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An Investigation into the Utensils to be used for the New Student Union Building for the Purpose of Sustainability

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Abstract

The new Student Union Building, set to open in 2014, will reflect students' claimed needs and wants. One such aspect claimed by every student in focus group testing was the want for a building that is sustainable and promotes itself as such. As a response to the students' wishes, the SUB Renewal Committee decided to make this building 'LEED Platinum+' certifiable. This means that every aspect of its conception, construction, and utilization has been deemed sustainable in the eyes of the Canadian LEED council. One such area, investigated in this report, is the purchasing of a sustainable utensil for use throughout the SUB's food court(s).

The constraint in place for this report is that a challenger-defender model is used to determine which utensil is best to use. The problem with this is that there are many, many plastic utensils available for purchase for use in the new SUB and one of the non-researched ones may have been both the most cost effective and sustainable. Another constraint is not being given the specific logistics of distribution and, as such, not being able to properly determine the overall energy analysis of the products' life cycle. Also, it is assumed primarily that the most sustainable utensil is biodegradable, disposable, and most of all affordable.

In order to achieve sustainability in the utensils used, one must overcome a few hurdles first. The product should originate from as local a location as possible. By doing so the overall energy spent in the product's life cycle, from creation to disposal, are decreased significantly. The utensil should also come from a process that sought to minimize its environmental footprint and as such, due care must be taken to properly choose the materials and methods used. Lastly, the utensil must reach its intended destination. In this case, the utensils must be thrown into the UBC recycling receptacles in order to be properly disposed of. These three points are the main problems facing the selection of an appropriately sustainable utensil and are addressed.

It was found, through analysis of manufacturing processes and a challenger-defender comparison of Aspenware's and BSI Biodegradable Solutions' utensils that the UBC should consider keeping its current business in BSI and should promote through much advertisement the proper disposal of all compostable materials in the new SUB.

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*All photos, figures, and tables were taken or created by the authors of this report unless otherwise noted in the captions.

List of Abbreviations

AMS – Alma Mater Society
APSC – Applied Science
BSI – Biodegradable Solutions International
CAD – Canadian Dollars
CO_2 – Carbon Dioxide
Kg - Kilogram
LEED – Leadership in Energy and Environmental Design
MJ – Megajoules
PET – Polyethylene Terephthalate
PLA – Polylactide Acid
PP – Polyproylene

rPET- Recycled Polyethylene Terephthalate
SUB – Student Union Building
UBC – University of British Columbia

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1.0. Introduction

In 1960's, a man named Kenneth R. Snider designed the currently standing UBC building. In 1968 it opened its doors to the students and contained "the AMS, a bank, a barbershop, a games room, a cafeteria, an auditorium, meeting rooms, club rooms, and a bowling alley..." (AMS_1, 2009) The designer took the needs and wants of the student body at that time to create a space that would serve them best. Thirty-eight years later the AMS formed the SUB Renewal Committee to assess the current needs and wants of the student body. The committee commissioned Cannon Design in February 2008 to prepare a summary of consultation. In this consultation, Cannon performed several studies with several focus groups and time and again the students declared that they wanted a place that, put succinctly, was 'sustainable' (AMS_2). The committee analyzed the report and determined, through cost analysis, that renovating the SUB to accommodate the needs of the student body would not be considered the most appropriate option. With the passing of a referendum in 2008, a 25 million dollar subsidy in the form of tuition increases will allow for a new SUB, the doors of which is projected to officially open to the student body in 2014 (AMS_3)**.**

Since the student body wanted a sustainable building with sustainable practices, the AMS has determined they will fulfill that want to the utmost by declaring that they will strive to achieve a Student Union Building with 'LEED Platinum+' certification (a strange thing considering 'Platinum' is determined by the Canadian LEED Council to be the highest). In order to attain the highest possible accreditation, the building must succeed at attaining 80 or higher points out of a possible 100. Worth 14 points, one of the categories is how the building procures, utilizes, stores, and disposes of materials and resources. With this in mind and in the spirit of taking into account student input, it was put forth by Doctor Carla Patterson in her Applied Science 261 course that her students would submit reports that researched sustainable aspects of the new SUB that fall under the aforementioned 14 point category. One such material suggested by Dr. Patterson is the cutlery and container utensils used in the food court (a.k.a. cafeteria).

