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An Investigation into the Sustainability of Paper Towels vs. the Dyson Airblade

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ABSTRACT

Paper Towels VS the Dyson Airblade hand-dryer in the new UBC SUB

UBC is a leader in sustainability. With the new Student Union Building (SUB) being designed, the university is aiming for the LEED Platinum+ award, which is the highest level of sustainability criteria achievable. One aspect of the new SUB's design is to implement the most sustainable hand drying device in washrooms, either the continued use of recycled paper towels or the introduction of Hand-dryers. The dryer assessed in the report was the Dyson Airblade, one of the best available. In evaluating both options, the triple-bottom-line assessment, which included the environmental, economical and social values, was used as the main methodology for analysis. Primary and secondary research was carried out in all three impacts to effectively determine the more sustainable of the two. Secondary research involved gathering information from previous scientific reports such as studies that compared paper towels with warm-air hand-dryers. Although not specifically directed at the report, it provided the fundamentals for analysis. Primary research involved the creation of a short survey to capture the overall opinion of students regarding these two products. Moreover, primary research aided calculations to be carried out on the carbon footprint, cost and energy consumption, thus, providing detailed scientific comparisons. The study assumed that the systems were used 300 times a day for 15 years.

Through the research, it was found that the Dyson Airblade hand-dryer was a better option in terms of both environmental and economical impacts. The hand-dryers were found to be around 46 times more carbon efficient than the paper towels, reducing the carbon footprint by 9754kg for the lifetime of the systems. The paper towels were also found to cost 10.6 times more than the Dyson Airblade, through 15 years of use. However, the survey revealed that a majority of the participants preferred the option of using paper towels over hand-dryers. Of the participants, 61% chose paper towels as the preferred option since they felt that hand-dryers were not time efficient. After carefully analyzing the three areas of impact in the triple-bottom-line assessment, the conclusion strongly indicated that hand-dryers would be the more sustainable option. Although some results implied that the hand-dryers may take time to be accepted socially, the environmental and economic benefits outweigh this issue. It was recommended that the Dyson Airblade be implemented in washrooms located in the new SUB.

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GLOSSARY

Anti-microbial additives	Chemical added to plastics to prevent the growth of mold and bacteria.
Downcycle	The process in which new products is made from recycling old material. However, the product created is of lower grade than the product it was made with.
EPDM	Ethylene Propylene Diene. A synthetic rubber that is widely used in everyday objects. Major properties are: heat, electrical and oxidation resistivity as well as weather aging.
Greenhouse gas	Gases which are trapped within the atmosphere where solar radiation is absorbed and released to the environment; this correlates to an increase in climatic temperature
HEPA	High Efficiency Particulate Air. Filters that remove 99.7% of particles present in air that are 0.3 micrometers in diameter.
NR	Nitrile Rubber. A synthetic rubber that is used in disposable items such as examination gloves. Major properties: oil, fuel and chemical resistivity.
NSF Protocol P335	The criteria for a hygienic hand dryer include: • Air filtration – Dust and bacteria must be removed from the air used to dry hands. • Unheated air – The air used shouldn't be heated up. Warming moist bacteria can increase their reproduction rate. Warm or hot air can remove beneficial oils from the skin. • Drying time – Hands must be dried in 15 seconds or under. Damp hands pick up and transfer up to 1,000 times more bacteria than dry hands. • Touch-free operation – The hand dryer must start and stop automatically.
Polycarbonate-ABS (PC-ABS)	A type of thermoplastic used in industry known for resistance to high temperatures and strength.
Virgin paper	Paper which are made with pulp from harvested trees which have not been prior recycled

1.0INTRODUCTION

As the University of British Columbia (UBC) prepares to build the new AMS Student Union Building (SUB), questions regarding design and implementation must be addressed in order for project goals to be met. UBC strives to create a learning environment that fosters a sustainable society and thus attempts to reflect this through their buildings. The new SUB building aims to achieve the LEEDS Platinum+ award, the highest Green Building rating in North America; therefore, sustainable design must be carefully analyzed. One aspect that needs to be looked at is the current use of paper towels in washrooms. The question as to whether alternate drying methods are more sustainable needs to be tackled, and thus, the use of hand-dryers is studied. Hence, a triple-bottom-line assessment composed of environmental, economical and social impacts should be carried out in order to effectively determine the more sustainable of the two. The hand dryer compared in this report is the Dyson Airblade which uses 400mph winds to scrape the water of hands instead of evaporation. The aim of this report is to recommend the better option to the SUB design team for implementation in the new SUB.

2.0 ENVIRONMENTAL

In order to effectively determine the environmental impacts of both the Dyson Airblade Hand-dryer and paper dispensers, we have to look at the life cycle of the product; from their creation to their disposal (see figure.1 and figure.2). This will aid in the assessments of their energy consumptions, embodied greenhouse gases and their ecological footprints. Due to difficulties in obtaining information through primary research, the use of previous scientific analyses will be used to assess the majority of environmental impacts. Most hand-dryers used in these analysis reports refer to hot air hand-dryers, thus, will slightly differ from the Dyson Airblade Hand-dryer. The major difference is in the day-to-day energy consumption of the dryers; however, this can be remedied through a few calculations and information from the product specifications. The environmental impacts of the paper towel dispensers will also be explored and assessed

