FOOD WASTE AT BOSTON COLLEGE SPORTING EVENTS

Report of the Waste Audit of Conte Forum and Possible Solutions

Taylor Blake, William Lee, and Megan Sonier

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Environmental Studies Department

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ABSTRACT

With the 2014 Commercial Food Waste Disposal Ban, Boston College (BC) must look for ways to reduce food waste stream to landfills. Food waste, when dumped in a landfill, emits methane, a greenhouse gas 21 times more potent than carbon dioxide (EPA, 2015). While studies have been conducted to assess and reduce the amount of waste generated by on-campus dining halls, no such study has measured the amount of waste produced at Conte Forum, BC's ice hockey and basketball arena, which operates up to 16 concessions food stands.

This study presents the data collected through the performance of a waste audit at two sporting events at Conte Forum. A waste audit is is an analysis of a specific facility's waste stream, which identifies the types of waste generated and the methods in which it is disposed of. We broke our audit down into two separate studies: 1) waste generated by BC concessions and 2) waste generated by consumers post-purchase.

We found that currently, all food waste produced at Conte Forum is directed to landfills. Furthermore, the majority of the waste produced at a single sporting event can be attributed to the vendor side of the equation, with the consumers-driven waste, on average, only compromising 14 percent of the total waste generated. We then used the data collected through this audit to make projections on different waste scenarios based on game attendance, the environmental and social impacts of the food waste generated, before exploring solutions to reduce Conte Forum's food waste.

INTRODUCTION

A food system is the energy input, land-use changes, and resource consumption necessary for the complete process of bringing produce and livestock from the farm to our plates. This system includes the deforestation necessary to create fields, the process of soil tilling, the application of chemical fertilizers and pesticides, the use of irrigation and watering technologies, the method in which the produce is harvested, and the ways in which the produce is packaged, transported, stored, and prepared. Moreover, food systems include the disposal of food waste

(i.e. the transportation of wasted produce to a management facility and the way in which it is disposed).

The Food and Agriculture Organization of the United Nations (FAO) defines food waste, as referring to "food appropriate for human consumption being discarded, whether or not after it is kept beyond its expiry date or left to spoil. Often this is because food has spoiled but it can be for other reasons such as oversupply due to markets, or individual consumer shopping/eating habits (FAO, 2013). More than one third of all the food produced globally does not reach a mouth. This is the equivalent of over 1.3 billion tons of food and 1 trillion dollars thrown into landfills, tossed down the garbage disposal, left to rot in the back of the fridge, or neglected in the field (National Geographic, 2015). Every step of the food system requires immense amount of water, energy, and land inputs. By throwing away food, we are essentially throwing away all of these resources that were used in the production of that food. Equally as significant as the amount of resources that are input into the production of our food is the amount of greenhouse gases that are emitted at every step in the production process. According to National Geographic, agriculture contributes more to global climate change "than all of our cars, trucks, trains, and airplanes combined (National Geographic, 2014).

However, the effects of wasting food is not limited to the production process. Over 30 million tons of food waste is sent to landfills each year in the U.S. alone (EPA, 2015). In landfills, organic materials, like food scraps, are broken down by bacteria to produce methane. Methane, a potent greenhouse gas, is shown to have a warming potential of 21 times that of carbon dioxide (EPA, 2015). According to National Geographic, if all of the food waste directed towards landfills was a country, it would be the world's third largest emitter, right behind China and the United States.

Small lifestyle changes made by individuals, such as buying less food at the grocery store or reusing leftovers, can make a considerable impact. However, institutions, such as college campuses, have significantly more power and reach to affect environmental change than one individual student does. By promoting sustainable and environmentally friendly consumer habits on campus, colleges are able to influence the behavior of a large group of people at once.

Additionally, the students being targeted by colleges are in positions to become the future leaders of our world. By exposing them to "green" initiatives and environmentally conscious consumption habits, these emerging leaders are more likely to adopt these habits into their future profession and respective fields, incorporate them into their daily lives and pass these habits down to future generations.

Universities must feed large numbers of people everyday, all day. In doing so, dining services imports, processes, prepares and ultimately, wastes, high volumes of organic produce. Despite the fact that Boston College Dining Services is rated among the top 75 university food providers (LeanPath, 2015), they are not free from food waste. 14 dining establishments are operated on campus, conducting 23,000 transactions every day (LeanPath, 2015). In addition to the daily provision of food for its students, as a D1 level collegiate sports institution, Boston College caters to thousands of spectators from all over the country. The food waste that accumulates from discarded popcorn and un-eaten soft pretzels is another layer to the complex food system of the university.