It comes as no surprise that a sustainable product is one that, after being disposed, can still be utilized in one form or another. In the following cases, the utensils come from plant materials then, after its scope of utilization has been realized, become food for more plants to grow. By definition,

biodegradable plastics are “plastics that will decompose in natural aerobic (composting) and anaerobic (landfill) environments. Biodegradation of plastics can be achieved by enabling microorganisms in the environment to metabolize the molecular structure of plastic films to produce an inert humus-like material that is less harmful to the environment”. There are many aspects to take into account when considering a ‘sustainable’ utensil. Such aspects are manufacturing processes, life cycle analysis, product origin and shipment logistics, and of course, business practicality. When it comes to the stakeholders concerning these utensils, it boils down to the big four: Alma Mater Society (AMS) Food Services, UBC Food Services, UBC Waste Management, and the supplier for the biodegradable utensils. Breaking the big topic of these utensils into three sub-groups allows us to look at the same issue from different perspectives and provide some insight as to which utensil might be best. A defender-challenger approach is taken in this report.

2.0. Manufacturing Processes

Both biodegradable and non-biodegradable cutleries are manufactured by injection molding. Injection molding is a process in which thermo-polymer granules are heated to a highly viscous state and forced into a mold cavity under high pressure. The polymer is cooled in the mold and once removed, maintains the desired shape. Since cutlery is small, uniform, and required in massive numbers, multiple cavity molds are used resulting in hundreds of utensils to be produced in parallel during every production cycle. One production cycle ranges from 10 seconds to 1 minute depending on equipment, heating capabilities, and size/geometry of the part (Groover, 2007). Since the only manufacturing difference between bio and non bio-utensils is the type of polymer granule used, there is no mechanical or technical advantage in manufacturing one over the other.

Energy cost and carbon dioxide (CO_2) production involved in creating the aforementioned utensils are two properties that capture environmental impact and allow relative material comparisons. It should be noted that the values in Table 2.1 do not fully encapsulate the complete environmental impact since they do not take into account elements such as toxic chemical usage (for whatever unknown reasons), waste products, freshwater consumption, or worker health effects due to the different chemical composition of the granules used.

2.1. Conventional Plastic Synthesis

Polypropylene (PP) and polyethylene terephthalate (PET) are two common materials used to make disposable cutlery. Both PP and PET are synthesized by polymerization, a process in which many small molecules are joined together to form long chain-like molecules. Polymerization occurs when a chemical catalyst breaks the carbon double bond (the –ene in each chemical name denotes a carbon-carbon bonded twice to each other), resulting in a very reactive monomer that bonds to other carbons 'freed' in such a manner (Callister, 1999).

Estimates of energy cost of PP and PET production are 73 and 80.3 MJ/Kg, respectively. The units express the energy required to produce one kilogram of PLA and are based on fossil fuel energy inputs. The energy cost to produce PP and PET will decrease as economies of scale increase production efficiency. CO_2 emission estimates for PP production is 1.9 Kg CO_2 per Kg. Emissions for PET are 3.2 Kg CO_2 per Kg.

2.2. Biodegradable Plastic Synthesis

Polylactide acid (PLA) is the polymer commonly used to produce biodegradable utensils. PLA is certifiably biodegradable under the ASTM D6400-04 Standard Specification for Compostable Plastics, a document that standardizes the biodegradability of plastics. PLA is produced through ring-opening polymerization which occurs when a catalyst is reacted with lactide at elevated temperature. This reaction is shown in Figure 2.1 below (Wiki).

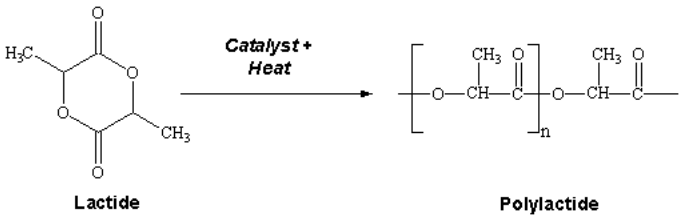

Figure 2-1: Chemical Formula for Creating Polylactide (Wiki)

Estimates of energy cost of PLA production from two different sources are 44 – 56.7 MJ/Kg (Vink, 2003)(Bohlmann, 2001). The units express the energy required to produce one kilogram of PLA and are based on fossil fuel energy inputs. The energy cost to produce PLA will decrease as economies of scale increase production efficiency. CO_2 emission estimates for PLA production is 1.3 Kg CO_2 per Kg (Vink et al., 2007).

