

UBC Social, Ecological Economic Development Studies (SEEDS) Student Reports

**An Investigation into Sustainable Options for The New Student Union Building Washrooms:
Recycled Paper Towels or Electric Hand Dryers**

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An Investigation into Sustainable Options for The New
Student Union Building Washrooms: Recycled Paper Towels
or Electric Hand Dryers

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ABSTRACT

Sustainable designs are to be a theme in the new Student Union Building. Every proposed design or idea must be economically, environmentally, and socially assessed (the *triple-bottom line* assessment). This report is about the sustainability of hand drying in the new building's washrooms. Two options of hand drying were considered: recycled paper towels and electric hand dryers. Cloth towels were initially included. However initial research into the option revealed that UBC abandoned cloth towels years ago and therefore this option was omitted from this report.

The research involved talking to UBC Waste Management staff, finding specifications from vendors of electric hand dryers and recycled paper towels, and finding data how hygienic each option is. Studies comparing the environmental impacts of recycled paper towels and electric hand dryers were analyzed as well.

Electric hand dryers were found to be the better option in the economic and environmental assessments. Recycled paper towels were found to be a better option in the social assessment. Since the electric hand dryer is a better option for two out of three *triple-bottom line* criteria, it is the recommended method for drying hands in the new Student Union Building.

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SECTION 1.0 - INTRODUCTION

The new Student Union Building (SUB) is to be sustainable as possible and therefore a sustainable option must be chosen for every aspect of the new building. This report is about what is the most sustainable option for drying hands in the washrooms in the new SUB. The options will be assessed using the *triple-bottom line* criteria: economic, environmental, and social.

The options considered are: recycled paper towels that are to be recycled after use and electric hand dryers. Cloth towels were omitted from this report because UBC does not use them anymore according to a post by Nick Gallant of UBC Waste Management on the “Fostering Sustainable Behaviour” website forum. The reasons were: cloth towels dispenser would run out quickly in high traffic areas (such as the SUB) and need to be replaced hourly meaning extra man power, the high cost of laundering the towels, and the cost of maintaining or repairing the dispensers as they would be vandalized by some students.

Each of the *triple-bottom line* criteria is analyzed in the subsequent sections. In the economic section, the installing/setup, supply, electricity, and recycling costs are analyzed for both options. The environmental section analyzes how the environment is affected by the use of hand dryers and recycled paper towels. The social section discusses the advantages and disadvantages of each option in a social context and which option is more hygienic. The option that prevails in at least two out of three assessments will be recommended.

SECTION 2.0 – ECONOMIC ANALYSIS

In this section, the economic impact in the *triple-bottom line* assessment is analyzed. Purchasing and composting recycled paper towels are compared to the cost of purchasing, powering and disposing electric hand dryers.

2.1 ELECTRIC HAND DRYER COSTS

Three high-speed hand dryers were investigated in the economic section: the Mitsubishi Jet Towel, the Dyson Airblade, and the Excel XLerator. Table 1 summarizes the power cost per year of operating each of the hand dryers. The calculations are based on one hand dryer unit being used 200 times a day and an electricity cost rate of \$0.0769 per kW-hr (Business Rates BC Hydro). A sample calculation is shown in appendix A.

Table 1: Power Cost of Each Hand-Dryer per Year

Hand Dryer	Wattage (W)	Maximum Claimed Drying time (s)	Energy Use (kW-hr per use)	Energy Cost per Year
Mitsubishi Jet Towel	730	6	0.0012	\$6.74
Dyson Airblade	1400	12	0.0047	\$26.38
Excel XLerator	900	15	0.0038	\$21.33

Sources: Mitsubishi Jet Towel: <http://www.mitsubishijettowel.com/about/literature/downloads/Spec%20Sheet%20US.pdf>
 Dyson Airblade: <http://www.english.dysonairblade.ca/specification/default.asp?product=AB02-AIRBLADE>
 Excel XLerator: <http://www.exceldryer.com/products/xlerator.asp>

Ken Paraig, a Sales Coordinator at Dyson Airblade, quoted each unit to be approximately \$1600 (\$1790.88 after taxes) (personal communication, November 9, 2009). A sales representative at Mitsubishi Electronics in Burnaby B.C, priced the Mitsubishi Jet Towel at approximately \$1500(\$1680 after taxes)(personal communication, November 18, 2009). Newton Distributing Company priced the Excel XLerator at approximately \$400 US (about \$500 CAD after taxes)(XL-BW Excel XLerator Hand Dryer, 2009). The hand dryers are recyclable after they have exceeded their lifetime. A company called Happy Stan's Recycling based in Port Coquitlam does this service (Jamie Kaminski, personal communication, November 9, 2009). They do have a pick-up service but the cost of the pick-up depends on the size and weight of the material being recycled. In the case of the hand dryers, the pick-up cost should be inexpensive since a quantity of, for example, 40 hand dryers can be loaded into one truck. Therefore, the recycling cost is estimated to be roughly \$100.