With the 2014 Commercial Food Waste Disposal Ban, Boston College must look for ways to reduce food waste stream to landfills. This will involve a coordinated effort in transforming student behaviors and innovating new dining service initiatives. Specifically, this report will focus on reducing the waste generated at Conte Forum, BC's sporting arena that hosts ice hockey, basketball, and a variety of other campus events. This arena has the ability to hold a maximum seating capacity of 8,606 fans, in addition to the numerous employees, athletes, and team personnel, which gives this location the potential to generate a lot of organic waste in a small time frame. By focusing on Conte Forum and BC sporting events, there is opportunity to dramatically reduce the waste produced on campus by both students and spectators.

METHODS

In order to figure out ways to reduce waste at large scale sporting events at BC, we needed to conduct a Waste Audit of Conte Forum. A waste audit is an analysis of a specific facility's waste stream. It identifies what types of waste the facility generates and how much of

each category is recovered for recycling or discarded. The audit is then used to make projections on feasible ways to reduce landfill waste, and increase recycling practices, while potentially saving money on waste disposal.

In this waste audit, we decided to divide our data collection into two different categories.: the waste generated by vendors and the waste generated by consumers. In this case, our vendors were the concessions team, a catering group contracted by Boston College Dining Services and Boston College Athletics. Waste on the vendor side would include any food item that was left unpurchased at the end on the day and ultimately discarded. On the consumer side, waste was considered anything that was found in the arena's trash bins at the end of the game.

Furthermore, we decided to conduct our research at two separate games. We chose the BC Women's Basketball v. Louisville on Sunday, February 21st at 1 PM (Game 1) to represent a small scale game. We also chose to attend the BC Men's Basketball v. Virginia Tech game on Tuesday, February 23rd at 9 PM (Game 2) to represent a large scale game. Having a large scale and small scale game allows us to gain insight on the differences in waste generation when different number of people are in attendance.

To get data on the vendor side we contacted Paul Flaherty, the manager of concessions. Flaherty walked us through of the entire concessions operations, including the kitchen, the vending stations, and the waste facilities. We also received a complete data sheet from concessions on how much food was purchased, how much was prepared, how much was wasted, and how much will be reused. Records are taken at every concessions stand in order to track waste.

In order to see how much food waste ended up in the trash on the consumer side, Bob Pion, the program director of sustainability, contacted facilities to collect the trashes around the concourse after the games. We arranged to have the trash brought to the landing zone, where we weighed all of it collected during the respective games. After, we opened each bag individually and sorted out the food scraps and recycled bottles. We weighed all of the food waste on a scale to get a percentage of the waste that could potentially composted.

As expected, there were limitations to our study. Human error is something that was considered in our waste audit. On the consumer side, we also have to take into account human

error including accuracy and precision of the scale used to weight waste. The scale, kindly lent by Robert Pion, was only able to measure the mass of the trash bags to the nearest 0.50 lbs. Although we used the scale to the best of our abilities, having a less than ideally accurate scale increases the margin for error in measuring the weight of both the total waste and the food waste. Additionally, popcorn and liquid sauces were very difficult to collect and we could not collect it all, as much had fallen out of the serving bags and into the bottom of the trash. Moreover, a conscious decision was made to audit only what was thrown away into the trash bins located in the main concourse of Conte Forum. We did not collect trash from what was left under seats in the arena or in the locker rooms. Along those lines, if someone left a full pizza under their seat or if the athletes threw away parts of their pregame meals, we were unable to incorporate that additional waste to our data. Similarly, any waste produced and thrown away in the VIP Suites were not taken into consideration due to lack of access. Finally, we had hoped to collect data from a men's ice hockey game, which is consistently BC's largest sporting event hosted in Conte Forum, as well as to collect data on the financials of concessions. However, we were restricted access to both by Boston College, limiting our investigation to the two basketball games in our study.

RESULTS

VENDORS

After all of the data on the vendor side of our waste audit was collected, we received a copy of concessions' records for both games, as shown in **table 1** and **table 2**. In these records, there was a discrepancy in the numbers that were recorded and the numbers that we collected from Flaherty at the time of our audit. Due to the fact that it was up to the employees, who are often student volunteers attempting to raise money and service hours for campus organizations and clubs, running individual concession booths to fill out the charts, the data was often unreliable or simply absent. Additionally, we were not provided data for every booth or vendor cart open for each game that we attended. Numbers that we found questionable are highlighted in red and areas that were left unrecorded are filled in with a '?.' Specifically, we found the largest

discrepancies to be amongst the soft pretzel data that was recorded by concession and the data that we collected ourselves at the end of both games (see **table 3**).

