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Geo Sciences 206
Final Paper

Reusable Napkins in Williams College Dining Halls

(I) Introduction

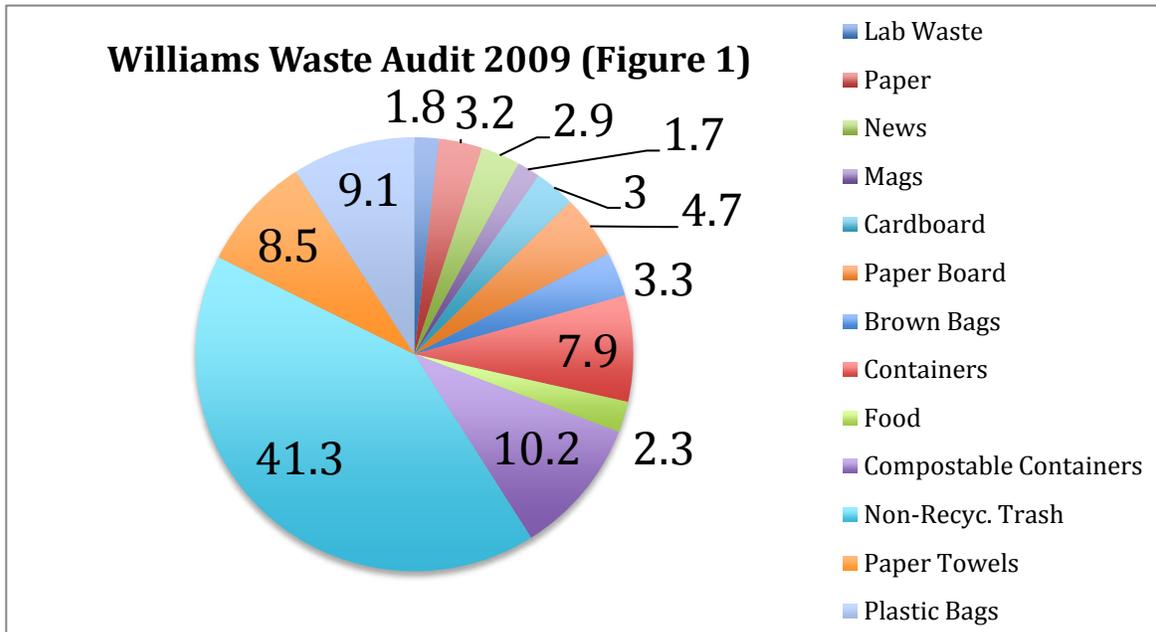
At Williams College there is a movement on campus to make the school and the surrounding area more environmentally friendly by teaching sustainable practices and promoting the use of green technology. As part of this movement there are many projects underway, ranging from sustainable water use to greening light fixtures to the reduction of waste and CO₂ emissions. I have chosen to look at the dining halls and one of their biggest contributors to their annual waste and the annual waste at Williams: paper napkins.

(II) Why Napkins?

There are many other areas on campus that could use the “greening”, so why target napkins at dining halls? During a 2009 waste audit of Williams College conducted by the Zilkha Center for Environmental Initiatives, paper towels and napkins were found to comprise 8.5% of the total waste at Williams (see figure 1).¹ This number seemed too high for me to just accept, especially since there seemed to be many reasonable ways to go about reducing this waste. Of the different solutions to this problem, the one I chose to research was the use of reusable cloth napkins,

¹ Class Slides. “Managing and Measuring Sustainability Part 2 April 8—2010”. April 8, 2010.

specifically what the environmental and economic impact would be of switching from paper to cloth napkins.



