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Environmental Seminar
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I. ABSTRACT

In a place like Boston College, one would assume that they are doing all that they can to maintain the health of their faculty as well as minimize the cost of running such an enormous enterprise. But with such a large campus as well as the scattering of departments across this campus, it is unsurprising that some of the smaller items fall through the cracks of awareness. We set out to research one of these forgotten items: water coolers. Through a survey to faculty on their water consumption, calculation of energy consumption, and discussion on water quality we came to the conclusion that BC should consider transitioning to filtered tap water coolers over the traditional free-standing water coolers. Regardless of the feasibility of this recommendation, our most important finding is that it is time BC centralize its information of these water coolers.

II. INTRODUCTION

Water coolers are quite often the setting for conversation with co-workers, but they are almost never its subject. Water coolers evade attention by design; their mundanity protects them from scrutiny, or even interest. These sorts of extremely mundane objects are also the ones that have some of the greatest environmental impact. We forget that these sorts of objects, used repeatedly, can use huge amounts of energy. We also forget that they can be gathering points for disease-causing bacteria and fungus. Their unremarkableness makes it very challenging to point out their very remarkable impacts.

With this project, we've attempted to understand the impacts of water coolers in the Boston College community. These coolers are dotted throughout the academic and administrative offices on campus. There are two general types that we see on campus: a Belmont

brand bottled water cooler with a 20L jug of bottled water attached to the top and an Alpine brand filtered tap water distributor that is attached to the main water supply. These two types are scattered around campus on every floor with faculty office buildings.

At the beginning of our search, we interviewed John MacDonald. John MacDonald is Boston College's energy manager. His job entails monitoring Boston College's total energy consumption and finding ways to decrease it. He also helps Boston College purchase energy, and is therefore well acquainted with its financial cost. John MacDonald helps to decide what projects our Environmental Seminar attempts to complete, and he personally created the water cooler project. He explained to us that Boston College has no centralized directory of water coolers. Each academic or administrative department is responsible for ordering their own water coolers. As a result, there is a large range of different products on the Boston College campus. John wanted us to gather knowledge about the different coolers on campus as well as about their overall energy usage. This would help him see if it would be worth it to change Boston College's water cooler system.

With help from John MacDonald, we decided to focus our own project on water cooler's on-site energy consumption. We made this decision mainly because of John MacDonald's guidance. He proposed the original project, and since it was going to be actually used for official Boston College purposes, we thought it would be the best plan for our project. We also made this decision because it seemed the most realistic for our scope. By constricting our focus to main campus, we can gain very accurate information to help John MacDonald make decisions.

While our focus has been mostly on energy, we've done research on water quality from different water coolers. This research will help us get a holistic view of water coolers and help us to make an informed decision about what Boston College should do. It is not within the scope of our study to do a water quality analysis, as this would be costly and time consuming. It is also beyond the skills and capabilities of our group. Instead, we will provide a quick survey of research that has been done about this issue in order to provide an understanding of the topic.

There are five large studies that have been done about water cooler quality. One of these studies was conducted in Canada, one was conducted in Brazil, one was conducted in Switzerland, one was conducted in Egypt, and another conducted in Italy. Every single study found that water coolers contained more contamination than tap water. They also unanimously

recommended regular cleaning as a solution to get rid of this contamination. A more in-depth discussion of the nuances of each study follows.

“Assessment of the Quality of Water from Some Public Coolers in Alexandria, Egypt” is a study published in 2009 by RA Hussein, AA Hassan, and WM Bakr.¹ The study was focused on bottleless water coolers, or the ones that dispense water straight from the tap. They selected twenty random water coolers and compared their concentration of contamination to the water mains that supply the coolers. They found that these coolers had large levels of both chemical and bacterial contamination. Of them, 85% had high levels of chlorine, 65% had high levels of lead, and 55% had high levels of magnesium. On the biological side, 15% were contaminated with *Cryptosporidium parvum*, 15% were contaminated with the total coliform group of bacteria, 5% had thermotolerant coliform contamination, and 5% were contaminated with *Streptococcus fecalis*. They recommended that all water coolers are regularly cleaned and maintained, as this would help to reduce levels of contamination significantly. This would be partnered with a large-scale testing program, so that any problematic coolers could be identified before they gave their contaminations to many people. They recommend even more strongly that all of these coolers should be replaced with water purification/filtration systems. This would help to get rid of any contamination, and would also mean that cleaning would have to be less frequent. This study is unique because it is the only one we read that was focused on bottleless water coolers. The rest of them focused on the more ubiquitous bottled water coolers. This study shows us that tap water dispensers also require cleaning and purification, and can also be contaminated.

