Divesting from Disposables:

An analysis and proposed plan for banning the sale of disposable water bottles at the University of Washington's Seattle campus

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Project Abstract

The University of Washington prides itself on being a leader in sustainability, but it is currently not doing all that it can to reduce carbon emissions and the waste that ends up in landfills. In particular, the UW continues to allow the sale of disposable water bottles, which contribute to the University's carbon footprint and the amount of plastic it sends to landfills. While many universities across the United States have banned the sale of disposable water bottles on their campuses, including five Washington State schools, the University of Washington has not made an effort to do the same. To address this problem, my project identifies the critical steps that the University of Washington needs to take in order to stop selling bottled water at their Seattle campus. To do this I wrote a report analyzing the human, environmental, and economic impacts of divesting from disposable water bottles on the University of Washington Seattle campus and then created a set of suggestions for the administration, detailing what needs to be done for the University to successfully stop selling bottled water. Getting the University of Washington to divest from selling disposable plastic water bottles on its Seattle campus will benefit student and environmental health.

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Introduction

This project aims to address the unsustainability of products sold at the University of Washington's Seattle Campus (UW). While the majority of Housing and Food Services (HFS) at UW now uses compostable materials for packaging, the items sold in the vending machines and bottled beverages sold in campus markets are not compostable. These beverages require plastic containers because of their long shelf life, but these containers create pollution at every stage of their life cycle: production, transportation, consumption, and disposal. Because they are such a small item, disposable water bottles are an often forgotten source of pollution, both in terms of pollutants that enter your body when you drink from them, and in terms of environmental pollution.

The unsustainability of, and health concerns related to disposable plastic water bottles has led campuses around the world to stop selling bottled water. One organization supporting campuses making this change is Ban the Bottle. This organization provides resources for groups trying to get their campus to stop selling bottled water and tracks what campuses have committed to or are working to "ban the bottle." According to Ban the Bottle, as of august 2017, 85 colleges around the world are working towards or have successfully stopped selling bottled water. While there are many large universities on this list, the University of

Washington would be the largest in the world if it were to also ban plastic water bottles.

The goal of this project was to analyze the pros and cons of the University of Washington divesting from selling disposable water bottles at its Seattle campus, and then create a plan for how the UW would go about divesting from disposable water bottles. To do this I analyzed the human health, environmental, and economic impacts of disposable water bottles. I also researched what steps other schools have taken to successfully ban the sale of disposable water bottles, and what changes did not work. I then synthesized my findings and created a list of recommendations for the University of Washington administration. These recommendations include suggestions for physical changes, policy changes, and increased outreach about the sources of water available on campus. Finally I conducted a preliminary cost benefit analysis to see whether banning disposable water bottles would be economically feasible or not.

Methods

Introduction

My project consisted of three main components. I first conducted a literature review that reports the differences between how disposable water bottles and tap water impact, human health, the environment, and economics. For the second part of my project I analyzed two case studies, Western Washington University and Seattle University. Both of these Washington State schools have similar characteristics to the University of Washington and have successfully banned the sale of disposable water bottles on their campuses. For the final portion of my project I created a list of suggestions for the University of Washington administration or a registered student organization that wants to take on this project, including policy changes, infrastructure changes, and reporting changes.

Literature Review

My literature review culminates information from scholarly sources and popular press sources. I included both types of sources in my literature review because I wanted to get a holistic view of the issues. The peer reviewed journals were important sources of credible scientific information, while the popular press

sources gave information on public opinion and what information is available to the general public. The publics' opinion on bottled water is an important factor in my research, because I need to know where opposition will come from and where support will come from.

My literature review is broken down into three main sections based on the three pillars of sustainability. The first section addresses the human health impacts of bottled water and compares these impacts to those of tap water. My main concern with this was making sure that the tap water at the University of Washington is safe to drink. I would not want to advocate for a policy change that has negative human health impacts. I researched where the University's water comes from, the safety of this water, and the safety of the water passing through the University's infrastructure. Then I looked at the health impacts of bottled water. I wanted to know whether bottled water really was healthier or safer to drink than tap water, like it is often advertised as being. To investigate this I looked at several peer reviewed journals that examined chemicals put into bottled water, chemicals leaching from the plastic into the water, and environmental conditions such as temperature that change the amount of contaminants in the water.

For the environmental portion of my report I used the University of Washington's "Climate Action Plan" to guide my research so that it is relevant to the University's goals. I investigated the carbon footprint of disposable water bottles

and how this relates to the carbon footprint of tap water. Next I compared the sustainability of tap water to that of bottled water over the course of the products life times by looking at life cycle assessments for both products. Then I looked at the solid waste generated by disposable water bottles, specifically at the University of Washington Seattle Campus. Because there is a large difference in the environmental impact on a water bottle that is properly recycled, and one that is thrown in the garbage or just thrown out into the environment, I also investigated what percentage of bottles sold at the university of Washington are properly disposed of. Finally I looked into the environmental impacts of improperly disposed of plastic bottles, specifically when they end up in the marine environment.

The third portion of my literature review looks at the economic impact of banning the sale of single use water bottles on the University of Washington's Seattle campus. To do this I conducted research on how many water bottles are sold on the campus, how much profit the University makes on these bottles, and how are partnership with Coca Cola will impact our ability to ban the sale. Some of this information comes from articles and publically available information, but much of it was attained through an interview with a Housing and Food Services (HFS) staff member.

Case Studies

I looked at two schools as case studies for my project, Western Washington University and Seattle University. I chose these schools because they are two out of the four schools in Washington State to successfully ban bottled water and they had information available on their bans (Ban the Bottle, 2017). Evergreen State College is also consistently listed by news organizations as having banned the sale of bottled water, but little can be found about it on their sustainability site, and it appears to be less of a policy than a campus wide movement. Gonzaga University was the first school in Washington State to ban the sale of disposable water bottles on their campus. Gonzaga banned the sale at all ZagDining facilities on campus back in 2008 (Campus Sustainability Initiatives, 2018). Because this initiative happened so early in comparison to many sustainability movements at universities across the country, this actually happened before the University had a sustainability office or committee. It was not until 2009 that the Advisory Council on Stewardship and Sustainability (ACSS) was created, and then in 2015 transitioned to the campus sustainability committee (Campus Sustainability Committee). Because there was not yet an office of sustainability at Gonzaga, there is very little information available about how their bottled water ban got started. The ban was brought about in the end through an initiative through the Gonzaga Student Body

Association (GSBA), but I could not find information about how it was proposed to be on the ballot (Schick, 2009). This lack of information available to the public is what prevented me from using Gonzaga as a third case study for my project.

Western Washington University and the University of Washington have similar campus cultures. Both Western Washington University and the University of Washington are located in Western Washington and have similar attitudes about sustainability and the environment. Western is also the only other public University in Washington State to ban the sale of single use water bottles, and the largest university in the sate to do so as well. Western made all of the documents that they used, including a timeline of events leading up to their ban, publically available online, which made researching Western extremely easy, and provided a good bases of what to look for in my other case studies.

Seattle University has a different campus culture than the university of Washington, being so much smaller with “only 4,647 undergraduate students” in the fall of 2017 (Seatte University, 2018), compared to the University of Washington’s 30,475 (University of Washington, 2018). Seattle University is also a private Jesuit Catholic University, while the University of Washington is a public institution. While these are large differences between the two institutions, both are also located within the City of Seattle city limits, and are sustainably minded institutions.

For my case studies I conducted research on what changes needed to be made at their schools before they could ban the sale of disposable water bottles. Most of this research was done through online searches, but some email interviews were conducted. The main things I was looking for through these case studies were to see how their contracts with large beverage corporations, such as Coca-Cola, were affected, what infrastructure changes needed to be made, and what information they make publically available to encourage and support people using reusable bottles.

Final Suggestions

The third portion of my project is a list of suggestions for whoever takes on this project after I graduate. Some of these suggestions are geared towards to the UW administration, including information on why banning plastic water bottles will help accomplish the University's 2020 climate action plan goals and what steps need to be taken to make this work, while others are geared toward the student who is interested in this work, like creating an RSO. I also gave suggestions to what additional information should be made public, and how to conduct outreach to the public and students when the ban is implemented. These suggestions are based off of the information I found during my case studies, and my knowledge of the

University of Washington's Seattle Campus.

Cost Benefit Analysis

The final portion of my project is a preliminary cost benefit analysis of the impact banning disposable water bottles would have for the University of Washington. To do this, I followed the procedures of Megan Curtis-Murphy and Caroline Sessions in their 2014 masters thesis. They completed a cost benefit analysis of banning the sale of plastic water bottles on UW's Seattle campus in 2013, so I followed their methods with updated numbers that I obtained through an interview with Housing and Food Services, and using my proposed suggestions instead of theirs. Because I have not taken a class on economics before, and have no previous experience with cost benefit analysis, this is only a preliminary approach to understanding the economic impact of a ban. A more in depth and thorough cost benefit analysis should be conducted before the ban is implemented.