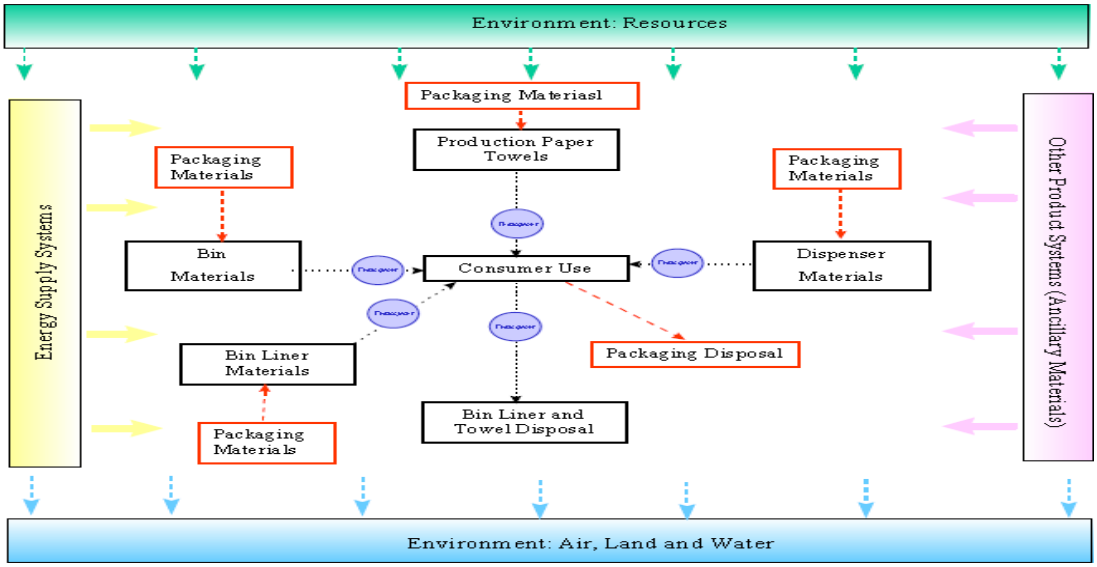

Figure 1. Paper Towel Life Cycle (Aumonier, 2001)

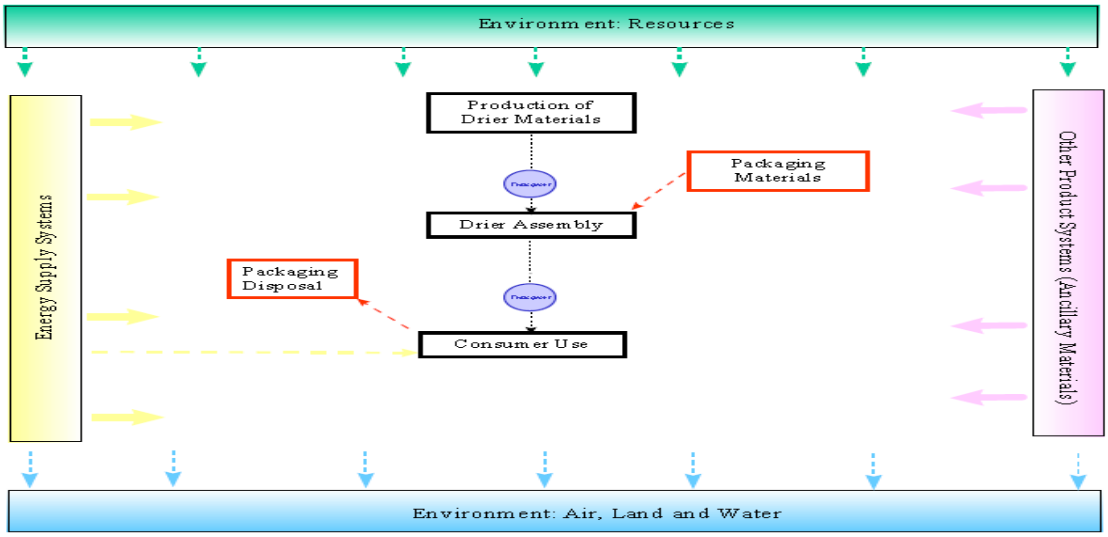

Figure 2. Hand-Dryer Life Cycle (Aumonier, 2001)

2.1 CREATION

The resources required are often forgotten when discussing sustainability. The creation of both the hand-dryer and paper towel systems require materials and energy. The origin of these materials and the type of energy used (such as hydro-electric or coal burning), play an important part in assessing sustainability.

2.1.0 Creation of Paper Towels

To reduce the amount of solid waste produced at the manufacturing level in paper mills, manufacturers recycle used paper products and reprocess their fibres. In 2008, City of Vancouver was able to recycle more than 130 tonnes of mixed paper products, which otherwise would have been disposed of at the landfill (City of Vancouver, 2008). This process further increases the life cycle of a paper product and reduces the amount of harvested trees needed to make them. A U.S. study claimed that recycling one ton of paper would save 17 mature trees from being logged, 26000 litres of water from being used, as well as avoiding 2.5 cubic metres of landfill waste (U.S. Environmental Protection Agency, 2008).

Additionally, reducing the amount of paper products decomposing at landfills will reduce the production of **greenhouse gases**. Greenhouse gases, such as methane, play an important role in climate change as they trap solar radiation within the atmosphere and cause an increase in temperature. Assuming 600 sheets of paper towels are used every day, greenhouses gases can be reduced by 47 percent and solid waste by 50 percent when made with 80 percent or more of postconsumer paper than its **virgin paper** counterpart (Environmental Defense Fund, 2007).

2.1.1 Creation of Dyson Airblade

Research carried out by AirDri Ltd. has listed a set of materials typically found in a hand-dryer (see table.1). However, the standard materials used to manufacture the Dyson Airblade are a combination of plastics, rubbers and metals (see table.2). Studies have shown that the effect on the environment due to manufactured materials is relatively small compared to the energy consumption (see figure.3). In this case, the period is 15 years of electricity utilization, which outweighs the potential of other processes by 98%. Even though the manufacturing process does not play a major role in the overall greenhouse gas emission, it is still worth mentioning some information. The Dyson Airblade's outer casing is made from a tough, heat resistant **polycarbonate-ABS (PC-ABS)** which produces over 50% less CO2 emissions during production than its regular aluminum counterpart (Dyson, 2009).