“Bacteriological Quality of Drinking Water from Dispensers (Coolers) and Possible Control Measures” is a study conducted in Switzerland and published in 2006 by A Baumgartner and M Grand.² The study compared 174 samples of water from bottled water coolers against samples from the 20-liter bottles that supply the coolers and from bottled water. The study found that the coolers from the sampler had higher levels of bacterial organisms than both controls. It found that 21.6% of coolers had the organism *P. aeruginosa*, which causes serious infections.

¹ Hussein, RA, AA Hassan, and WM Bakr. "Assessment of the Quality of Water from Some Public Coolers in Alexandria, Egypt." *The Journal of Egypt Public Health Association* 84.1-2 (2009): 197-217. *PubMed.Gov*. Web. 27 Apr. 2015.

² Baumgartner, A., and M. Grand. "Bacteriological Quality of Drinking Water from Dispensers (Coolers) and Possible Control Measures." *Journal of Food Protection* 69.12 (2006): 3043-046. *PubMed.Gov*. Web. 27 Apr. 2015.

Upon regular cleaning, interestingly, the bacterial organisms did not disappear. However, *P. aeruginosa* was successfully eliminated by a cleaning. The other two bacteria being checked for, *E. coli* and enterococci, were not found at all. While the finding that cleaning did not reduce total counts of bacteria might make it seem that cleaning is not helpful, it got rid of the harmful *P. aeruginosa*. This makes for pretty clear evidence that cleaning of water coolers is essential. It is able to reduce human exposure to harmful bacteria and thus should be considered for anyone purchasing a water cooler. The study said cleaning is especially important in places that care for those who have weaker immune systems, such as hospitals and nursing homes.

“Comparison of the Microbiological Quality of Water Coolers and that of Municipal Water Systems” is a study published in Quebec, Canada in 1994 by B Levesque, P Simard, D Gauvin, S Gingra, E Dewailly and R Letarte.³ This study got its samples from 50 bottled-water coolers in residences and workplaces, giving this study a much larger web of samples than the other ones. This also led them to factor in different usages and conditions in their study. They found that indicator bacteria contaminated 36% of the coolers and that pathogenic bacteria contaminated 28%. This is compared to the 18% and 22% contamination rates respectively found in tap water samples. This study was not able to find the reason why certain containers got contaminated, but also suggested that regular cleaning would limit contamination.

“Comparison of the Bacteriological Quality of Tap Water and Bottled Mineral Water” is a study published in Brazil in 2008 by ME Zamberlan da Silva, RG Santana, M Guilhermetti, IC Filho, EH Endo, T Ueda-Nakamura, CV Nakamura, BP Dias Filho.⁴ This study compared the 20-L bottles of water that have already seen on a water cooler to new water bottles, as well as to tap water. It found that 36.4% of tap water was contaminated by at least one pathogenic bacteria, while 76.6% of the used water bottles had contamination. The new bottles were also contaminated at a much higher rate before installation than the tap water, but at less of rate than the used water bottles. Therefore, much of the contamination is coming from the bottling plant of

³ Levesque, B., P. Simard, D. Gauvin, E. Dewailly, and R. Letarte. "Comparison of the Microbiological Quality of Water Coolers and That of Municipal Water System." *Applied Environmental Microbiology* 60.4 (1994): 1174-178. *PubMed.Gov*. Web. 27 Apr. 2015.

⁴ Silva, Marie Eliza Zamberlan Da, Rosangela Getirana Santana, Marcio Guilhermetti, Ivens Camargo Filho, Eliana Harue Endo, Tânia Ueda-Nakamura, Celso Vataru Nakamura, and Benedito Prado Dias Filho. "Comparison of the Bacteriological Quality of Tap Water and Bottled Mineral Water." *International Journal of Hygiene and Environmental Health* 211.5-6 (2008): 504-09. *PubMed.Gov*. Web. 27 Apr. 2015.

the water, but some of it is also coming from the contact with the cooler. This essay recommended that water-bottling companies be much more severely watched and regulated, so that they contaminate less. They also recommended testing for *P. aeruginosa*, as they also found it to be the most common contaminant in water coolers.