Conte Forum's concessions is comprised of two permanent Papa Gino's stands; six permanent stands that sell hotdogs, nachos, drink, soft pretzels, and prepackaged snacks; and eight mobile specialty carts, which include packaged ice cream, sausage, Meatball Obsession, clam chowder, chili, pulled pork, cotton candy, popcorn, and grab n' go items. However, not every stall is opened at each game. For estimated small games, like Game 1, fewer stands will be opened and fewer food options are made available for purchase. Additionally, at every game, all stands stop selling and shut down 10 minutes after halftime concludes

All food waste generated on the vendor side is disposed of in the trash, nothing is composted. Items such as bagged chips, bagged peanuts, boxed candy, cotton candy, and packaged ice cream never produce any waste, due to the fact that they non-perishable, individually wrapped, and easy to store. On the other hand, grab n' go items - another individually wrapped item that includes pre-made sandwiches, salads, apple dippers, and vegetable trays - are made by BC dining services and imported from Lyons Dining Hall. Generally, concessions only brings in a few of these items and whatever is left will either be used to feed staff or is thrown away. However, in the event of larger volumes of leftovers, these items will be transported back to Lyons for student consumption the next day. The records given to us by Flaherty gave us no indication which scenario occurred after our waste audit.

Much of the food products sold by concessions first imported to Conte Forum frozen. For instance, the cheese and pepperoni personal pizzas come in frozen from Papa Gino's Inc. and are heated and made to order. The same goes for chili, clam chowder, pulled pork, and Meatball Obsession, all which come in frozen and are cooked as demand is placed. If these frozen items are heated and left unsold at the end of the day, they cannot be refrozen and will be discarded. However, the items that never leave the box and remain unthawed are able to be stored in the freezer and reused throughout the rest of the week. This keeps the waste for pre-frozen food items relatively low, as the are directly controllable by the individual stand managers, based on the day.

Hot dog meat and buns are other items that produce a relatively small amount of pre-consumer waste. Hot dog buns arrive to Conte Forum fresh and bulk-packaged. Once they arrive, the buns are good for three days. For Game 1, the hot dog buns that we saw were new and the remaining 240 buns leftover at the end of the game were stored and saved to be used at Game 2 three days later. However, after Game 2, all 1104 unsold buns had to be discarded at the end of the night. The hot dog links, like the personal pizzas, are kept frozen in the freezer and are perishable as soon as they are cooked. Any hot dog links that have been boiled are immediately placed inside of a hot dog buns and packaged in a foil pouch, ready to serve. Once both items are packaged, if they are not sold, they will be thrown away at the end of the night.

Popcorn and nacho chips, however, have shelf-lives similar to that of the hot dog buns. For popcorn,, once popped on the weekends, it can last up to five days. Therefore, the popcorn that was popped on Saturday for Game 1 and that remained unsold was reused at Game 2 on the following Tuesday. Additionally, the leftovers from Game 2 were then saved for Thursday's game. Nacho chips, as long as they are not removed from their bulk-packaging and placed on an individual nacho tray with cheese, can be stored and saved for up to five days as well.

We found that the food product that is wasted in the highest volumes was the soft pretzels. These pretzels are baked fresh by a local retailer for each game and if they are not sold during a game, they cannot be stored and reused for a later game, so they are directed straight to the trash (**table 3**).

Additionally, in Game 2, VIP boxes were open. The food for these boxes is pre-selected from a special menu by the box holders, which is then cooked in Walsh Hall by BC Catering Services and transported to Conte Forum. Food selections for these boxes tend to be more upscale than the usual concessions menu, consisting of options such as shrimp cocktail, fruit and cheese platters, and buffalo wing trays. Once these items are prepared and placed on the counter for consumption, they cannot be salvaged if left uneaten.

CONSUMERS

We discovered that Conte Forum is equipped with 19 trash bins and 21 recycling bins. After weighing all of the trash bags from Game 1 and Game 2, we found that the total weight of

consumer generated, post-purchase waste was 54.0 lbs and 61.0 lbs, respectively (**table 4**). After separating the food waste from the total waste and weighing it, we found the weight of the food waste to be 6.0 lbs at Game 1, and 10.5 lbs at Game 2. We then used these numbers to calculate the percentage of the total waste that was food waste, finding that at Game 1, about 11% of the total waste was organic (**figure 1),** and at Game 2, about 17% of the total waste was organic (**figure 2)**.

Although we were unable to attend a large scale game, such as a men's ice hockey game, we were able to use these numbers in order to estimate the potential waste generated by consumers, had attendee numbers been greater:

A typical Boston College NCAA men's ice hockey home game typical draws in an average of 4,965 fans, which is 63 percent of Conte Forum's total ice hockey capacity of 7,884 people (USCHO, 2016). Game 1, a small scale game, had about 1,000 attendees, which is more than the NCAA average of 800 (NCAA, 2015). Game 2, although predicted to host about 3,000 fans, ended up only hosting 1200 people. For basketball games, Conte Forum is setup to be able to hold a maximum capacity of 8,606 fans (NCAA, 2015).

If we divide the total amount of waste generated by consumers in pounds by the amount of attendees per game, we can calculate that at Game 1, each person generated 0.054 lbs of waste and at Game 2, each person generated 0.051 lbs of waste. By averaging these two numbers, we can estimate that at a typical sporting event at Conte Forum, 0.0525 lbs of waste is generated per person.