(III) Napkin Facts At Williams

I did some fact-finding about the current environmental and economic impact of the paper napkins. After contacting Chris Abayasinghe, the Assistant Director of Dining Services at Williams, I found out that the college spent \$9,000 on napkins during the 2009-2010 school year, which totaled up to 6,552 pounds of paper napkins. Disposing of all of these napkins would have an estimated environmental impact of 9,394 pounds of CO₂ emissions and 61 million BTUs of energy as well. With these numbers in mind, it was time to begin the process of figuring out if a switch from paper to cloth napkins was the right move for the college to make.

(IV) Cloth Napkins On A Williams Campus

Many hotels and restaurants across the country use cloth napkins as their napkin of choice, so why not Williams? The price of the napkins themselves is very affordable. In fact, I found a deal online where the school could purchase five cloth napkins for every student, faculty, and staff member (approximately 3,000 persons) for \$320 less than the cost of purchasing paper napkins for the entire year.² This is just one website I consulted, and I would imagine that, if Williams were interested in pursuing such an avenue, they could find an even cheaper quote than I did. However, as I will demonstrate, the upfront economic cost of purchasing the napkins is only part of the story when considering a possible switch.

In order for the paper napkins to be successfully replaced by cloth napkins for at least one meal per week there will be many steps that have to be followed. First of all, once the napkins are used, they will have to be disposed of in containers that are separate from the food. These containers will then have to be picked up by somebody and have their contents (the napkins) transported to a washing facility. I have identified the Athletic Center and Cole Field House as the best possibilities for washing facilities. This is for two reasons: first, both are relatively close to what are going to be the three dining halls on campus in future years (Paresky, Driscoll, and Mission). Secondly, both of these facilities have large industrial washers and dryers that are used to clean the practice garments and game uniforms of the student-athletes at Williams. Therefore, both of these facilities have the opportunity and ability to serve as washing facilities.

² www.efavourmart.com

After the napkins are laundered they will need to be transported back to the three dining halls where they will have to be folded and prepared for student and faculty use at the next meal.

(V) Washers and Dryers

In the Athletic Center there are two washers and two dryers. The washers are fifty gallons each and the dryers can hold up to seventy-five gallons. Both of the washers and one of the dryers are from the UniMac Company and the second dryer is from American Computer Dryer. The majority of the information I was able to attain about these pieces of equipment came from phone interviews with employees of both of these companies. Any heating done for these machines (the water for the washers and the heat for the dryers) is done by gas. One dryer uses 263,000 BTUs of gas per hour to run while the other dryer uses 200,000 BTUs of gas per hour. The washers use 0.45 kW of electricity per cycle, with an average cycle lasting thirty minutes. There is some electricity used in the process of drying, however, this information was unable to be provided by the companies due to them not having any record of this information. In light of this, the cost of electricity for the dryers will not be calculated, although it can be estimated that in comparison to both the amount of electricity used by the washers, as well as the amount of energy used by the gas to heat the dryers, the electricity used to run the dryers is a negligible amount when considering the grand environmental and economic impact. It should also be noted that a drying cycle appropriate for cloth napkins would take approximately 40 minutes.

So the big question is, “Would a switch from paper to cloth napkins be affordable as well as sustainable?” There are many variables that need to be considered when answering this question, such as the number of napkins the college buys up front, the frequency with which the napkins are used and washed, and how often these napkins need to be replaced.

(VI) Example Scenario

In this example scenario I will be calculating the environmental and economic impacts of using 2,000 cloth napkins per week, i.e., enough for every student on campus to use a cloth napkin for one meal per week. If the school were to use the deal I found on efavourmart.com to purchase their cloth napkins, the price for 2,000 napkins would come in at \$1,024. For this example I am going to assume that 20% of these napkins have to be replaced every year. This means that before the start of every school year the school will need to purchase 400 new cloth napkins, coming in at \$215.80.