“Microbiological Quality of Drinking Water from Dispensers in Italy” was published in 2010 by G Liguori, I Cavallotti, A Arnese, C Amiranda, D Anastasi.⁵ This study also compared water coolers to tap water, but, like the first study, looked at both chemical and biological contaminants. Neither source of water was over the recommended levels of chemicals, but 86.8% of samples from coolers were below the recommended PH. The water coolers’ water was higher than recommended amounts of bacteria 81% of the time, and *P. aeruginosa* was found in 28.9% of the water cooler water and only in one tap water sample. The study concluded quite emphatically that tap water has a superior bacteriological quality and should be used when possible. It also recommended a monitoring system in order to keep track of potential contamination.

All of these studies lead to pretty clear conclusions. For one, water coolers are more contaminated than tap water from the source. The Hussein study, which focuses on contamination of bottleless coolers, shows that the contamination occurs at least partially from the cooler itself. However, the Zamberlan Da Silva study shows us that some contamination in bottled water-coolers come from the bottled water itself. This seems to suggest that bottled water coolers combine the bacterial breeding ground qualities of every water cooler with the lower quality of bottled water.

The studies are also notable for the fact the none of them were conducted in the United States. The US is well known for the high quality of their tap water, so if tap water was cleaner than bottled water in other countries, it is likely to be even cleaner in the United States. This finding only further reinforces that tap water consumption is safer than bottled water consumption, and that filtered tap water is the safest form of consumption. While water quality is not the main focus of our study, it is important to have a survey of research done about its relationship with water coolers. A good decision about Boston College’s water coolers cannot be

⁵ Liguori, Giorgio, Ivan Cavallotti, Antonio Arnese, Ciro Amiranda, Daniela Anastasi, and Italo F. Angelillo. "Microbiological Quality of Drinking Water from Dispensers in Italy." *BMC Microbiology* 10.1 (2010): 19. *PubMed.Gov*. Web. 27 Apr. 2015.

made without this understanding of water coolers. This is even more essential in a college campus, where the concentration of people makes it easy for disease to spread.

To return to the energy discussion, our study is attempting to find out the total KWH that Boston College expends weekly on water coolers, and whether bottled water coolers or tap water coolers are more energy efficient. This discussion on energy combined with our analysis of the healthy aspect of water coolers brings a fuller picture to the topic of water coolers at Boston College. It will allow BC to reach the best solution for the health of faculty members as well as minimizing the cost of water cooler energy consumption. The next section will explain our methods to do this in more depth. By surveying the types of water coolers on campus, surveying faculty about their personal usage of water coolers, and then by measuring the wattage used by different types of water coolers, we are able to come to a conclusion about energy usage.

III. METHODS

After speaking with John MacDonald, we realized the task we had chosen must be broken down into several components. If we were to answer the question of water cooler quality and energy usage on campus we would need to first discover how often faculty and staff use water coolers for hot or cold water. The distinction is important because of the varying energy usages as well as varying quality dependent on where the water was coming from. Secondly, we knew we would have to collect information of the variety of water coolers across campus. As we learned in our conversation with Mr. MacDonald, departments individually organize water coolers and thus there is no centralized inventory of them. Lastly we would use a “Kill-A-Watt” meter energy-measuring tool to collect data on how much energy is used per cup of hot or cold water on standard water cooler systems. We complete our methods by using that data combined with the faculty and staff usage data to calculate the total amount of energy used by Boston College.

A. Faculty and Staff Survey

When conducting research on human subjects, researchers are required to gain approval from the Boston College Institutional Review Board (IRB). This process is constructed to protect

human participants in any research that contributes to “generalizable knowledge”. There are several important aspects of this phrase that we ran into while attempting to create a faculty and staff survey. We assumed that since we would be asking faculty and staff their water cooler usage that we would need IRB approval and thus we began the process.