Literature Review

Introduction

Disposable plastic water bottles made of Polyethylene terephthalate (PET) plastic have increased in popularity over the last thirty years and are now a billion dollar industry. In 2014 the global industry was valued at 170 billion US dollars and it is projected to reach $280 billion by 2020 (John, 2017). This increase in consumption and production means that the impacts of disposable water bottles need to be carefully evaluated, because the impacts are increasing with the increased market demand. Many universities and other organizations have stopped selling disposable water bottles after assessing their impact on the three pillars of sustainability, social, environmental, and economic (Ban the Bottle). This literature review aims to evaluate the impacts of disposable water bottles in relation to the University of Washington. The first section of the literature review addresses the social impacts of disposable water bottles by comparing the health impacts of disposable water bottles to normal tap water on campus. The second section of the literature review examines the environmental impacts of these water bottles, and how eliminating them could help the University of Washington meet its sustainability goals. The third section of the literature review looks at the economic impacts of disposable water bottles on our campus, and evaluates whether it is

economically feasible for the University to stop selling them. Examining the human, environmental, and economic impacts of disposable water bottles helps create a more holistic picture of how disposable water bottles sold at the University of Washington affect us.

Health Impacts:

There is a widespread perception among consumers that bottled water is safer to drink than tap water. In fact, one study done in the United States found that 58% of people said that safety was their main motivating factor when choosing to drink bottled water over tap water (Fox & Staddon, 2011). In many cases though, the water in bottled water bottles comes from municipal sources, just like tap water. This includes all of the water bottled by Dasani, (Charles, 2007) the company that the University of Washington gets their bottled water from (University of Washington, 2017). Dasani gets its water from different municipal sources around the country (Fineman, 2011), and then ships it around the world. Even though consumers usually associate bottled water as being the safer choice, the plastic bottles are actually known to leach toxins. Dasani says their product has a shelf life of 12 months to “hold its crisp, fresh taste” (Dasani, 2018), but part of the reason for this short shelf life is that chemicals are more likely to leach over time, and the

bottles are more likely to be exposed to heat, a catalyst in chemical leaching.

Naphthalene, bisphenol A, and antimony are just some of the harmful chemicals known to be in disposable plastic water bottles (Fox & Staddon, 2011). Antimony is particularly concerning because it can lead to death in higher concentrations, in low concentrations it can lead to dizziness and depression (Krachler & Shotyk, 2009). Knowing that there is a common misconception about the safety of disposable plastic bottles is important to my campaign to ban their sale at the University of Washington's Seattle campus. Breaking the misconception about their health benefits, and showing that they are often more likely to contain carcinogens and other toxins than tap water, makes divesting from disposables the obvious choice.

The University of Washington's Seattle Campus gets their water from Seattle Public Utilities (Kelley, 2005). Seattle Public Utilities regularly monitors their water supply to make sure that it is safe to drink and meets all of the EPA's regulations for safe drinking water. They are also required to publish an annual report detailing the water quality. In 2016, there was not a single chemical that they tested for that was above the EPA's allowable contaminant level (Seattle Public Utilities, 2016).

Despite the water from the vendor being completely safe to drink, I was worried that the Universities' aging infrastructure could mean water leaches chemicals from the pipes on UW's campus. This would mean that water that met

the EPA's standards when it left the vendor, does not meet the EPA standard by the time it leaves the tap. This is a valid concern, as proven by Seattle Public Schools' "Drinking Water Quality Program" tests, which found that some schools with older pipes were leaching lead, cadmium, and copper into the drinking water. The Seattle School District took immediate action to solve this problem by working to replace piping in 62 schools and set up a strict monitoring program for their schools drinking water (Seattle Public Schools, 2018). This is proof that individual infrastructure as well as public infrastructure should be regularly tested to make sure they are not leaching harmful chemicals. In cases where the tap water is not meeting EPA standards, bottled water might be the safest solution.

UW does have a lot of older infrastructure, so concern that the water running through the aging pipes could be picking up contaminants is reasonable, however in 2005 the Facilities Services and Environmental Health & Safety departments worked together to test the water on all of the University's campuses (Kelley, 2005). Through these preemptive tests, they were able to identify any points of concern in the safety of the water and solve the problems that they found. The University of Washington does not conduct annual drinking water assessments however (at least that they publically report on), so there is a risk of future leaching going undetected. The University has also started installing filtered water bottle refill stations in many of the buildings on campus. According to UW sustainability, there

are 17 buildings with these filtered water bottle refill stations (UW Sustainability). This number is out of date though, and there are now even more buildings with these refill stations. These refill stations further filter the water and improve its safety, while providing an easy way for students to use their own refillable water bottle. Overall the UW and Seattle Public Utilities both have worked hard to ensure that the potable water in drinking fountains and sinks on campus is safe to drink and meets the EPA standards under the Clean Water Act.

While we can conclude that the tap water on campus is safe to drink, water in disposable water bottles might not be. Despite the marketing campaigns that lead consumers to believe bottled water is a safer alternative to tap, it has been shown that water stored in disposable plastic bottles can leach chemicals from the packaging. In fact over 50% of the chemicals are not added intentionally, and are migrating from packaging (Bach, Dauchy, Severin, Munoz, Etienne, & Chagnon, 2013). This is particularly concerning because many of the toxins leaching into the water are genotoxins, or toxins that damage DNA and can lead to mutations or cancer (Barthélémy, et al., 2014). While genotoxins are extremely concerning, ingesting them in very small quantities has been shown not to impact human health. Threshold of toxicological concern (TTC) is the term given to the “pragmatic risk assessment tool that is based on the principle of establishing a human exposure threshold value for all chemicals, below which there is a very low

probability of an appreciable risk to human health" (Kroes, et al., 2004). Using this tool, researchers can recommend acceptable daily intakes (ADIs), which are then used as a guideline for consumers or used in regulations created by government agencies. In their 2004 paper on TTC, Kroes et al. value the ADI of genotoxins at 15 micrograms per day for adults (Kroes, et al., 2004).

So is the water in disposable water bottles exceeding the ADI for genotoxins and other contaminants? This depends on a couple of factors, including the temperature the bottles are stored at, whether the water is carbonated, and the percent of the plastic that is from recycled material. When temperatures increase, the leaching of chemicals from the packaging into the water also increases. A study done by Bach and colleagues in 2013 found that ultrapure non-carbonated water packaged in disposable PET packaging at 20ºC (68ºF) had 0.5 micrograms/L antimony (Sb), but when the water was stored at 60ºC (140ºF) for 10 days, the level of antimony increased to 3.5 micrograms per liter (Bach, Dauchy, Severin, Munoz, Etienne, & Chagnon, 2013). This shows a large increase in the amount of antimony (a known genotoxin) leaching into the water when temperature increases. Carbonated water also had a higher level of antimony than pure water, and when combined with higher temperatures the antimony levels were "twice as high as non-carbonated water, suggesting that Sb release was accelerated by carbon dioxide." Sb levels for carbonated water stored at 60ºC (140ºF) for 10 days was 8

micrograms/L (Bach, Dauchy, Severin, Munoz, Etienne, & Chagnon, 2013).

The ability for elevated temperatures and carbonation to increase leaching of toxins from PET packaging into the drinking water is extremely important. Drinking just two 1L carbonated waters that had been stored at 60ºC (140ºF) for 10 or more days would exceed the ADI of at least one genotoxin. While these levels of toxins are concerning, it is important to note that 60ºC (140ºF) is very hot, and most water bottles sold at the University of Washington are probably rarely exposed to temperatures this high. Room temperature is often assumed to be 20ºC (68ºF), where the data showed little impact on leaching. On hot days in Washington, more leaching could occur, but the real concern is water bottles stored next to heat sources. Heat sources could be anything from a vent, to a refrigerator, to a hot car, and storing water bottles next to these sources could expose them to the high temperatures that lead to increased leaching. Cars are a particularly common source of this heat, and even in Seattle, which has relatively mild temperatures, car temperatures can be high enough in the spring and summer to increase leaching. The average Seattle temperature in July and August is about 75ºF (U.S. climate data, 2018), which means that after being outside for an hour, the cars internal temperature is roughly 120ºF (Null). This means that water bottles left in cars over the summer are exposed for long periods of time to temperatures high enough to increase the chemical leaching into the water.

The same study that evaluated the affect of heat on antimony levels in water, also evaluated the affect of heat on other contaminants. They found that both formaldehyde and acetaldehyde were present in bottled water, and that their concentrations also increased with increased temperature. Acetaldehyde was more sensitive to temperature than formaldehyde, and was 4 times higher than formaldehyde concentration at 60ºC (140ºF) (Bach, Dauchy, Severin, Munoz, Etienne, & Chagnon, 2013).

