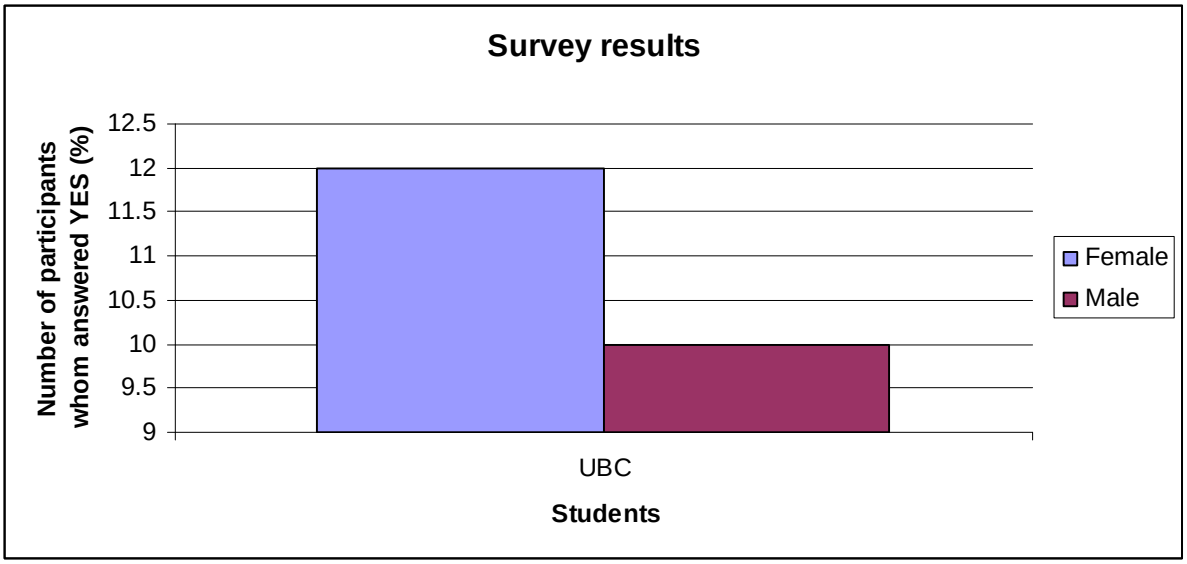
Note: Present value (PV) of a sum of money M payout at the end of year i discounted at a rate of r is equal to PV = M/(1+r)i

APPENDIX B: “Survey Results”

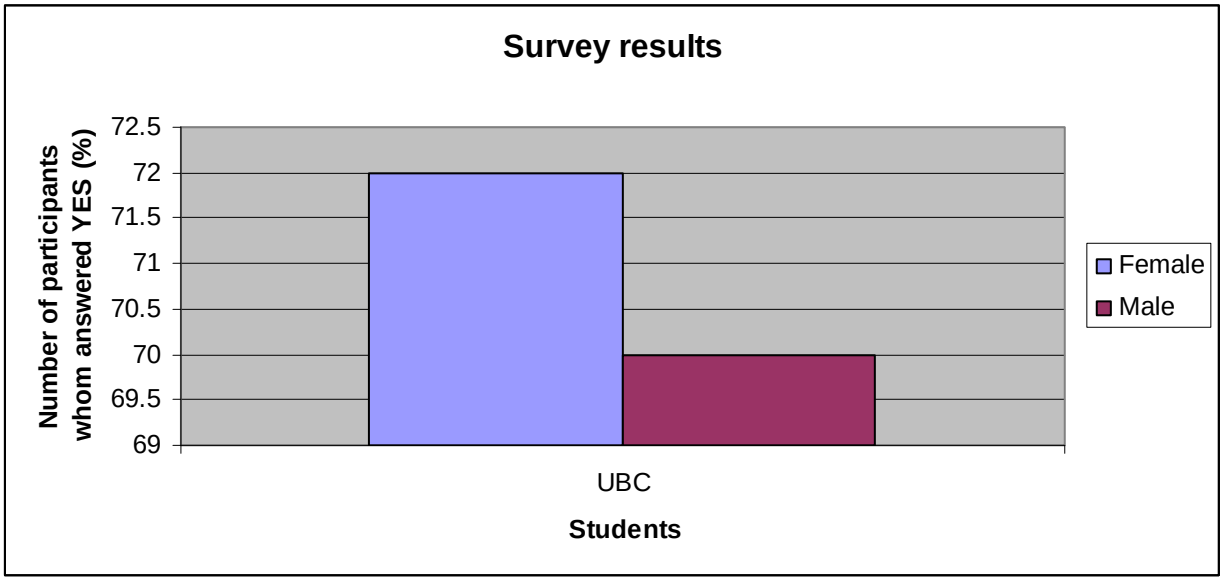
1)



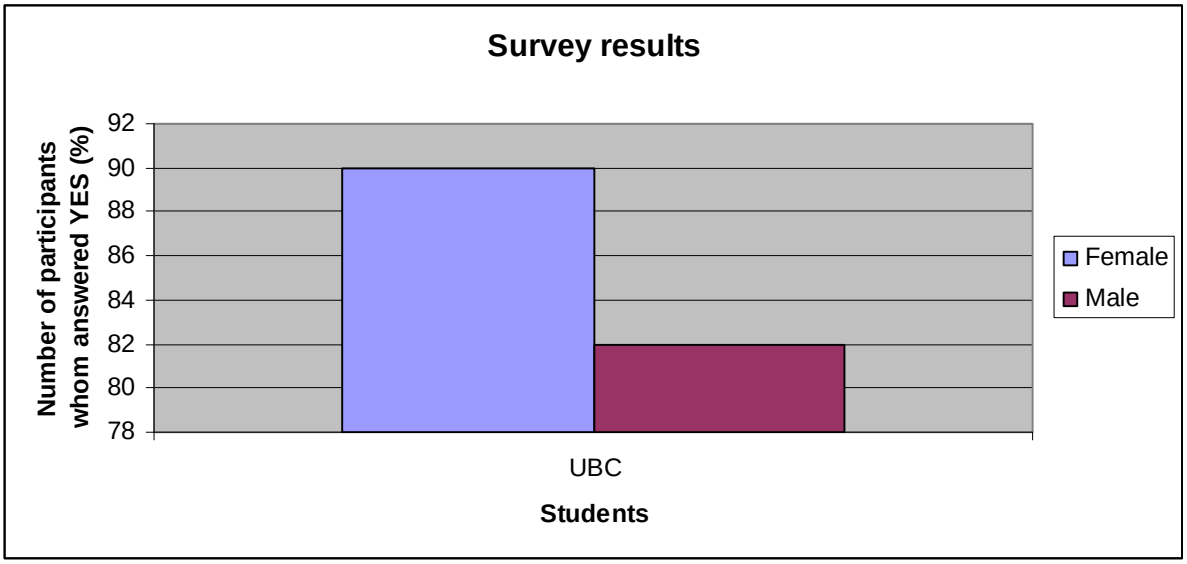
2)



3)


Survey results
Number of participants whom answered YES (%)
72.5
72
71.5
71
70.5
70
69.5
69
UBC
Students
Female
Male

4)


Survey results
Number of participants whom answered YES (%)
92
90
88
86
84
82
80
78
UBC
Students
Female
Male

5)

Criteria:

RECYCLING RANGE					
0	1	2	3	4	5
NEVER	RARELY	OCCASIONALLY	USUALLY	MOSTLY	ALWAYS

Results:

Male	Female
[3.4]	[3.6]

6)