The first interesting aspect of this process is the federal definition of human subjects. According to Federal regulation 45 CFR 46.102, human subjects are defined as “a living individual(s) about whom an investigator conducting research obtains: data through intervention or interaction with the individual, or identifiable private information”⁶. In addition, the same regulation defines federal research as: “A systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable known”. Since our study did involve interactions with faculty and staff, we assumed that we would need IRB approval. But after completing and submitting our application, the IRB Review Board informed us that we did not meet that criteria for the federal definition of federal research or human subjects. I suspect this is because our paper will not contribute greatly to any general knowledge as it is merely a direct inquiry into Boston College.

Thus we were allowed to create a survey for faculty and staff without IRB approval. This lack of regulation both hurt and helped us in our study. For one thing we were able to immediately send out the survey to several departments to collect data. But without the official seal of the IRB, we ran into trouble with some departments being unwilling to cooperate with us since they assumed we had not gone through the process. Regardless, the IRB process was helpful for us in focusing our thoughts on what was necessary to ask our survey participants. We narrowed down our survey to three questions so that staff could answer it without any effect on their regular day. We asked participants how many cups of cold water he or she took from the water cooler per week as well as the number of hot cups of water. Our last question was whether they preferred bottled water, filtered tap water or were indifferent. With the first two questions we hoped to gather the number of cups of water per week then multiply that by the number of weeks in a typical school year. This data would contribute to our analysis of the energy usage while the last question would contribute to our analysis of water quality on campus.

B. Main Campus Inventory

⁶ "Boston College." *Human Participant FAQs*. N.p., 28 Nov. 2012. Web.

Since our project is the beginning of water cooler information on BC's campus, we decided to narrow the focus of our study to a section of main campus buildings. The section includes Stokes North and South, Fulton, Cushing, Lyons, Gasson, Devlin, Higgins and Maloney. These buildings were chosen because of their centrality as well as their high concentration of department offices. Across those departments there is also great variety in subjects, ranging from nursing to business and all liberal arts subjects in between. With this cross section selected, we began collecting an inventory by walking through each building and inquiring with administrative assistants about the type of water cooler used in the office. We gained extremely useful information from the faculty and staff on the whereabouts of campus water coolers as well as their opinions on potentially upgrading offices to have filtered water units that ran through the plumbing.

C. Kill-A-Watt Meter

The final step in our data collection was using the "Kill-A-Watt" tool given to us by Energy Manager, John MacDonald. This tool is extremely easy to use and widely available for homeowners who might want to understand the energy consumption of their appliances. The tool works by being plugged into the wall outlet then whatever appliance one wants to test is plugged into the Kill-A-Watt meter. The gadget has five buttons that can give information on line voltage, line frequency, KWH consumption, amperage and wattage power consumption of the device. For our study we required the wattage that was used during both one hot and one cold.

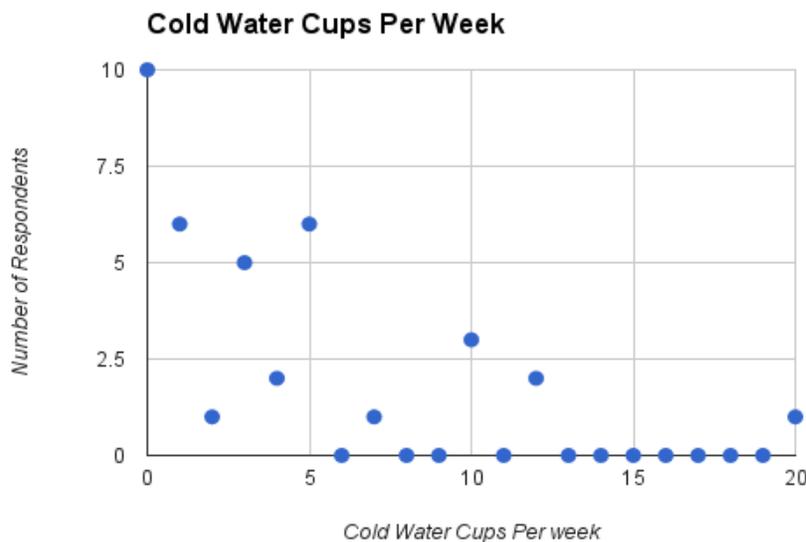
We began with the standard Belmont water cooler in the Thea Bowman AHANA Multicultural Center. Upon plugging in the Kill-A-Watt meter, the screen read zero because there was no energy immediately being used on this device. However when we pressed the nozzle for hot water and dispensed a hot water cup, the numbers on the display dramatically increased revealing the wattage power consumption for one cup of hot water. After collecting this first number we waited until the power consumption on the meter returned to 0 watts, and then we performed the same process for the cold cup of water. Using this same process we then gathered data on the power consumption on the Alpine filtered tap water cooler.