Another factor that can impact the amount of chemicals present in the water is the amount of plastic that is from recycled material, and the quality of the recycling facility. Recycled PET containers are not just from food-safe packages, but also include plastics from things like cosmetics, cleaners, and other household products. The chemicals in these products can be absorbed by their plastic containers, and cause the final recycled product to contain these contaminants. Barthélémy et al. describe four main types of contaminants that can be found in recycled PET plastics. The first is “chemicals from materials other than PET,” these can come from the glues and caps, and they “may be degraded under the high temperatures used to recycle Pet to form potentially hazardous new compounds. The second is “chemicals used in the recycling process.” The third is “degradation products of the PET plastic,” these are parts of the PET itself that break apart and react during the recycling process and can create new compounds. The fourth is

“components of the food packaged in the PET in the first use,” this includes things like fat or oils that are absorbed into the plastic and contaminate the finished product (Barthélémy, et al., 2014). While there are strict guidelines in place to make sure that recycling facilities are creating food safe plastics, it is almost impossible to test every batch of plastic produced, and so instead they perform a test on plastics they know are contaminated, and make sure that their final product does not contain these contaminants (Barthélémy, et al., 2014). The problem with this method is that when the plastic being recycled is more contaminated than those of the test, the final product can contain higher levels of these contaminants than is safe. This leads to an increased leaching into the water itself, and increased consumption of these chemicals by the consumer.

There are health risks associated with both tap water and disposable plastic water bottles, and regulations in place for both products to protect consumers. Even though the bottled water industry has done a good job marketing itself as safe and pure, it is important to know that tap water is also safe and that in Seattle the municipal water consistently meets the EPA’s standards for clean drinking water. It is also important to know that while water in disposable bottles is also usually safe to drink, there are contaminants that can be found in it, and these contaminants are more likely to be present the longer the water is stored and at higher temperatures.

Environmental Impacts:

Aside from human health impacts, disposable plastic water bottles also have large environmental impacts. Most plastics, including those used for disposable bottles are petroleum based and their production contributes to our dependency on fossil fuels. In fact, 8% of the world's oil production goes into making plastics (Halden, 2010). There is also a high carbon footprint associated with disposable PET water bottles; it is much higher than the carbon footprint of tap water (Botto, 2009). The solid waste created by disposable water bottles is a problem, because they are not intended for multiple uses, they generate large amounts of solid waste that need to be dealt with. When this waste is not properly recycled, it can create pollution that negatively affects our environment, especially marine ecosystems.

The carbon footprint, or amount of carbon emitted from a given activity, is extremely large for the production of bottled water. This is because the plastic is made from oil, a fossil fuel, and the oil along with other materials needs to be transported to factories. Then there is also the carbon footprint associated with the transportation of the finished product. In a study done at the University of Siena, bottled water was found to have a carbon footprint roughly 300 times that of tap water (Botto, 2009). This large difference in carbon footprint is an important aspect of my argument that it is better for the University to divest from disposable water

bottles. The University is working hard to lower their carbon emissions by 15% from 2005 levels by the year 2020. Currently the UW has succeeded in lowering carbon emissions by 9% (University of Washington, 2010). The factors going into this calculation currently include emissions from heating and power costs as well as transportation costs. At this time the University is not including the emissions created through the transportation and manufacturing of products sold on campus. If they were to include this information their baseline would be much higher, but there would also be several new ways to lower it, including eliminating products like bottled water from on campus markets and stores. The extremely large difference between tap water and bottled water's carbon footprints could help the University of Washington make that last jump in lowering their carbon footprint, if they were considering products in their calculations.

Packaging of products has started to take up a larger and larger portion of our solid waste. A 2011 paper by Pasqualino found that individuals' disposal of packaging had increased by 24.7% between 1995 and 2005. When looking more closely at the type of beverage packaging, water, juice, and beer are the main contributors to solid waste (Pasqualino, 2011). This is important to my proposal because by banning disposable water bottles, we would eliminate one of the top three contributors to beverage packaging waste from the UW's campus. PET is the most common plastic used in disposable water bottles. According to a life cycle

assessment (LCA) of PET water bottles, the Global Warming Potential (GWP) and Cumulative Energy Demand (CED) both dramatically increase throughout almost every stage of a water bottle's life cycle. The total increase of GWP for a single PET plastic water bottle that is thrown in a landfill is 100%, and the increase in CED is around 100% as well (Pasqualino, 2011). By recycling PET water bottles, both of these indicators can be reduced by 50%.

In 2012, it was found that 2/3 of what was thrown in the trash at UW could have been composted or recycled (University of Washington, 2017). This means that currently, our impact is close to twice as high as it would be if we were recycling every plastic bottle sold on campus. More could be done to lower this metric than just recycling though, by not purchasing and selling the bottles in the first place, we would cut down on their impacts even more dramatically. According to Pasqualino et al., because PET water bottles have short lifespans, "the amount of packaging waste approximately equals the amount of packaging on the market" (Pasqualino, 2011). This means that by reducing our own consumption, we will reduce the amount of PET water bottles on the market, and therefore reduce the amount of packaging waste.

In a LCA comparing tap water to various forms of bottled water conducted by the University of Michigan in 2009, tap water was always the more sustainable choice. They found that bottled water used between 17-32 times more energy than

tap water of the course of its life. It also produces 6-20 times more solid waste over the course of its life and uses 2-3 times more water (Dettore, 2009). Overall tap water is clearly the more sustainable choice.

Mixed recycling, the classification of recycling that PET water bottles fall into, made up 11% of the waste at UW in 2016. The classification also includes cans, cartons, and containers (UW Recycling). There was 1,268 tons of mixed recycling disposed of by the University during 2016 (University of Washington, 2017). Reducing even just one contributing factor to this waste stream, PET water bottles, could dramatically reduce the amount of waste the University is disposing of every year.

When PET water bottles are improperly disposed of, like roughly 2/3 of the ones at UW are, they can cause serious pollution issues. One of the largest problems associated with the PET bottles is their impact on the marine environment. As I discussed in the section of human health impact, the chemicals in the PET bottles can leach into water. This same leaching can occur when the plastic is in a body of water, as when the drinking water is inside the bottle. Not only can the chemicals leach from the plastic into the water, but as the plastic breaks down and becomes smaller it can be ingested by organisms even as small as zooplankton (Law & Thompson, 2014). The chemicals are then directly consumed by these organisms and can bioaccumulate in the food web. This means that while only

small amounts of plastic and chemicals are present in zooplankton, as a small fish, and then a bigger fish, and then a small mammal, and then a shark, eat, the amount of the toxin accumulates and the shark ends up with high levels of toxins in its body.

Microplastics not only contribute to toxicity in megafauna like sharks, they are also creating new habitat for microorganisms. While creating new habitat might sound like a good thing, it can actually disrupt the complex ecosystem it is growing in. This is because the types of microbes that thrive in these habitats are different than those normally found in that region of the ocean, and they can even differ among type of plastic (Law & Thompson, 2014). Because these microorganisms are the base of the food web, disrupting their distribution can change things at all other levels of the food web and completely shake up the marine system.

Disposable plastic water bottles have many negative environmental impacts including a much higher carbon footprint than tap water, the creation of large amounts of solid waste, and pollution problems when the solid waste is improperly disposed of. Banning the sale of disposable water bottles on the UW's Seattle campus could dramatically reduce our solid waste and even carbon emissions. While the UW is currently working on diverting the plastic they are disposing of from landfills, and instead recycling it, more could be done. By not selling the water bottles in the first place, even more waste would be reduced. By preventing these

bottles from ever entering the waste stream we would also be preventing the pollution problems associated with them and the degradation of the marine environment that they are known to cause.

Economic Impacts:

The United States is a capitalist country and while the UW is a public institution, it also functions as a business. Convincing the University to do something that will cost them a lot of money is not easy. That is why the economic portion of this paper is so important. In this section I researched the monetary costs and benefits of a disposable water bottle ban. I started this research by coming up with a list of questions I wanted to answer about the monetary value of disposable water bottles. I wanted answers to the following questions: How many bottles of water does the UW sell a year? How many water bottles has the UW sold in the last 15 years? How much profit do we make off of the bottles? How does our partnership with Coca-Cola affect our sales and purchases of bottled water? What percentage of total beverage sales is bottled water? How many of them are bought with Husky cards? What percentage of total HFS profits is from bottled waters? What options are currently available at dining facilities for getting water (other than bottled)?

I quickly realized that most of these questions could not be answered by looking at information easily accessible to the public, so I got in contact with a staff member of HFS. She was able to answer most of these questions for me, which provided a basis for continued economic research. What was available to the public was a cost benefit analysis of banning the sale of disposable water bottles at the University done by two Evans School students in 2014. This was an extremely useful source of information, but much of the data was outdated. I used their procedures and the updated information I gathered from HFS and the University's sustainability website to redo the cost benefit analysis with updated numbers. The results of this cost benefit analysis can be found later in the paper.