If we multiply this number by the average numbers of attendees at a men's ice hockey game, we can estimate that 260.7 lbs of waste would be generated. Furthermore, using this same method, if Conte Forum was at maximum capacity, 451.8 lbs of waste would be generated post purchase.

Similarly, we can calculate that at Game 1, 0.006 lbs of food waste can be attributed to a single person and at Game 2, one person contributed 0.00875 lbs of waste. Taking the average of these two numbers, we find that an individual can be estimated to waste about 0.00738 lbs of food. Projecting this number to an average men's ice hockey game, we can calculate that about 36.62 lbs of food would be wasted, about 14 percent of the total waste. If Conte Forum was at

maximum capacity, 63.5 lbs of food would be wasted by consumers, about 14.1% of the total waste.

During the 2015-2016 season, Conte Forum hosted 14 women's basketball games, 17 men's basketball games, and 18 men's ice hockey games. It is notable to point out that concessions does not operate at women's ice hockey games. If we take the average game attendees (as projected by the NCAA), we can calculate that about 168,689 people in total attended games this season. This would equate to 8,856 lbs of total waste and 1,257 lbs of food waste that is produced by consumers.

According to the Waste & Resources Action Programme, 1 ton of food waste results in 3.8 tons of greenhouse gas emissions (End Food Waste, 2013). Using this, is we convert the total weight of post-consumer food waste generated during the 2015-2016, that we calculated above, into tons, we get 0.6285 tons. This would equate to 3.8 tons of greenhouse gas emissions, or 4600 lbs of greenhouse gas emissions produced by the food that Conte Forum directs to a landfill in one season.

Using waste emission calculation tools provided by the Environmental Protection Agency, and assuming that the only greenhouse gas emitted from landfilled food waste is methane, we discover that 4600 lbs of methane is equivalent to 11 passenger vehicles driven for one-year, the CO_2 emissions from 55,670 lbs of coal burned, the CO_2 emissions from 5,870 gallons of gasoline consumed (EPA, 2015).

This would be a low estimate, considering that Conte Forum hosts a number of events other than sporting events throughout the year, such as Pops! On the Heights, The Annual Showdown, Pep Rallies, and Concerts, etc., for which concessions is in operation. Additionally, this number only considers the food waste that ended up in the trash cans at the end of the night, it does not include the food waste left in stadium seats or produced by concessions.

According to the United States Department of Agriculture, the average adult American eats about 5.5 lbs of food each day, or the equivalent of 2,700 calories (USDA, 2001) . Although this number is above the necessary nutritional requirements for an average adult human, we can calculate that the waste produced by Conte Forum during the 2015-2016 season had the potential to feed at least 228 people for a full day.

DISCUSSION

The results of our study show that sporting events at Boston College waste a great deal of food that ultimately ends up in landfills. Although recycling efforts have been implemented at Conte Forum and are relatively successful, food waste remains an issue on both the vendor and consumer side. If a better waste management system, such as composting, was implemented, BC could divert a significant amount of food waste from landfills. Not only will this eventually save BC money, but it would also be much more environmentally and socially sustainable.

Throughout the course of the waste audit of Conte Forum, we discovered that there are a variety of issues that contribute to the amount of food waste produced. One such issue includes infrastructure limitations that restricts the amount of perishable food that can be kept on site. Conte Forum is only equipped with one freezer, which is extremely small relative to the amount of food that is purchased, prepared, produced, and ultimately sold to consumers. This results in Boston College Dining Services having to purchase from its vendors in smaller quantities more frequently. Although one may assume that doing so would reduce food waste because items are not bought in bulk, the reality is that a reduction in freezer space leads to unused products not being able to be stored. These unused products, once opened, thawed, or cooked, must be thrown away due to lack of storage space.

An additional problem that was discussed with Flaherty is that the current infrastructure of the concessions team does not allow for the use of promotional deals to boost sales in times when it becomes apparent that too much food has been ordered for a particular game. When presented with the suggestion of potentially offering a two-for-one deal towards the end of games, a potential solution for reducing perishable wasted products at Conte Forum, Flaherty responded that he does not have the advanced signage to quickly promote this nor the cash registers necessary to process these transactions. However, the addition of a simple button on a cash register would require weeks to months to gain approval. Furthermore, Flaherty stated that he would not have the authority to initiate such deals, and would need prior approval from his supervisors.

Flaherty described to us the many factors that go into deciding how much food he chooses to order for a given game. The number of attendees at an athletic event is correlated with the amount of food sales that BC Concessions prepares, so one of Flaherty's main jobs is to make an educated guess as to how many people will attend each game. Additionally, he must consider what types of food people will be more drawn to buy that day. Some of the factors that he considers in this prediction includes:

1) Time of the game - if the game falls around lunch time, people tend to buy more entrees, such as pizza or sausages. Whereas if the game is at night, more snack-type foods are purchased.

2) Weekend vs. weekday- more people typically attend games on Thursdays, Fridays, Saturdays.

