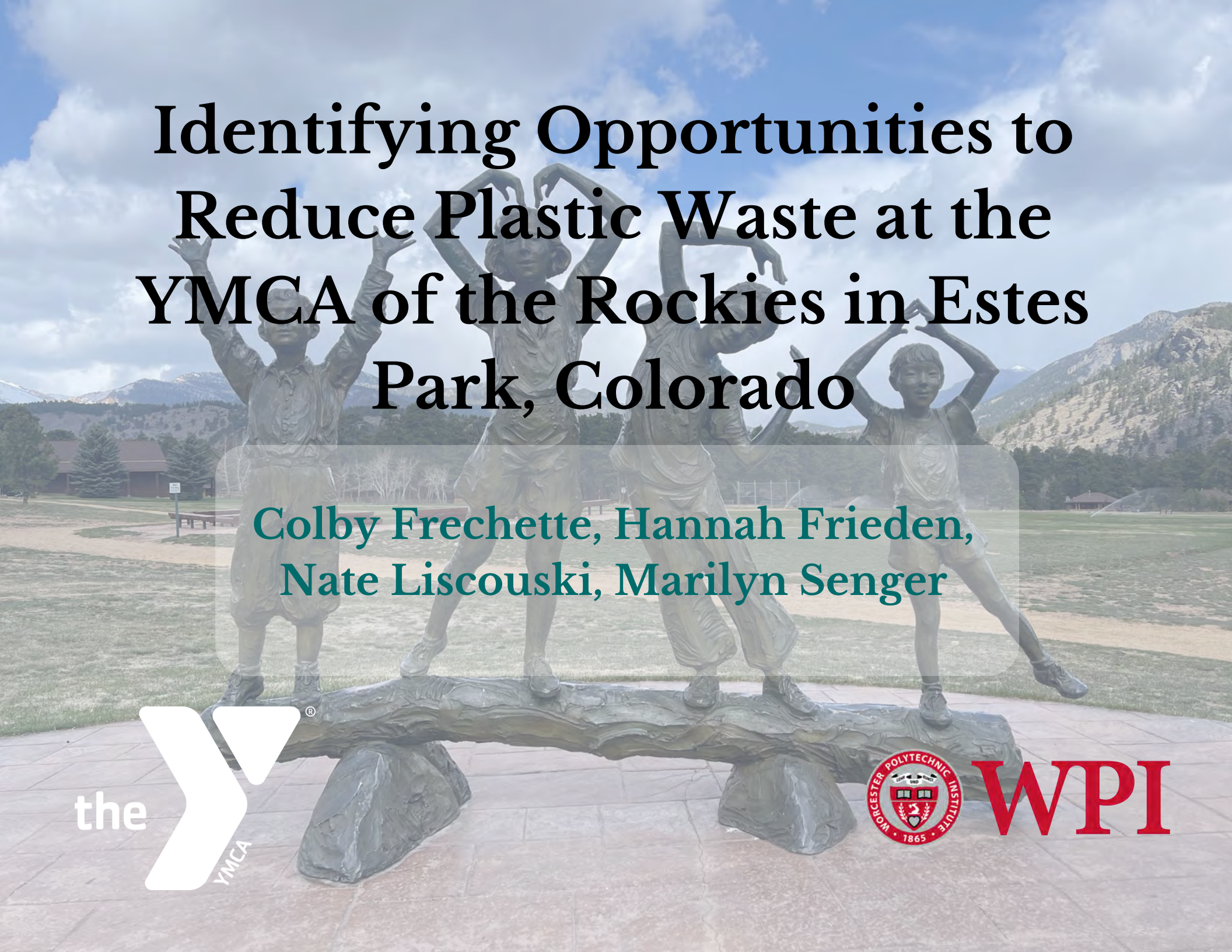

Identifying Opportunities to Reduce Plastic Waste at the YMCA of the Rockies in Estes Park, Colorado

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WPI

Identifying Opportunities to Reduce Plastic Waste at the YMCA of the Rockies in Estes Park, Colorado

An Interactive Qualifying Project Report submitted to the faculty of WORCESTER POLYTECHNIC INSTITUTE in partial fulfilment of the requirements for the degree of Bachelor of Science

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Abstract

Excessive plastic use across the globe is an alarming issue due to its contributions to environmental and public health risks. The YMCA of the Rockies in Colorado is seeking to reduce its plastic waste as part of its sustainability plan. Our project's goal was to audit plastic use at the YMCA and suggest material substitutions and alternative operations to reduce plastic waste. We investigated this by interviewing employees, surveying guests, and observing department operations. Major areas of plastic waste were single-use plastic items and packaging in the Food Service, Housekeeping, and Building & Grounds Departments. We recommend that the YMCA expand guest recycling education, promote internal communication, replace plastic products with other materials, and reuse items when possible.

Figure 1 - Photo of Estes Valley as seen from Lumpy Ridge

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We would like to give a special thanks to the following people, without whom this project would not have been possible.

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All of the YMCA employees and guests who participated in our research for their support to the project and commitment to sustainability

Meet the Team

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Authorship

All team members contributed to the drafting and revision of all sections of the paper, however, some focus was taken by each team member on different parts of the work. Team members worked together each day to ensure consistency and clarity between each section.

Colby Frechette

Colby contributed largely to the environmental parts of the paper. These included the Background on plastic, Constraints on plastic alternatives, and general facts such as plastic recycling rates, plastic materials, and environmental impacts of many of the recommendations. Colby also focused largely on researching and developing alternatives and conducted most interviews.

Hannah Frieden

Hannah focused mainly on writing, furnishing much of the first drafts of each section, with a major contribution to many of the sections on the background of the YMCA. Hannah also took deliberate notes during much of the field work and outlined a large portion of the structure of the paper.

Marilyn Senger

Marilyn ensured design and consistency throughout the entire paper and presentations. Marilyn outlined many of the design aspects of each section and deliverable. Marilyn also contributed largely to the plastic materials science and spearheaded research on much of the comparison between similar industries and companies.

Nate Liscouski

Nate focused largely on data collection and structure as well as another large portion of the first drafts of each section. Nate created many of the interview questions and guest survey questions. Nate also organized and collected massive amounts of invoice data and contributed to a lot of the cost analysis and cost comparison of plastic alternatives. Nate conducted most of the research on customer flow and customer and employee attitudes towards sustainability.

Executive Summary

Microplastics are tiny pieces of plastic that are scattered across our planet and infiltrate environments and organisms alike. They have been found in the soil of US national parks, on the ocean floor, and even in the bloodstream of humans (Choi-Schagrin, Tabuchi, 2022; Parker, 2020). According to Environmental Health Expert Leigh Shemitz, in marine environments these particles can "disrupt reproductive systems, stunt growth, diminish appetite, and cause tissue inflammation and liver damage," and it is unknown if the same damage can or will occur in humans (Shemitz, Anastas, 2020, p. 1). Earth's rising temperature is also exacerbated by plastics. Current warming is occurring ten times faster than it was when the Earth recovered from the last Ice Age (NASA, 2020). Production of plastic uses fossil fuel, a non-renewable resource, which releases greenhouse gasses that trap the sun's radiation and heat in our atmosphere. To begin to tackle this vast issue, our efforts were targeted to reducing plastic use and improperly disposed plastic at the YMCA of the Rockies. The YMCA is a complex institution with competing priorities relating to decisions about plastic reduction.

The YMCA of the Rockies' Estes Park Center serves as a camp and conference center, able to house up to 5,000 people at one time in both hotel-style lodging and individual or group cabins. Located in Colorado in close proximity to Rocky Mountain National Park, the YMCA can serve up to 2,000 people in one day in its various dining halls. The YMCA offers numerous programs, activities, events, dining and housing options for guests of all ages which generate large amounts of plastic waste. In 2021, the YMCA identified sustainability as a major goal for the coming years and established an employee-led sustainability team, demonstrating the YMCA's dedication to building a more sustainable future.

Figure 2 - YMCA of the Rockies Estes Park Center

Methods

Our team worked with department heads, ground-level employees, and guests to investigate and understand how plastic was used and disposed of at the YMCA. We conducted interviews, surveys, and shadowed employees from several departments while noting our observations and analyzing company invoice data to compile a comprehensive list of potential areas that would benefit from alternative materials or operations. We conducted the majority of our research in the Building and Grounds, Housekeeping, and Food Service departments, as we identified those to be the largest contributors to plastic waste at the YMCA of the Rockies.

We also conducted shadowing sessions with operational employees of each department to understand specific uses and quantities of plastic use. With a comprehensive understanding of why plastic is used, we then brainstormed and researched possible plastic alternatives for areas of excessive plastic waste. These possible alternatives were then proposed to department heads for feedback on each solution's feasibility, to fill information gaps, improve upon our suggestions, and tailor them to the needs of the YMCA.

Guest surveys were used to identify and assess plastic alternatives and gauge guest views on sustainability. Guests were asked about their personal feelings towards sustainability as well as the difficulties of participating in various plastic reduction initiatives. These were considered in conjunction with our observations of plastic usage, disposal, and operations at the YMCA, which were enhanced by our situation as guests at the YMCA. Living, eating, and engaging with the YMCA all served as first-hand opportunities to gain perspective beyond what we learned from interviews or shadowing.

We investigated invoice data for each of the key departments, which yielded both quantity and costs, allowing us to compare how our proposed alternatives would compare with the products the YMCA was using. For each invoice, we examined each product that used plastic and compiled them into a spreadsheet that would serve as our database when comparing alternatives. Invoices were examined over a one year period to include annual fluctuations in product ordering during busy or slower seasons.

Findings

The YMCA uses a significant amount of plastic in a few key places; through milk bottles, cups, trash bin liners, single-use gloves, soap refills, laundry storage, cutlery, coffee cup lids, grocery bags, condiment packets, single-use coffee creamers, food packaging, single-serving ice cream cups, plastic-wrapped firewood bundles, and trash bag use in common areas. We identified multiple recommendations for each plastic use to reduce the amount of plastic waste being generated, while operating within the constraints of the YMCA.

We also identified constraints that sustainability measures at the YMCA are likely to encounter, and were able to recommend alternatives to overcome these. The first is general employee shortages, a common issue across America. We recommend that the YMCA take measures to attract more employees to expand the flexibility and capabilities of each department.

The cost and availability of plastic substitutions is also an issue, due to the added cost of production for these products. Additionally, a recent demand for these products by companies looking to be more sustainable have reduced the amount of supply available. Further complicating this is supply chain issues from COVID-19, which has made obtaining certain products especially difficult. Another issue with the YMCA's suppliers is that they often ship in plastic packaging, which is difficult to change. We recommend that department heads call companies that package their products in plastic and use their status as a large customer to persuade the supplier to grant their request. The food service department at both Estes Park Center and Snow Mountain Ranch have had success with these requests.

Some alternatives may also be complicated by sanitation concerns, such as the use of reusable gloves. There are many sanitation codes, from sources such as the Colorado Department of Health and County Department of Health that departments must comply with.

We acknowledged the differences between Snow Mountain Ranch and Estes Park Center, because their fundamental differences prevent us from comparing them directly. Snow Mountain Ranch hosts less than half of the amount of people than Estes Park Center each year. Snow Mountain Ranch is also consistently about 15 degrees colder than Estes Park Center with much more snow, which means that the buildings and grounds crew spends much more time maintaining roads.

Internal communication at the YMCA also stunts sustainability initiatives. We recommend that communication between the sustainability team and employees, between the Estes Park Center and Snow Mountain Ranch, and of the YMCA mission to its employees. This would spread enthusiasm for sustainability and allow for collaboration on sustainability projects.

Our team also created several deliverables for use by the YMCA. These included our recommendations for alternative materials and practices, educational materials, and ordering plastics information sheets. Our team created

Figure 3 - YMCA Snow Mountain Ranch

drafts of informational materials for employees about ordering plastics and material to clarify the recycling system for guests. While not directly plastic waste reduction, this educational material will encourage guests and employees to reduce the amount of plastic they use, and to properly dispose of the plastic they do use.

Conclusion

In each aspect of our project, we aimed to make our recommendations accessible and beneficial to the YMCA. By presenting multiple recommendations for each area of plastic use, interviewing all levels of employees, and looking for least-cost solutions to problems, we hope to have made thoughtful, impactful, and sustainable recommendations for change at the YMCA of the Rockies. We estimate that our optimal recommendations could eliminate the use of 650,000 plastic items, and reach cost savings in under a year.

The YMCA began to prioritize sustainability when the COVID-19 pandemic gave them time to rethink their priorities as an organization. They realized that they were lacking in the sustainability and technology sectors, and began a push for both of these as a part of their 5-year plan. While a large part of their organization's image is the feel of an old camp nestled in the mountains, the world is now technologically and sustainably driven for a reason; our people and planet depend on it.

Figure 4 - YMCA of the Rockies Estes Park Center

Table of Contents

Table of Contents (continued)

Table of Contents (continued)

List of Figures

List of Figures (continued)

List of Tables

Glossary

YMCA.....Young Men's Christian Association
EPC.....Estes Park Center
SMR.....Snow Mountain Ranch
CSS.....Conference and Setup Services
B&G.....Buildings and Grounds
PLA.....Polylactic acid
HDPE.....High-density Polyethylene
LDPE.....Low-density Polyethylene
ABS.....Acrylonitrile Butadiene Styrene

Introduction

Introduction

Plastics are notoriously detrimental to the environment, contributing to climate change and harming ecosystems, people, and animals across the world. Fossil fuels, a non-renewable resource, are used in 99% of plastic production (CIEL, 2021). These fossil fuels release greenhouse gasses into the atmosphere, which trap the sun's radiation and contribute to climate change. Plastics also do harm to our Earth both on land and in the water. The International Union for Conservation of Nature (IUCN), an international NGO, estimates that at least 14 million tons of plastic enter the ocean each year (IUCN, 2021). Once plastic enters the ocean, it degrades slowly over the next few hundred years, ultimately becoming microplastic (NOAA, 2022). Microplastic has made its way into almost every ecosystem on the planet and is found everywhere from the ocean floor, the soil of US national parks, and the bloodstream of humans (Choi-Schagrin, Tabuchi, 2022; Parker, 2020). Microplastic has been found both in the bloodstream and lung tissue of humans.