Manufactured materials are more important in the disposal phase of the product due to recycling of certain parts becoming an issue.

Table 1. Materials In An Average Hand-Dryer (Aumonier, 2001)

Drier (includes Packaging) Materials	Weight (g)
Galvanised Steel	1900
Steel	1125
Al (Recycled)	843
Al	843
Zinc	484
Card	444
Copper	231
wood	190
Nylon	103
Ceramic	91
Polyethylene	54
PBT	40
Other materials	82
Total	6430

Table 2. Materials In Dyson Airblade (Dyson, 2009)

Manufactured materials
Plastic: ABS, PC/ABS, PC, PP (+ PPGF and PPTF), PET-TS
Thermoset (BMC/DMC), PEEK
Rubber: EPDM, SBR, NR (Nitrile Rubber)
Metal: Stainless steel, galvanized steel, zinc diecast alloy brass

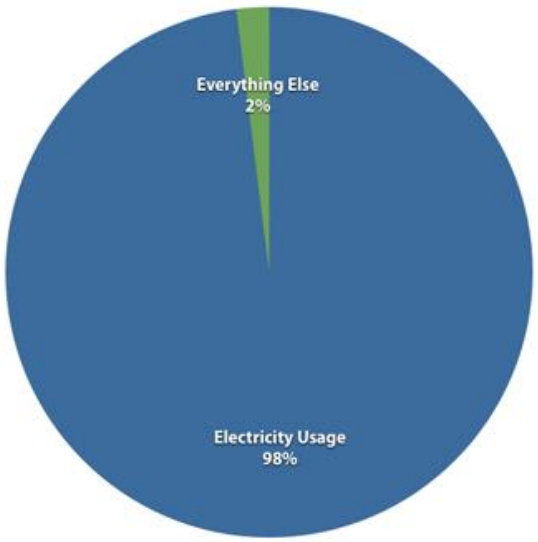

Figure.3 Global Warming Poterntial from Electric Hand-Dryers (Skoczen, 2009)

2.2 CONSUMPTION

The energy consumption required during the use of the systems is the most direct and visible part during the sustainability assessment. The life cycle of a system is assumed to be 15 years, and the research was performed according to this specification. The greenhouse gas emissions due to use and transportation will be discussed below.

2.2.0 Consumption of Paper Towels

Recycled paper towels are consumed and eventually depleted once placed in a dispenser. Therefore, the requirement of purchasing more recycled paper towels once the inventory is low is imminent. Although the need for trees may not be required when producing recycled paper, other resources such as energy and water are still essential during the production of any paper product. Once the recycled paper towels are made, they require a vehicle to transport them to the customer. This is usually done by large semi-trailer trucks. Larger trucks are assumed to be used as it yields a greater efficiency for transporting products than smaller vehicles that may be used in practice. In theory, trucks will be fully loaded when transporting goods. However, in reality, trucks may not carry as much load per delivery as theoretically implied. Also, as the demand for paper towels increase, the amount of trucks on the road increases as well. A typical semi-trailer truck emits 3.6kg of carbon dioxide, 36g of nitrogen oxide, and 0.13g of sulphur every 100km (Volvo Truck Company, 2008). With additional vehicles travelling on the roads due to an increase in demand for paper towels, the amount of total emission released to the environment increases proportionally.

2.2.1 Consumption of Dyson Airblade

Looking at the life cycle of dryers, transportation is required to deliver the product from manufacturer to consumer (see figure.1). Many retail providers such as AirEfficient.com ensure that the Dyson Airblade is transported and accredited with TerraPass, an organization that takes care of the carbon offset for the product (free of charge), for a 5 year period. The Dyson Airblade is required to be transported to the consumer only once over the lifetime of the product. Because of this one time transportation, the emissions due to it are neglected. Hence, the overall contribution to greenhouse gas emissions can be effectively approximated solely by the electricity consumption of the hand-dryer. Therefore, calculations regarding energy consumption and the resulting production of CO2 can be carried out. A few assumptions have to be made in order to proceed with the calculations. It is assumed that the average usage of a dryer is 300 times per day, irrelevant to the time of year. Furthermore, it is

assumed that rates and costs are constant for the lifetime of the hand-dryer, and that the hand-dryer has a lifespan of 15 years. The data used is taken from the technical specifications of the Dyson Airblade hand-dryer and BC hydro.

$$\textit{The Dyson Airblade consumes } 0.00467kWh \textit{ per operation.}$$

$$\textit{Average mass of } CO2 \textit{ produced per } kwH = 28\frac{g}{kWh}$$

$$0.00467kWh \times 300 \textit{ uses per day} = 1.401kWh \textit{ per day}$$

$$1.401kWh \textit{ per day} \times 365 \textit{ days} = 511.365kWh \textit{ per year}$$

$$511.365kWh \textit{ per year} \times 15 \textit{ years} = 7670.475kWh \textit{ for the lifetime}$$

$$7670.475kWh \textit{ for lifetime} \times 28\frac{g}{kWh} \textit{ of } CO2 = \mathbf{214.77\ kg\ of\ CO2\ for\ its\ life\ time}$$

Warm air hand-dryer (World dryer - Air Max DXM5): 826.82 Kg of CO2 for its life time

Compared to an average warm air dryer, the Dyson Airblade reduces the carbon footprint by 612.12 kg of CO2 for the 15 years of use.

2.3 DISPOSAL

The disposal of a product does not end its effect on sustainability. The waste it produces will stay forever as many parts are not decomposable. Recycling is an option at times, but there are more times when the product cannot be recycled due to problems, such as physical or chemical limitations. The disposal of both the options will be analyzed and the findings will be discussed below.