3) Type of game - men's athletic games attract a larger audience than women's athletic games and men's hockey games attract a larger audience than other men's athletic games.

4) Weather conditions - if it is predicted to rain or snow, less people will attend. Additionally, when the temperature is cold, fans tend to buy comfort foods such as chili and soup, and when the temperature is hot, more ice cream is sold.

5) Midterm seasons / vacation periods- There will be much less of a student population and therefore less food consumed.

6) Other sporting events - Flaherty has noticed that less people attend games when the New England Patriots are playing.

7) Who will be attending - Young girls attending a women's basketball game have smaller appetites than those of college men.

8) Religious events - being a Catholic school, Flaherty noted that less people attend games on Sundays due to church. He also pointed out during lent, he must provide more vegetarian options on Fridays.

Being able to accurately predict the attendance is crucial in effectively managing the waste being produced, as it is usually difficult to reuse over-purchased or over-produced goods. Predictions on game attendees as well as purchasing directly from vendors are at the sole discretion of Flaherty, and so the process can be very subjective. If there was an algorithm that was created

that could calculate the factors aforementioned such as time of game, inclement weather conditions, etc., it could be implemented to reduce human error and relegating the entire process to a 'guessing-game.'

As big time sporting events tend to produce lots of waste, efforts to divert waste from landfills are becoming more and more popular. Many sporting venues have successfully implemented various waste reducing solutions to mitigate this problem. These changes to diminish waste set an example to everyone who involved in the sports world. In fact, going green in the sports world is proving to be a business model for other big businesses.

In analyzing different case studies, the National Resources Defense Council, or NRDC, has found venues that have made changes to be more environmentally aware have benefitted immensely from these changes. In fact, according to the NRDC, "all commissioners of professional sports leagues in the United States have made commitments to environmental stewardship and are actively encouraging the teams in their leagues to incorporate sustainable measures into their operations" (NRDC, 2014). Although there are many ways to go green at sporting venues, effective waste management programs have diverted tons of landfill trash while saving organizations money.

Going green, and specifically composting, on a large scale presents difficult challenges, but has worthwhile results. The Seattle Mariners set an example for the rest of the sports world to follow. In 2006, Scott Jenkins took over as vice president of ballpark operations with the desire to make the stadium more efficient. As a founding member of the Green Sport Alliance, Jenkins states, "It's an opportunity to drive financial performance, reduce your costs and green your brand, which gives you the ability to sell to more people and build a deeper relationship with your customer. Reducing your environmental impact is an opportunity to do the right thing a business" (NRDC, 2014). By establishing a zero waste goal, the mariners have diverted tons of trash from landfills. In doing so, Over 2.4 million pounds of recyclable materials, including paper, plastic, glass, aluminum, food waste, grass clippings and other organic matter was composted or recycled last season. By making changes in the waste system, they increased waste diversion rates from 12 percent in 2006 to 81 percent in 2011, saving $95,000 in landfill

costs in 2011 and reducing greenhouse gas emissions by 10.4 million pounds (CO2-equivalent) from 2006 to 2011.

The San Francisco Giants divert the most waste out of any professional sports venue in North America. The Giants' aggressive recycling and composting program has ratcheted up their waste diversion rate from 57 percent in 2009 to over 86 percent in 2013(NRDC, 2014). According to Jorge Costa, senior vice president of ballpark operations, one secret to the team's success is hand-sorting waste. "We process all waste at the end of the game by hand as it comes through the loading dock," Costa said. "Even though it's costly and a dirty job, we get our money back and definitely see dividends." Unlike the Mariners, the Giants decided to take on composting their products behind the scenes. Although it is more time consuming, a composting system like that minimizes contamination. However, like the Mariners, the Giants have taken extensive measures to divert waste from landfills. In doing so, they are acting to preserve our planet while simultaneously saving money.

Collegiate sports are also making strides to implement "zero waste" policies. The University of Colorado Boulder is a pioneer in the field, setting realistic but aspirational goals and standards for other college venues. From 2008 to 2012, the program collected more than 394,000 pounds of recyclable and compostable materials. This included more than 100,000 pounds of cans and bottles and 151,000 pounds of compostables from inside the stadium. (NRDC, 2013). Folsom Stadium reduced its waste by roughly 38 percent from 2008 to 2012 by implementing intensive composting and recycling initiatives. The zero waste initiative was branded "Ralphie's Green Stampede" by the athletics department to market the program, which was a success as many outside companies worked with the school to contribute to its success. As it is debatably the most successful collegiate green program, understanding the trials and tribulations they faced can aid in other schools adopting similar sustainable practices. The greatest challenge for green sports projects is related to developing a support for change. Dave Newport, the director of CU- Boulder's Environmental Center, stated "It takes a campus to green sports and recreation. All that we have accomplished in sports and recreation is the result of a campus-wide commitment to sustainability" (NRDC, 2013). Getting everyone involved in various ways brings a sense of unity to the school, while also educating about sustainability.