2.2 RECYCLED PAPER TOWEL COSTS

Using recycled paper towels is the other option for the washrooms in the new SUB. Based on the Betty Mills Company website, a case of recycled paper towels costs approximately \$48. Each case has 10 packs, each pack has 3 rolls and each roll has 112 sheets. This translates into a cost of approximately \$0.013 per sheet. If we assume each paper towel dispenser is used 200 times a day and each use consists of two paper towels, this translates into \$5.20 a day and \$1898 a year. An automatic paper towel dispenser is valued at approximately \$187 after taxes (Primestar Supply Inc.). The cost of one 246 L container (similar to the ones found on the UBC campus) for recycling the soiled paper towels is approximately \$315 after taxes (Primestar Supply Inc.). Soiled paper towels cannot be composted at the UBC compost site according to Christian Beaudrie and Sara Orchard of UBC Waste Management (personal communication, November 10, 2009). The composting machine gets jammed because the paper towels cake onto the ventilation holes. Therefore, the composting of soiled paper towels must be done offsite. This would mean a disposal company such as Smithrite would have to haul the used paper towels to a compost site. Restaurants in the lower mainland have hired Smithrite Disposal to pick up their organic waste and deliver it to a company call Sea to Sky Organics in Squamish for composting (“Composting Catches”, 2006). The cost of this service depends on how many times Smithrite would come and how large the bin is that holds all the soiled paper towels. This cost will be estimated to be \$50 monthly (it could be much higher). The total cost of the initial setup of one dispenser and container is \$502. The yearly cost of providing and recycling paper towels is \$2498.

2.3 COMPARISON AND CONCLUSION

The initial and operating costs of the hand dryers and the paper towels are compared below in Table 2.

Table 2: The Total Cost of Setup and Operation of Paper Towels and Hand Dryers

Type	Initial Cost	Yearly Operating Cost	Total Cost After 15 Years
Mitsubishi Jet Towel	\$1680	\$6.74	\$1881.10
Dyson Airblade	\$1790.88	\$26.38	\$2286.70
Excel XLERator	\$500	\$21.33	\$919.95
Recycled Paper Towels	\$502	\$2498	\$37970

The hand dryers are overall cheaper than the paper towels. Expanding the analysis to include more than one hand dryer and paper towel dispenser would yield even greater savings. Clearly the hand dryer is the better choice in the economic sense.

SECTION 3.0 – ENVIRONMENTAL ANALYSIS

Electric hand dryers and paper towels are the two major hand drying methods used in most offices, institutions, and hospitals. Some argue that paper towels are quicker, cleaner and more efficient method compared to other techniques, especially, electric hand dryers. They say when hot air exits the hand dryer, it has enough energy to circulate the bacteria around the bathroom area. Some, on the other hand, argue that the environmental impacts from hot air are much less than paper towels, due to the less resource depletion and emissions. Both groups have valid arguments, and therefore, a Life Cycle Assessment (LCA) is necessary to uncover the real environmental performances of both techniques. LCA is the investigation and study of the environmental impacts of a product during its existence (total life).

Land use is claimed as the most potential environmental effect category. Environmental effect is also assessed based on the quality of ecosystem. Electric dryer was, however, outperformed by paper towel. The emission of greenhouse gasses is relatively higher from paper towels, compared to electric hand dryers. Emission of sulfuric oxides is higher from the life cycle of paper towel, which results in acid rain. The paper towel life cycle also creates more water pollution.

The LCA in this report includes all energy, material, and pollutant input and output. Three different systems, a XLERATOR electric hand dryer (high speed, efficient), a conventional electric hand dryer, and paper towel, are compared. It is assumed that each system dries 260,000 pairs of hands during its service life. Figure 1 shows this comparison between the three systems.