The first question I was hoping to answer was how many bottles of water were sold last year and how many bottles of water were sold in the last 15 years. I was hoping to see if there was a trend in the sale that either followed the national trend of increasing by an 8.5% compound annual growth rate (John, 2017), or if there was a negative trend as awareness of the impacts single use plastics have increased. According to my emails with Kara Carlson, the Purchasing and Project Specialist at HFS, from 2016-2017 HFS "sold approximately 235,272 bottles of water (this includes various sizes and brands such as Smart Water and Dasani)" (Carlson, 2018). Unfortunately the data for the last 15 years is not available. Kara was able to see the sale of "683,904" water bottles from the same products she looked at for

the 2016-2017 sales, which we both agree was much lower than the actual number. Kara believes there may have been a shift in products sold or contract changes, but the information is not available to her because she was not on the staff during that time (Carlson, 2018). According to a report done by Megan Curtis-Murphy and Caroline Sessions, in 2013 the UW was buying and selling about 50,000 20 oz. water bottles ever month (Curtis-Murphy & Sessions, 2014). Which would total about 600,000 water bottles between 2012-2013. Even if the number of water bottles bought and sold significantly decreased during the summer, when fewer students are in attendance, they would still have sold around 400,000 water bottles during autumn, winter, and spring quarter. This number is also only including 20 oz. bottles, while the number for 2016-2017 includes all beverage sizes. If this approximation for 2012-2013 is accurate, there appears to be a decrease in the number of bottled water bottles being sold.

The second question I wanted answered was how much profit the University makes off of bottled water. According to Kara, the university “typically has about a 50% margin on bottled water” (Carlson, 2018). So on a $1.99 20 oz. bottle of Dasani (the average price of this type of water found through surveying campus dining facilities and vending machines), the University makes roughly $1.00 in profit.

The third question I wanted to answer was, how does the University’s partnership with Coca-Cola affect our sales and purchases of bottled water? This

question was particularly important to me because I fear that our partnership with Coca-Cola will cause the greatest push back from the administration, my fear was confirmed by the response to this question I received from HFS. In response to this question, Kara said, “It greatly does. Coca-Cola is a great partner and we do have contract obligations. Bottled water is a huge money-maker for them. However, they are also very sustainability focused. They partnered with us on reusable mugs when we wanted to limit the number amount of paper Coke cups that were hitting the compost stream, and I know their bottles are partly plant-based (working towards a completely plant-based bottle). They are also a water-neutral company, so whatever water they use to produce products they have programs in place to replenish that supply” (Carlson, 2018). While this response was heartening in that it showed Coca-Cola’s willingness to work with the University on previous sustainability initiatives, it also showed HFS’s loyalty to Coca-Cola. They were quick to defend Coca-Cola and the sustainability of their product when only asked how the partnership impacted water bottle sales.

The fourth question I asked was what percentage of total beverage sales are bottled water? I wanted to know if cutting bottled water from their inventory would dramatically decrease their beverage sales. This is important because while bottled water sales might not be a large portion of HFS’s total profits because of how many other things they sell, Coca-Cola is only selling beverages, so bottled water makes

up a bigger portion of their sales. Since I knew that our partnership with Coca-Cola was very important from my last question, I was curious to see how much of Coca-Cola's sales were bottled water compared to other beverages. Kara was unable to find an exact percentage of bottled water to total beverages sold through HFS, but she was able to find a percentage of bottled water to other Coca-Cola products, which is the information I was most interested in. Kara said, "Out of all of our Coke purchases, we spent $262,718.51 on bottled water. Our total spent with Coke was $1,158,280.05. This works out to be about 23% of our purchases, which is fairly large considering we carry a huge product line from Coke" (Carlson, 2018). Kara is right UW does carry a huge product line from Coke. The UW sells the following Coca-Cola company products: Coca-Cola, Sprite, Fanta, Diet Coke, Coca-Cola Zero, Minute Maid, Simply Beverages, Vitaminwater, Fuze, Odwalla, PowerAde, PowerAde zero, honest tea, Fuze tea, Fresca, and the two bottled water brands: Dasani and SmartWater. The two bottled water brands making up about 23% of total sales is important when you consider that they are only 2 out of the 18 Coca-Cola brands that the University sells. This means that bottled water is an important part of Coca-Cola's profits from the University, and could cause them to push back against a ban on the sale of their water. According to interviews done with Seattle University's Campus Sustainability Manager by Curtis-Murphy and Sessions in 2013, Seattle University was easily able to "renegotiate their contract with Coca-Cola to exclude

plastic water bottles" (Curtis-Murphy & Sessions, 2014). However, during their interviews at the same time with UW HFS they were told that, "the existing contract would preclude the University from dropping any Coca-Cola product," (Curtis-Murphy & Sessions, 2014) which is a similar response to what I got when talking to HFS in April of 2018.

The fifth question that I asked was what percentage of these bottled waters were bought with Husky Cards. I wanted to know this because I was trying to get a rough estimate of what percentage of bottled water is bought by students on the campus. Though some students buy things from HFS with cash or a credit or debit card instead of their Husky Card, there are incentives for buying with a Husky Card, so I was assuming most student purchases would be done on a Husky Card. Unfortunately information on what percentage of certain products are bought by different forms of payment is not tracked, so there is not data available for what percentage of bottled water is bought with a Husky Card. Kara says she "would assume it's the majority of them" though (Carlson, 2018).

The sixth question that I asked was what percentage of total HFS profits is from bottled waters? I asked this question to see what kind of impact banning the sale of bottled water would have on HFS profits. I realize that the roughly $260,000 dollars in revenue they made last year is a lot of money, but if that is only a small percentage of their total profits, I believe they will be more willing to consider the

bottle ban. While Kara did not have access to these exact numbers, she did say she believed the percentage would be “very minimal” (Carlson, 2018). I was also able to do some extrapolating based on the University’s 2017-2018 HFS budget, and come up with a rough estimate of the percentage. According the University of Washington’s Proposed Operating Budget for the fiscal year 2018, Housing and Food Services is projected to net $3,220,000. Their total revenue from “Residential and Retail Food Revenue” is projected at “$45,694,000” for 2018 and their projected “Total Operating Revenue” for 2018 is projected at “$129,064,000” (University of Washington, 2017). If you take the revenue from disposable plastic water bottles, about $260,000 and divide this by the total revenue you get what percentage of total HFS revenue (for all three campuses) is from bottled water sold on the UW campus. The answer is roughly 0.002 or 0.2%. This is less than one percent of total HFS profit, which is very low.

The final question I asked was what options are currently available at dining facilities for getting water (other than bottled water)? I asked this question because I was curious to see what options students had to choose from at student residential dining facilities. Kara told me that, “all buildings have drinking fountains and most I believe are updated with bottled dispensing systems so people can refill their reusable bottles. Our residential dining locations have designated water dispensers and promote infused waters. We also have water and sparkling water

on our freestyle Coke machines as an option" (Carlson, 2018). The residential dining facilities having designated water dispensers and water options in the Coke freestyle machines means that they already have multiple ways for people to access water in reusable cups at these locations, and little to no physical improvements would be needed to ready these facilities for a bottled water ban.

Through my research I concluded that the sale of disposable water bottles is not a huge portion of HFS's budget. It makes up less than a quarter of a percent of their annual revenue, but it is a huge portion of Coca Cola's sales on our campus. Roughly 25% of all of Coca Cola products sold on our campus come from Dasani and SmartWater sales. This is an indicator that renegotiating our contract with them might be difficult, but it would not be a burden to the University to do so, only to Coca Cola. Later in the paper, in my cost benefit analysis section, more information on how banning the sale would affect the University is estimated.

Conclusion:

The bottled water industry has rapidly increased over the last couple of decades, and the waste has increased with it. While 83 schools around the country and 4 within Washington State have decided to stop selling bottled water on their campuses, the University of Washington has not made this commitment (Ban the

Bottle, 2017). There are many benefits associated with banning the sale of plastic bottles and very few drawbacks. The quality of water coming from UW taps has been proven to be safe, while the water from disposable plastic bottles is less certain. Both are probably equally safe to drink, but the water coming from the taps is easier to test than the bottled water. There are also environmental benefits to banning the sale of disposable water bottles. It will lower the UW's carbon footprint, prevent waste from being generated in the first place, and help us reduce our solid waste diversion goals. And it will help reduce pollution, especially to our marine environments where plastics are currently a major threat to many species and habitat types.

Case Studies:

Introduction:

I conducted case studies on two schools. I looked at how they went about creating the change, how their contracts with large beverage corporations, such as Coca-Cola, were affected, what infrastructure changes needed to be made, and what information they made publically available to encourage and support people using reusable bottles. I also looked to see what evaluations of success they had, and if they came up with other suggestions after evaluating the program a couple of years later. Information found in this section is what I used to form the suggestions I present in the following section.