Like the Seattle Mariners and the University of Colorado Boulder, BC should strive to meet a zero waste goal. In order to solve this issue, BC needs to commit to take charge and it expands beyond just the athletic and concessions departments. The solution to food waste on the vendor side is slightly less complicated. In regards to the logistical and infrastructure issues that were introduced earlier, there is much that could be done if financial investments were made by Boston College Dining Services' management team. One such aforementioned change could be the creation and implementation of an algorithm that would more accurately predict the attendance at games. Flaherty has extensive experience doing so over the years, but the margin for error is still much too great and the amount of food (pretzels in particular), is still significant enough that more must be done. Introducing calculations that take into consideration the multitude of factors that determine the number of attendees at a sporting event would make the entire process much more efficient and less wasteful. Additionally, a seemingly simple solution to reducing waste is to increase the freezing space inside of Conte Forum itself. BC Concessions uses a sole freezer that is much too small to accommodate the needs of an arena that has a maximum capacity of 8,606 people. If an additional freezer could be purchased, this would open the gateways for perishable items being able to be stored for a longer period of time as well as items being purchased more in bulk, reducing the costs per unit. Although it may be a large upfront financial investment, the economics of cheaper products being purchased in bulk would eventually make up that difference. In regards to environmental impact, there is no dollar amount that can be attached to making the world a better place for our future generations.

An additional solution to reducing the food waste and overall carbon footprint generated during athletic events held at Conte Forum could be establishing a connection with a food recovery organization. It had been found in *American Wasteland: How America Throws Away Nearly Half Of Its Food (And What We Can Do About It*, that food recovery programs have been extremely efficient and effective in taking excess food from restaurants, vendors, and even farms and reusing them to distribute to those in need (Bloom, 2010). A potential issue that may arise is that most food recovery programs are partnered with local grocery stores for fresh fruits, vegetables, and meats. However, if a relationship could be established with a food recovery program such as Rock and Wrap it Up, then it would be mutually beneficial to both parties. This

particular organization is partnered with numerous franchises across the spectrum of US sports, including the NBA, NHL, NFL, MLS, and the MLB in order to collect unsold product to provide food for food shelters and soup kitchens (Johnston, 2015). Conte Forum, similar to the athletic facilities of these professional sports franchises, does not produce the healthiest of food options. For this reason, many local food banks will not accept their leftover pretzels and hotdogs. It has been shown through non-profit food donation organizations such as Rock and Wrap it Up, however those food banks who are willing to accept items from Conte Forum are usually unable to commit to picking them up same-day. Due to the limited storage space, concessions is unable to store them overnight for food bank employees to pick up later. If professional sports venues can have a positive contribution to food donations, so can collegiate athletic venues such as our very own Conte Forum, which some small structural adjustments, such as increasing storage space.

Successfully composting on the consumer side has proven to be difficult for every sport venue. Properly disposing of products, to prevent contamination, is critical in successfully composting. In order to reduce waste on the consumer side at Conte Forum, there has to be a university wide initiative. In order to be successful, concessions must collaborate with diverse campus stakeholders. To encourage interdepartmental buy-in, sports greening initiatives should align with campus-wide sustainability goals. Also, support and involvement from BC students is critical for success. Students can aid in educating the general public, as well as helping in actual waste sorting events. If, and only if, everyone buys into this change, a composting system in Conte Forum is a definitely feasible solution. Along with student and fan engagement, practicality of disposing of waste is important in limiting waste contamination. Investing in the right product and signage is the first step to successfully composting around the concourse. As our study found food waste to be approximately only 14 percent of total waste, looking into compostable packaging would divert many more tons of landfill waste. Although it does not mitigate the food waste issue, it would save in overall waste production. As there is a more competitive market for compostable packaging, the price for these products has lessened in recent years. Instead of sending food packaging straight to the landfill, investing in compostable products reduces landfill waste which reduces environmental impacts and eventually cost.

CONCLUSION

Conte Forum is the second largest athletic facility on the Boston College campus and as such, contributes a lot of waste to the environment and produces a much larger carbon footprint than most people realize. One of the most feasible methods to reduce this carbon footprint is tackling the issue of food waste. It was discovered throughout the study that much of the food waste was produced on the vendor side, behind the scenes. Although the occasional consumer may throw away a full hot dog or pizza, much more food was wasted through overproduction, lack of storage space, and over purchasing of goods. Therefore, efforts to reduce food waste should be focused on the vendor side, whether it is through the potential solutions proposed previously or other creative solutions.

With this assessment, it is acknowledged that substantial and meaningful change can only be made if the Boston College Dining Services management team takes a leadership stance for the cause of sustainability. It is clear that there are steps that can be taken place to make the entire process much more efficient. However, a commitment towards reducing food waste must be made by all those involved, as our research has shown that it is clearly possible.