2.3.0 Disposal of Paper Towels

Due to the nature of the recycling process on paper products, paper towels cannot be recycled any further after several cycles. Paper products can be recycled approximately five times because the fibre strands become weaker and shorter, and can no longer be used. It should also be noted that paper products produced from recycled post-consumer papers can only be **downcycled** to lower grade products (U.S. Environmental Protection Agency, 2008). Paper towels are usually made with the lowest grade of recycled paper fibres which cannot be reused. In the current Student Union Building, all used paper towels are thrown into the garbage bin to be disposed of at the landfill. This leads to many environmental problems such as soil contamination and generation of methane into the atmosphere, becoming a potent greenhouse gas.

2.3.1 Disposal of Dyson Airblade

After 15 years of use, the Dyson Airblade will be disassembled down to its components and will be disposed off accordingly. The essential manufactured materials are plastics, rubbers and metals (see table.2). The steel and zinc brass alloy are easily recyclable at any recycling organization. Most of the plastics and rubbers are readily recyclable as well, but the **EPDMs** and **NRs** require intensive chemicals. Please refer to Appendix B for a list of the readily recyclable plastics. As in most electronics, the wires and motor can be reused for other purposes after the lifetime of the hand-dryer. Overall, the Dyson Airblade has been manufactured with materials that can be reused again to ensure little waste is produced. One company that recycles appliances in Vancouver is Happy Stan's Recycling Services Ltd. They ensure that the product is handled properly, making use of all recyclable materials.

3.0 ECONOMIC

Economic feasibility is often a major obstacle for sustainability. Cost is an important issue and may be a deciding factor in an assessment. Research in the costs for both options was performed and the results will be discussed below.

3.1 Economical Impact of Paper Towels

The initial cost of implementing a paper towel dispenser system has many factors that need to be considered. It is assumed that each order of the paper dispenser system includes one paper towel dispenser; one carton of recycled paper towels; each carton contains 12 rolls of paper towels; each roll has 350 sheets and one garbage bin. The cost of one system, including shipping charge, would be approximately $260 (Uline Shipping Supplies, 2009). If we assume that at least two dispenser systems will be made available per washroom and each level of the building has both a male and female washroom, then the new Student Union Building, with its five storey high design, will cost a minimum of $5200 to implement the paper dispenser system. However, the rest of the calculations will be based on one dispenser.

Operating costs for paper towels can be quite costly as the number of uses increase. Although paper towel dispensers do not consume any electricity, with the exception of those equipped with motion sensors and motors, they require a constant purchase of paper towels. Assume 300 individuals visit the washrooms each day and each person uses 2 sheets of paper towels per visit. The washrooms would require 600 sheets of paper towels per day. With the price of recycled paper towels at approximately $32 per carton, it would cost $0.015 a person per visit (Uline Shipping Supplies, 2009). In 15 years, the operating costs of the paper towel dispenser will be approximately $24500.

Unlike the hand-dryer system, which practically produces no waste, the paper towel system produces wastes proportional to the amount of uses. As describe in previous section, the fibres in used recycled paper towels are too short and weak to be reused. Therefore, the only option is to dispose of it via landfill. Assuming garbage disposals to the landfill are done weekly, the cost of garbage disposal of the paper towels would cost around $20 per week (Engineering Services, Solid Waste, 2009). In 15 years, the cost is estimated to be $15600.

$$TOTAL = \$260\ for\ dispensor + \$24637.5\ for\ paper\ cost + \$15600\ for\ disposal$$
$$= \$40497.5\ for\ lifetime\ of\ paper$$

3.2 Economical Impact of Dyson Airblade

The main costs associated with the Dyson Airblade are the initial overheads, maintenance, recycling and the energy consumption. The manufacturer provides a 5 year warranty on the product and its services, including a 1 year labour warranty. Furthermore, the **HEPA** filter is guaranteed to filter out 99.97% of particles and 99.9% of bacteria for 5 years. Following this, two sets of calculations were carried out. The first one assumed the product to last 15 years, with the filter changed every 5 years. The second calculation assumed the entire hand-dryer had to be replaced every 5 years. Although it is possible that the Dyson Airblade will last the entire lifetime, the second calculation is presented for some accuracy and provides a larger scope of possibilities.
Again, values are based on Dyson's pricing and BC Hydro's cost of electricity.

$$Initial\ Cost\ of\ Dryer = \$1400\ US \cong \$1475\ CAN$$

$$Cost\ of\ Filter = \$150 - \$350 \cong \$250$$

$$Electricity\ Rate = \$0.07\ per\ kWh$$

$$7670.475kWh\ for\ the\ lifetime \times \$0.07 = \$536.93$$

$$Cost\ of\ Recycling\ through\ Happy\ Stan's\ Recycling\ Services \cong \$60$$

$$TOTAL = 1475 + 2(250) + 536.93 + 60 = \$2571.93\ for\ the\ lifetime\ of\ the\ dryer$$

$$Assumption\ of\ Dryer\ Never\ Changed = \$2571.93$$

$$Assumption\ of\ Dryer\ Replaced\ Once = \$3796.93$$

$$Assumption\ of\ Dryer\ Replaced\ Twice = \$5141.93$$

As shown above, it will cost $2571.93 for the lifetime of the Dyson Airblade, assuming it lasted for 15 years. Under the assumption that the hand-dryer is replaced every 5 years, the total cost would be $5141.93. An assumption made is that the cost of the hand-dryer will be consistent over the 15 year lifetime which, in terms of most electronics, may not be true. It is important to mention that even though the 5 year warranty implies a lifetime of 5 years, it does not necessarily dictate the lifespan of the dryer.