Western:

Western Washington University successfully completed their campaign to stop the sale of bottled water during their Earth Week Celebration in 2014. The campaign was spearheaded by the associated student club, Students for Sustainable Water (SSW), and took three school years to complete (Students for Sustainable Water at Western Washington University, 2014).

SSW provided online access to the materials that they used throughout their

three year campaign as well as a timeline for their campaign, this was helpful in evaluating what steps would need to be taken for the University of Washington to ban bottled water, if they were to use the same approach that Western did. During the first year, SSW went about campaigning for the end of bottled water sales by applying to Western's green fund, "The Green Energy Fee," to get money to install three hydration stations and getting the initiative onto their ASWWU ballot for students to vote on. After being put on the ballot, students had the opportunity to vote for western to stop selling bottled water, and it received a "74% approval from students who voted" (Students for Sustainable Water at Western Washington University, 2014).

Starting at the beginning of the next school year, SSW started to conduct more outreach events. This included events that engaged the students as well as staff and faculty. The club met with the Deans of every college at the University to discuss with them faculty and staff awareness of the campaign, and to gain support for their movement (Students for Sustainable Water at Western Washington University, 2014). During Spring Quarter of the second year of the club lobbying to end the sale of bottled water, the club hosted "water week" where they had several events spreading awareness about the impacts of bottled water and raising awareness of their campaign. At the end of the quarter, the Director of University Residences released an official memo "stating the intent to assess 'prohibiting the

sale of bottled water' at WWU and to 'strive toward implementation as soon as practically possible.'" (Students for Sustainable Water at Western Washington University, 2014).

The next four quarters were spent researching the "implementation of other university bottle bans" and continuing outreach through events. Three hydration stations were also installed during these three quarters. On April 1, 2014, the bottled water initiative was implemented and bottled water was removed from markets and vending machines on the WWU campus (Students for Sustainable Water at Western Washington University, 2014).

Western did not have a partnership with Coca-Cola, like the University of Washington does, when they were trying to ban the sale of bottled water, but they did have a contract with Walton Beverage (SSW Western Washington Univeristy, 2014). Walton Beverage is a local, independent Pepsi bottler in the state of Washington (Walton Beverage, 2018). This difference in size may mean that there are differences in the ability to negotiate contracts, but Western had little trouble renegotiating their contract to no longer include the sale of bottled water.

Western only made a couple of infrastructure changes to make their ban a success, but the changes were very important. They installed three new hydration stations between 2012 and 2014, for students, faculty and staff, and visitors to fill up their own reusable water bottles with. They also started providing ice water

coolers in campus markets, cafes, and at large events, including graduation and family weekends. In addition to increasing the ways that people have access to tap water on their campus, Western started selling branded reusable water bottles in campus markets, cafes, the stadium, and at large events (SSW Western Washington Univeristy, 2014). To replace bottled water at catered events, Western invested in reusable cups and additional ice water coolers (SSW Western Washington Univeristy, 2014).

As for what information they made publically available to help with the transition, they created outreach materials educating all affected parties about the ban and created a map of water bottle refill stations on campus. To educate the affected parties, including students, staff, faculty, visitors, and visiting sports teams, Western trained their tour guides and administration to be comfortable talking about the ban. They also include a reminder about being a bottle free campus in all emails sent to visiting groups, with a link to their sustainability website where they can find more information on the ban. Along with the email that is sent out to visitors, they include information about the ban on promotional materials for the events (SSW Western Washington Univeristy, 2014). To help people find the best locations to refill their water bottles, SSW created a water bottle refill station map, that has the location of the water bottle refill stations marked on it (Students for Sustainable Water at Western, 2014).

Seattle University:

Seattle University stopped selling bottled water everywhere on their campus back in the fall of 2010 (Price, 2012). While the bottled water ban was a student run movement and initiative, there was not one single student club or registered student organization dedicated to the cause. Instead it started in its first year with two seniors who were passionate about banning bottled water; they worked with the university's sustainability manager to pass their work on to current students the following year. The next year, a junior took over the movement and made a significant amount of progress on the campaign, but because she did not work with the sustainability manager or a specific club, most of the information was lost in the transition when other students took over the movement the following year. In the third year of the campaign a senior again worked with the sustainability manager at the University, and together they were able to work with the Vice President of business and finance at Seattle University to figure out what needed to be done to get the executive committee to agree to ban the sale, and then accomplish those tasks (Price, 2012).

During discussions with the VP for Business and Finance, the senior who was spearheading the campaign during its third year found that the executive board would consider the ban if it was passed as a resolution by the student government.

They also found that they would need to get more signatures for the petition to show that there was a campus wide support for this ban (Price, 2012). After the student government passed the ban, the faculty government endorsed it. This further showed campus wide support for the ban from both students and faculty, and got the executive board's attention. The executive board agreed that they would stop selling bottled water on campus if education on why bottled water is bad was provided to the student body and faculty and staff, and if alternatives for bottled water were provided (Price, 2012).

In the second year of the campaign, over 30 water bottle refill stations were installed. Some of them were modified water fountains, and others included a filter. During this same time, students involved in the movement conducted an education campaign. The campaign included a tap water vs. bottled water taste tests, putting up posters, and emailing students and clubs.

Seattle University did not have a partnership with Coca-Cola for their beverages, like the University of Washington does, but they do have a partnership with Pepsi. Their contract still had two more years on it when they voted to ban the sale of bottled water, but their vice president of finance and business affairs was able to renegotiate the contract part way through the term. The renegotiated contract no longer included Aquafina (Pepsi's bottled water brand), but it did include Aquafina Flavorsplash, Pepsi's flavored water brand. According to their VP

of finance and business affairs, renegotiating their contract was not difficult. When asked about it he said, “they were very receptive and understanding. It is going to cost us something, but they appear to want to be fair about it ” (Seattle University, 2012).

Seattle University made significantly more infrastructure changes than Western Washington University did during their movement. During the second year of the campaign the facilities department installed over 30 water bottle refill stations. Some of the stations were Elkay brand water filtration systems, and some were simple fixtures that can be added on to any water fountain, to make it easier to fill water bottles (Price, 2012). The Elkay filtration systems are the same ones used in many buildings on the University of Washington campus. To accommodate fans at sporting games, they installed water bottle refill stations next to all concession stands and trained staff on how to talk to fans about the bottle ban, and to help fans find water (Seattle University, 2012). At catered events hosted on their campus, “Water is served in carafes or pitchers along with compostable cups for free. Customers can opt to buy an assortment of sparkling mineral waters sold in glass bottles and aluminum cans” (Seattle University, 2012).

As for the information that was made publically available, Seattle University has a webpage dedicated to their ban on disposable water bottles. This page features links to information about why tap water is better than bottled water, as

well as links to a case study done on their school, and a FAQ sheet for other schools to look at when they are planning on banning bottled water. Seattle University does not have information on water quality tests done on their campus, though they do have several programs helping test water quality in other cities. Seattle University has also chosen not to make any evaluations of the program publically available, but their "follow up article one-and-a-half years later on the bottled water ban in the bi-monthly online employee newsletter was the most read article the entire year with 669 unique page views" (Price, 2012).

Conclusion:

Banning the sale of disposable bottled water on college campuses takes time. Both Seattle University and Western Washington University took three years of concentrated effort to get bottled water banned on their campuses. Because of this it is important to have participation and leadership from both upperclassmen and underclassmen involved in the campaign. It cannot just be a senior or group of seniors leading the campaign because then information is lost when they graduate. This is why it worked so well having a student club dedicated to the cause at Western Washington University. Another big take away from these case studies is that getting the initiative on the student government ballot and having students vote for the reform is the best way to get the bottle ban to actually happen. While

there are probably other ways to get the administrations attention and encourage them to renegotiate their contracts, Western, Seattle University, and Gonzaga all accomplished their bottle bans by having the associated student body vote for it. To get the students staff and faculty on board with voting to ban disposable water bottles it is also important that they are educated on the issue and have access to other sources of water. The University of Washington already has drinking fountains located in every building on campus, and water bottle refill stations in most buildings, so that is not a problem, but education still is. Before people will vote for banning water bottle sales they need to know why disposables are not worth the convenience. Education campaigns are the way to create that awareness and get students interested in creating change.

Recommendations:

Introduction:

After researching what Western Washington University and Seattle University did to make their bottle bans a success, I compiled a list of my own suggestions for the University of Washington. Some of the suggestions are taken directly from these institutions, while others have been adjusted to better represent the UW campus, and still others were created from my own perception of needs on our campus. There are six main suggestions listed, with additional suggestions that fall under the broader category included as well.