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EXHIBITS

Table 1: Vendor Data from Game 1 (measured in single portion sizes)

Women's Basketball v. Louisville - Saturday, Feb. 21 @ 1 PM						
Food Item	**Beginning Inventory**	**Employee Meals**	**Wasted Product**	**Product Sold**	**Ending Inventory**	**Percentage Wasted**
Bagged Chips	67	0	0	14	53	0%
Bagged Peanuts	10	0	0	1	9	0%
Boxed Candy	225	0	0	93	132	0%
Cheese & Pepperoni Pizza	372	13	11	132	216	3%
Cotton Candy	?	?	?	?	?	?
Grab n' Go Items	12	0	?	1	11	?
Hot Dog Buns	320	7	22	73	240	6.9%
Hot Dog Meat	180	7	22	18	140	12.2%
Nachos	25	?	?	?	?	?
Package Ice Cream	?	?	?	?	?	0%
Popcorn	?	?	0	?	?	0%
Soft Pretzels	75	2	3	70	3	4%

Stalls	Amount Open	Data Collected
Pizza:	2 out of 2	2 out of 2
Hot Dog:	2 out of 6	1 out of 2
Specialty Carts:	2 out of 8	0 out of 2
VIP Boxes:	Not Open	N/A

Table 2: Vendor Data from Game 2 (measured in single portion sizes)

Men's Basketball v. Virginia Tech - Tuesday, Feb. 23 @ 9 PM						
Food Item	**Beginning Inventory**	**Employee Meals**	**Wasted Product**	**Product Sold**	**Ending Inventory**	**Percentage Wasted**
Bagged Chips	185	0	0	38	147	0%
Bagged Peanuts	71	0	0	28	43	0%
Bakery Items	?	?	?	?	?	?
Boxed Candy	439	0	0	71	368	0%
Cheese & Pepperoni Pizza	396	3	4	83	306	1%
Chili	?	?	?	?	?	?
Clam Chowder	?	?	?	?	?	?
Cotton Candy	?	?	?	?	?	?
Grab n' Go Items	33	0	?	5	28	?
Hot Dog Buns	1200	15	1104	81	1104	92.0%
Hot Dog Meat	1540	15	81	217	1220	5.3%
Meatball Obsession	?	?	?	?	?	?
Nachos	88	0	58	30	58	65.9%
Packaged Ice Cream	?	?	?	?	?	0%
Popcorn	?	?	0	?	?	0%
Pulled Pork	?	?	?	?	?	?
Sausage	?	?	?	?	?	?
Soft Pretzels	325	6	206	113	206	63.4%

Stalls	Amount Open	Data Collected
Pizza:	2 out of 2	2 out of 2
Hot Dog:	4 out of 6	4 out of 4
Specialty Carts:	6 out of 8	0 out of 6

Table 3: Discrepancies in Soft Pretzel Data (measured in single pretzels)

Game 1	Beginning Inventory	Employee Meals	Wasted Product	Product Sold	Ending Inventory	Percentage Wasted
Data from Concessions	75	2	3	70	3	4%
Data by Us	200	?	137	?	137	69%
Game 2						
Data from Concessions	325	6	206	113	206	63.4%
Data by Us	625	0	510	115	510	82%

Table 4: Consumer Generated Waste

Women's Basketball v. Louisville - Saturday, Feb. 21 @ 1 PM		
Total Waste Weight (lbs.)	**Total Food Waste Weight (lbs.)**	**Percent of Waste from Food**
54.0	6.0	11.1%
Men's Basketball v. Virginia Tech - Tuesday, Feb. 23 @ 9 PM		
Total Waste Weight (lbs.)	**Total Food Waste Weight (lbs.)**	**Percent of Waste from Food**
61.0	10.5	17.2%

Figure 1:

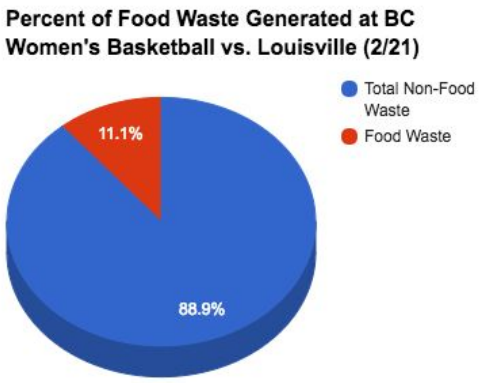

Figure 2:

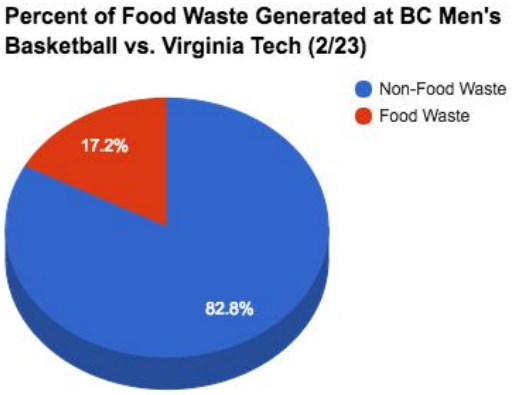

Figure 3: Consumer-generated waste, collected at the end of Game 2 for our waste audit

Figure 4: Tools used for the waste audit: bins for separation and the scale at Game 2

Figure 5: Separation of food waste from total consumer generated waste at Game 2

Figure 6: Lee and Sonier separating consumer waste during waste audit for Game 2

REFERENCES

Belson, Ken. “Recycling Peanuts and Cracker Jack.” *The New York Times.* 22 April 2015: Web. Accessed 29 Jan. 2016.