Table 2.1: Energy Cost and CO_2 Emission

Polymer	Energy Cost [KJ/Kg]	Carbon Dioxide Emission Kg CO2 / Kg
PLA	42.2	1.3
PET	80.3	3.2
PP	73	1.9

2.3. Life Cycle Analysis

In January of 2009, NatureWorks commissioned a life cycle analysis to the Institut Fur Energie und Umweltforschung (IFEU). The full report is available from the NatureWorks web site at natureworks.com. The analysis was aimed to quantify the differences in environmental impact between PLA, PET and recycled PET (rPET). The report investigated clam shell food containers over the entire life of the product. Although the report is not specific to cutlery, its relevance enables a very interesting look at the environmental impacts of bio and non-bio cutlery. A few important points illustrate the ability to extend the IFEU results to that of all utensils. First, the report was based on food containers and thus is subject to the same food and health standards. Secondly, PLA and PET are both materials that are commonly used to manufacture cutlery. Finally, clam shell food containers and utensils go through very similar manufacturing processes.

The IFEU findings for a US framework are summarized in the following statement. Note that IngeoTM is the trade name of the PLA produced by NatureWorks.

> "In many scenarios clamshells made from IngeoTM show lower potential environmental impacts than clamshells made from either PET or rPET for the indicators

fossil resources, climate change, summer smog, human toxicity: carcinogenic risk, non renewable and total primary energy. On the other hand, PET (and rPET), has a better score for *use of: farmland, terrestrial and aquatic eutrophication, renewable energy,* and often a better score for *acidification*. In order to define the final preference for one or the other clamshell depends on the individual value judgment applied to these indicators (IFEU, 27)."

3.0. Current Situation

The Student Union Building is currently divided into two primary food providers that manage product delivery at the food courts. The two divisions are the UBC Food Services and the AMS Food Services. Each shares the same goal of providing great quality food products as well as keeping with the current cultural trend of practicing sustainability wherever possible. In furthering those goals, the SUB underwent a major change to thicker, more reliable biodegradable clamshell containers. The biggest reason for the switch to this more robust utensil is that it is still is 100% recyclable and the new version has greater heat resistance than the older one. The figures below illustrate the old clamshell utensil along with two new 100% recyclable clamshells used throughout the SUB.

Figure 3-1: Clamshell The Moon is using now.

Figure 3-2: Clamshell The Moon used in 2007-08.

Figure 3-3: The biodegradable container used in Honor Roll

Although most food suppliers already use the new biodegradable containers, there are a number of restaurants in the SUB which have not or cannot convert. A&W and Subway are two examples of shops which cannot convert because they sign contracts with their franchise to use brand-certified utensils, napkins, etc. Pendulum is a cafeteria-type restaurant which is located on the first floor of the SUB. The Pendulum uses real plates and forks which are made of ceramic materials. The Little Tea House, which is located in the basement of the SUB, is an independent store which is neither under UBC or AMS Food Services guidelines and therefore have no control over what types of utensils are used in that store.

3.1. Current Provider

The recent change of the biodegradable utensils brings peoples' attention to where the so-called bio-utensils come from. AMS Food Services actually buys the utensils from BSI Biodegradable Solutions. This company "[supplies] 100% biodegradable and compostable food service ware, food packaging, and flatware products that perform as well or better than conventional petroleum based versions" (BSIBS, 2009). However, the biodegradable products from BSI are actually manufactured by another company, Besics.

Besics is a company which focuses on designing biodegradable products. Their products include biodegradable plates, clamshells, cutlery, straws, cup sleeves, and sandwich paper (Besics, 2009). Both Besics and BSI Biodegradable Solutions are Vancouver based and in good relations with each other. The products designs for all their products consist of primarily cornstarch.

3.2. Disposal

All biodegradable utensils deposited into the compost bins are transferred to the waste management department in UBC. The utensils are broken down and decomposed into the soil which takes approximately three weeks. This amalgam is then reused for gardens in UBC. In general, the cycle of the biodegradable utensils is simplified as below:

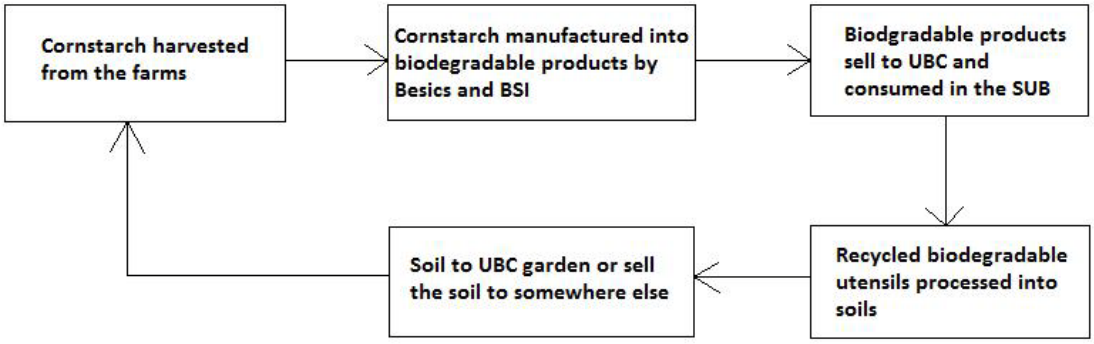

Figure 3-4: Typical lifecycle of an utensil at UBC.