Plastic use and production has been exponentially increasing for decades. It is widely used across the U.S., but from 2012-2019 only 9% of plastic waste in America was recycled, contributing to the accumulation of plastic waste in oceans and landfills (Parker, 2019). Despite the global consequences of plastic production and waste disposal, its production is expected to double by 2050 (Loria, 2021).

The food services and hospitality industries are a few of the many culprits of single-use plastic use. Cutlery, to-go containers, cups, bottled water, plastic packaging, plastic wrapping, and toiletries are just a few of the many uses of single-use plastics in these industries. The COVID-19 pandemic has only amplified the reliance on single-use plastic. Fear of the virus persisting on reusable materials caused an increase in single-use plastic items (Vanapalli et al., 2021), while a reduced workforce caused by the pandemic meant that constantly washing reusable and sustainable options was not feasible (Karidis, 2020).

Figure 5 - "Marine litter. Closeup of Colourful plastic trash on the shoreline." by Snemann is marked with CC BY-NC-ND 2.0.

The YMCA of the Rockies, our sponsor, would like to reduce plastic use at its Estes Park Center and Snow Mountain Ranch facilities. These comprise hotel-style lodges, cabins, and cafeterias that can serve up to 2,000 visitors a day. The scale of their operation means that the housekeeping, dining, and groundskeeping departments produce and dispose of large amounts of plastic waste. The YMCA has already begun work towards sustainability with the formation of its Sustainability Team. The team initiated the project "That's a Wrap on Plastic Wrap" which assessed plastic wrap use by the housekeeping department (Leet, 2021). The YMCA hopes to continue this initiative and identify new opportunities to reduce plastic waste.

The goal of this project was to audit plastic use at the YMCA of the Rockies and propose alternative operations and products to reduce the amount of plastic used and improperly disposed of. We considered the extent to which minimizing plastic use can decrease operating costs, simplify employee tasks, and decrease the YMCA's negative impact on the environment. To achieve this goal we interviewed employees and observed operations to identify the largest sources of plastic use, confirmed that our suggestions aligned with the YMCA budgetary priorities, and investigated if employees and customers were willing and able to participate in plastic reduction programs. With these perspectives in mind, we developed suggestions to help the YMCA reduce its plastic usage and better manage the plastic that is unavoidable through recycling. Plastic reduction not only results in benefits to the environment but also to the YMCA's business, as there is a significant public and moral appeal to environmentally friendly initiatives.

Figure 6 - Mule deer on the Estes Park Center property

The Negative Impacts of Plastic and its Prevalence in Today's World

The Plastic Life-Cycle has Numerous Effects on Humans and the Environment

Plastic has a widespread negative impact on the environment in every step of its lifecycle, which contributes to the current environmental crisis. Plastics are a major contributor to climate change, air pollution, and global environmental injustice.

Plastic Production

The production of plastic requires the use of limited fossil fuel resources, whose extraction and use contributes significantly to climate change. The Center for International Environmental Law states that "Over 99% of plastic is made from chemicals sourced from fossil fuels, and the fossil fuel and plastic industries are deeply connected" (CIEL, 2021, p. 1). Not only does this affect the health and wellbeing of every living being on Earth, but disproportionately affects marginalized groups who are forced to manage the negative consequences of both plastic production and disposal.

Plastic creation and deterioration also contribute to air pollution. Marginalized groups in the United States are exposed to higher levels of air pollution on average, according to the National Institute of Environmental Health Sciences (NIEHS, 2016). Our dependence on plastic has furthered environmental injustice and will continue to do so unless steps are taken to reduce the amount of plastic used. Most of the plastic from the U.S. was sold to China in the past, where recycling was prioritized to support the rapid development of the country (Brooks, Wang, Jambeck, 2018).

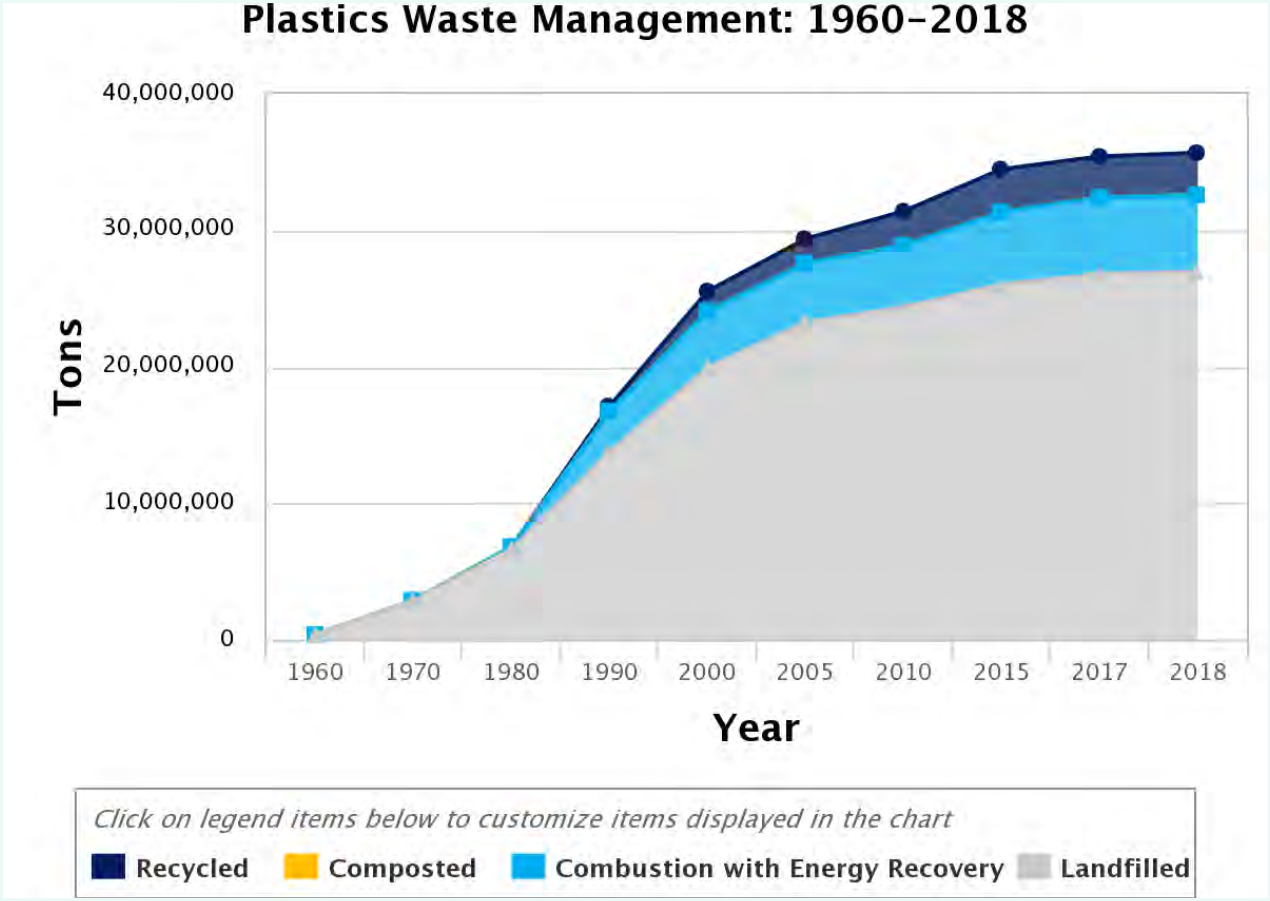

Figure 7 - Plastic Waste Management: 1960-2018, US EPA

However, according to Brooks et al. researchers at the College of Engineering, New Materials Institute, University of Georgia, “in 2017, China announced a new import policy permanently banning the import of nonindustrial plastic waste” (Brooks et al. 2018). Due to this, the U.S. started shipping more plastic waste to less developed countries, leaving them to live with and manage our waste without the necessary infrastructure to do so sustainably. Even after over 180 nations agreed to limit exportation from developed countries to less developed ones, data shows that American exportation of plastic has reduced very little (Tabuchi, Corkery, 2021).

Despite the negative consequences of plastics, its production is expected to double by 2050 (Loria, 2021). This is because plastic is easy and cheap to make and has many different forms and applications, making it a very versatile material that is used broadly across the world.

Difficulties of Plastic Waste Management

Plastic waste contributes significantly to litter and pollution across the globe, which destroys natural environments and jeopardizes public health. One of the largest complications of plastic is its difficulty to be recycled. Plastic must be clean, sorted by type, and sometimes even by color, before it can be recycled (Eureka! Recycling, 2021). Loose enforcement of regulations on labeling plastics as recyclable contributes to limited access to recycling plants for certain kinds of plastics. Because of this, the vast majority of plastic is not properly disposed of. This lack of recycling in the United States has contributed to a mere 8.7% of plastic being recycled in 2018 (EPA 2021), compared to over 30% in the European Union (Di, Reck, Miatto, Graedel, 2021). Minimal recycling can also be attributed to the lack of infrastructure in the United States. Resin identification codes (Figure 1), which identify plastic types, draw many similarities to Gary Anderson’s recycling symbol (Figure 2) created in 1970 (MTSU, 2021). This is misleading, as American consumers then assume that all types of plastics can be recycled, whereas many can be difficult to recycle, or are not recyclable at all. Even plastics that are easiest to recycle are often not. According to Kevin Loria at Consumer Reports, only 29 percent of the plastic that is easiest to recycle, resin identification codes 1 and 2, were recycled in 2018 (Loria, 2021).

Figure 8 - Resin Identification code for PEHD [1]

Figure 9 - Gary Anderson’s Recycling Symbol

Both illegal dumping and lack of recycling has led to the large influx of plastic into the natural environment. Plastics that are not properly recycled or reused end up in landfills or, more often, the ocean. Plastic does not biodegrade into the

1. *"recycling" is marked with CC0 1.0. To view the terms, visit https://creativecommons.org/publicdomain/zero/1.0/?ref=openverse*

environment (Loria, 2021) and can affect large numbers of wildlife. As it ages, plastic breaks down into microplastics, which are not filtered by wastewater treatment plants. The accumulation of microplastics through drinking water, or other ingested materials in an organism can block gastrointestinal natural abilities and the adhesion of toxic chemicals to plastic can lead to high concentrations of toxic chemicals in an organism's body (Haslam, 2012). In addition to these microplastics, large plastic waste items such as rope and plastic bags may be perceived by larger marine life as food. "Plastic ingestion can lead to damage or blockage of intestinal tract resulting in infection, starvation and death." (Wani, Pathan, Bose, 2021p. 3). Due to this, plastics have a detrimental effect on both human health and the well-being of wildlife.

Additionally, it can be difficult to determine if plastic alternatives are actually better for the environment than the plastic they would replace. One example of this is in greenwashing, particularly around bioplastics and starch-based plastics, which is discussed in Appendix C.

Opportunities to Reduce Plastic Use and Waste in Dining and Hospitality Industries

Plastic use is exponentially growing and it touches every aspect of our lives (Parker, 2019). However, there are numerous natural, biodegradable, or recyclable options that can be used to avoid the production and disposal of plastic products while fulfilling the same function. Industries that notoriously rely heavily on plastic include hospitality and dining. The nature of these industries creates a high plastic dependence, particularly on single-use plastic items, given that they are often a convenient and low-cost option for a wide range of operations. The benefits of single-use plastic in these industries, however, in no way negate the destructive consequences of plastic use.

While there are many benefits to plastic reduction, it is important to consider that some plastic alternatives may result in larger consumption of limited resources compared to that of plastic products. Metal and glass, for instance, can create large greenhouse emissions in their life cycle, which may make them counterproductive options if the goal is environmental sustainability. Plastic also has excellent mechanical properties which can sometimes make it the best option for certain applications. For example, food stored in plastic is able to stay fresher for longer, leading to less food waste and fewer preservatives in food. Therefore, care must be taken to select plastic alternatives that have a lesser environmental impact than plastic (Stanton et al. 2020).

Strategies for Reducing Plastic Waste in Food Service

Decisions related to plastic reduction programs in food services include cost and environmental impact. Typically, plastic reduction efforts in food services focus on substituting single-use plastic straws, cups, and utensils with alternative materials such as paper, metal, plant material, or multi-use plastic. In addition, limiting how often these plastic products are used is another commonly used technique.

Possible challenges in reducing plastic include higher costs of plastic alternatives and limitations of available recycling infrastructure, whether due to recycling plants or building waste collection (Su et al., 2015, p. 21, 34; Starbucks, 2013). Finding an alternative material can also be a challenge. Plastic trash bags and plastic wrap can be particularly difficult materials to suitably replace (Su et al., 2015). In some cases customer may put recyclable materials in the wrong bins, causing improper disposal, more employee workload to separate trash and recycling properly, or both (B. Wilder, personal communication, February 11, 2022). With the current state of the supply chain, some plastic alternatives can be more difficult to supply, forcing the use of plastic materials (B. Wilder, personal communication, 2022). Plastic reduction programs using multi-use materials may require added work hours, often to wash reusable alternatives. When there are not enough workers, such programs can be put on hold. (Karidis, 2020; personal communication with Bob Wilder, 2022). Specific ways that institutions have reduced plastic use are organized in table XXX.