	 XLERATOR®	 CONVENTIONAL DRYER	 PAPER TOWELS
Functional Unit	Drying 280,000 pairs of hands		
Product needed for	One dryer and 1381 kWh electricity	One dryer and 5108 kWh electricity	One dispenser plus 37,960 m ² of paper towel
Housing Components	Zinc, stainless steel or reinforced resin	Zinc and aluminum	Polypropylene
Internal components	Motor, fan, optical sensor, wiring	Motor, fan, optical sensor, wiring	Motor, optical sensor, batteries
Manufacturing Location	East Longmeadow, Massachusetts, USA	USA	USA
Distribution	Shipped as single units or on pallets to distributor	Shipped as single units or on pallets to distributor	Shipped as single units or on pallets to distributor.
Supply Chain Distances	750 km by truck and 750 km by ship for all components	750 km by truck and 750 km by ship for all components	750 km by truck and 750 km by ship for all components
Packaging Material	Plastic liner bag within cardboard box, with molded pulp end caps	Plastic liner bag within cardboard box, with molded pulp end caps	Dispenser in plastic bag within cardboard box; towels in cardboard box.
Recycling Rate	Packaging recycled at national material averages; dryer components not recycled	Packaging recycled at national material averages; dryer components not recycled	Packaging recycled at national material; dispenser components not recycled; towels not recycled
Use Phase Assumptions	12 sec. run time at 1500 W/ electricity (+1.5 sec shutdown)	30 sec. run time at 2300 W/ electricity (+1.5 sec shutdown)	2 towels used, with 0.073 m ² area per towel.

Figure 1. Environmental Considerations of Three Different Hand Drying Methods

Source: http://www.nacsonline.com/NACSShow/ForExhibitors/Congreenience_Store/Documents/Excel%20Dryer%20Green%20Information.pdf

Detailed studying of Figure 1 has shown a 50% to 75% reduction of environmental impacts by XLERATOR electric hand dryer. Many categories of environmental impacts were evaluated in this study and XLERATOR excelled in all of them. Particularly, when compared to paper towels, XLERATOR contributed to far less pollutions, after taking into consideration the environmental impacts of both the production and associated materials. Figure 2, below, shows an overview of study results for climate change score.

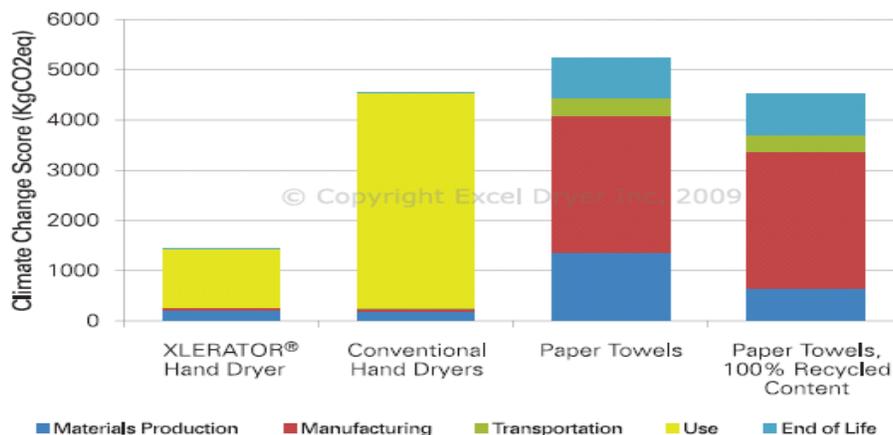


Figure 2. Overview of study results for climate change score

Source:

http://www.nacsonline.com/NACSShow/ForExhibitors/Congreenience_Store/Documents/Excel%20Dryer%20Green%20Information.pdf

It can be observed from Figure 2, the XLERATOR hand dryer obtains the least score among all other methods. The majority of the impact for electric dryers is the Use, while for paper towels are the Materials Production, End of Life, and the Manufacturing.

Another study (Figure 3) shows that the electric hand dryer performs better than paper towel with the exception of resource depletion.

Impact Category	Drier	Paper Type 1	Paper Type 2	Paper Type 3	Paper Type 4	Towel: Average Paper
Resource depletion (kg Oil equiv.)	1780	800	594	424	476	574
Global Warming (CO ₂ equiv.)	1607	4330	2187	5574	6289	4595
Acidification (kg SO ₂ equiv.)	10.2	12.4	15.3	12.4	15.3	13.8
Ecotoxicity (Aquatic m ³)	0.052	0.104	0.079	0.050	0.064	0.07
Human Toxicity (kg/kg)	15.7	24.1	27.2	23.9	22.8	24.5
Nutrication (kg PO ₄ equiv.)	1.2	1.7	0.9	1.4	1.6	1.38
Ozone depletion (kg CFC 11 equiv.)	0.0003	0.0016	0.0009	0.0002	0.0002	0.00
Smog (kg ethylene equiv.)	0.4	3.0	1.9	4.6	2.2	2.94
Energy MJ	35999	38527	34167	76079	87084	58964

The drier system performs better than the average paper towel systems with the exception of resource depletion (all the paper towel systems perform better).