1. Create A Registered Student Organization (RSO):

Having an RSO take on this project would ensure that there are current students who have access to all of the research and work that has been done on the campaign. Without having an RSO, we risk information and progress being lost in the transition of leaders, especially when someone heading the campaign graduates. This happened during Seattle University's campaign, and they had to redo several time consuming steps, including getting student signatures. RSO's can also take on a large portion of the work that would be necessary to complete my

following suggestions.

2. Get the Initiative on the ASUW Ballot:

Every school that I looked at was able to get their administration to agree to a bottle ban after having the student body approve an initiative through a vote done by their associated student body. The RSO that I suggest above could be responsible for getting the initiative onto the ballot and for campaigning to get students to vote for the initiative.

3. Educate Students, Faculty, Staff, and visitors:

The Education portion of my recommendations has two steps, the first is the education that needs to be done before the ban, and the second is the education that needs to happen after the ban.

Educating students, faculty, and staff needs to happen before we can ban sales, because the only way we are going to be able to get the administration to buy into the idea of banning disposable water bottles is if the students, faculty, and staff show their support. To get students, faculty, and staff invested in this cause they need to be educated about it. Right now there are several nationwide movements to ban single use plastics and in Seattle they have been extremely affective. Seattle

is currently in the middle of a citywide campaign called “Strawless in Seattle”, that urges restaurants to stop giving out straws, and patrons to ask not to receive straws. With so many movements already spreading information on why single use plastics are a problem, now is the perfect time to start spreading information about why disposable water bottles are a problem, and what better alternatives exist.

I envision the education campaign being led by the RSO that takes on this campaign. There are many creative ways they can educate people on the issue, including flyers, tap vs. bottled water taste tests, and hosting viewing parties for movies like “Tapped” that discuss the bottled water industry.

After the sale of disposable water bottles has ended on our campus, the education on the issue will need to continue. Current students, faculty, and staff will need to be informed that the ban is happening and how to prepare. Incoming students will need to be made aware of the ban so that can be prepared when they come to the school in the fall. Visitors will need to be told about it and reminded before they come so that they are aware that they cannot simply buy bottled water here, and should instead plan on bringing their own water bottle, or purchasing a reusable water bottle instead. Visitors to sports games will also need to be made aware of the change.

A lot of this education can be done by the RSO in the beginning, including drafting an email template that will go to people visiting campus and sports fans

attending meets and games. The RSO could potentially be in charge of presenting a short presentation to incoming students during orientation as well, but this may be outside of the scope of the RSO and fit better with a paid position. Other education will have to be taken on by UW employees though. This includes training the orientation leaders and campus tour guides on how to talk about the bottle ban, and training dining staff and concessions stands staff at games on how to talk about it.

4. Increase Publically Available Information:

There are a few things that need to be updated to make this ban a success. One is the campus map of bottled water refill stations. There is not a date on the map, so I do not know exactly when it was last updated, but from my experience it is lacking several new water bottle refill stations on it (UW Sustainability). Updating this map will make finding water bottle refill stations easier for people on campus, and will help make refilling a reusable water bottle just as convenient as buying a disposable one from a campus market. At Western they created a mobile website, where you could scan a code at several locations on campus and find the nearest refill station. I considered including this as a suggestion, but I believe because we have so many water bottle refill stations on our campus, this is now an unnecessary

task. They are prevalent enough currently that you do not have to search more than one building to find one.

Another piece of information that would be good to have publically available is tests of the water quality after it comes out of UW pipes. Research was done on this in 2005, but finding any information on the results is extremely difficult. If we were to make a webpage about the water bottle ban, under the UW sustainability webpage, I would like it to include this information. Having a webpage with all the information on where water bottle refill stations are, why we banned the sale of bottled water, how we did it, and the quality of our water would help everyone concerned with the issue understand it better.

5. Possible Infrastructure Changes:

The University has already installed several water bottle refill stations since the early 2000's. While this is often one of the biggest steps that need to be taken to successfully ban disposable water bottles, I do not believe this is necessary on our campus. UW has Elkay water filtration systems in several buildings on campus, water bottle refill spouts attached to water fountains in most buildings, and water fountains in every building on campus.

One thing the University could change is where they sell reusable water

bottles. While these are available several places on campus already including two locations in the HUB (the University book store and etc. market), they could be sold in additional places. Selling reusable water bottles would be an additional source of revenue for HFS, and could help mitigate the losses to sales from no longer selling bottled water. I recommend selling a selection of these water bottles in all the campus cafes, in addition to the locations they are currently sold.

6. Renegotiate the contract with Coca-Cola:

This will likely be the last step in the process of banning the sale of water bottles on our campus, and is the only step that cannot be handled by an RSO or student employee. This will take renegotiations with Housing and Food Services contract with the company, so it needs to be handled by the appropriate University of Washington Employees. In order for this step to happen, the University will have already needed to decide to ban the sale of bottled water. This will be their final step towards making the ban official.

Cost Benefit Analysis:

Introduction:

In 2013 two Evans School of Public Affairs masters candidates performed an ex-ante analysis of the economic impacts of creating a program to ban the sale of disposable water bottles on the UW Seattle's campus. Their findings were extremely useful to my paper, but a lot of the information is out of date, because it is now almost 5 years old. With this in mind, I followed their methods to create my own cost benefit analysis of banning water bottles in 2018. My cost benefit analysis also differs slightly from theirs because our proposals for a program to ban the sale of disposable water bottles vary slightly, and these differences are accounted for in my work as much as possible.

Proposal:

The following cost benefit analysis is done assuming that all the recommendations from my previous section are implemented, and that the office of sustainability hires someone to help with the transition period. This person would be in charge of helping to train other staff, like student tour guides, HFS staff, and concessions stands staff that need to talk with people affiliated with the university and visitors about the ban. Based on the paper by the Evans students, I

am making the assumption that the employee would work an average of 20 hours a week during the first year of the ban, and then work only five hours a week in upcoming years (Curtis-Murphy & Sessions, 2014). This difference in work hours would be because in the first year of the transition there would likely be significantly more work that needs to be done. This staff member would work directly with the administration and the RSO that I recommend spearhead the campaign.

I am not recommending that the University install more water bottle refill stations, because several refill stations have been installed since the original cost benefit analysis was done in 2013. I do not believe there is the same need for new ones to be installed now, that there was when the fist cost-benefit analysis was performed.

Assumptions:

I am making many of the same assumptions that were made in the 2013 paper. I am only conducting a cost-benefit analysis for the University of Washington Seattle Campus. There may be other stakeholders affected by this ban, including our partner, Coca-Cola, and business near campus, but they are not taken into consideration in this analysis. For the discount rate, I used 3.5% (Curtis-Murphy &

Sessions, 2014). I chose this rate because it is what Curtis-Murphy and Sessions used in their analysis in 2013. I annualized the costs and conducted the assessment based on the 15- year lifespan of the Elkay water bottle refill stations, again because this is what was done in the 2013 analysis. Finally I again followed the methods and assumptions of the 2013 paper, and assumed a substitution rate from water to sugary drinks of 35% (Curtis-Murphy & Sessions, 2014). While I followed their guidelines and used 35% as my substation rate, I believe this number may be lower now than it was in 2013 because of Seattle's sugar tax. There is not yet any reports on how consumer habits in Seattle have changed after the tax, but a study done on a similar tax found that people bought 9.7% less sugary drinks after the tax was implemented (Nutritional Science Program - School of Public Health, 2017). Because there is not data for how Seattle is specifically affected, I decided to stick with the substitution rate of 35%.

Impact Categories:

I again followed the methods of Curtis-Murphy and Sessions for choosing my impact categories. I assessed the same categories they did except for the cost of "New and Retrofitted Water Fountains, because I am not recommending the University install more. The costs I assessed are: "Increased Water Usage," "Loss of

Revenue from Sale of Water Bottles," "Cost of Launching Ban (Salary/Admin/Publicity Bottles)," "Health Costs from Substitution." (Curtis-Murphy & Sessions, 2014). The benefits I assessed are: "Decreased Recycling Costs," Saved Expenditures," and "Environmental Benefits" (Curtis-Murphy & Sessions, 2014).

Benefits:

There are three benefits assessed in this section, decreased costs for recycling, money saved by students, faculty, and staff, and environmental benefits.

Decreased costs of recycling will save the University roughly $56,270 a year. The University will save on recycling costs when disposable water bottles are eliminated from the waste stream. In this analysis I am assuming that amount of water bottles improperly disposed of is negligible on our campus. Because of this I only look at the recycling costs, not the costs of landfill. Landfill costs are actually higher than recycling costs though, so any water bottle that ends up in the landfill costs the University more than one that is recycled (Building Services Department, 2017). Because I am only looking at recycling costs, this is a conservative estimate on how much the University would save in disposal costs. Disposable water bottles fall under the mixed recyclables category of waste (UW Recycling). In 2017 UW Recycling reported spending $1,731,447.00 on the recycling program. To calculate

what portion of this cost comes from bottled water, I used the percentage found in the 2013 cost benefit analysis of 5% of mixed recyclables being water bottles. They got this number by doing an audit of recycling bins at four locations in 2012. In a more in depth cost benefit analysis, following their procedure to find the current percentage of recyclables that are from bottled water would be important. Using 5% as an estimate for current percentage of recyclables coming from bottled water, we find that the University spent roughly $86,570 on recycling water bottles in 2017. Assuming that 35% of students then switch to another plastic bottled beverage, the University would save %56,270 a year.