Figure 10 - Plastic wrapped food items

Area	Plastic Reducing Practices (Bhardwaj, 2022; Cook, 2014; Karidis, 2020; Michelin Guide, 2020; Slavikova et al., 2011; Starbucks, 2013; Starbucks, 2015; Su et al., 2015; Ted's Montana Grill, 2017; B. Wilder, personal communication, 2022)
Takeout food and beverages	• Use of paper bags for packaging to go orders over plastic bags • Using to go cutlery made of corn and tapioca starch • Reusable/returnable container and cup programs • Not providing take out services
In store and sit down dining	• Use of beeswax-chitosan emulsion-coated paper and chitosan-coated paper over plastic LDPE bread packaging • Avoid individually packaged items • Using reusable cups, bowls, and plates in place of single-use plastic containers • Only using paper straws • Use of natural and recycled paper for pan/basket liners and table coverings • Replace products packaged in plastic with those using non plastic materials
Organizational level initiatives	• Choosing suppliers that use recyclable or less plastic packaging • Using reusable crates to transport materials • Have recycling available in the front of stores/takeout locations • Research life cycle of plastic materials to make educated decisions • Where plastic is used, limit its use as much as possible

Table 1 - Summary of plastic reducing behaviors in food services

As a part of several of these initiatives, some institutions sought to engage the customer in their plastic reducing programs. These efforts took the form of discounts to customers bringing their own containers, selling reusable containers, or paying customers to return reusable containers (Karidis, 2020; Su et al., 2015, p. 16; Starbucks, 2013). Others display sustainability certificates in restaurants, participate in community organizations, display information about their plastic reducing practices online and on-site, and try to educate consumers to change their behaviors (Su et al., 2015, p. 17, 21). Some factors considered when evaluating the effectiveness of plastic reducing programs included, costs, amount of waste diverted, number of plastic items saved, recyclability of alternative products, and tons of recyclables used (Slavikova et al., 2011).

Strategies for Reducing Plastic Waste in Hospitality

Hospitality is another major industry that uses a significant amount of single-use plastic items. Plastic can be found in hotel rooms in many forms, such as garbage bags, coffee cups, water bottles, and more. Hotels and resorts implementing plastic-reduction programs hope to not only generate a good public image for their company but also strive to improve the quality of guests' stays by allowing people to enjoy a more environmentally sustainable vacation. According to the President and Chief Executive Officer of Marriott International, Arne Sorenson, "Our guests are looking to us to make changes that will create a meaningful difference for the environment while not sacrificing the quality service and experience they expect from our hotels" (Marriott, 2019, p.1).

One of the largest areas of interest regarding plastic use in hotels and resorts is plastic bags in waste bins. Some hotels have identified that they can successfully reduce the number of plastic waste bags used simply by updating their waste collection process. For instance, housekeeping may refrain from putting plastic liners in the waste bins of bedrooms, which usually do not contain messy waste. Guests can then be informed to put any messy waste in the bathroom bins instead, which will effectively half the use of plastic bags. Hotel staff may also be trained to only replace trash bags when necessary, allowing the bags to potentially be reused, leading to less bags being wasted (Slavikova, 2011).

Figure 11 - A traditional lodge room at the YMCA of the Rockies

Plastic cups and bottles are other notorious sources of single-use plastic in hotel rooms. To combat this issue, many companies have made the switch towards durable cups that guests can reuse to drink water, in substitution of single-use plastic cups. Some hotels have also implemented water bottle refill stations, which encourage guests to reuse water bottles, leading to less waste (Rhone, 2019).

A large contributor to the success of programs is being able to educate guests and employees on how to properly carry out sustainable practices. Making sure that employees are involved in sustainability decisions and passionate about their impact is important. Many companies chose to implement committees or teams, which include employees from several different departments, whose task is to help develop sustainable solutions. Since the work of employees can be heavily impacted by sustainability programs, it is important to include their input when drafting and implementing changes (Sustainable Hospitality Alliance, 2021). Slavikova (2011) argues it is also critical that guests are informed of the sustainability practices so that they can effectively participate in the programs which can have the added benefit of generally raising environmental awareness among both customers and employees.

Generally, by implementing new policies and programs, hotels and resorts are able to significantly reduce their plastic usage and in some cases are able to see cost savings as well (Slavikova, 2011). These cost savings are a result of not needing to order as much stock in single-use plastic, less storage space being needed for these items, and less staff being needed to clean up litter from single-use plastics (Slavikova, 2011).

Figure 12 - Plastic-wrapped plastic cups for use in hotel rooms

Plastic End of Life Management

Waste disposal practices and capabilities limit the management of plastic at the end of its lifecycle. In large establishments, groundskeeping services are often tasked with the management of waste, including both garbage and recycling. In order for recycling to be efficient, both customers and groundskeeping employees must be educated on proper recycling practices, along with a commitment to ensure recycling is properly managed. Once recycling is properly sorted, cleaned, and managed by customers and groundskeeping, access to suitable recycling technology is required. Ideally, recycling facilities should be nearby (to avoid long distance shipping), capable of handling large amounts of material, and cost-efficient.

Covid-19 Related Challenges

The Covid-19 pandemic has created difficulties related to sanitation for the reduction of single-use plastic. Out of concern for the spread of COVID and reduced workforces as a consequence of COVID, some plastic reduction programs using washable multi-use plastics have had to be put on hold (Karidis, 2020; B. Wilder, personal communication, 2022). Public concern for the spread of Covid-19 caused rollbacks of laws banning single-use plastics (Monella, 2020). Food plastic packaging has seen a reemergence due to rollbacks of plastic bans in many countries (Vanapalli, 2021). The pandemic's adverse effect on the global supply chain has also contributed to an increase of plastics, making locations unable to source the plastic alternatives they typically used before the pandemic (personal communication with Bob Wilder, 2022). The pandemic also significantly reduced the number of available workers in the United States. About 1.6 million full-timeworkers are missing from the economy, and their absence is believed to be due to long-lasting COVID complications (Picchi, 2022). Employers have seen this impacting the scope of work that they are able to accomplish, and sustainable efforts that require additional labor fall short on their list of priorities.

Sustainable Programs' Success Depends on Participation

Reusable plastic alternatives are often made of materials that have a greater environmental impact than the single-use plastic on its own. These items require a certain use threshold to be met before their long term environmental benefit can surpass the initial impact (Fetner, 2021). Reaching this use threshold to become more sustainable requires active support from employees, management, and customers. Thus, in recommending plastic reducing programs, it is important to consider the attitudes, participation, and behavior of the employees and customers who would directly interact with the program.

Impact of Plastic Alternatives on the Workforce

Some types of plastics alternatives can add new tasks to a workflow, such as the need to wash reusable items. If an organization's capacity is exceeded by these programs, they may be halted or not be able to get off the ground, resulting in no return on the time and resources used to research and develop the policies (Karidis 2020; personal communication with Bob Wilder, 2022).

Improperly Designed Programs have Negative Effects on Employees

Even if there is enough time or work for the program to be put in place, added workloads can still have a negative effect on the program's efficacy, and the broader organization as a whole. If an employee's workload is increased or their responsibilities change dramatically, they may feel less supported by their supervisors, less secure in their

job as their role changes, and less respected as their experience in their field may not be properly recognized in the design of new programs. In Employee Engagement and Commitment, Robert Vance claims that these are all factors that can contribute to lower employee engagement. Vance describes employee engagement's importance in increasing productivity and decreasing employee turnover, overall contributing to a more healthy, stable, and effective company and workplace environment (Vance, 2006). Just as poor employee engagement can harm a company, it could decrease the efficiency of sustainable programs by reducing employee participation in said programs. Therefore it is important to take employee input into account in the designing of these programs so that employee morale remains high and the program can have the best opportunity for success.

Creating Employee Engagement and it's Benefit to Progress Productivity

Conversely, proper employee engagement could drive the productivity of environmental programs, ensuring their best chances for success. Vance describes one method of task design to achieve greater engagement: offering a greater variety of tasks and involving the employee more across different areas of the policy (Vance, 2006). This grants the employee a better understanding of how their work ties into the company's mission. If the employee values the goals of the organization, they may feel more pride and satisfaction with their employer. Vance lists both of these as drivers of employee engagement (Vance, 2006). The Sustainable Hospitality Alliance (2021) also recommends that employee input be included in sustainability programs because of the heavy impact that they can have on their work.

In their pilot testing of plastic reducing programs in their hotels, Thomas Cook Hotels emphasized training their staff in how to use less plastic in their duties. In doing so they informed employees of their goals and the impact they hoped to achieve. Testimonials from their employees made clear that those who understood the impact their actions could have on the environment were excited to use less plastic (Slavikova et al., 2011). At the YMCA, employee's positive attitudes toward sustainability enabled us to drive their engagement by developing policies that align with their values.

Figure 13 - Maggie Ruff (left) and Rod Hightower (right), Food Service employees at SMR

Consumer Participation's Importance and Education as an Option to Increase it

Since some plastics alternatives rely on the proper use of alternatives, such as: returning reusable containers, not asking for straws, and properly recycling materials, the participation of customers in plastic reduction programs is important to take into consideration. Studies have found that people are generally willing to make more sustainable actions and are willing to pay more for environmentally friendly packaged foods (Lindh et al., 2016). However, to be able to make sustainable actions, individuals need to be educated on the impacts of their actions.

Education's impact on individual sustainable and plastic-reducing behaviors is identified by Kakadellis, Woods, and Harris, who found clear labeling of plastic packaging can help consumers make informed decisions (2021). In combination with collective commitment, educating people on sustainability has also been shown to cause lasting changes in behavior, including plastic reducing ones, by the study carried out by Lindemann-Matthies et al. (2021). Education is also suggested as a means to turn pro-environmental feelings following nature tourism experiences into intentions to reduce plastic use (Clark et al., 2019). One prevalent example of plastic reducing movements/programs being bolstered by education is the save the turtles campaign. This campaign was ignited by viral footage showing people the impact that even a single straw could have on the environment. Since this event, movements to use alternatives to plastic straws have become widespread among customers and businesses (Rosenbaum, 2018). Furthermore, Thomas Cook Hotels made directly reaching out to consumers, telling them their goals, what actions guests can take to use less plastic, and informing them of the impact these changes could make, a key step in their successful efforts to reduce plastic use (Slavikova et al., 2011).

The YMCA of the Rockies

The YMCA of the Rockies is a family-oriented organization ideal for vacations, reunions, and conferences. They host a wide variety of programs, mainly based outdoors to enhance their guests' experience in their local surroundings, Rocky Mountain National Park. Dining, lodging, and a wide selection of activities are provided to guests, which offer a large number of areas for plastic use.

The YMCA of the Rockies is situated on 900 acres of land in Colorado's Rocky Mountain Range. The YMCA has two locations, Estes Park Center, located in Larimer County, and Snow Mountain Ranch, located in Grand County. The two locations are separated by the main range of Rocky Mountain National Park. Maps of these locations are shown below in Figures 3 and 4.

The YMCA of the Rockies is the largest YMCA camp and conference center in the world. The Estes Park Center can host 5,032 people at a time (YMCA, n.d). Many guests travel from the Midwestern United States and Colorado's surrounding states.

Emphasizing their connection to their natural landscape, the YMCA of the Rockies provides guests with a range of programs that explore this landscape. These include hiking, outdoor education programs, and recreational sporting activities, all of which immerse guests in the outdoors and provide an appreciation for them.

The YMCA's mission's inclusion of activities with educational and recreational nature displays their connection to the natural world and its preservation. Through their sustainability goals, the YMCA aims to reduce their negative environmental impacts on the planet. As such, the YMCA asked our team to help them audit and reduce their plastic usage to further this goal.

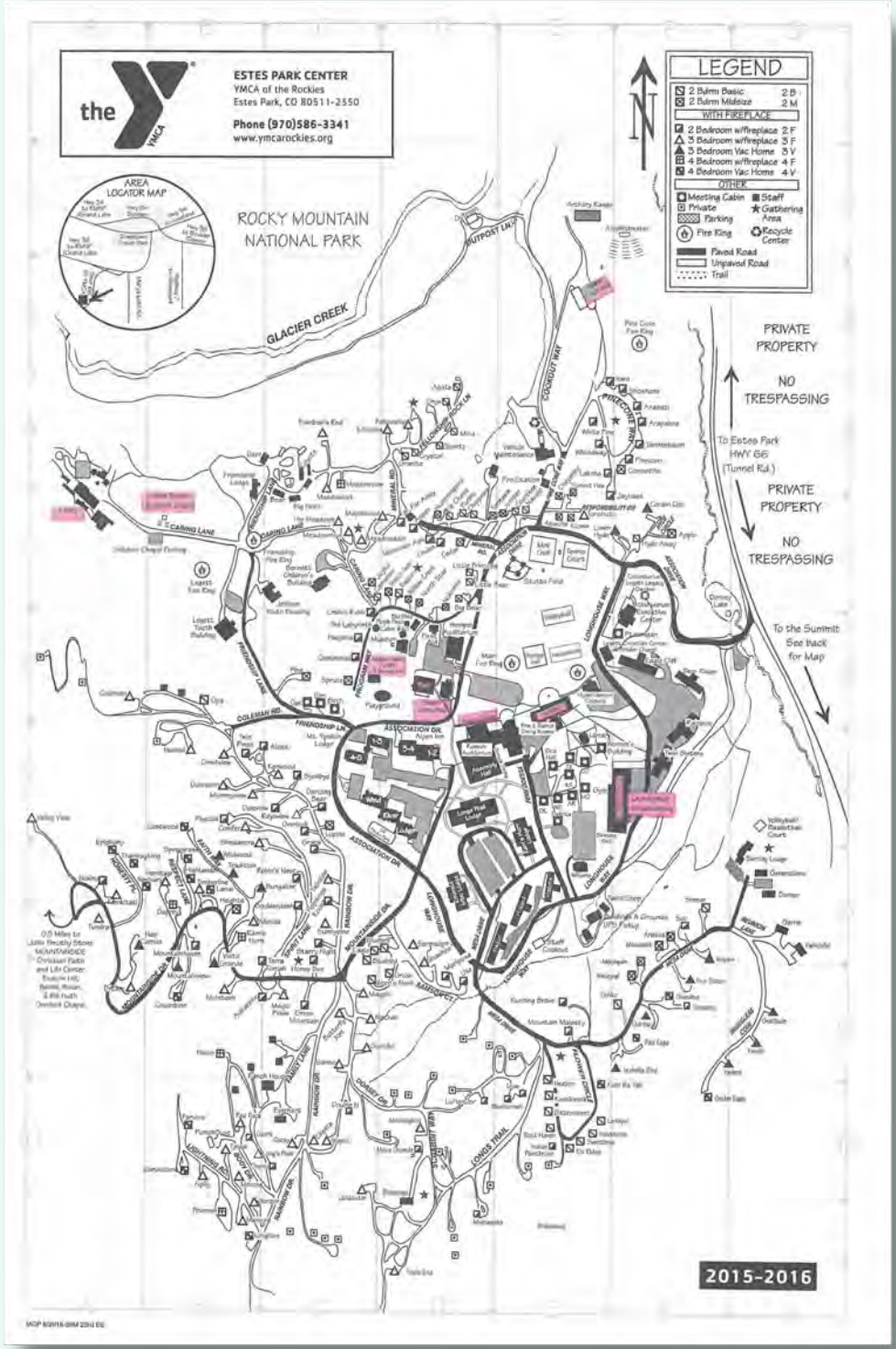

Figure 14 - Map of the YMCA of the Rockies, Estes Park Center (YMCA, 2016)