4.0 SOCIAL

In addition to the environmental and economic aspects to the triple bottom line assessment, there is another equally important aspect – the social aspect. At times there may be an option that has been proven to be more sustainable, but this is only a part of the solution. If the general public refuses to accept this proven option, then there will be no change. Due to this problem, the sustainable option must be socially accepted before it can make a difference, and thus must be attractive to the people. This applies to the choice between paper towels and hand-dryers as well. A short survey on the choice between paper towels and hand-dryers was conducted and the results will be discussed below. The possible ethical implications and the societal impacts of the choice will also be explored. There are often many social problems faced by proposed ideas for improved sustainability. Regardless of whether or not the idea will benefit sustainability, it will be for naught if society refuses to accept it. There may be many different reasons for the rejection, such as cost, a lack of understanding or change in lifestyle.

4.1 Research

A short survey was answered by 56 people and its results can be referred to in Appendix A. The participants were mainly in their 20s and many were unaware of the current products being used in the SUB washrooms. The results show that an overwhelming 91% of the participants feel that sustainability is important. Furthermore, a majority of them feel that implementing hand-dryers would the more sustainable option, however, they'd rather have paper towels in their washrooms. The reasons given vary with opinions on the environmental and hygienic issues, but a majority of the reasons given were due to time and convenience. When given the option of a faster-drying hand-dryer, over three-quarters of the participants who chose paper towels stated they'd change their initial choice. When asked whether finding out how/where the products were produced/disposed of affect their choice, over half the participants stated it would not. This is an important factor that should be explored more closely as it affects the issue of sustainability greatly. The location of where the product is produced, how it is produced and the jobs that may come with the product are important parts of the social aspect to sustainability.

4.2 Findings from Survey

The results of the survey show an important factor that determines a person's choice – convenience. The more convenient option is often more attractive than a more environmentally friendly

option. The participants stated that time and the multiple uses of paper towels were the main reasons for their choice, and that hand-dryers would be difficult to use during sudden increases in usage at times. There were some responses where they would choose solely on the environmental aspects, but in these responses there were many different opinions on which one was more environmentally friendly. Some believe that paper towels were more eco-friendly because they thought the paper would be recycled again once used. Some also believe that the energy consumption for operating the hand-dryers would be close to the production of paper towels. Neither of these assumptions is true and it seems that general knowledge on the product in question should be given to the public for better decisions. Paper towels are currently the option being used in UBC washrooms, but if people refuse to use the hand-dryers (61% from survey), that would defeat the purpose altogether.

4.3 Health and Hygiene

Concerning the hygienic and health side of the products, the hand-dryers appear have more advantages. Paper towels require chemical substances during production for better quality, and the remnants of such substances could remain indefinitely. It is also possible for the paper towels to be contaminated during transportation or while they're inside the dispenser. Since paper towels also produce waste, they can create a messy environment within the washroom. These used paper towels may contain and transmit bacteria if left unattended (Budisulistiorini, 2007). One problem in toilettes is the faecal contamination and pathogenic bacteria present in the air which can be transferred onto the hands, body and even inhaled. The use of paper towels does not affect this issue; however, research has shown that wet hands are more likely to have bacteria than ones dried effectively (Coates, Hutchinson, & Bolton, 1987). Furthermore, the use of hot air dryers provoke this hygienic problem as air circulation spreads the faecal germs from toilet bowls and urinals into the surrounding area. Research carried by the University of Westminster (U.K) has shown that bacteria on hands increased by 436% when hot air dryers were used in washrooms (Redway et al.,1994) . On the other hand, the Airblade hand-dryer is designed to solve this problem. While in use, the dryer kills 99.9% of the bacteria in the air through a HEPA filter ensuring no faecal contamination is spread. Furthermore, the external surface of the dryer is coated with **anti-microbial additives** that kill bacteria for the lifetime of the product, and infra-red sensors that allow touch free hand drying. The Dyson Airblade is accredited by the National Sanitation Foundation (NSF) and is the only commercial hand dryer to meet the **NSF Protocol P335**. These are the standards that need to be met in order to be considered hygienic.

4.4 Other Concerns

In addition to the local social opinion, there are social issues concerning the production and disposal of the products. The paper towels are made from recycled paper, and are most likely collected and processed from local factories. This provides jobs for the local community from production to transportation to disposal. The company that sells the hand-dryers is an international company and the materials used to produce the hand-dryers are most likely imported from other countries. It is also unknown where exactly the finished product is produced. The probability that at least some parts of the hand-dryers being made in developing countries is fairly high. Due to this, it is difficult to assess if fair employment practices are ensured during the entire production of the hand-dryers.

5.0 CONCLUSION AND RECOMMENDATIONS

Based on calculations and research, the Dyson Airblade hand-dryer has proven to be more feasible in terms of both environmental and economical impact. It does however seem to fail in appealing the general public. The following information summarizes the key points of the analysis on recycled paper towels and hand-dryers based on a 15 year life cycle assuming 300 uses per day:

- Hand-dryers are 46 times more carbon efficient than paper towels
- Using hand-dryers reduces the carbon footprint by 9754kgs
- Dyson Airblade hand-dryer is 3.86 times more energy efficient than using recycled paper towels
- Hand-dryers are 10.6 times more cost efficient than paper towels, given the need to replace the hand-dryer once throughout the 15 year period

Given the benefits of hand-dryers on both the environmental and economical aspects, it is clear that hand-dryers are far superior as a hand-drying device than recycled paper towels in terms of sustainability. On the contrary, the participants whom we surveyed preferred paper towels over hand-dryers. In the survey, 61% preferred paper towel and 39% preferred hand dryers. One of the complaints is that the population dislike the waiting time involved when using the hand-dryer. However, 76% of the population in the survey would be willing to use hand-dryers if the drying time is reduced. Based on the environmental, economical, and social aspects pertaining to the studies, the Dyson Airblade is a better candidate as a hand-drying device than recycled paper towels for the new Student Union Building.