Students, staff and faculty will save roughly $305,560 a year. Students, staff, and faculty would save money by eliminating the possibility of them purchasing bottled water. According to Kara from HFS, UW sold about 235,272 between 2016-2017 and made about $262,700 profit and purchased *$262,718.51* of bottled water from Coke (Carlson, 2018). This means that students, faculty, and staff spent roughly $525,420 on bottled water. After surveying the other drink options available, I found they have an average cost of $2.67. Assuming that 35% of students will buy these other drinks instead of water ($219,862 worth), we can calculate that students, staff and faculty will save roughly $305,560 annually.

Environmental costs will be roughly $0.11 per year. To evaluate the environmental costs of bottled water, I again used the methods used in the 2013

cost benefit analysis. “For every 1,000 gallons of water produced, there are 1,121 pound of CO_2 equivalent emitted” (Curtis-Murphy & Sessions, 2014). Assuming that UW sells about 235,272 20 oz. water bottles a year (Carlson, 2018), or roughly 36,761.25 gallons, there are 41,209,361.2 pounds of CO_2 emitted, or roughly 18.7 metric tons of CO_2. Like Curtis-Murphy and Sessions, I used the EPA’s “Social Cost of Carbon” to monetize this value. In 2020, the cost of carbon is estimated at $42 per metric ton (The Social Cost of Carbon, 2016). By multiplying the cost per ton by the tons of CO_2 from water bottles sold at UW between 2016 and 2017, we get a cost of $785.40. The EPA is a federal agency though, so to get this on a scale of the UW, we need to divide the cost by the population of the US, roughly 323,837,000 in August 2016 (United States Census Bureau, 2018), and then multiply by the population of students and faculty at UW, about 46,165 people (University of Wisconsin, 2018). The number we then get is much smaller at only $0.11. While eleven cents is a low number, it is much higher than the number found in 2013, which was $0.0006 (Curtis-Murphy & Sessions, 2014). This shows an increase in the environmental costs increased by a factor of 186 in the past 5 years. Eleven cents is not a lot of money, and economically speaking there are much more compelling reasons to ban the sale than environmental ones, but the rate at which environmental costs are increasing shows how important it is to make environmental changes like banning the sale of disposable water bottles immediately.

Upfront Costs:

Total upfront costs will cost the University $14,270 in the first year. There are upfront costs associated with my proposal to hire an employee through the sustainability office to help with the transition. I assumed like Curtis-Murphy and Sessions did, that the employee would work roughly 20 hours a week for 30 weeks during the first year after divestment (Curtis-Murphy & Sessions, 2014). Assuming that hourly wage for this employee will be, $15.45 (Compensation - Student Employees, 2018), this position would cost the administration $9,270 in the first year.

There are also the upfront costs associated for education materials needed in the first year. I am assuming like Curtis-Murphy and Sessions that this would cost the University roughly $5,000.

Ongoing Yearly Costs:

In addition to the upfront costs, there are annual costs that need to be accounted for. These include: increased water usage, Lost revenue to HFS, and ongoing administrative costs.

Increased water usage will cost the University roughly $8,170 a year. In 2013 they assumed that students and staff bought 12,000,000 ounces of bottled water a

year, which equaled 12,532 CCF per year of tap water (Curtis-Murphy & Sessions, 2014). This means there are 0.00104 CCF tap water/ ounce bottled water. If students and staff buy about 235,272 20 ounces a year, and 65% of them switch to tap water, they will increase demand for tap water by about 4,893 CCF per year. At an average rate of $1.67 per CCF (Seattle Public Utilities, 2018), that would cost the University an additional $8,171 a year.

Lost revenue to HFS will cost the University roughly $40,140 a year. The University makes approximately $260,000 a year in revenue from bottled water (Carlson, 2018). Using our baseline substitution rate of 35%, we can assume that 35% of the roughly 235,272 water purchases a year will become purchases of other beverages. This means there will be roughly 82,350 additional purchases of other beverages a year. By surveying beverage costs on campus, I found an average beverage cost of $2.67. If 82,350 sales of these beverages are made a year, it will total roughly $219,875 in revenue. The loss of bottled water sales minus the additional revenue from these other sales means the University would loose roughly $40,140 a year by banning the sale of plastic water bottles.

Ongoing administrative costs will cost the University $3,317 a year. Following the assumptions made by Curtis-Murphy and Sessions that ongoing work after bottles are banned would take less time than the initial year, I am assuming that the employee would need to work roughly five hours a week for thirty weeks in the

following years (Curtis-Murphy & Sessions, 2014). At a rate of $15.45 an hour (Office of Planning & Budgeting, 2018), this would cost the UW about $2,317 a year. In addition to this cost, Curtis-Murphy and Sessions estimate that the cost to print and make additional educational materials will be roughly $1000 a year. Total continuing administration costs will be roughly $3,317 a year.

Aggregated Costs and Benefits

	Upfront costs	**Yearly costs**	**Yearly benefits**
	Student employee $9,270	Increased Water Usage $8,170	Decreased Recycling Costs $56,270
	Education Materials $5,000	Education Materials $1,000	Saved Student Expenses $305,560
		Student Employee $2,320	Environmental Benefit $0.11
		Loss in Revenue $40,140	
	11,270	$51,630	$361,830
Total yearly net benefit	$310,200		

Kaldor-Hicks Tableau

	Administration	**Students/Faculty/Staff**
Yearly Costs		
Increased water usage	$8,170	$0
Loss in Revenue	$40,140	$0
Student Employee	$2,317	$0
Education Materials	$1,000	$0
Yearly Benefits		
Decreased Recycling	$56,270	$0
Saved Expenditures	$0	$305,560
Environmental Benefit	$0.11	$0.11
Yearly Net Benefits	$4,823	$305,560

Conclusion:

Based off of the preliminary cost benefit analysis, and my proposal for how the University should go about banning disposable water bottles, the University and students staff and faculty will all save money. The savings will be higher for students, faculty, and staff than for the administration, saving over $300,000 a year just by not being able to purchase water bottles, but the administration will not be

loosing money by banning the sale of disposable water bottles. The savings of roughly $4,000 dollars a year is not a large savings for the administration, and would represent only a very tiny portion of their budget. The more important part is that because of all the infrastructure changes the University has already made, banning disposable water bottles will not cost the administration a large amount. In 2013, it was estimated that banning disposable water bottles would cost the administration almost $245,000 dollars a year. Now that they have updated the infrastructure though, the ban wouldn't cost them anything.

Conclusion:

Banning disposable water bottles on the University of Washington's Seattle campus is better for student faculty and staff health, the environment, and will save the administration as well as students staff and faculty money. While banning the sale of bottled water is important, it will take time to accomplish, the other schools that banned bottled water in Washington State took around three years to implement a bottle ban, and I expect that the University of Washington would take roughly the same amount of time. To get the bottle ban to happen, I recommend that an RSO dedicated to the ban spread outreach on the impacts of water bottles and lobby to get a ban on the ASUW election. After students are aware of the issue and vote to ban bottled water, the University should hire a student employee to help with the transition and outreach to visitors to our campus, while an administrator works on renegotiating our contract and partnership with Coca Cola.

Works Cited

Bach, C., Dauchy, X., Severin, I., Munoz, J.-F., Etienne, S., & Chagnon, M.-C. (2013). Effect of temperature on the release of intentionally and non-intentionally added substances from polyethylene terephthalate (PET) bottles into water: Chemical analysis and potential toxicity. *Food Chemistry , 139* (1-4), 672-680.

Ban the Bottle. (n.d.). *Bottled Water Facts*. Retrieved October 18, 2017, from Ban the Bottle: https://www.banthebottle.net/bottled-water-facts/

Ban the Bottle. (2017). *Map of Campaigns*. Retrieved October 18, 2017, from Ban the Bottle: https://www.banthebottle.net/map-of-campaigns/

Barthélémy, E., Spyropoulos, D., Milana, M.-R., Pfaff, K., Gontard, N., Lampi, E., et al. (2014). Safety evaluation of mechanical recycling processes used to produce polyethylene terephthalate (PET) intended for food contact applications. *Food Additives & Contaminants. Part A: Chemistry, Analysis, Control, Exposure & Risk Assessment , 31* (3), 490-497.

Botto, S. (2009). Tap Water vs. Bottled Water. *Nature* .