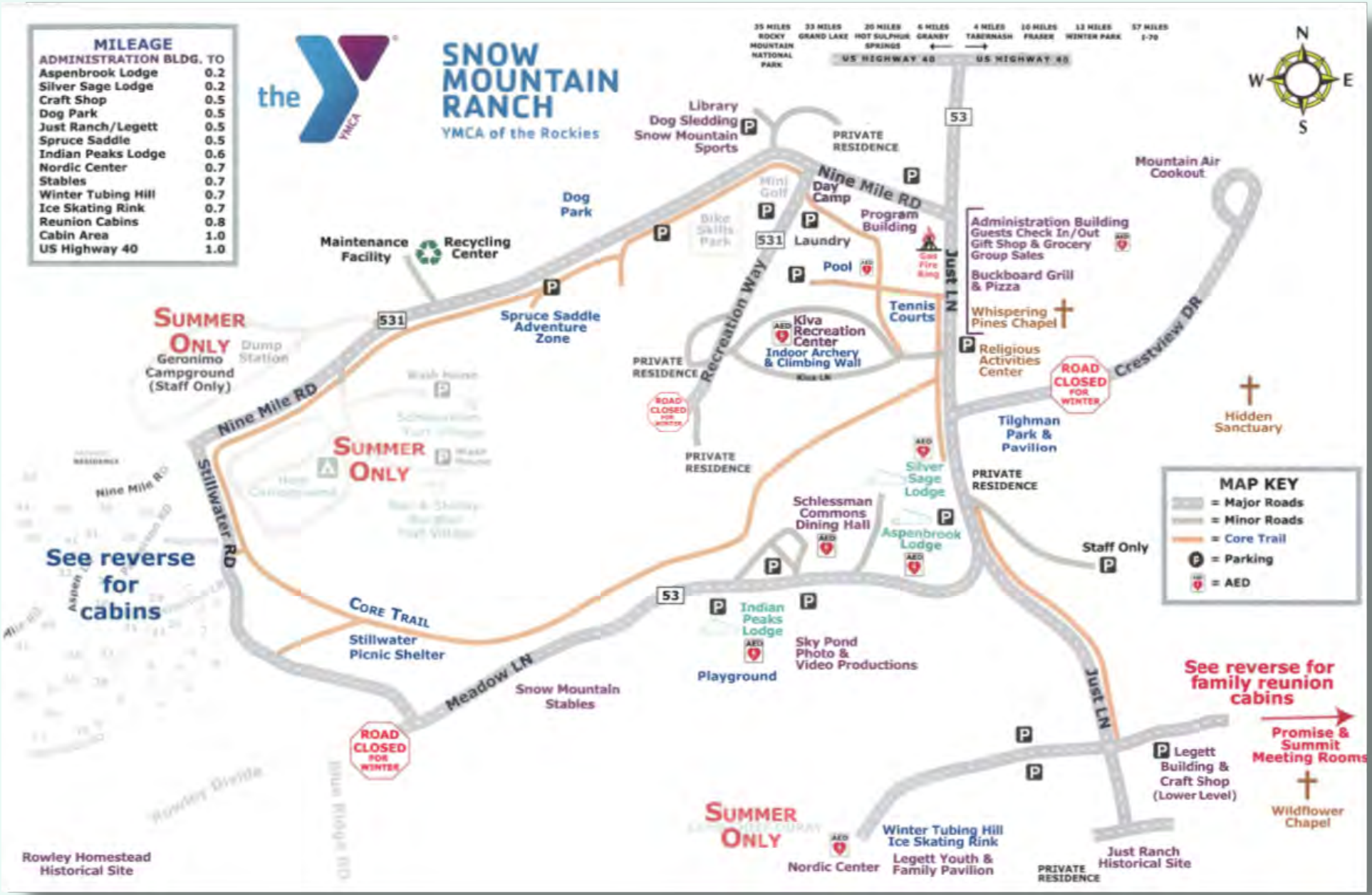

Figure 15 - Map of the YMCA of the Rockies, Snow Mountain Ranch (YMCA, 2014)

Designing an Approach to Investigating Plastic Use

The goal of this project was to audit plastic use at the YMCA of the Rockies and propose alternative operations and products to reduce the amount of plastic used, and improperly disposed of. We considered the extent to which minimizing plastic use can decrease operating costs, simplify employee tasks, and decrease the YMCA's negative impact on the environment. Our project's objectives are listed as follows:

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- Assess where and how plastic is used at the YMCA
- Determine sustainable alternatives to plastic
- Evaluate consumer and employee/organization willingness and ability to adopt plastic reducing changes
- Suggest initiatives to reduce plastic use and improper disposal

Identifying Plastic Use and Disposal at the YMCA

In order to develop possible solutions to reducing plastic usage at the YMCA of the Rockies, we first assessed how plastic was being used and disposed of at their facilities. The scope of this project focused on the food service, housekeeping, and grounds departments.

Interviewing YMCA Employees about Perspectives on Plastic Usage

To better understand executive, managerial, and ground-level employee perspectives on how plastic was being used at the YMCA, interviews and shadowings were conducted with those involved in foodservice, hospitality, and groundskeeping. All interviews were recorded when given permission to do so and notes were taken by our team members in field note documents. Interviews were conducted in person whenever possible or over video conference technology.

Executive and Managerial Employees

To gain a better understanding of decisions made around plastic use, we interviewed executive and managerial employees of the YMCA, specifically those in key areas. Our questions focused on their knowledge of how certain materials or products are chosen in favor of others, how the YMCA selects and communicates with their suppliers, and plastic reduction efforts that had been proposed in the past, whether successful or not. Interviews were conducted with the following people:

- Food Service Director at EPC - Michael Kingston
- Housekeeping Director at EPC - Emily Pullen
- Housekeeping Crew Leader at EPC - Nick Whittemore
- Grounds Supervisor at EPC - Kelly Wilkerson
- VP of Advancement - Carrie Rossman
- Accounting Manager - Jennifer Leivestad

- Brand Manager SMR & Sustainability Team Liaison
  - Amy Wolf
- Food Service Director at SMR
  - Rod Hightower
- Food Service Manager at SMR
  - Maggie Ruff
- Superintendent of Buildings and Grounds at SMR
  - Neil Willems
- Assistant Housekeeping Manager SMR
  - Matthew Price

Questions for these interviews can be found in Appendices A.2 and A.5, while supplementary questions are located in Appendices A.6-A.8. In addition to these employees, members of the sustainability team were interviewed for their expertise and relation to plastic use using questions from Appendices A.2, A.3, as well as A.4 and A.5-A.8 where appropriate. In addition to interviewing members of the team, we also attended the biweekly sustainability team meetings which gave us the opportunity to work closely with members of the sustainability team and to better align our goals with the sustainability goals of the YMCA.

Figure 16 - Cody Corbett during a trash and recycling run

Ground-Level Employees

To avoid information gaps that could arise from only using interviews, we observed and, in some cases, participated in employees' daily tasks when given permission. This helped us to gain a first-person view as to how plastic was used, what roles plastic products fulfilled, and how plastic usage could be reduced. These “shadowings” were conducted by our team members with ground-level employees to understand how plastic is used in the daily operations of the YMCA. During these shadowings, questions from Appendices A.2 and A.7-A.9 were asked, garnering a better understanding of how, where, and why their work used plastic.Asking employees about areas where they believe plastic is overused gave us additional places to search for ways to reduce plastic. These questions and shadowing experiences also gave us an understanding of the roles that the plastic products filled, which helped us to find sufficient alternatives.

Shadowings were carried out in these areas:

- Grounds with Cody Corbett and Ethan Lotzer - Helping to collect recycling/trash from the property
- Housekeeping with Nick Whittemore - Shadowing laundry services operations, and lodge/cabin crew cleaning
- Food Services with Jorge Escobar- Observing kitchen work and trash disposal

Figure 17 - Ethan Lotzer during a trash and recycling run

Evaluating Plastic Usage and Procurement in Key Areas Through Recent Invoices

We utilized the YMCA's invoice system, Sage APA, to understand the influx of plastic products into the YMCA. Access to the system was granted by Jennifer Leivestad, the Accounting Manager of Snow Mountain Ranch and the Estes Park Center. We searched through invoices for plastic products identified by our observations and interviews with employees. We identified what plastic products were being bought in high volume which revealed possible areas for significant plastic waste reduction. Our team also looked at whether products were bought in bulk or in smaller recurring purchases that may use more plastic packaging. This analysis provided further knowledge of how plastic is purchased and in what quantities. This information also helped us to compare the costs of possible alternatives to the system already in place.

Guest Plastics Experience

Our team continuously reflected and discussed our observations, described how we used and disposed of plastic, how we participated in plastic reducing actions, and what barriers to reducing plastic we encountered in that week. We actively investigated the disposal of plastic by exploring different locations at the YMCA, such as the recycling center and waste disposal receptacles. We also talked to other WPI students to obtain this information from them as well. This portion of data was kept separate from data collected about other consumers, and didn't include questions about attitudes towards sustainability or willingness to change behavior. This is because WPI students differ from the typical demographic of tourists at the YMCA of the Rockies. We also talked with our advisors about their experiences with plastic use at the YMCA.

This gave us information outside of our observations because they stayed in cabins while we stayed in lodge style housing at Twin Sisters.

Proposing and Evaluating Alternatives to Plastic

Section 3.1 identified plastic use across the YMCA campus. Alternative operations or materials were then identified for these areas of significant plastic use through research and brainstorming. Multiple alternatives were then organized in a spreadsheet tool, which evaluated each alternative in terms of their environmental impact and impact on the YMCA. The spreadsheet tool was organized by first identifying our proposed alternative and the current YMCA operation that the alternative sought to address. Specific questions regarding the alternative's environmental impact and impact on the YMCA were also addressed in the spreadsheet in order to weigh benefits and feasibility. These are environmental impact of production and disposal, reusability, recyclability, compostability, added cost, and ease of use to employees and customers. These additional questions are shown in the following table. Each of these criteria were considered based on their relative importance and impact, which varied for each proposed alternative. This consideration allowed us to determine which alternatives we believed to be best for the YMCA. We also received feedback on the list of criteria from YMCA staff so that our suggestions best reflect the YMCA's priorities. In talking to YMCA staff we discussed each set of alternatives, presenting the benefits and drawbacks of each possible alternative. After discussing with YMCA staff, we reanalyzed the alternatives we identified to better determine what alternatives were best suited to reducing plastic use and the YMCA's needs. We used this analysis to create a ranked list of several possible alternatives, which outlined our reasoning, benefits, and drawbacks. In some cases, supplemental suggestions were made to be used until larger recommendations could be addressed. In others we included backup suggestions in case other suggestions did not work.

Environmental Impacts					Organizational Impacts		
Impact of Production	Is it Reusable?	Is it Recyclable?	Is it Compostable?	Impact of Disposal	Added Monetary Cost	Ease of Use to Employees	Ease of Use to Guests

Table 2 - Categories to evaluate environmental impacts and impacts on the YMCA

Evaluating Consumer and Employee Willingness/Ability to Adopt Sustainable Changes

Developing sustainable programs to be implemented at the YMCA required consideration of the employees that would run the programs and the consumers who would take part in them. Through talking with employees and guests, we gauged their attitudes to see how invested they were in plastic reduction programs.

Guests were directly asked about their attitude towards plastic reduction in our surveys. Employee attitudes were gauged by their enthusiasm and interest in plastic reducing efforts, as well as their responses to questions about plastic use. Employee and customer experience were also used to identify barriers that these programs might face.

Employee Interviews

During our employee shadowing sessions as described in Section 3.1.1 , we investigated their worries about changes to their work, potential roadblocks they anticipated in implementing new programs, suggestions they had on where plastic use could be reduced, and how their input had been received. The specific interview questions are found in Appendices A.7-A.9.To ensure we obtained as accurate a depiction of the YMCA workforce as possible we asked as many employees as we could while we shadowed them. Soliciting responses from the full workforce in each area, Food Services, Housekeeping, and Grounds, helped us best represent the employees in the areas we shadowed.

Guest Surveys

We surveyed guests to the YMCA to assess their attitudes towards sustainability and plastic use reduction programs, how such programs would affect their view of the YMCA, how willing they would be to change their behavior to participate in the programs, and what they foresaw as obstacles to their participation in plastic reduction programs. Most questions were multiple choice with one open ended question.

Figure 18 - Team members during an interview with Conference Set up and Services employees

All questions were optional in order to not turn away potential respondents. Survey specifics can be found in Appendix B. Google Forms was used to host the survey. Responses were solicited from guests leaving the Aspen Dining Hall upon receiving permission from the YMCA.