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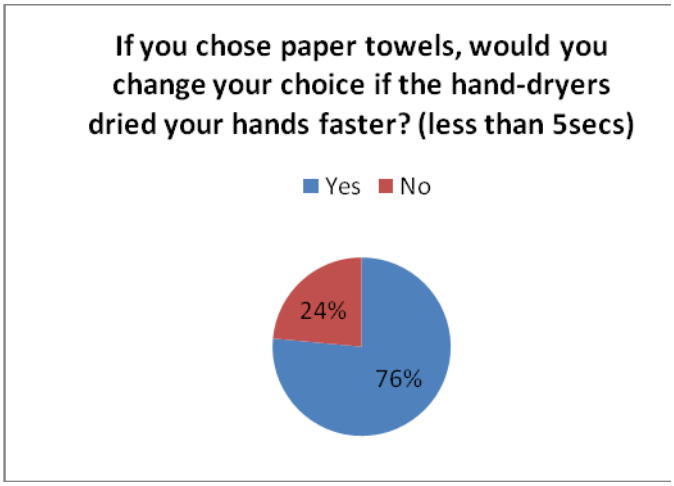
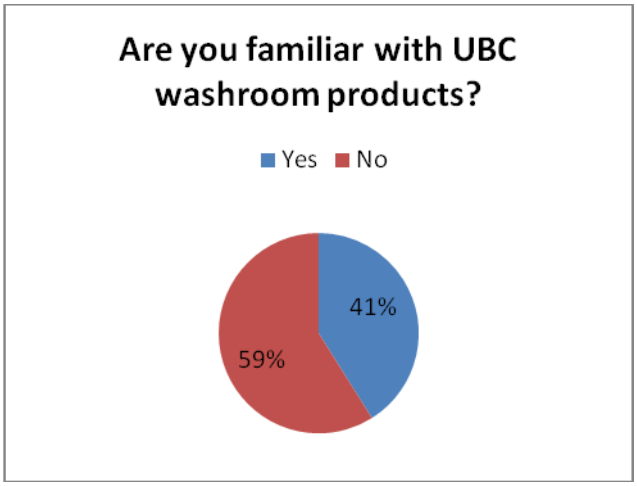
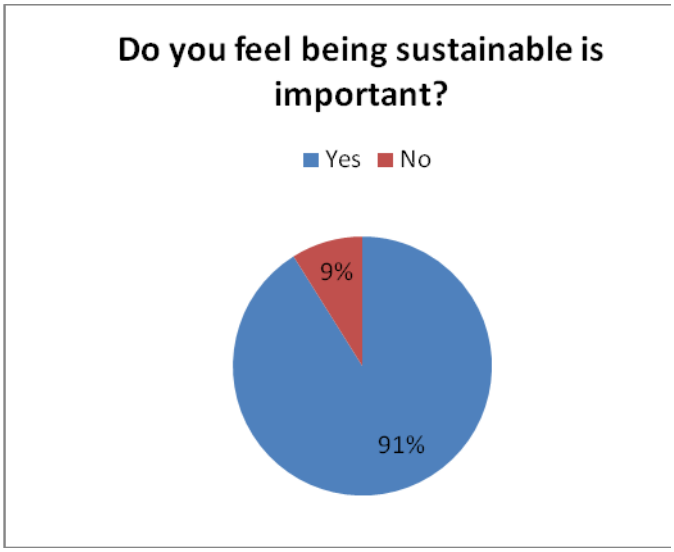
Happy Stan's Recycling Services - HYPERLINK "http://www.happystan.com/index.html" http://www.happystan.com/index.html

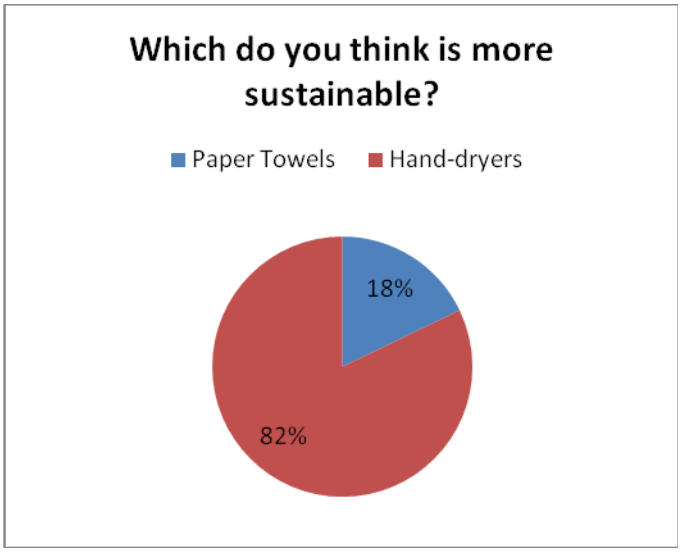
TerraPass - HYPERLINK "http://www.terrapass.com/" http://www.terrapass.com/