3.3. The Dilemma

Even though Besics and BSI Biodegradable Solutions exist as a Vancouver based company, they are still only designers and distributors, respectively. Their products are actually sourced from Oregon, United States. Furthermore, their products are actually manufactured in China. On a wide scope, the purpose of choosing biodegradable, 100% recyclable plastic wares in the first place is to have less harmful environmental impacts. However, having the products sourced and manufactured from other parts of the globe creates carbon footprints as transportation is needed in the form of transcontinental oceanic container vessels. It is understandable that BSI would need to lower their cost to minimize the already higher prices compared to traditional non-biodegradable plastic wares. However, it is important for one to factor in the transportation aspect into the overall sustainability equation before making a conclusion.

One of the biggest concerns about the recycling of biodegradable products is the sorting problem. According to research from AMS Food Services, only approximately 10% of the biodegradable containers are thrown into the compost bins every year. The biggest reason of why the degradable utensils are not thrown into the compost bin is that students do not have adequate understanding on the importance of recycling. If these utensils are not properly disposed of the entire situation of deciding which utensil is more sustainable is rendered moot.

On a smaller note, it was stated by Nancy Toogood during her lecture in the Applied Science 261 course that the UBC composter has a difficult time processing the aforementioned cutlery. The cornstarch based material that the cutlery is composed of is, in fact, completely and readily composted into soil. The concern arises when considering the length of time the cutlery takes to compost due to its thickness.

3.4. Aspenware

One possible alternative to cornstarch bio-utensils comes from a company located in Vancouver, Canada. They specialize in environmentally friendly biodegradable cutleries as well. Unlike BSI, however, their products are made from Birch and Aspen trees. They have chosen such materials since

"wood is renewable, recyclable, and biodegradable, making it the material of choice for people today and for the future generations." Furthermore, Aspenware tries to "optimize the use of [their] wood and [they] will be developing products to make from surplus or excess materials. [Their] plant runs on hydro-electric power and [their] manufacturing process emits minimal, if any, carbon". Lastly, their products are locally manufactured, locally sourced, and locally distributed. This obviously minimizes the environmental issues of carbon footprints generated by the transport of the product.

4.0. Cost Analysis

Many aspects of the product must be taken into account before a conclusion can be reached about whether to stay with the current utensils or to switch to new ones. The most important aspect, one could argue, is the bottom line problem of cost. In a for-profit business money is still the final goal and a line has to be drawn somewhere when taking into account expense vs. ecological non-impact.

Since the SUB is the centre for food distribution, the number of biodegradable containers needed is enormous. In 2008, the number of biodegradable utensils used by AMS Food Services is approximately 355 cases, or 44,375 containers. The Moon, in the SUB's basement, consumes 147 cases or 18,375 containers and is actually the biggest biodegradable utensils consumer in the AMS. The upgraded, more heat resistant material is also 100% more expensive than the older, less robust containers. Fortunately, the extra money paid for this upgrade comes purely out of the AMS Food Services profit instead of UBC student's tuition or increased food prices.

For in-depth analysis and comparison, the typical fork is chosen due to its commonness

4.1. BSI Biodegradable Solutions

As a random walk-in customer, BSI retails their box of 24 forks (as seen with its cutlery counterparts in Figure 3.1 below) for $5 CAD. That works out to be around $0.21 CAD per fork. Small quantities are chosen here simply for the ease of comparison later on. Of course, the price does not scale linearly when one buys, for example, 1000 forks. BSI offers special prices to certain businesses and

organizations when they purchase mass quantities of product. As their company slogan suggests, "[at] BSI, we think it is important that biodegradable products work no only for the environment, but for your business [as well]". In other words, UBC is currently paying much less than the quoted price above. The exact price at this time remains unknown.

Figure 4-1: BSI plastic cutlery.