Data Organization and Analysis

During interviews team members took notes by hand, later typing them and uploading them to a folder in our Google Drive. Notes went into folders organized by interviewee name and title. If the interviewee consented to recording, audio files were placed in the same folder as summary notes. If any photos or videos were taken to illustrate a point or describe a process they also went in these folders. At the end of each week the interviews, realizations, progress, and our observations were summarized to condense relevant findings and future lines of questioning that had been raised.

We analyzed visitor survey questions by first looking at the range of responses for each question to get a broad understanding of where feelings lied. Open ended questions were reviewed individually, along with observations from our experience surveying. They were summarized by grouping together similar answers along with insights from our observations and those of others in our cohort.

For each objective we identified major themes of data collection by grouping and condensing similar responses and further summarizing the findings of individual interviews to synthesize information from each objective into one location.

Suggestions for the YMCA to Reduce Plastic Usage

We made recommendations for changes with the goal of providing the most environmental benefit at the least financial cost, labor cost, and impact to customer experience. This was done by carefully considering cost, employee needs and abilities, geographic constraints, and environmental impacts. Our interviews with department heads as well as the accounting manager helped us to understand the cost constraints of the YMCA as a whole as well as the flexibility in budgets of the specific departments. Data collected from employees helped us to explore adaptability in scheduling, workload, and logistical changes, such as workspace setup and processes, training, and educational material.

The spreadsheet which was synthesized in section 3.3.2 helped to show the advantages and disadvantages of each alternative. This information was presented to the employees to identify what alternatives were feasible at the YMCA.

Identifying Constraints Through Key Informant Interviews

Management of the YMCA had a final say for exactly what changes were feasible for the facility. By interviewing department heads,

we sought to understand the YMCA's flexibility in changing operations and vendors. Some possible solutions required that substantial changes be made to the YMCA's operations, including changing budgets, vendors, or waste disposal systems. To clearly see if any of the solutions we identified could be considered as an option, interviews with the managers from each key department investigated the limitations and hesitations of their department.

Figure 19 - The laundry backroom of Housekeeping

Synthesis of Methods

A summary of our methods is shown in the following table.

Task Type	Task Name
Initial Data Collection	• Reflect on our Experience with Plastic Use • Interviews with executive and managerial employees (exploring where plastic is being used) • Analyzing company plastic purchasing records • Interviews with Ground-level employees (exploring where plastic is being used) • Shadowing of Ground-level employees • Distribute Consumer Surveys
Initial Analysis	• Create Spreadsheet of possible alternatives/practices • Organize Interview, Survey Data, and Reflection
Analysis Review	• Interview employees about willingness to adopt sustainable changes/specific alternatives identified • Interviews with Department Managers (Identifying constraints)
Reanalysis and Conclusions	• Reanalyze and address any changes to spreadsheet for future use by the YMCA • Write and Revise Results and Conclusions for Final Paper • Present Results

Table 3 - Synthesis of Methods

Assessing Plastic Use at the YMCA and Identifying Areas of Improvement

Conducting interviews with over ten employees, receiving tours from four departments at Estes Park Center and three at Snow Mountain Ranch, as well as researching best practices and plastic alternatives led us to the findings described in this chapter. We identified competing priorities at the YMCA that must be addressed or overcome. We also pinpointed key differences between the Snow Mountain Ranch and Estes Park Center that guided the development of our recommendations.

This section presents the identified uses of plastic at the YMCA and lists possible alternative materials and operations for each use of plastic.

In this chapter, we discuss the constraints that characterize the institutional setting at the YMCA and discuss some areas of improvement. We then provide an overview of Snow Mountain Ranch's operations to highlight key differences between the two locations. Next, we discuss how communication between Snow Mountain Ranch, Estes Park Center, the sustainability team, and operational employees impacts sustainability projects. Section 4.4 reviews our findings from guest surveys, followed by supplementary research in Section 4.5. Lastly, we discuss plastic use, disposal, and recommendations for alternatives that could reduce plastic use and improper disposal of plastic waste. Findings and recommendations are discussed for Grounds, Housekeeping, Food Services, and CSS departments.

Figure 20 - A view from the Estes Park Center

Constraints

Economics

As a result of production difficulties and lack of options for environmentally sustainable alternatives, the cost of plastic substitutes is often higher. Products which are made from reclaimed materials may require additional production steps, which lead to additional costs. Similarly, production of plant-based plastic alternatives requires growing and harvesting, which incur costs. Recycled material also may not be easily accessible or cost-effective. Additional production and reclamation of material can result in the creation of byproducts, such as the release of greenhouse gasses. All of these factors often make it more difficult for companies to produce environmentally sustainable options and result in an increased cost passed onto consumers or distributors. From our observations and analysis of invoices at the YMCA, environmentally friendly options can cost up to four times as much as their petroleum-based counterparts.

Sanitation

Across every department, sanitation and safety are vital considerations when attempting to make any change, including plastic reduction. Single-use plastic is a convenient way to achieve sanitation due to its disposable nature. The Food Service and Housekeeping departments must comply with certain sanitary standards and regulations as defined by The Colorado Department of Health, The County Department of Health, and the Sanitary Standards and Regulations for Public Accommodations.

Supply Chain

When purchasing from large distributors, like the YMCA does, finding sustainable packaging options is a major challenge. Mass manufacturing plants may not be prepared to utilize environmentally sustainable packaging for large operations like the YMCA. The YMCA purchases bulk quantities of goods when it can, but must buy smaller packaged goods when suppliers cannot provide large enough containers. These smaller packaged goods often contain individually wrapped food items for freshness. When possible, staff in Food Service all request less packaging, but manufacturers are not always able or willing to grant their requests. Supply chain issues related to the pandemic can also increase the difficulty of obtaining certain products. Certain products, especially environmentally friendly disposable materials, can be incredibly hard to obtain in sufficient quantities large for the YMCA.

The YMCA's Business can be Used to Influence Product Packaging

The scale of the YMCA of the Rockies, especially that of the Estes Park Center, gives it weight when negotiating with manufacturers. Discounts, alternatives, and preferential treatment have all been mentioned in relation to the amount of product the YMCA purchases from its suppliers. By utilizing this pull, the YMCA has been able to convince suppliers to provide alternative packaging such as cardboard or other environmentally sustainable packaging, and supply products in bulk. If suppliers do not comply, the YMCA can seek others that will, until they find the best suppliers to meet their needs economically and environmentally.

Due to the location of both centers, suppliers may need to come from hours away which can exacerbate environmental factors, such as emission of greenhouse gasses from vehicles. By choosing closer suppliers shipping-related pollution can be avoided, furthering the YMCA's commitment to sustainability.

Staffing Shortages Promote Plastic Use

Across all departments at both centers, the largest and most prominent issue the YMCA faces is staffing shortages. Staffing shortages affect the capacity and efficiency of work that can be done, while complicating logistic planning. Every manager and director we interviewed mentioned the lack of employees as one of the most detrimental problems of their operations. Neil Willems, Superintendent of Buildings & Grounds at Snow Mountain Ranch, mentioned that they have had at least five job listings posted for months with no applicants. News outlets claim low-wages, unemployment benefits, and lack of desire to work certain jobs, especially post-pandemic, are to blame for the recent rise in unemployment. This was anecdotally corroborated by many YMCA staff.

Disposable options are favored when there is not enough staff to make reusable options possible, and employees may not have time to search for sustainable alternatives or critically review plastic use when staff levels are low. With the addition of more staff, certain sustainable actions can be made possible in every department.

Snow Mountain Ranch

Snow Mountain Ranch, the second YMCA of the Rockies's location, has a noticeably different setup than its counterpart in Estes Park. Snow Mountain Ranch has a capacity of 2,100 guests at a time. Compared to the Estes Park Center's ability to house around 5,000 guests on only 860 acres, making for a much different setup.

Snow Mountain Ranch and Estes Park Center operate on drastically different scales, therefore operations are not necessarily equivalent and plastic reduction efforts that are in place at Snow Mountain Ranch may or may not be applicable for Estes Park Center. Some potential alternatives that we identified at SMR that may be applicable to the EPC are: using reusable gloves in housekeeping crews, buying firewood bundled in cord, and having signs promoting use of reusable water bottles. Snow Mountain Ranch is located on the west side of the main range of Rocky Mountain National Park. It is also about 1,500 feet higher in elevation than Estes Park Center, making it consistently about 15 degrees colder.

This creates a multitude of fundamental differences between Snow Mountain Ranch and Estes Park Center, one being that the buildings and grounds department spends a significant amount of time focusing on issues like road maintenance, which may decrease their capacity for other initiatives, such as recycling. When compared to the Estes Park Center, there is very little recycling available at the Snow Mountain Ranch.

Figure 21 - WPI Students at Snow Mountain Ranch

Communication and Collaboration

Communication Between the Sustainability Team and Employees can Promote Sustainable Programs

Members of the YMCA community noted that communication and coordination flaws hinder sustainability efforts. The sustainability team at the YMCA comprises high-level executives, managers, department heads, and members of the marketing department. Members of the sustainability team are volunteers who are not paid for their work in sustainability, so their time to devote to sustainability issues is limited. The team meets biweekly to discuss progress on sustainability agenda items and to move projects forward. The team usually only tackles 2-3 projects at a time. However, employees on the team do not have an official avenue to communicate the initiatives of the sustainability team to those in their respective departments.

Members of operational departments at the YMCA have expressed a desire for better communication between their departments and the sustainability team. Many departments are attempting or have attempted to make changes, but require additional resources from executive-level employees. Recording and sending minutes from each meeting to operational departments would allow them to understand what and why changes are being made around campus, as well as reasonings for any delays or cancellations of sustainable projects. We found that operational-level employees are often not aware of the YMCA's sustainable programs but are in favor of sustainability measures. Communication of the YMCA's dedication to sustainability should be shared to all levels of the YMCA.

Communication of the YMCA's Pillars can Inspire Sustainable Change

A pillar of the YMCA's five-year plan is sustainability. The YMCA fosters a productive and positive workplace for its staff, and part of this is having sustainability as a common goal. As such, the pillars of the YMCA should be inspiring change not only at the executive level as they already are, but also at the ground-level, since these are the people who will be implementing the changes. They handle plastic on a day-to-day basis, which makes them capable of changing the amount of plastic waste produced by the YMCA. Throughout our comprehensive tours and interviews, we only heard of the long-term sustainability goals of the YMCA once, in an interview with Emily Pullen.

To increase participation and enthusiasm in the sustainability initiative, it should be advertised through fliers.

Communication between the Estes Park Center and Snow Mountain Ranch

Estes Park Center and Snow Mountain Ranch have historically had little to no communication between them. When speaking with employees at Snow Mountain Ranch, multiple employees remarked, “Well, I don’t know how they do it at Estes Park, but…” Having two similar locations means that they can adapt each other’s practices, and learn what has and has not worked. Matt Price, Housekeeping Manager at Snow Mountain Ranch, remarked that there has been an increase in communication recently.

Regular meetings between counterparts at the Snow Mountain Ranch and Estes Park Center would allow them to discuss any changes or problems that have occurred at each location. At a minimum of a biweekly meeting, managers or directors would be able to receive feedback and recommendations from someone who has dealt with similar issues.

Figure 22 - An interview at Snow Mountain Ranch

Plastic Reducing Changes are Favorable to Guests

Demographics and Bias

Our survey received 12 responses. The guests we surveyed were mostly young to middle aged, with 4 guests in the 35-44 age range, 3 who were 25-34, 3 who were 45-54, 1 who was 55-64, and 1 who was 65-74. The guests surveyed were 41.7% male, and 58.3% female. The majority of guests surveyed (8) were from Colorado, 2 were from Wyoming, and 1 each was from New York and North Carolina. Half of the guests surveyed had been to the YMCA more than once. 25% had been one time previously, and 25% had never been to the YMCA of the Rockies. All guests had been at the YMCA of the Rockies for under 3 days. They had all either been at the YMCA for one day, or the day we surveyed them was their first day. Six guests surveyed were staying in lodges, 4 were not staying at the YMCA and 2 were staying in cabins.

Our survey has a small sample size, which may make conclusions drawn from it less generalizable. However, the interactions we had still generated useful information. Additionally, our survey may have some selection bias, where guests uninterested in sustainability may not choose to take part in a survey about plastic use. Furthermore, we were unable to obtain demographic information on the guests of the YMCA, so we cannot compare our survey population to the entire population of YMCA guests to ensure that it is a representative sample.

Responses

Our survey found that reducing plastic use at the YMCA was attractive to guests. We found that most guests we interviewed were willing to change their behavior to support plastic reduction, either by being more likely to stay at the YMCA or by paying more for sustainably packaged products (typically 11-30%).

Overall guests thought most plastic reducing actions they were asked about were relatively easy. These included recycling plastic products, using a reusable water bottle, and using a milk dispenser instead of milk bottles. The only options that a few guests found difficult was not having plastic lids for the hot cups in the dining hall, having non-plastic cups in the lodge rooms, using bulk condiment dispensers, and having a soft-serve machine instead of ice cream cups. Specific responses can be found in Appendix E.

A concern of some guests was that bulk dispensers may be messy or unclean. Despite this, several guests were excited about the idea of a soft-serve ice cream machine, saying that they would prefer it to the ice cream cups.

One guest expressed that they had been to the YMCA multiple times, and felt better when the YMCA used ceramic and metal

than when they used plastic cutlery and paper plates. Another felt that recycling needs a serious overhaul surrounding the clarity of what plastic products can or can't be recycled.

Supplementary Research

Food Services Operations Must Take Design Principles into Account

Since potential operational changes require alterations to the operation of the dining hall, dining hall design principles needed to be taken into account. We researched dining hall and food bar configurations to propose informed changes to the layout of the YMCA dining halls to avoid congestion points and long lines. This can be done by distancing condiments, beverages, and desserts from the main food line, since these are items that not all guests take. Employing circular or line-based flow around stations can also help with congestion. More details can be found in Appendix D.