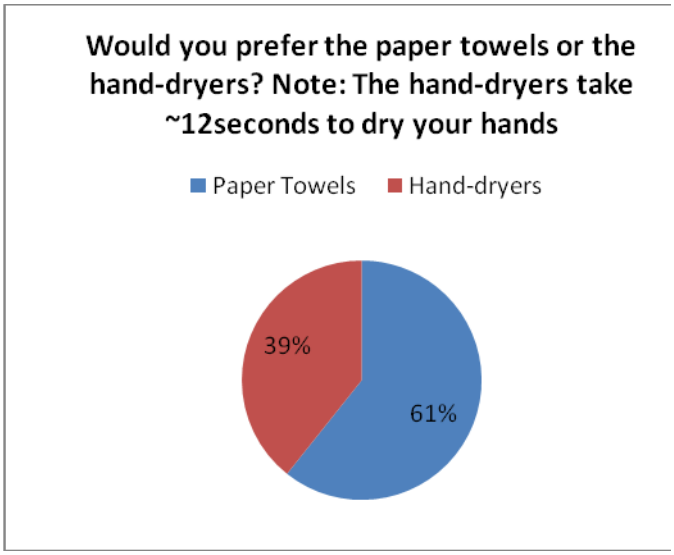
APPENDIX A – SURVEY RESULTS

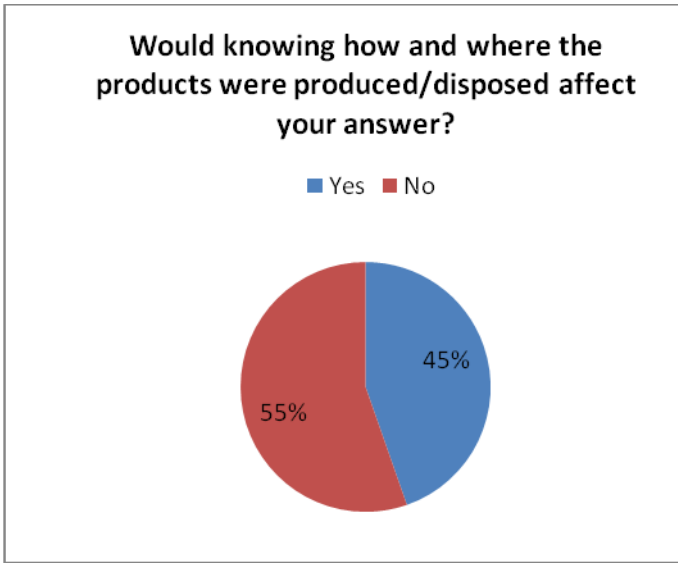












What is the reason for your choice? Give as many as you like.(eg. time, environmental, convenience, you like how one feels, etc...)

1.Sanitary living before sustainable and even with the best custodial staff there are times when there's no paper in the dispenser.

2.Time, convenience

3.saves trees, less waste, dryer makes my hand feel warmer

4.environmental

5.Very sustainable, makes the washroom look more clean (no loose papers lying around)

6.Obviously the electronic hand-dryers are cleaner and greener. However if there's only hand-dryer in the washroom and there are lots of people lining up for it, I'd rather use paper towels.

7.When I go to the bathroom it is usually a quick process. I hate those hand dryers, they do a terrible job of drying your hands. However, I also think that the energy it takes for a handdryer to work for 12 seconds migth be very close to the energy it takes to produce and recycle a paper towel. I'm a student in Chemical Engineering, and I would be quite interested in finding out which option is more ENERGY efficienct because that is just as important and resource efficiency.

8.I don't want to touch the door handle with my bare hands

9.Environmental

10.Easy

11.time, dryer, feels cleaner

12.hygenic and environmental

13.less paper waster

14.Enviorment, less of a mess inside the washroom

15.Many people do not wash their hands and then touch the door, so you can use paper towels to hold the handle.

16.Paper Towels have already been made.

17.envrionmentally friendly, warms hands when its cold

18.time, convenience

19.Paper Towels are more hygienic

20.Time

21.paper towels can only do so much. when you spill some water on your crotch while washing your hands a hand dryer is the only way to go

22.Time

23.Hand dryers provide the ideal temperature for bacteria to grow on your hands.

24.depends on efficiency of hand-dryers...whichever more ecofriendly really.

25.Convenience

26.Faster

27.environmental

28.easier..

29.convenience

30.electricity = renewable energy

31.convenience, less energy, recycled product

32.time, convienance

33.Time, convenience

34.more effective

35.hand dryers don't generate as much garbage, saves more trees, and is generally more enfironmentally friendly on the long run.

36.dyers are much more sanitary; towels end up thrown everywhere and create a mess

37.Time, Convenience and I prefer paper towel.

38.Usually in a hurry, so its more fast

39.useability

40.environmentally friendly, warms hands (especially in winter)

41.convenience

42.takes less time, feels cleaner

43.doesn't make my hands feel dry

44.Time and dryness

45.Time is money.

46.time, convenience, use the towel to then open the door

47.paper towels are quicker to dry my hands than using hand dryers which takes up a bit of time.

48.time, convenience

49.time, convenience - esp if you have a lot of things to hold, the dryers make your skin really dry

50.Quick, can be used for other purposes (ex. wiping off stains)

51.hygeine

52.the hand driers though they take energy to operate are more sanitary, and scince most of bc's energy is green energy from a hydroelectric source i feel they are more sustainable than towels.

53.Environmentally friendly, saves time, saves trees

54.convenience

55.Time, Convenience, Ease

56.Time, convenience, easier, dryer hands,...

APPENDIX B – PLASTIC PACKAGING RESINS

(American Chemistry Council, 2007)

American Chemistry Council

Plastic Packaging Resins

Resin Codes	Descriptions	Properties	Product Applications	Products Made with Recycled Content*
	**Polyethylene Terephthalate (PET, PETE).** PET is clear, tough, and has good gas and moisture barrier properties. This resin is commonly used in beverage bottles and many injection-molded consumer product containers. Cleaned, recycled PET flakes and pellets are in great demand for spinning fiber for carpet yarns, producing fiberfill and geo-textiles. Nickname: Polyester.	• Clear and optically smooth surfaces for oriented films and bottles • Excellent barrier to oxygen, water, and carbon dioxide • High impact capability and shatter resistance • Excellent resistance to most solvents • Capability for hot-filling	Plastic bottles for soft drinks, water, juice, sports drinks, beer, mouthwash, catsup and salad dressing. Food jars for peanut butter, jelly, jam and pickles. Ovenable film and microwavable food trays. In addition to packaging, PET's major uses are textiles, monofilament, carpet, strapping, films, and engineering moldings.	Fiber for carpet, fleece jackets, comforter fill, and tote bags. Containers for food, beverages (bottles), and non-food items. Film and sheet. Strapping.
	**High Density Polyethylene (HDPE).** HDPE is used to make many types of bottles. Unpigmented bottles are translucent, have good barrier properties and stiffness, and are well suited to packaging products with a short shelf life such as milk. Because HDPE has good chemical resistance, it is used for packaging many household and industrial chemicals such as detergents and bleach. Pigmented HDPE bottles have better stress crack resistance than unpigmented HDPE.	• Excellent resistance to most solvents • Higher tensile strength compared to other forms of polyethylene • Relatively stiff material with useful temperature capabilities	Bottles for milk, water, juice, cosmetics, shampoo, dish and laundry detergents, and household cleaners. Bags for groceries and retail purchases. Cereal box liners. Reusable shipping containers. In addition to packaging, HDPE's major uses are in injection molding applications, extruded pipe and conduit, plastic wood composites, and wire and cable covering.	Bottles for non-food items, such as shampoo, conditioner, liquid laundry detergent, household cleaners, motor oil and antifreeze. Plastic lumber for outdoor decking, fencing and picnic tables. Pipe, floor tiles, buckets, crates, flower pots, garden edging, film and sheet, and recycling bins.