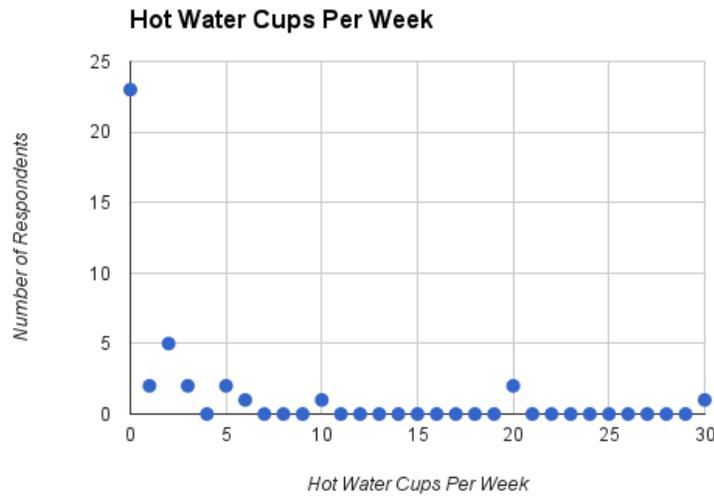
IV. RESULTS

A. Faculty and Staff Survey Results

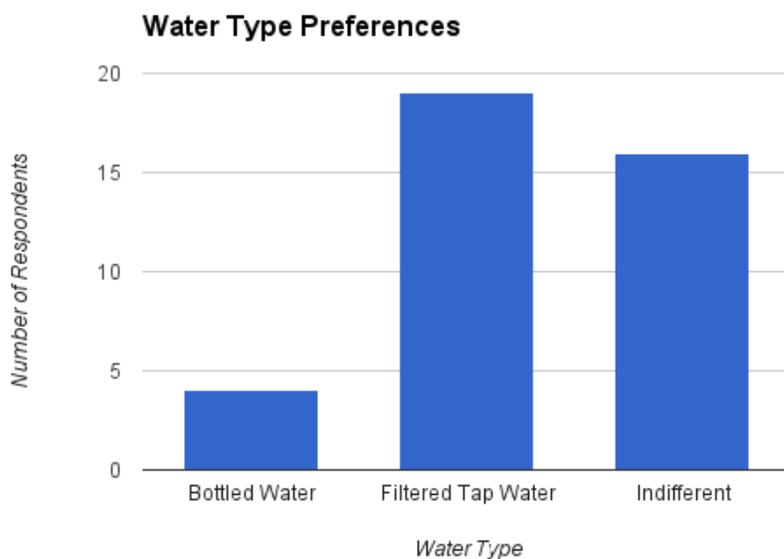
After submitting the survey to several departments, we allowed a two-week response period in which we gathered answers from 39 Boston College faculty members. All of those respondents answered every question which resulted in a better understanding for us about what the campus culture is like surrounding water coolers.

The first question asked how the respondent many cups of cold water he or she took per week out of their office water cooler. The responses had large variation with a range from 0 (10 or 25.6% of responders) up to a maximum of 20 (1 respondent). Overall the mean number of cups taken from the water cooler was 3.79 cups of cold water per week. The second question asked the same thing but this time inquiring about the number of hot cups of water taken from the office water cooler. Again the variation we found surprised us with a range from 0 (23 or 58.9% of respondents) to the maximum of 30 (1 respondent). This time the overall mean number of hot water cups was 3.69 cups taken per week.