Figure 3. Impact Burden for Drier and Towel Systems

Source: http://www.treehugger.com/files/2007/05/lca_handdryer_papertowels.php

The UBC SUB is currently using paper towels in all the bathroom facilities. The used paper towels are not currently being recycled. In conclusion, the method that is the most environmentally friendly is the electric hand dryer.

SECTION 4.0 – SOCIAL ANALYSIS

Social values and social behaviour will play a big factor in us deciding which of these two methods will be recommended for the new SUB. In the previous sections we talked about the environmental and economical aspects of paper towels and hand dryers, this section will address the social implications of each one of those two hand-drying methods. Let's start with the electrical hand dryers and their positive and negative social characteristics. Hand dryers obviously require much less maintenance; this is a great example of a social implication. In the new SUB the staff involved in up keeping and maintenance would much rather have hand dryers just to minimize the amount of work done by them and would be less costly in the long run. There is no excess paper towels on the floor that require cleaning up and will have the bathrooms looking cleaner and neater which will lead the students to be less reluctant to use the bathrooms and will not want to avoid a smelly dirty bathroom. Another advantage of having the electric hand dryer is that people will feel much more satisfied and fulfilled knowing that they've gone with the greener choice in hand drying. At the moment the big craze is environmental responsibility, people are obsessed with trying to be as green as possible and it makes them happier knowing that they took the more environmentally friendly choice instead of throwing away a paper towel. Even though the hand dryer takes the ball in the environmental and economical aspects, socially the paper towels would be much more accepted.

According to research conducted by scientists at the University of Westminster, UK, it is far more hygienic to use paper towels instead of the leading brands of jet hand dryers. According to this research the total number of bacteria on the fingers and palms is reduced by 76% and 77 % relatively. As for the jet hand dryers the bacteria on the fingers is increased by 42 % and on the palms by 15%. This is very important information regarding our decision due to the fact that the sub will have thousands of students

walking in and out of these bathrooms. With an outbreak of a flu or other infectious diseases, as we are having now, decreasing the amount of bacteria being spread and shared by students is very significant. When it comes to hand dryers students can be very impatient leaving their hands slightly wet, this wetness multiplies the amount of bacteria on your hands up to 200 percent more. The paper towel in everyway is the more hygienic choice. In a social standpoint the hand dryer does have the advantage of being known as the more environmentally friendly choice, but students and other SUB users would be less reluctant to accept paper towels if the fact that they can be recycled is more known. This would defeat the idea that using these paper towels is the worst possible choice for the environment as long as measures are taken not to waste paper towels. Another issue that makes the paper towel a better choice is the fact that it can be used to clean up and dry off other objects rather than just your hands. A spill can't be cleaned up with an electric hand dryer, a ketchup stain on your shirt can't be wiped off with an electric hand dryer either and this is where the paper towel takes the cake.

SECTION 5.0 - CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSION

The new Student Union Building will be a model of sustainable design. This report analyzes what is the best sustainable option for hand drying in the washrooms. Recycled paper towels and electric hand dryers were the options considered. The options were analyzed using the *triple-bottom line* assessment which entails the economic, environmental, and social impacts of each option. After the analysis, the hand dryer was the better option for the economic and environment impacts and the paper towel was the better option for the social impact.

5.2 RECOMMENDATIONS

The electric hand dryer units are much cheaper to operate and are more environmentally friendly than paper towels. In the social context, paper towels are better mainly because of hygienic reasons. The hygienic issue is an important concern but perhaps the use of better anti-bacterial soap can counter the advantage paper towels have over electric hand dryers.

The electric hand dryers are better in two out of three *triple-bottom line* assessments. Therefore, they are the recommended option for the washrooms in the new SUB. There are a few vendors to choose from for electric hand dryers. The Mitsubishi Jet Towel, Dyson Airblade, and the Excel XLerator are all potential choices. The new SUB designers should analyze which of these models is most appropriate.

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APPENDIX*A - SAMPLE CALCULATION*Dyson Airblade Yearly Costs Calculation

Given Information:

- Wattage: 1400 Watts
- Drying time: 12 s
- BC Hydro Rate: \$0.0769 per kW-hr
- Uses per day: 200
- Standby Electric Use (when the hand dryer is not being used) = 1 W

$$(12 \text{ s})(200 \text{ uses}) / (3600 \text{ s/hr}) = 0.67 \text{ hr}$$

$$((1400 \text{ W})(0.67\text{hr}) + (1 \text{ W})(0.33 \text{ hr})) / (200 \text{ uses}) = 0.0047 \text{ kW-hr per use}$$

$$(0.0047 \text{ kW-hr/use}) (200 \text{ use/day}) (365 \text{ days/yr}) (\$0.0769/\text{kW-hr}) = \$26.34 / \text{yr}$$

The same calculation is done for each electric hand dryer.