Educational Materials can Passively Promote Sustainability

In order to make educational materials most effective, these materials should be visual and clear to understand. This was supported by YMCA employees, who expressed that the materials would need to be accessible to children and easy for guests to interpret, since they may not read signage closely. Including specific pictures of items used at the YMCA could be particularly helpful for providing examples of materials that can or can not be recycled. This was confirmed by the educational recycling signs found on Waste Management's website, which showed that educational material should be specialized to the location they are in and include specific pictures of materials that may be found nearby the sign. Examples of signage around Estes Park communicating sustainability efforts and how customers can engage in them with various businesses confirmed this.

Figure 23 - Poster located at Kind Coffee encouraging guests to participate in environmentally friendly behaviors

Such examples included a call to action mural by a water bottle station at Latitude 105 and a sign at Kind Coffee illustrating sustainable consumer behavior and Kind Coffee's sustainability efforts. The example at Latitude 105's water bottle filler also demonstrated how visual educational materials can be used to draw attention to something for guests to interact with it.

Figure 24 - Sign at Kind Coffee located over water bottle filler informing customers on the impact of single-use plastic water bottles

Figure 25 - Mural located at Latitude 105 water bottle filling station encouraging guests to reduce waste and conserve water

Bioplastics are not Suitable Replacements to Petrochemical Plastic

In researching organically based plastics we found that comparing the environmental impact of bioplastics is very difficult because of the many different metrics that need to be considered. One prevalent type of bioplastic is PLA, a plastic produced by polymerizing lactic acid, a byproduct of fermented corn starch.

Life cycle analyses have found that it is hard to conclude if PLA is better or worse for the environment compared to its petrochemical equivalent. On one hand, PLA has fewer greenhouse gas emissions and less nonrenewable energy use compared to petroleum plastics. However, PLA requires the growing of corn crops, which results in higher agricultural land use and disturbs water and soil quality. Another petroleum plastic alternative is starch-based plastic, which is made by combining starch from plants with a copolymer (sometimes PLA or another bioplastic). These are generally thought of as better for the environment than PLA, however, they still have more negative effects in some categories than petrochemical plastics. It is important to note that the life cycle analyses for bioplastics and starch plastics are limited, which restricts the conclusions we are able to make about their overall environmental impacts. For more details see Appendix C.

Figure 26 - An example of plant starch based plastic products

The Food Service Department Uses Over 806,000 Plastic Items Per Year

The Food Services department is responsible for running numerous dining locations on the property, ranging from year-round to seasonal and from restaurant to buffet-style. The Food Service department is sectioned into several areas: the customer-facing side on which the food is served, the kitchen-facing side on which the food is made, and the banquet department which handles food for large functions and delivery for special events. The Food Service department is also responsible for running the Rustic Cafe on the property, which offers coffee, bottled drinks, and to-go options for food. In the summer, Y's Guy's Pizza, Pine Room, and Spruce Dining Hall are also open. The Spruce Dining Hall is exclusive to YMCA staff. Aspen Dining Hall, one of the largest dining halls on the property, is open year-round for both guests and staff. This dining hall is where most of our first-hand observations took place, as it was the only one open to general guests during our stay. In Aspen Dining Hall, there are 3 buffet-style meals per day with both pre-prepared and made-in-house foods. In the peak season, this dining hall may serve up to 2,000 guests per day, according to YMCA staff.

205,000 Pieces of Plastic Cutlery are Landfilled Each Year

One major use of plastic in the Aspen Dining Hall (one of the two dining halls at the YMCA) was the use of single-use plastic cutlery. This cutlery is available for guests at the beginning of the buffet line, where they are also able to grab a tray, paper plates, and paper bowls. Over the course of this past year alone, the YMCA purchased over 205,000 pieces of plastic cutlery, amounting to about $4,000.

Figure 27 - Plastic cutlery at Snow Mountain Ranch

88,000 Plastic Coffee Lids are Used Each Year

At both the Aspen Dining Hall and the Rustic Cafe, paper hot cups are used with plastic lids for both dine-in and take-out beverages. These plastic lids are made of PLA, a bioplastic that is commercially compostable and non-recyclable. It is difficult to say whether PLA is better for the environment than traditional plastics, especially considering that the YMCA does not have access to commercial composting through their current waste disposal contracts (see appendix C for more information about PLA). The YMCA orders fewer coffee lids than they do coffee cups, indicating that some guests probably only take lids when they need them, rather than every time they take a cup. This is already an environmentally friendly behavior, since it is minimizing the number of plastic lids used. However, the YMCA still buys at least 88,000 lids per year, which costs them about $9,900 (about $0.1125 per cup lid).

Plastic Grocery Bags are Unnecessarily Available for Take-Out

Plastic bags are used in dining halls for guests to take to-go meals and in the General Store. In the dining hall, the bags are available at the counter right before the food lines, next to the paper clamshell containers, also used for to-go meals. Michael has attempted discontinuing the use of plastic bags for taking out meals but reverted the change after receiving pushback from guests and staff.

Figure 28 - Plastic coffee cup lids

Condiment Packets and Salad Dressing Packets are Large Contributors to Plastic Waste

One significant use of plastic in the Aspen Dining Hall is single-use plastic condiment packets. These packets are used for ketchup mustard, mayonnaise, breakfast syrup, honey, peanut butter, and jelly. In total, over the past year, the YMCA has purchased nearly 212,000 condiment packets, totaling $19,200. In addition, the YMCA also provides guests with single-serving salad dressing packets at the salad bar. In the last year, the YMCA purchased about 43,800 of these packets, amounting to $23,000.

121,900 Milk Bottles Become Plastic Waste Each Year

Plastic milk bottles are possibly the largest use of plastic in the dining hall. There are two refrigerators in the dining hall dedicated to stocking single-serving seven-ounce plastic milk bottles. These bottles are recyclable, but only once the outer label is removed and the bottle is clean and dry. Currently, recycling is not available in the dining hall, meaning the plastic milk bottles are typically disposed of in the trash regardless of their recyclability. In the past year, the YMCA purchased 121,900 of these bottles, costing over $44,500. If these bottles were stacked end-to-end, that would extend the equivalent of 10.6 miles.

Figure 29 - Plastic milk bottles in the dining hall

86,400 Coffee Creamer Cups are Used Each Year

Coffee creamer cups are available near all coffee stations at the YMCA, including the Rustic Cafe and the dining hall. In the dining halls, they are in fridges, and at the Rustic Cafe, they are on a counter. These single-serving creamer cups are non-recyclable and non-compostable. In this past year alone, (April 1, 2021, to March 31, 2022) the YMCA has purchased 86,400 individual creamer cups, totaling almost $3,500 spent on plastic creamer cups.

Plastic Food Packaging is a High Volume of Plastic Use

A large volume of plastic waste in the kitchen and dining hall comes from foods being delivered by suppliers wrapped in plastic. This is not only a material waste, but it can also add workload for the employees who must remove the plastic packaging. For instance, whenever they receive fish filets, each filet is individually wrapped in plastic packaging. This means that the employees must spend time unwrapping and disposing of all of the packaging before the filets can be prepared.

Similarly, many foods, snacks, and drink items come pre-made and plastic-wrapped by the supplier. For instance, sandwiches, cookies, chips, trail mix, and water bottles are all sources of plastic packaging. Having these items wrapped in plastic is convenient since it takes less labor to receive these items pre-made than to make them all in-house. The plastic wrap also keeps food items fresher for longer than if they were not wrapped. Additionally, it makes preparing boxed lunches for large groups very easy, since all the items are already pre-portioned and sealed.

Ice Cream Cups Contribute to 37,680 Pieces of Plastic Waste Each Year

Another high volume of plastic waste is the single-serving ice cream cups in the dining hall. These ice cream cups are available in a freezer in the dining hall for guests to quickly grab. In the past year alone the YMCA purchased 37,680 of these plastic cups, resulting in $16,250 spent on ice cream cups alone.

Plastic Wrap on Food Trays is Used to Keep Food Sanitary

In the kitchen, plastic wrap is typically used to cover the trays of food before they are put in the warmer. This keeps the food sanitary and at temperature while it waits to be served in the dining hall. Whenever possible, aluminum foil is used to cover trays. However, due to the price of aluminum foil, it is not a feasible option to be used on all trays.

Plastic Water Bottles are Sold in High Volumes in Coca-Cola Vending Machines

Plastic Dasani and Smartwater water bottles are sold in Coca-Cola vending machines, the General Store, and the Rustic Cafe. Over one year the YMCA spent about $7,900 on 11,800 bottles of varying sizes, totaling over 1400 gallons of bottled water.

Employees noted that some guests are from areas where tap water is not typically safe to drink, so they assume that they must buy plastic water bottles at the YMCA. However, our sponsor has told us that the YMCA's tap water is very safe to drink and many staff members have expressed that they wish more people would use reusable water bottles.

Figure 30 - Plastic water bottles in a Coca-Cola vending machine in the General Store at the Estes Park Center

The Housekeeping Department Uses Over 246,750 Plastic Items Per Year

The Housekeeping Department is headed by Housekeeping Director Emily Pullen. Our main point of contact with the department was Housekeeping Crew Leader Nick Whittemore. The department has three divisions; housekeeping, laundry services, and janitorial. The housekeeping department is responsible for cleaning and restocking lodge rooms and cabins, while the janitorial division is responsible for cleaning and restocking common spaces. Laundry services provide washers and dryers for guests and cleans sheets, towels, and blankets used in housing accommodations.

The Housekeeping Department Currently Reuses Many Plastic Items

The housekeeping department makes an active effort to reuse and reduce plastic wherever possible. During a shadowing session in the housekeeping department, we noticed that they reuse sealable bags to store sponges, rags, and other small items until they are no longer usable. They also refill dish soap bottles that go in cabin kitchens. Additionally, the lost and found items they accumulate are shipped to their owners by repurposing bubble wrap from previous packages they received. In 2020, their first plastic reduction initiative, “That’s a Wrap on Plastic Wrap” was very successful. According to staff, the change was far better than what they were doing before, both in terms of the environment and in labor. The change entailed that laundry services stopped wrapping sheet sets in plastic wrap to transport to rooms, and began using a reusable plastic bag. Sheet sets are put in reusable bags to bring to cabins and are put in large carts to bring to lodges. While this reduces the amount of plastic used, the cart cannot go to the 2nd floor without an elevator which most lodges do not have. Employees carry each bundle to the rooms individually, which is time consuming and inefficient.

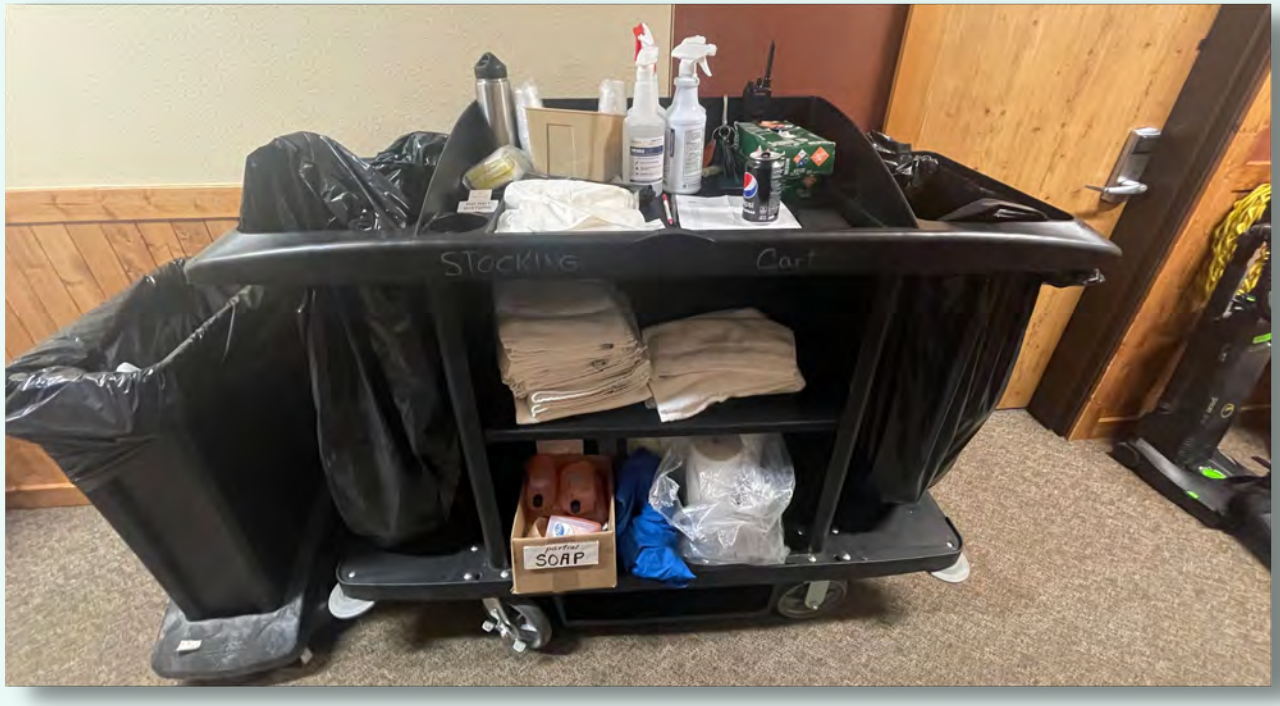


Figure 31 - A Housekeeping crew supply cart

The plastic wrap bundles were much easier to carry since they were able to stack the bundles in their arms. Additionally, on very cold days, the reusable plastic material can become brittle and fall apart. The Housekeeping managers noted that they are open to a material change, though it would need to be either transparent or color-coded to allow employees to easily identify the contents.