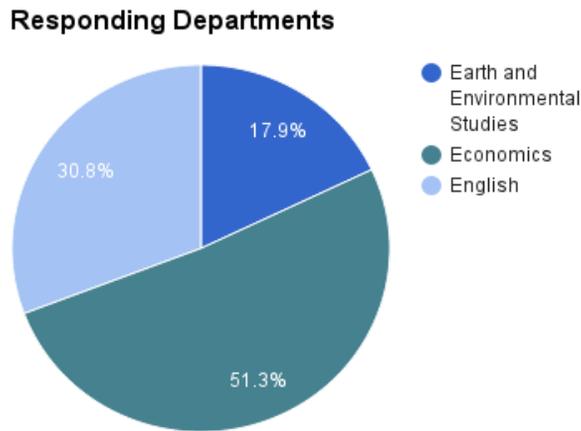


The third question asked whether the respondents preferred bottled water, filtered tap water, or were indifferent to the type of water that they drank. Surprisingly, the largest percentage of respondents preferred filtered tap water. Out of the 39 responders, 19 of them (~49%) stated their preferred filtered tap water. The second largest group was those who stated they were indifferent to where their water came from. This group had a total of 16 responders (~41%). Lastly, and most surprisingly, only 4 respondents (~10% of total respondents), stated that they preferred bottled water. This fact is surprising given the way that in America bottled water is typically perceived (though oftentimes unfoundedly) as being healthier or safer.



Another interesting facet to these results is where our results came from. The final question of the survey asked which department the respondents worked in. This would allow us to make sure that the results weren't confounded by a specific department's behavior or building location. Seven respondents were from the Earth and Environmental Studies department, or 17.95% of total respondents. Twenty respondents, or 51.28% of total respondents, were from the Economics department. The remaining twelve respondents, or 30.77% of total respondents, were from the English department. We sent the survey to the administrative assistant in the Carroll School of Management but she either did not send the survey to the department or the members of the Finance department were not interested in completing the survey.

This survey was sent out so that it would cover as many different buildings (Stokes, Devlin, Fulton, and Maloney) and as many different disciplines (Science, Social Science, Business, and Humanities) as possible while keeping the overall response group small. The surveys were taken voluntarily, which could confound the results.



B. Campus Inventory Results

The results of the campus inventory of water coolers were particularly interesting. We gathered that there were two types of water coolers present on Main Campus: Alpine brand filtered water coolers and the typical Belmont brand office water-cooler.

Gasson Hall, the oldest building from the survey, opened in 1909 and has obviously undergone renovations since that time⁷. The building did have the typical freestanding office water cooler but there were also two locations that had Alpine filtered water units. Only Gasson Hall and Maloney Hall had a combination of the two different styles. Maloney had three stand alone Belmonts and one Alpine filtration that was part of the kitchen. Maloney Hall completed renovations over the summer and thus it has been installed with some of the newest technology. This model of water cooler being built into the kitchen is a modern idea that is witnessed in the newest buildings on campus.

The newest buildings on campus are Stokes North and South which were completed in the spring of 2013. Both of these buildings have full kitchens on several floors in the buildings and thus those kitchens come equipped with Alpine water filtration systems. RDK Engineers constructed Stokes North and South and both buildings achieved LEED Silver certification⁸. This certification is a scale used in recent architecture to help improve the energy efficiency of buildings.

As you can see in Table 1, the range of water coolers on campus can vary slightly but stays consistently around 4, which is the rounded average number of water coolers per building. This table summarizes the data on the total quantities and styles of water coolers across Main Campus that we collected while doing our campus inventory.

<u>Table 1: Water Cooler Inventory</u>									
<u>Building:</u>	Cushing	Devlin	Fulton	Gasson	Higgins	Lyons	Maloney	Stokes North	Stokes South
Belmont	4	4	5	4	3	7	3	0	0
Alpine	0	0	0	2	0	0	1	2	4

⁷ "Boston College." *Welcome to BC*. N.p., 25 Apr. 2015. Web.

⁸ "Boston College Stokes Hall Commissioning." *Boston College Stokes Hall Commissioning*. N.p., n.d. Web. <<http://www.rdkengineers.com/BostonCollegeStokesHallCommissioning.cfm>>.