4.2. Aspenware

The walk-in price for a box of 24 forks is $8 CAD. This equates to around $0.33 CAD per fork, which is 36% more expensive than BSI. If one requires a combination of a fork and a knife for a meal that costs $5 CAD, the utensils themselves add up to be $0.66 CAD, or roughly 13% of the meal. If UBC were to use these, then the AMS would either have to subsidize the cost within their food products with the end result being higher food prices or tuition increases for everyone, or have the utensils as a separate cost. Either way, such high prices would be a burden for both the consumer and the AMS. Again, note that when mass quantities are purchased, they will most likely offer special prices. Small portions are compared simply for ease of comparison. Even at mass quantities the price difference, in percentage profit margins, between BSI and Aspenware should remain relatively constant to the walk-in price percentage differences given above (Aspenware, 2009)

Figure 4-2: A fork from Aspenware website

5.0. Conclusion

Some businesses want to maximize their revenue only, others would not mind losing some profit in contributing to the global issue of sustainability. Different business models have different means in balancing between the two sides of the scale. The comparison above between BSI and Aspenware showcased this concept nicely. One way or the other, the bottom line is that no business exists to lose money. It is one thing to produce products as a mean of biodegradable solution to the billions of plastic knives, forks, and spoons that end up in landfill every year, but making the solution work for the customer is another story. For this reason, continuing the business with BSI should be a better balance in contributing to the sustainability issue without incurring major costs to the AMS Food Services. Unfortunately, the problem still remains that the current business dynamic of AMS and UBC Food Services and various independent stakeholders all having a say in what happens in their particular shops confuses or aggravates the problem.

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The LEED platinum accreditation is very strict in that accommodations must be made to become sustainable and non-recyclable, non-biodegradable, non-renewable materials have no place in the scheme of things, even if they are cheaper. As such, in order to combat these issues, there should be a consolidation of food service organizations with the purpose of implementing standard purchasing practices in all eateries located in the new SUB with the only exception being given to independent stakeholders that satisfy all LEED platinum standards.

In order to eliminate the problem of decreased awareness of recycling practices expected of the students, ads should be placed in the Ubyssey school newspaper as well as ads placed throughout the food court. Illustrative and descriptive advertisements are the only way to spread knowledge to the students about what they can do to help maintain sustainability during their tenure as students and/or residents at UBC.

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Appendix A: Conversation with Nancy Toogood

Anthony: Which companies are involved in the biodegradable utensils the SUB is now using?

Nancy: We buy the utensils from BSI. But Besics is the actual company that manufactures the utensils.

Anthony: Do you know what the biodegradable utensils used in the SUB are made of?

Nancy: Cornstarch.

Anthony: Why would the SUB use biodegradable utensils instead of other alternatives? How about real plates?

Nancy: We weren't able to come up another solution that is better than biodegradable utensils. For the reason of not using the real plates is because people will take the plates away.

Anthony: How will the biodegradable utensils be recycled?

Nancy: The utensils will be sent to the waste management of the SUB. They will break down, process and decompose the biodegradable utensils into soil. The soils will eventually go into the gardens in UBC. However, only 10% of the biodegradable utensils are actually thrown into the compost bins in the SUB. The rest are actually thrown into the normal garbage bin. This really causes problem on recycling the utensils.

Anthony: As I noticed from last year that the AMS Food Services switched the types of biodegradable utensils. Why is that?

Nancy: The reason why we switched the utensils is because the upgraded utensils have greater heat resistance. In fact, the upgraded utensils are actually 100% more expensive than the old utensils. That means for a little utensil that costs 2 cents before is now cost 4 cents.

Anthony: Where are the extra money coming from? Does the AMS Food Services put any burdens on students' tuitions?

Nancy: No. We simply make less profit. That's it.

Anthony: How many biodegradable utensils AMS Food Services were actually used last year?

Nancy: The Moon actually used the most utensils last year. According to the research from last year, we found out that Moon used 147 cases, which are 147 x 125 = 18,375. For AMS in general, we used 355 cases last year, which are 44,375 utensils.

Anthony: I noticed that some places in the SUB is still not using the biodegradable utensils. Why is that?

Nancy: There are some restaurants in SUB that are actually managed by the UBC Food Services instead of AMS. Therefore we have no control over these kinds of restaurants. However, for restaurants like A&W and Subway, I think they signed a franchise contract which requires them to use the same kind of utensils on every store in Vancouver. Honor Roll is actually using biodegradable plastics, which is also 100% recyclable. πr2 is now using 100% recyclable paper plates. Pendulum is a cafeteria type restaurant so they use real plates instead.

Anthony: How about the Little Tea House in the basement?

Nancy: Little Tea House is actually independent from the UBC and AMS Food Services.

Anthony: As only 10% of the utensils go into the compost bins, are there any effective ways that can enhance the results?

Nancy: Education. This is the most efficient way to make people understand the importance of recycling. And we are now depending on you to promote the idea of sustainability through your report.

Anthony: May I take these conversions as a reference to our report?

Nancy: Sure. Definitely.