Figure 32 - An Individually Wrapped Plastic Cup

29,000 Plastic-Wrapped Cups are Purchased for Guest Lodging Each Year

In lodge rooms, one 9 oz. plastic-wrapped plastic cup from Western Paper is provided for each pillow in the room. These plastic cups are labeled with the resin identification code 5 and are rarely recycled, making their impact on the environment substantial. The same cups are used at Snow Mountain Ranch and interviews with Housekeeping Directors at both centers revealed that there should be no issues with changing the material of this cup as long as it is disposable. Reusable cups would require a considerable amount of additional labor to wash. Over the course of a year (March 31, 2022 to April 1, 2021) $2,100 was spent on 29,000 plastic cups.

A Minimum of Two Waste Bins are Put in Lodges and Cabins; 145,750 Bags are Used Per Year

Cabins and Lodges are supplied with trash bins lined with plastic, which must be emptied during a room cleaning, even if only one small item is put in the bin. Lodge rooms, which do not have kitchens, have trash cans in the bathroom and bedroom about 10 feet apart. Cabins have trash cans in the kitchen and bathrooms, which may be on opposite sides of the cabin and are much more appropriate. In our experience as guests at the YMCA, trash cans in the rooms can take upwards of 3 weeks to completely fill. This was supported by staff from Housekeeping, who told us that the trash bins are rarely full when they are collected.

Figure 33 - A lodge bathroom trash bin

Snow Mountain Ranch has an identical process and the same number of lined trash bins in each room. Both locations previously provided trash bins in each bedroom of cabins, but Estes Park stopped providing the bins in bedrooms about a year ago and Snow Mountain Ranch followed suit about a month ago. This change received only one guest complaint. As a result of the change, EPC Housekeeping has a surplus of trash bins.

Within one year, $6,470 was spent on 72,750 large trash bags used in the lodge bedrooms and cabin kitchens. Smaller trash bags located in bathrooms cost $1,750 for 73,000 for one year.

The Department Purchases 61,800 Disposable Plastic Gloves Each Year

The Housekeeping Department uses a significant amount of single-use nitrile, vinyl, and latex gloves. Latex gloves are the most durable and can reduce perspiration, but latex allergies have made nitrile and vinyl

Figure 34 - A box of disposable vinyl gloves

common alternatives that are weaker and not as tight to the hand. The laundry division uses mostly latex, since their durability is ideal for their work. The housekeeping division uses mainly vinyl gloves, as many workers have complained about latex being a possible allergen.

Snow Mountain Ranch's Housekeeping Department uses yellow reusable latex gloves. On average they are used for about a day before they are thrown out. Snow Mountain Ranch's Housekeeping department keeps one box of vinyl gloves on hand, but they only use them for very messy situations. Not many employees request vinyl due to latex allergies, as latex allergies are not very common.

Over one year, the YMCA spent $5,600 on 61,800 plastic vinyl gloves. This correlates to an average cost of $0.091 per glove.

Bathroom Soap Bottles are Currently not Reused

Soap dispenser refills located in all bathroom sinks and showers cannot be reused or recycled due to soap residue that remains in the bottle. The plastic used in these is thick and a significant waste of plastic when only used once. A significant portion of the cost of a soap dispenser refill is the cost of the container, which means there is an opportunity for cost savings if soap is bought in bulk. The YMCA was not able to consistently source hand soap refills over the last year, being forced to use reserves and wrapped bar soap, even running out of soap at one point. Their original soap was Dial Hand soap refills costing $0.41 per ounce. The new soap they were able to source cost $0.55 per ounce. We were not able to accurately estimate how many bottles they would typically use in a year, since they used bar soap for much of the year. However, we did find that they spend at least $1,700 on over 210 soap refill bottles per year.

10,200 Single-Use Plastic Laundry Bags are Used to Store Clean Linens Per Year

Clean linens in the laundry rooms are bundled in large plastic trash bags. These bags are tied at the top for storage, then ripped open, emptied, and disposed of. The Housekeeping department spent a total of almost $3,900 on 10,200 bags used for this purpose in the last year. This averages to $0.38 per bag. This is because reusable bags would need to be laundered frequently to keep linens sanitary, which the department does not have the capacity for.

Single-Use Plastic Laundry Cart Bags are Used to Protect Linens

Sheet sets are laundered, folded, and brought to lodges in large carts which are protected by a large, thin, single-use plastic bag. These plastic bags were not identified in our invoice analysis, but there are about five of these carts in each lodge and about 30 in Laundry Services, totaling approximately 75 bags in use at any given time.

Figure 35 - Plastic laundry bags for clean linens

Waste Disposal is Managed by the Grounds Department

The Grounds department, headed by Kelly Wilkerson, is a subdivision of the Buildings and Grounds Department (B&G). Grounds is responsible for managing waste disposal, landscaping, and maintaining grounds and roads. They contract with Waste Management to dispose of all waste.

The YMCA Provides Opportunities for Guests to Recycle, But Currently Does Not Have a High Success Rate

By shadowing Grounds department employees on trash and recycling runs, we learned that trash bags are placed in bear-proof bins outside of cabins. Most cabins only have one bear-proof trash bin outside, while some have a combination of recycling and trash housed in one unit. Currently, all cabin guests can recycle by using a blue bag located below their sink, which they can leave in the cabin or put in the bear-proof bin outside. Grounds workers make trash runs twice a week in winter and every other day in the summer, when they fill more quickly. If the trash bins are less than half full, they will be left for the next pickup. Guests may place full trash bags from their cabins in the bins, and these small trash bags will be removed without changing the larger bag in the bin in an effort to save bags. Otherwise, the bag will be removed and replaced.

For guests staying in lodges, recycling bins are located in lobbies and guests are expected to bring their recycling there. Plastic waste is often improperly disposed of using either of these systems, either by being put in the trash or by the recycling being contaminated with trash. This is because there are no specific instructions on what exactly can be recycled.

Figure 36 - A Grounds truck during a trash and recycle run

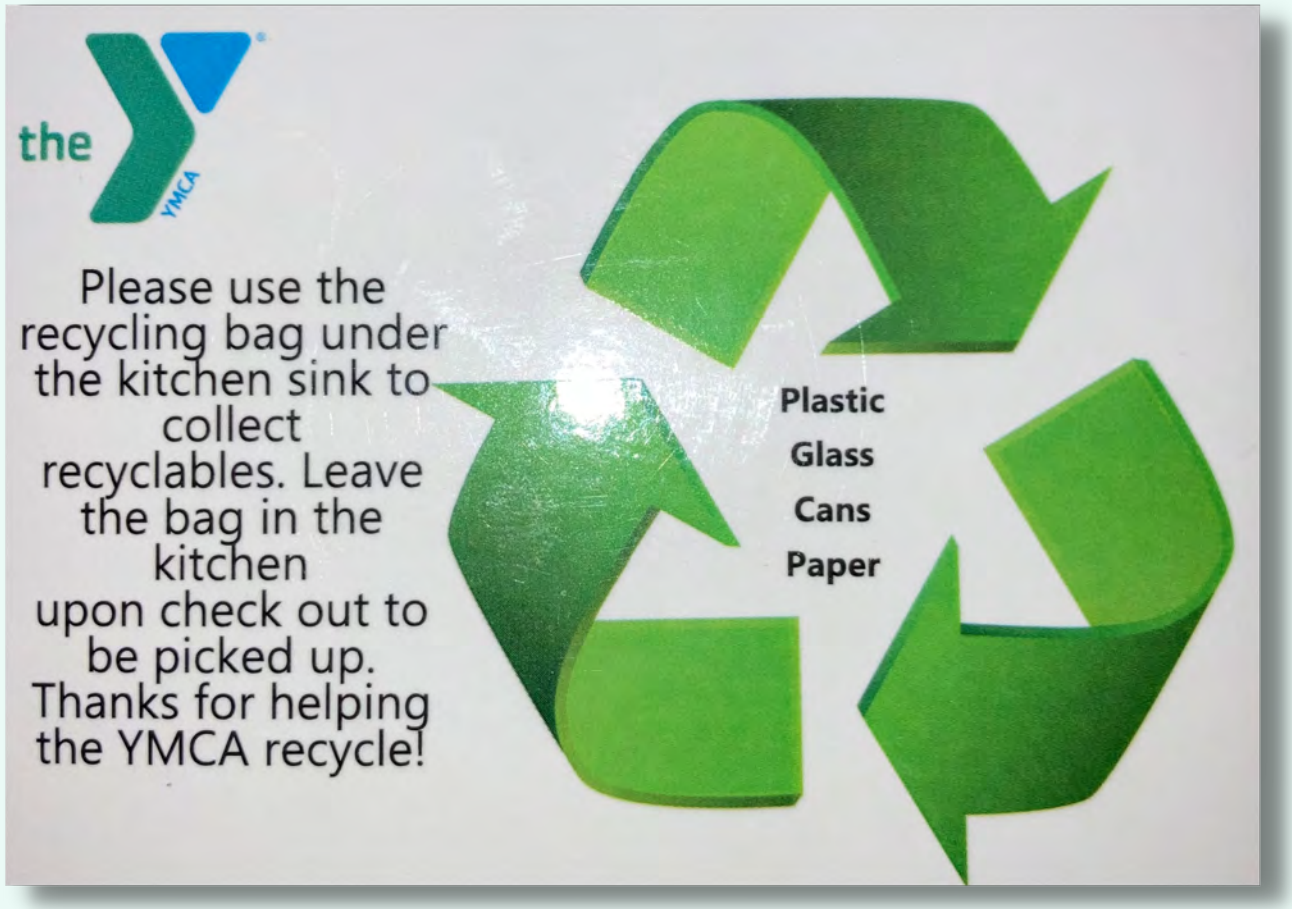


Figure 37 - Magnet located on refrigerators in cabins

The orientation packet that guests receive says the following: "Recycling receptacles are located in our lodge lobbies and public spaces. In cabins, look for a recycling bag under the kitchen sink. DO recycle paper, cardboard, metal cans, glass bottles and plastic bottles. DO NOT recycle plastic bags, Styrofoam, used paper cups/plates, or garbage."

This brief statement neglects to inform guests where they should leave the bag, and is not nearly specific enough to guarantee that recycling is not contaminated.

In most, but not all cabins, the refrigerator has the magnet shown in Figure 37:

While these materials are helpful, they rely on guests thoroughly reading all materials given to them and already having an understanding of what can and cannot be recycled. These magnets are not in every cabin, and some guests we spoke to were not initially aware of the cabin recycling system until we informed them.

At Snow Mountain Ranch, they do not have the same system. Guests are informed that there is a recycling bin located at the Buildings and Grounds building and they can bring their recycling there, but are also not provided with enough information to guarantee that the bin does not get contaminated. The recycling bins have the sign shown in Figure 38 on them, but this is not readily accessible to guests.

Figure 38 - The label of what can and cannot be recycled at the YMCA recycling dumpsters

At the Estes Park Center, trash bags are thrown in trash compactors at the recycling drop-off, while the recycling bags are torn open, briefly searched for contaminating materials, emptied into recycling dumpsters, and the bags thrown out as they cannot be recycled. We observed that roughly 20% of the collected blue recycling bags contained trash and needed to be landfilled. But, according to the Grounds crew, the average is even higher, at about 30% of blue recycling bags needing to be thrown out. One member of the Grounds department described guests' views that recycling was a sort of 'magic box' where anything they placed in recycling would be recycled. We also noticed many recyclable materials in the trash bags, which meant those recyclable products had to be landfilled as well. We also noticed far more trash than recycling was collected, estimating around only 10% of all waste collected was recyclables. The Grounds department in one year, from April 1, 2021 to March 31st, 2022,

spent $2,412.28 on 2,600 blue bags for recycling and $11,009.47 on 13,300 bags for trash. These trash bags constitute the highest volume of plastic use in the Grounds department.

One of the challenges to reducing use and improper disposal of plastic in Grounds is the lack of financial incentive to increase recycling. There is no significant difference between the cost of trash versus recycling disposal: $280 vs $260 per dumpster. Recycling is more labor intensive than trash because the bags must be emptied to be recycled, instead of simply put in a trash compactor. Additionally, the YMCA gets charged a fee for guests contaminating recycling. We observed that about 12.5% of blue recycle bags were contaminated with food or garbage. In such cases, the Grounds crew staff would invariably throw a contaminated blue bag into the trash. Contaminated recycling cannot be sorted because doing so can be a safety hazard if there are needles or sharp items in the bags. Sorting recycling would be difficult for the Grounds crew to do properly, due to a low staff count and other work demands. We saw multiple contamination fees in our review of the Grounds' invoices.

There are Very Few Alternatives to Traditional Trash Bags

Reducing plastic use in the Grounds Department would be difficult. The most significant use of plastic in Grounds is trash bags, but they can be very difficult to replace. As found in our background research, alternatives to thin plastic trash bags can be challenging to manufacture because of plastic's unique material properties at low cost. According to the Grounds crew, reusable recycling bins or bags would also be difficult to implement as this would make more work for employees. When asked about using reusable bins or bags for recycling, the grounds crew thought that reusable items would become unsanitary quickly, especially as guests misuse them. Because of the difficulties in finding alternatives to trash bags, we did not focus on reducing plastic in this area.

Figure 39 - The back of a Grounds truck during a trash and recycle run

Other Departments

During our research employees at the YMCA suggested touring other departments that we had not initially considered. The Programs Department, which handles the guest events and activities, were suspected to use little plastic. Another of the commonly mentioned departments was Conference Setup and Services (CSS), which manages setup and cleanup for large group events. We toured both the operations and office areas of this department, interviewing employees in each area.

Programs Department

The Programs Department at the YMCA is responsible for all guest activities, including puzzles, board games, archery, axe throwing, mini-golf, sledding, and many more. They also manage firewood bundles that are sold to guests for campfires and used for non-gas fireplaces in buildings. This firewood is ordered by the Grounds department on behalf of the programs department. Our invoice analysis found that in one year (from April 1, 2021, to March 31, 2022) the YMCA spent almost $20,000 purchasing about 7,900 bundles of firewood. Given the amount of plastic wrap that is used to wrap each bundle, this is equivalent to about a 3.98 mile strip of 19 inch wide plastic, about 33,200 square feet of plastic or ¾ of an acre.