Resin Codes	Descriptions	Properties	Product Applications	Products Made with Recycled Content*
	**Polyvinyl Chloride (PVC, Vinyl).** In addition to its stable physical properties, PVC has good chemical resistance, weatherability, flow characteristics and stable electrical properties. The diverse slate of vinyl products can be broadly divided into rigid and flexible materials.	• High impact strength, brilliant clarity, excellent processing performance • Resistance to grease, oil and chemicals	Rigid packaging applications include blister packs and clamshells. Flexible packaging uses include bags for bedding and medical, shrink wrap, deli and meet wrap and tamper resistance. In addition to packaging, PVC's major uses are rigid applications such as pipe, siding, window frames, fencing, decking and railing. Flexible applications include medical products such as blood bags and medical tubing, wire and cable insulation, carpet backing, and flooring.	Pipe, decking, fencing, paneling, gutters, carpet backing, floor tiles and mats, resilient flooring, mud flaps, cassette trays, electrical boxes, cables, traffic cones, garden hose, and mobile home skirting. Packaging, film and sheet, and loose-leaf binders.
	**Low Density Polyethylene (LDPE).** LDPE is used predominately in film applications due to its toughness, flexibility and relative transparency, making it popular for use in applications where heat sealing is necessary. LDPE also is used to manufacture some flexible lids and bottles as well as in wire and cable applications. Includes Linear Low Density Polyethylene (LLDPE).	• Excellent resistance to acids, bases and vegetable oils • Toughness, flexibility and relative transparency (good combination of properties for packaging applications requiring heat-sealing)	Bags for dry cleaning, newspapers, bread, frozen foods, fresh produce, and household garbage. Shrink wrap and stretch film. Coatings for paper milk cartons and hot and cold beverage cups. Container lids. Toys. Squeezable bottles (e.g., honey and mustard). In addition to packaging, LDPE's major uses are in injection molding applications, adhesives and sealants, and wire and cable coverings.	Shipping envelopes, garbage can liners, floor tile, paneling, furniture, film and sheet, compost bins, trash cans, landscape timber, and outdoor lumber.
	**Polypropylene (PP).** PP has good chemical resistance, is strong, and has a high melting point making it good for hot-fill liquids. This resin is found in flexible and rigid packaging, fibers, and large molded parts for automotive and consumer products.	• Excellent optical clarity in biaxially oriented films and stretch blow molded containers • Low moisture vapor transmission • Inertness toward	Containers for yogurt, margarine, takeout meals, and deli foods. Medicine bottles. Bottle caps and closures. Bottles for catsup and syrup. In addition to packaging, PP's major uses are in fibers, appliances and	Automobile applications, such as battery cases, signal lights, battery cables, brooms and brushes, ice scrapers, oil funnels, and bicycle racks. Garden rakes, storage bins, shipping pallets, sheeting, trays.

Resin Codes	Descriptions	Properties	Product Applications	Products Made with Recycled Content*
		acids, alkalis and most solvents	consumer products, including durable applications such as automotive and carpeting.	
	**Polystyrene (PS).** PS is a versatile plastic that can be rigid or foamed. General purpose polystyrene is clear, hard and brittle. It has a relatively low melting point. Typical applications include protective packaging, foodservice packaging, bottles, and food containers. PS is often combined with rubber to make high impact polystyrene (HIPS) which is used for packaging and durable applications requiring toughness, but not clarity.	• Excellent moisture barrier for short shelf life products • Excellent optical clarity in general purpose form • Significant stiffness in both foamed and rigid forms. • Low density and high stiffness in foamed applications • Low thermal conductivity and excellent insulation properties in foamed form	Food service items, such as cups, plates, bowls, cutlery, hinged takeout containers (clamshells), meat and poultry trays, and rigid food containers (e.g., yogurt). These items may be made with foamed or non-foamed PS. Protective foam packaging for furniture, electronics and other delicate items. Packing peanuts, known as “loose fill.” Compact disc cases and aspirin bottles. In addition to packaging, PS’s major uses are in agricultural trays, electronic housings, cable spools, building insulation, video cassette cartridges, coat hangers, and medical products and toys.	Thermal insulation, thermometers, light switch plates, vents, desk trays, rulers, and license plate frames. Cameras or video cassette casings. Foamed foodservice applications, such as egg shell cartons. Plastic mouldings (i.e., wood replacement products). Expandable polystyrene (EPS) foam protective packaging.
	**Other.** Use of this code indicates that a package is made with a resin other than the six listed above, or is made of more than one resin and used in a multi-layer combination.	Dependent on resin or combination of resins	Three- and five-gallon reusable water bottles, some citrus juice and catsup bottles. Oven-baking bags, barrier layers, and custom packaging.	Bottles and plastic lumber applications.

***Recycling may not be available in all areas. Check to see if plastics recycling is available in your community.**

American Chemistry Council, Plastics Division
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