Building Services Department. (2017). *UW Recycling Annual Report 2017.* Seattle: UW Recycling.

Campus Sustainability Committee. (n.d.). Retrieved 5 21, 2018, from Gonzaga University Website: https://www.gonzaga.edu/about/sustainability/experience/campus-sustainability-committee

Campus Sustainability Initiatives. (2018). Retrieved May 5, 2018, from Gonzaga University Website: https://www.gonzaga.edu/about/sustainability/caring-for-creation/campus-sustainability-initiatives

Carlson, K. (2018, April 20). Senior Capstone Informational Meeting. (K. McCarroll, Interviewer) Seattle, WA, USA.

Charles, F. (2007, September 20). Message in a bottle. *Business Review Weekly , 29*, p. 62.

Compensation - Student Employees. (2018). Retrieved April 21, 2018, from University of Washington Human Resources Website.

Curtis-Murphy, M., & Sessions, C. (2014). Ban the Bottle: Implementing a Ban on the Sale of Plastic Water Bottles at the University of Washington. *The Evans School Review , 4* (1), 44-58.

Dasani. (2018). *Frequently Asked Questions*. (Coca-Cola) Retrieved March 5, 2018, from Dasani: http://www.dasani.com/faq.html#what-is-the-shelf-life-of-dasani

Dettore, C. G. (2009). *Comparative Life-Cycle Assessment of Bottled vs. tap Water Systems.* University of Michigan, Center for Sustainable Systems. Ann Arbor: University of Michigan.

Fineman, J. (2011, August 9). *Where Your Bottled Water Comes From*. (US News and World Report) Retrieved March 5, 2018, from Travel: https://travel.usnews.com/features/where_your_bottled_water_comes_from

Fox, A., & Staddon, C. (2011). Bottled Beverages (Water). In J. Mansvelt, & P. Robbins (Eds.), *The SAGE Reference Series on Green Society: Toward a Sustainable Future. Green Consumerism: an A-to-Z guide* (pp. 30-35). Thousand Oaks, CA: SAGE Reference.

Gonzaga. (2018). *Campus Sustainability Initiatives*. Retrieved April 5, 2018, from Gonzaga University Website: https://www.gonzaga.edu/about/sustainability/caring-for-creation/campus-sustainability-initiatives

Gonzaga University. (2018). *Facts and Figures*. Retrieved May 13, 2018, from Gonzaga University Website: https://www.gonzaga.edu/about/at-a-glance/facts-and-figures

Halden, R. U. (2010). Plastics and Health Risks. *Annual Review of Public Health , 31*, 179-194.

John, J. (2017, May 26). *Global Bottled Water Market will reach USD 280.0 Billion by 2020*. (Z. M. Research, Producer) Retrieved January 10, 2018, from Nasdaq: GlobeNewswire: https://globenewswire.com/news-release/2017/05/26/998349/0/en/Global-Bottled-Water-Market-will-reach-USD-280-0-Billion-by-2020.html

Kelley, P. (2005, January 13). *UW to test campus water*. Retrieved December 12, 2017, from UWNEWS: http://www.washington.edu/news/2005/01/13/uw-to-test-campus-water/

Krachler, M., & Shotyk, W. (2009). Trace and ultratrace metals in bottled waters: Survey of sources worldwide and comparison with refillable metal bottles. *Science of The Total Environment , 407* (3), 1089-1096.

Kroes, R., Renwick, A., Cheeseman, M., Kleiner, J., Mangelsdorf, I., Piersma, A., et al. (2004). Structure-based thresholds of toxicological concern (TTC): guidance for application to substances present at low levels in the diet. *Food and Chemical Toxicology , 42*, 65-83.

Law, K. L., & Thompson, R. C. (2014). Microplastics in the seas. *Science , 345* (6193), 144-145.

Null, J. (n.d.). *Estimated Vehicle Interior Temperature V. Elapsed Time*. (San Francisco State University) Retrieved March 5, 2018, from AVMA - Our Passion. Our Profession.: https://www.avma.org/public/PetCare/Pages/Estimated-Vehicle-Interior-Air-Temperature-v.-Elapsed-Time.aspx

Nutritional Science Program - School of Public Health. (2017, December 27). *Jesse Jones-Smith CO-Leads Study of Soda-Tax Impact on Seattle Health, Economics*. Retrieved May 10, 2018, from Nutritional Science Program - School of Public Health: http://depts.washington.edu/nutr/uw-to-study-soda-tax-impact-on-seattle-health-economics/

Office of Planning & Budgeting. (2018). *Fast Facts: 2017*. Retrieved March 9, 2018, from University of Washington: Office of Planning & Budgetting: https://opb.washington.edu/sites/default/files/opb/Data/2017_Fast_Facts.pdf

Pasqualino, M. &. (2011). The carbon footprint and energy consumption of beverage packaging selection and disposal. *Journal of Food Engineering , 103(4)*, 357-365.

Price, K. (2012). *Seattle University Seattle, Washington Water.* National Wildlife Federation .

Schick, T. (2009, December 11). *Green Initiatives.* Retrieved May 7, 2018, from The Gonzaga Bulletin: https://www.gonzagabulletin.com/article_7ec7d5a7-77ba-5245-8b2c-5d7e66cfd3c0.html

Seatte University. (2018). *Seattle University About* . Retrieved May 5, 2018, from Seattle Univesity Website: https://www.seattleu.edu/about/

Seattle Public Schools. (2018). *Drinking Water Quality Program*. Retrieved March 6, 2018, from Seattle Public Schools: https://www.seattleschools.org/cms/One.aspx?portalId=627&pageId=18101

Seattle Public Utilities. (2016). *Water Quality Results*. Retrieved December 12, 2017, from Seattle Public Utilities: http://www.seattle.gov/util/MyServices/Water/Water_Quality/WaterQualityAnnualReport/WaterQualityResults/index.htm

Seattle Public Utilities. (2018). *Wholesale Water Customer Rates*. Retrieved May 10, 2018, from Seattle Public Utilities Website:

http://www.seattle.gov/util/ForBusinesses/Water/WholesaleCustomers/WholesaleRates/index.htm

Seattle University. (2012). *Frequently Asked Questions: Seattle University's Removal of Bottled Water.* Seattle.

SSW Western Washington Univeristy. (2014, January 22). *Bottled Water Alternatives.* Retrieved April 20, 2018, from Google Sheets: https://docs.google.com/spreadsheets/d/193r-dBcU1nb5DX31yA4x6J3xBFIRtkcNi725IytTx3g/edit#gid=0

Students for Sustainable Water at Western. (2014). Filling Station Map. Bellingham, WA, USA.

Students for Sustainable Water at Western Washington University. (2014, April 5). *Timeline.* Retrieved April 12, 2018, from Google Docs: https://docs.google.com/document/d/1t-n1U27wm7sFPBtouZOmEd8E5Ywn-kLMycr3syAx--w/edit

The Social Cost of Carbon. (2016, August). Retrieved May 4, 2018, from EPA Climate Change Website: https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html

U.S. climate data. (2018). *Climate - Seattle Washington*. Retrieved March 5, 2018, from U.S. climate data - temperature, precipitation, sunshine, snowfall:

https://www.usclimatedata.com/climate/seattle/washington/united-states/uswa0395

United States Census Bureau. (2018, May 5). *U.S. and World Population Clock*. Retrieved May 5, 2018, from https://www.census.gov/popclock/

University of Washington. (2018). *About UW*. Retrieved February 24, 2018, from University of Washington Website: http://admit.washington.edu/why-uw/about-uw-university-of-washington/

University of Washington. (2010). *Climate Action Plan 2010 Update.* Retrieved October 24, 2017, from University of Washington Sustainability.

University of Washington. (2017). *Coca-Cola and the UW*. Retrieved December 1, 2017, from University of Washington: http://www.washington.edu/coca-cola/

University of Washington. (2017). *Proposed Operating Budget - Fiscal Year 2018.* Office of Planning & Budgeting, Seattle.

University of Washington. (2017). *Sustainability Metric: Landfill Reduction*. Retrieved December 1, 2017, from UW Sustainability: http://green.uw.edu/dashboard/landfill-reduction

University of Wisconsin. (2018). *UW Facts and Figures*. Retrieved March 9, 2018, from University of Wisconsin: https://www.wisc.edu/about/facts/

UW Recycling. (n.d.). *Signs and Posters.* Retrieved March 7, 2018, from Facilities Services: https://facilities.uw.edu/files/media/recycling-mixed-containers.pdf

UW Sustainability . (n.d.). *University of Washington UW Campus Sustainability Map*. (U. Sustainabilty, Producer, & University of Washington) Retrieved March 6, 2018, from https://green.uw.edu/map/sustainability#type:WaterBottleRefill

Walton Beverage. (2018). Retrieved May 1, 2018, from https://www.waltonbeverage.com