Bloom, Jonathan. *American Wasteland: How America Throws Away Nearly Half Of Its Food (And What We Can Do About It).* Cambridge, MA: Da Capo, 2010. Print.

"Case Study: Ohio State, Home of the Buckeyes." *NRDC Collegiate Game Changers: How Campus Sports Are Turning Green* (2013): 35-38. Web. Accessed 15 Mar. 2016.

Collins, Andrea, Calvin Jones, and Max Munday. “Assessing the environmental impacts of mega sporting events: Two options?” *Tourism Management* Vol. 30. Issue 6. (2009): 828-837. Sciencedirect. Web. 2 Feb. 2016.

End Food Waste Now. “Facts.” 2013. Web. Accessed 3 May 2016. http://www.endfoodwastenow.org/index.php/resources/facts

Environmental Protection Agency. “Greenhouse Gas Equivalencies Calculator.” EPA, San Francisco, October 2015. Web. Accessed 3 May, 2016. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

Environmental Protection Agency. “Turning Food Waste into Energy.” EPA, San Francisco California, October 2015. Web. Accessed 2 Feb. 2016. http://www3.epa.gov/region9/waste/features/foodtoenergy/food-waste.html.

Food and Agriculture Organization of the United Nations, “ Food Wastage Footprint: Impacts on Natural Resources.” *FAO Summary Report.* 2013. Web. Accessed 13 Feb. 2016. http://www.fao.org/docrep/018/i3347e/i3347e.pdf.

Ferris, D.A. “Proximate analysis of food service wastes.” *Applied Engineering in Agriculture* Vol. 11. Issue 4. (1995): 567-572. Scopus. Web. Accessed 29 Jan. 2016.

Johnston, Marsh W. "Sports Teams Build Food Recovery Awareness." *The Organics Recycling Authority*. BioCycle, June 2015. Web. Accessed 27 Apr. 2016.

National Resources Defense Council. “Collegiate Game Changers: How Campus Sport is Going Green.” By Alice Henly, et. al. New York, August 2013 (NRDC Report 13-08-A). Web. Accessed 3 May 2016. https://www.nrdc.org/sites/default/files/collegiate-game-changers-report.pdf

National Resource Defense Council. "Game Changer: How the Sport Industry Is Saving the Environment." By Allen Hershkowitz et al. New York, September 2014. (NRDC Report 12-08-A). Web. Accessed 3 May 2016. https://www.nrdc.org/sites/default/files/Game-Changer-report.pdf

National Resource Defense Council. "Guide to Composting at Sporting Events." By Darby Hoover, et al. New York, 2014. (NRDC Report 13-11-C) Web. Accessed 2 Feb. 2016. http://compostingcouncil.org/wp/wp-content/uploads/2015/06/sports-venue-composting-guide.pdf.

National Resource Defense Counsel. "Waste > Composting." *Greening Advisor for Collegiate Athletics & Recreation.* 2016. Web. Accessed 13 Feb. 2016 http://collegiate.greensports.org/waste/composting/.

National College Athletics Association. "2014 NCAA Men's Basketball Attendance." NCAA, 2014. Web. Accessed 13 Feb. 2016. http://fs.ncaa.org/Docs/stats/m_basketball_RB/Reports/attend/2014.pdf.

National College Athletics Association. "2015 Division I Women's Basketball Attendance." NCAA, 2015. Web. Accessed 13 Feb. 2016. http://fs.ncaa.org/Docs/stats/w_basketball_RB/reports/Attend/15att.pdf.

Smith, Roff. "How Reducing Food Waste Could Ease Climate Change." *National Geographic.* Washington D.C. January 22, 2015. Web. Accessed 2 Feb. 2016. http://news.nationalgeographic.com/news/2015/01/150122-food-waste-climate-change-hunger/.

United States Department of Agriculture. "Profiling Food Consumption in America." *Agriculture Fact Book.* USDA, 2002 2001. Web. Accessed 13 Feb. 2016. http://www.usda.gov/factbook/chapter2.pdf.

United States Department of Agriculture. "The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States." By Jean C. Buzby, Hodan Farah Wells, and Jeffrey Hyman. Washington: Government Printing Office, February 2014. (*Economic Information Bulletin* No. 121).