C. Kill-O-Watt Results

After our survey of the different water coolers on campus found two different types of water coolers, we used the Kill-O-Watt meter to test their power consumption. The results showed that there is actually almost no difference between the power consumption of a filtered tap water cooler and of a bottled water cooler. This result is not very surprising in retrospect, but it was not what we expected.

Table 2 summarizes what we found using the Kill-A-Watt meter to test the energy consumption of the different cups of water. Upon testing the Belmont bottled water cooler we found that one 8 oz cup of water took 480 watts of power to make. After waiting for the meter to return to zero, we tested a cold cup of water and found that an 8 oz cup of water took 114 watts of power to make. The same process took place for the Alpine water cooler and we found the exact same amount of energy was used in a hot cup of water but slightly more was used to make a cold cup of water (120 W).

<u>Table 2: Water Cooler Power Consumption</u>		
	Hot Water	Cold Water
Alpine	480 W	120 W
Belmont	480 W	114 W

These results show that the power consumption of the filtered tap water cooler was almost identical to the power consumption of the bottled water cooler. The only difference was that it took 6 more watts of power to make a cup of cold water. This could be because of the energy used to move the water through the filter, or because of filtering itself. However, it is quite similar.

D. Calculation Results

The final step of our results is an estimation of the actual amount that water coolers use on campus. This requires a calculation that combines all of the data collected up to this point. This calculation will compare the overall energy difference between both types of coolers. The overall calculation of energy usage will be done using the following formula:

$$Kw = \frac{C \times W \times N}{1000}$$

Where Kw is the energy expended per week, C is the mean number of cups used, W is the energy expenditure per cup, and N is the number of Boston College Faculty. We found online that Boston College employs 758 full time faculty.⁹ While it would be naive to assume that a sample of 39 adequately expresses the behavior of the other 699 faculty, the range of answers as to water usage make it seem likely that it gives a good estimation.

In order to find how much energy both the Belmont and Alpine water coolers per week to make cups of water expend, we must make two different calculations. For Belmont, the calculation follows: $(3.79 \times 114 \times 758) / 1000$. This shows that every week, if Boston College had only Belmont bottled water coolers, it would expend 327.5 Kw of energy a week on cups of cold water. For Alpine coolers the calculation follows: $(3.79 \times 120 \times 758) / 1000$. If Boston College only used Alpine filtered tap water coolers, it would expend 344.73 Kw of energy a week on cups of cold water. This shows that using exclusively Alpine water coolers would lead to a 17.23 Kw increase of energy usage per week.

In order to find how much energy water coolers hot water Belmont and Alpine water coolers per week to make a cup of hot water would expend only requires one calculation, as each variety uses the same amount of watts per cup. The calculation is as follows: $(3.69 \times 480 \times 758) / 1000$. Using either type of water cooler leads to an energy usage of 1342.57 Kw per week.

V. Discussion

The results of our study were not what we expected them to be, but they were also not surprising. There is virtually no difference between the energy that is used by a Belmont tap water cooler or by a Alpine filtered water cooler. There is only a 6 Watt per cup difference between a Belmont cooler and Alpine cooler with cold water, and none at all with hot water. We

⁹ "Boston College Facts." Boston College. Boston College, Sept. 2014. Web.

expected the filtered water coolers to use more energy in the process of filtering, but this isn't true. We also thought that, because they don't have the advantage of gravity to make the water move through the machine, they would use more energy. Both of these possibilities were proven wrong. While this sameness might seem to make it hard to make conclusions based off of the data, it actually helps to support our position. This will be outlined more thoroughly in the conclusion.

One of the more interesting things that we learned was that hot water is used by less people than cold water, but that a few outliers make the mean almost the same. Around 25% of faculty does not use water coolers for cold water, but almost 60% of them don't use water coolers for hot water. Their means are almost the same, though, because 3 of hot water drinkers drink 20+ cups a week, while only 1 cold water drinker drinks 20+ cups a week. These hot water drinkers might just be hopelessly addicted to caffeine, but they still drag the mean to a higher number. This does not confound the results though, because our study is about energy usage. Mean may not be the best indicator if we were trying to find out the average behavior of a Boston College faculty member, but it is the best indicator when we're trying to find out how many total cups are made. These outliers still use just as much energy as the person making only one cup a week.