For this example I am also going to assume that the cloth napkins are transported to and from the washing facilities by student workers either on bikes or by cart, thereby reducing the amount of CO₂ emitted during the transportation and also limiting the additional cost brought on to the school throughout this process. The napkins will be washed in cold water, removing the need to pay to heat the water, and they will be washed and folded by student workers as well. Finally, I am going to estimate that it will take five loads of wash every week to wash all of the napkins. I am arriving at this estimate by relating the amount of material in the

machines when the men's basketball team has their practice uniforms washed to the equivalent amount of material I believe would be able to fit in the machines if they were filled with cloth napkins. Essentially, all twenty pins from the basketball team can fit into one washing machine, and I am estimating that twenty cloth napkins could fit on each of these pins. This comes in at 400 napkins per load of wash, leading me to my estimate of five loads of wash to clean all 2,000 napkins. Likewise, I will also be assuming it takes 5 loads of drying to finish the cleaning process.

Focusing on the environmental and economic impact of washing the napkins now, I will first look at the electricity. According to Don Clark of the Williams College Heating Plant, Williams pays \$0.12 per kWh of electricity. Going back to Section V, we see that the washers use 0.45 kW of electricity per cycle, with the average washing cycle lasting thirty minutes. Multiplying these numbers by the estimated five loads (cycles) of wash per week, we see that the washers will be using 1.125 kWh of electricity per week, costing the school approximately \$0.14 per week. Using the calendar from the 2009-2010 school year, we can see that there are 29 weeks of school, including Winter Study and Reading Periods. This brings the total price of electricity to run the washers for the entire year to \$4.06.

In order to estimate the environmental impact of using 1.125 kWh of electricity per week I will use a conversion formula from the second homework exercise of the semester. This formula says that electricity emits 0.41 kg of CO₂ per kWh. Multiplying this out show us that every week the electricity used to run the washing machines will emit 0.461 kg of CO₂, which means that over the course of the school year 13.37 kg of CO₂ will be emitted.

The next step is to figure out the cost of water. Since the water will not be heated, there will not be any CO₂ emitted during this process. With the washers using 50 gallons of water every load, there will be 250 gallons of water used every week. The price of water hovers around \$0.0002 per gallon, bringing our weekly cost of water to \$0.51 and our yearly cost of water to \$14.79.

The dryers are the biggest energy hogs during this process. For simplicity sake I am going to say that only the bigger of the two dryers will be used, the one that uses 0.263 MMBTUs per hour compared to the one that uses 0.2 MMBTUs per hour. As I state in Section V, the running time of these machines is forty minutes, which means their MMBTU consumption will have to be multiplied by 2/3 in order to find out how much energy is used per drying cycle. Doing so gives us 0.1753 MMBTUs per cycle, and doing five cycles per week means that 0.8765 MMBTUs of gas will be used per week. This means that 25.4185 MMBTUs of gas will be used per year, which converts to 254.185 therms per year. As with the price of electricity, the price per therm of gas was given to me by Don Clark, coming in at \$1.10 per therm. This means that over the course of a school year the school would have to spend \$279.60 to heat the dryers in order to clean the napkins once a week. Looking to the second homework exercise of the semester, once again, it can be found that gas emits 52.94 kg of CO₂ per MMBTU. Simple multiplication shows us that this weekly drying would emit 1,345.7 kg of CO₂.

(VII) In Total

Summing up all of the numbers from this example scenario, we arrive at grand totals of 1,359.07 kg of CO₂ released every year along with an annual fee of \$514.25, which includes the cost of replacing 20% of the napkins every year along with the cost of running the washers and dryers for five cycles once every week. There would be the initial starting fee of \$1,024 for the first 2,000 napkins, but there is also the possibility that the school is able to work out a better deal than what I found online. There are also the wages that are going to have to be paid to the student workers who are doing the washing, drying, folding, and transporting of the napkins. At the Athletic Center I earn \$8.00 an hour, so I will use that wage for my model and estimate that the total time will take to do the aforementioned tasks will be five hours per week, costing the school an additional \$40 per week and \$1,160 per school year. However, this could be a gross overestimate of the amount of time additional time it will actually take as the folding of the napkins could be done while the students are on duty but without other tasks that need to be done. This would bring the annual cost up to \$1,674.25.

Now that I have the totals figured out for using 2,000 cloth napkins per week, I need to figure out what the total would be for using paper napkins the rest of the week. According to Chris Abayasinghe, the school bought 1,404,000 napkins for the 2009-2010 school year. Dividing this number by the number of meals available to students per week (20) and the number of weeks during the school year (29), I find that almost 2,421 napkins are used per meal, which translates to 1.21 napkins used by every student at each meal. Essentially, if the school were to buy enough cloth

napkins such that every student could use one every week, we would decrease our paper napkin consumption by 2,421 napkins per week. Considering 48,414 paper napkins are used on a weekly basis right now, our new total for paper napkins per week would be 45,993. According to Chris, the napkins come in cases of 6,000 individual napkins and the school bought 234 of these cases last year. Recalling that we spent \$9,000 on these 234 cases of napkins, we derive that the cost per case is \$38.46. A decrease of 2,421 napkins per week means a decrease of 70,209 napkins per year, which is 11.7 cases, or \$450 dollars that the school would be saving every year by using paper napkins for one less meal per week, which almost covers the entire annual cost of switching to cloth napkins minus the cost of labor.

In Section III I stated that the total weight of the school's paper napkins was 6,552 pounds, which I calculated from a website that sold napkins in bulk.³ I then searched for a conversion between paper, CO₂ emissions, and energy use, but was unable to find one for napkins. I was, however, able to find this conversion for 100% recycled newspaper, so I used the napkin weight and took the energy and emission numbers from this calculation.⁴ This gave me a total energy use of 61 million BTUs and 9,394 pounds of CO₂ emissions. However, if cloth napkins were introduced for one meal a week, that would bring down the total weight of the napkins to 6,224.4 pounds and the environmental impact to 58 million BTUs of energy and 8,924 pounds of CO₂ emissions. This would be a decrease of 3 million BTUs of energy and 470 pounds of CO₂ emissions, or 213.63 kg of CO₂.

³ <http://www.papersourcemfg.com/soft-nature/dispenser-napkins.asp>

⁴

<http://www.edf.org/papercalculator/index.cfm?action=calculate&mode=individual>
&

In conclusion, the reduction of CO₂ emissions by using less paper napkins is not enough to combat the CO₂ emissions from the washing and drying of the cloth napkins once per week, and once labor costs are included in all of this, cloth napkins become far less economically intriguing as well.

(VIII) Final Thoughts

While in many scenarios cloth napkins are the more environmentally friendly option, it appears that in this case this does not hold true. The biggest problem that is holding the cloth napkins back is the washers and dryers, specifically the energy to heat the dryers. Every time I talked to a representative from UniMac or American Computer Dryer they commented on how “old” our machines are. There are now “green” washers and dryers sold by UniMac, so looking into these to upgrade our current machines may be a good option. Then the numbers could be re-run to see if cloth napkins are a more viable option.

To address our napkin consumption and disposal in the immediate future we may have to look for solutions outside of the cloth realm. One solution that has been brought up, and is likely to be enacted, is that the paper napkins be disposed up with the food compost. This would require us to find a facility that will process the paper products along with the food, but, like I said, this seems as if it’s about to be taken care of in the very near future.

Another solution may be to change how we disperse of the napkins themselves. Currently, they are kept in containers that float around from table to table, with most tables having one container. It is unclear as to whether or not

moving the napkins to a stationary spot next to the silverware, for example, would lead to students using fewer napkins because they have to get out of their seats to grab them, or if they will grab significantly more than they need when they grab their silverware so they don't have to get up to grab more later. I think the only way we're going to know what will happen in this case is to have a trial period and see how the students react.

In the mean time, let's all buy local and wipe our mouths with our hands so we can avoid the dining halls and paper napkin use altogether. Cheers!