It is also important to note that Boston College faculty either prefer tap water to bottled water or just do not have a preference. Only about 10% of faculty actually preferred bottled water. This runs counter to a public perception that bottled water is safer than filtered tap water. This public perception is actually opposite to the fact, as shown by the introduction. Maybe it is not surprising that college faculty, working at a place dedicated to the pursuit of knowledge, is more likely to see beyond the marketing of bottled water. Regardless, Boston College faculty seems to have no allegiance to bottled water.

Our study attempted to get a sampling of many different academic disciplines and building locations on campus. We were somewhat successful, but our results were far from ideal. The biggest problem is that no one from the Finance department responded to our survey. We tried multiple times to get in contact with the administrative assistant of the department, but to no avail. As a result, one of our fields (business) and one of our buildings (Fulton) was not counted. There were more problems with our sampling, as Economics was slightly more than half of all respondents. This could be for many reasons; some possibilities are that Economics is a bigger

department than the others, or that Economists just like surveys. Regardless, this discrepancy in our research should be noticed.

It is worth reiterating that many faculty members do not use water coolers at all. A quarter of them do not use them for cold water, and over half do not use them for hot water. This is a large percentage of the overall group, and might indicate that there are more water coolers than are needed on campus.

VI. Conclusion

After completing our analysis we have come to some clear conclusions on the topic of water coolers at Boston College. One of the most important and interesting facts came from our energy consumption calculations. Upon completing our calculations on the energy consumption of water coolers, we found very little difference and thus cannot suggest simply based off of those numbers whether one water cooler brand is more economical than the other. However, if we expand the scope of our picture we might realize that filtered water coolers, such as the Alpine brand cooler, are the long run solution to water cooler problems. These devices are installed once and then run through the plumbing system. Additionally, any cleaning could be learned in house by facilities services or even a member of the staff.

The typical free-standing water coolers, such as the Belmont brand, bring with them a myriad of other environmental externalities. These coolers must be first delivered from the company, then 20L jugs delivered on a regular schedule and then empty ones must be dealt with. The life cycle of those typical water coolers, filled with the externalities of water transportation costs, the cost of throwing away or recycling the empty jugs, and the health risks we learned about all point to filtered tap water as the best long run solution.

Another extremely interesting and important discovery came from our survey of faculty. The result that these staff members are either indifferent or prefer tap water when they choose to use a water cooler. Regardless of the reasons for this opinion amongst professors, it is important to note that a transition from the typical water coolers to the more modern filtered tap water option would not be met with any sort of resistance. In fact some professors might even applaud this measure. Since filtered tap water has much less environmental externalities, it is almost

identical in energy consumption, and the majority of professors would prefer that style of water cooler, it seems a pretty clear solution to the discussion.

The number one lesson from this study, however, is the need for Boston College to centralize its information on the water cooler inventory at BC. Without this central database, we were unable to accurately assess the total amount of energy being consumed on campus. Potentially if we had a clearly image of water cooler energy usage as well as water usage, we could have come to a more concretely founded solution. Having a centralized database would also improve difficulties with cleaning and hopefully prevent issues of contamination that we became aware of in our discussion of water quality. Rather than ceding this control to the departments, we recommend BC Faculties Services take control over the inventory of water coolers. This way they may track the usage so as to minimize energy consumption. Currently when there are water coolers present on every floor they may only be used several times a day, but if there were fewer and they were placed in more strategic positions then they would be used much more effectively.

Similar to how BC Dining was able to monitor its food waste so that they could limit the amount of food they were over producing, monitoring the usage of water coolers could result in an awareness of water coolers that may be unnecessary. This sort of centralized information could yield new results that we have not even expected. Also since departments are not able to install the filtered water coolers on their own, incorporating this aspect into Boston College Faculties would then present the possibility of this renovation.

Overall this project has given water coolers the attention they so often do not receive. It not only brought to light some interesting information on campus preferences and availability of water coolers, but we also hope to bring an interesting discussion of water quality and the issues of sustainability when two appliance might have similar energy consumptions. With our recommendations to centralize as well as consider transitioning to filtered tap water, we now hope that the conversation does not end here. Issues of sustainability and health can be answered on the smallest level and this project is the perfect example of that.

Works Cited

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