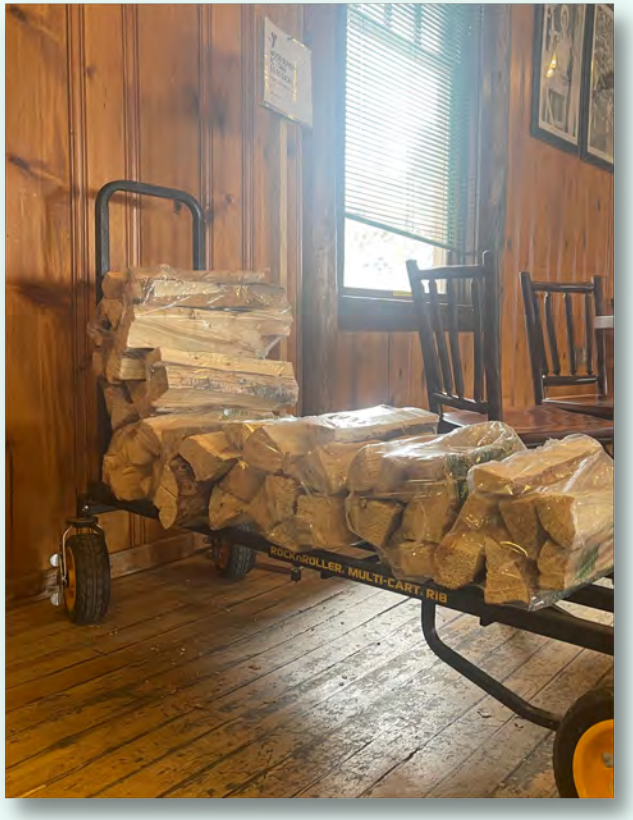


Figure 40 - A cart of plastic wrapped firewood bundles

One solution that we considered to eliminate the use of plastic wrap on firewood would be to use firewood wrapped in twine. Supplier limitations are a challenge, however, since the firewood supplier that the YMCA currently uses only wraps their firewood in plastic and there are no other suppliers local to the Estes Park Center YMCA. The Snow Mountain Ranch center does have a supplier that wraps the firewood in nylon rope instead of plastic wrap. However, since this rope is still made of plastic, it would not reduce plastic use entirely from the firewood. The Snow Mountain Ranch firewood supplier, is also much farther from the Estes Park Center, compared to the supplier they currently use, which would make them much more difficult to access, especially in the winter months when the passage through the mountains is closed. Additionally, the SMR supplier has recently increased in price, so much so that Snow Mountain Ranch will be changing suppliers to one that does use plastic wrapped firewood.

Another option may be to purchase the firewood that is not pre-bundled and store it in bulk, from which employees can distribute it to guests without plastic wrap. The biggest obstacle to this option would be the greatly increased amount of employee labor, especially considering the number of firewood bundles that the YMCA would need to stack per year. There would also need to be a standardized system (e.g. by weight) for the employees to bundle the firewood so that all the packages are equal. This way guests can be satisfied with the amount of firewood they receive and the YMCA would not lose money by accidentally giving out too much firewood.

CSS Operations

The operations side of CSS cleans and sets up meeting rooms and larger venues such as the Assembly Hall which is commonly used for weddings and larger events. As a part of this, they handle the waste disposal for these events. Mirroring our findings in the Grounds department, CSS employees told us that there is commonly trash in the recycling bags and vice versa. They told us that they use yellow recycle bins and black trash bins. We have seen that the yellow trash bins have recycling information on their tops, but the information may be faded and not visible from a distance. They noted that guests are usually better about recycling in the Assembly Hall, possibly because those bins are more distinguishable. Youth groups were reported to be particularly bad about recycling. With youth groups in mind, CSS recommended that education material be simple and easily understandable. Additionally, members of the CSS department told us that they have to take out any trash bag that has food waste inside of it, noting that these are commonly only around one-third full. CSS operations have to use thicker trash bags to protect from breakage and leakage, increasing the total amount of plastic used.

CSS operations also use plastic in the form of vinyl gloves, which are used to clean bathrooms, pick up trash, and clean windows and rooms. The prevalence of improperly disposed waste in CSS Operations further stressed the importance of education for guests on proper disposal methods. We learned that baggier plant-based plastic gloves as a replacement for their vinyl plastic gloves may not be feasible as CSS needs tight gloves to protect their hands from liquids.

CSS Office

We also toured the office side of CSS, seeing that the only large use of plastic was in key fobs. The office is already planning on switching these keys out for RFID cards, eliminating the plastic used in the key fobs with a smaller amount of more durable plastic. We suggested adding larger signs not to forget these cards by the roadside key drop off after CSS office staff identified guests not returning keys as an issue. This could reduce plastic use by avoiding the need to order more cards/key fobs. Staff also discussed charging guests for not returning these, leading to talk of slogans on the signs like ‘Save the environment and a buck’.

Final Recommendations and Conclusions

In our research, we identified many possible alternatives to current practices at the YMCA of the Rockies. The goal of choosing each alternative was to select an option with the least environmental impact while adding the least monetary and labor costs to the YMCA. The final recommendations are shown in order of priority, and multiple options are meant to imply that if one option is not currently feasible, a temporary alternative should be used to ease the impact on the planet in the meantime. Some recommendations can be combined and enacted together.

Table 4 shows the cumulative plastic reduction, up front cost, payback period, and cost savings per year of our primary recommendations. Cost analyses could not be performed for all recommendations and invoice data was not gathered for every plastic item. This table is a conservative estimate of the amount of plastic that could be reduced and the cost savings per year. The table shows only recommendations aimed at direct plastic reduction, leaving out recommendations in areas of communication and educational material.

Figure 41 - Estes Valley as seen from Kruger Rock

Alternative Material / Operation	Amount of Plastic Reduced	Upfront Cost	Payback Period	Cost Savings / Year
Food Services				
Milk Dispensers	121,900 bottles	$3,200	N/A	>$0
Bulk condiment dispensers	171,700 packets	$1,270	60 days	+$7,700
Paper coffee cup lids	88,000 lids	N/A	N/A	+$3,915
Soft serve ice cream machine	37,680 cups	$22,200	2.5 years	+$9,000
Refillable coffee creamer dispenser	86,400	$260	120 days	+$780
Refillable syrup containers	29,200 packets	$330	45 days	+$2,760
Move cutlery to end of food line	N/A	N/A	N/A	N/A
Use of only metal cutlery	N/A	N/A	N/A	N/A
Remove plastic grocery bags in dining halls and general stores	N/A	N/A	N/A	N/A
Food Service Totals	**>534,900 plastic items**	**$27,260**	**13.5 months**	**>+$24,155**

Alternative Material / Operation	Amount of Plastic Reduced	Upfront Cost	Payback Period	Cost Savings / Year
Housekeeping				
Latex Gloves	61,800 gloves	N/A	N/A	+$2,160
Remove cups from lodge rooms	29,000 cups	N/A	N/A	+$2,530
Remove trash liners from lodge bedrooms	~18,200 bin liners	N/A	N/A	+$1,620
Alter clean linen bag tying method	5,100 bags	$105	20 days	+$1,950
Use a laundry cart cover	N/A	N/A	N/A	N/A
Reuse soap refill bottles	>210 soap containers	N/A	N/A	>+$1,150
Housekeeping Totals	**114,300 plastic items**	**$105**	**4 days**	**>+$9,410**
Other Departments				
Reduce the amount of trash bags used in CSS	N/A	N/A	N/A	N/A
Totals for All Departments	**>650,000 items**	**$27,365**	**300 days**	**>+$33,600**

Table 4 - Analysis of optimal path for recommendations

General Recommendations

Increase communication and collaboration between operational departments and sustainability team

Members of the sustainability team should meet biweekly. Recording and sending meeting minutes to operational departments would allow them to understand what and why changes are being made around campus.

Increase communication between Snow Mountain Ranch and Estes Park Center

Regular meetings between counterparts at the Snow Mountain Ranch and Estes Park Center would allow them to share any changes or problems that have occurred while enacting sustainable changes at each location. At a minimum of a biweekly meeting, managers or directors would be able to receive feedback and recommendations from someone who has dealt with similar issues.

Promote the sustainability goals of the YMCA to all employees

To increase participation and enthusiasm in the sustainability initiative, it should be advertised through fliers much like the sustainability plan was. The pillars will also demonstrate the priorities of the YMCA to its guests, which will give them context for other changes that occur across the campus and garner enthusiasm for them.

Enhance Recycling Success Rates

A thorough exploration and discussion of recommendations for enhancing recycling rates can be found in Appendix I.

- Place educational materials near waste disposal areas around campus to inform guests on what items should be recycled. These should be located near large recycling receptacles in common areas, conference spaces, lobbies, cabins, and in orientation packets.
- Place a recycling bin in the cabins to make it more clear to guests that there is an area to put recyclables other than the trash.
- Place a bin marked as recycling without a liner in lodge rooms. Housekeeping should add a bag for recycling to the supply cart to empty the recycling into.

Negotiate with suppliers about reducing plastic packaging

- Urge suppliers to reduce the amount of plastic packaging used in products bought by the YMCA. Making it clear to a supplier that the YMCA values sustainable packaging may incline a supplier to change its packaging process.
- Identify new suppliers that use more sustainable packaging. The possibility of changing suppliers can increase pressure on the YMCA's current suppliers to change their packaging.

Reduce the amount of plastic water bottles used in Coca-Cola vending machines

- Encourage guests to use refillable water bottles and utilize the water bottle refill stations instead of buying plastic water bottles. Guests could be encouraged to do so by the use of flyers emphasizing cost savings, environmental benefit, and water quality.
- Continue pressing Coca-Cola to include or allow non plastic water bottles to be sold in Coca-Cola refrigerators.

Food Service Recommendations

This section proposes our recommendations to reduce plastic in the Food Service department. A thorough exploration and discussion of alternatives can be found in Appendix G.

Reduce the amount of plastic milk bottles

Primary Recommendation: Implement a milk dispenser[1] in the dining hall. This option would decrease plastic significantly, but increase employee labor by some due to the added labor of refilling and cleaning the machine. This option would cost $3,200 upfront, but would save money over time. If employees have difficulty switching milk bags, multiple employees should be assigned to change milk bags together. Using crates to manipulate the milk bags could make changing the bags easier.

Secondary Recommendation: Switch the plastic milk bottles for cardboard milk cartons[2]. Since most milk cartons have a shorter shelf life than the bottles, the fridge may need to be restocked more frequently, adding to employee labor. However, the plastic use would be reduced dramatically since milk cartons have very little if any plastic.

Tertiary Recommendation: Switch the plastic bottles for shelf-stable milk cartons[2]. Shelf-stable milk cartons typically cost more than regular bottles or cartons. While they use less plastic in their packaging, the shelf-stable milk cartons that have been tried in the dining hall still have a plastic straw on each carton, which contributes to plastic waste.

Reduce the amount of condiment packets used in the dining hall

Implement two refillable bulk condiment dispensers for ketchup, mustard, BBQ sauce, and mayonnaise packets in the dining hall.[3] These options have a higher upfront cost, but save money over time. These dispensers need to be properly cleaned and emptied. We recommend the dispensers be placed in locations that are both accessible to children and out of the flow of guests from the food service lines. Optimal locations in Aspen Dining Hall would be either side of the dessert cart. According to our research, with two of each ketchup, mustard, mayonnaise and barbecue sauce dispensers, cost savings would begin in less than one year.

1. "Silver King SKMAJ2/C4 Majestic Double Valve Bulk Milk Dispenser" from TundraFMP
2. Cardboard milk cartons and shelf stable milk cartons already purchased by the YMCA
3. "Nemco 10950 Asept Black Plastic Countertop Pump Dispenser for 1.5 Gallon / 6 Qt. Pouches" from WebstaurantStore
"French's 1.5 Gallon Ketchup Dispensing Pouch with Fitment" from WebstaurantStore
"Heinz 1.5 Gallon Yellow Mustard Dispensing Pouch with Fitment" from WebstaurantStore
"Heinz 1.5 Gallon BBQ Sauce Dispenser Pouch with Fitment" WebstaurantStore
"Heinz 1.5 Gallon Mayonnaise Dispenser Pouch with Fitment" from WebstaurantStore

Reduce the amount of plastic coffee cup lids used for hot cups

Replace all plastic coffee cup lids with paper lids.[1] This would both reduce plastic use and save around $3,915, since the paper lids are less expensive than the PLA plastic lids. This could be done in conjunction with encouraging guests to bring their own thermoses when possible, which would decrease the frequency that guests would need to use the lids in general.

Reduce the amount of plastic ice cream cups used in the dining hall

Buy a soft serve ice cream machine[2] to replace the plastic ice cream cups in Aspen Dining Hall. A soft serve ice cream machine would cost about $22,200 up front, but the change would save $9,000 per year using chocolate and vanilla soft serve ice cream mix.[3,4] Not including maintenance costs, the cost of the ice cream machine would be offset in about two and a half years.

Reduce the amount of single-use plastic coffee creamers used in the dining hall

Implement a refillable half and half dispenser[5] in the dining hall by each coffee, tea and sugar area. The dispenser should be filled with cardboard cream cartons.[6] 10 dispensers should be bought, enough to have some extra dispensers and place one per coffee station in the dining hall. This option would require extra employee time since the dispenser would need to be emptied, cleaned, and refrigerated each night. Some single-use creamers could still be available in the fridge for busier days in the summer when the cream dispenser cannot be refilled quickly enough. These single-use creamers should not be in the forefront of the fridge so that guests only take them when they are needed. This option would take about 120 days to offset the cost of 10 dispensers, at which point it would save $783 per year. If refilling and cleaning the dispensers is too much work during busy periods, the cartons can be put directly into the fridge for guests to use.

1. "EcoChoice 8 oz. Squat to 24 oz. White Compostable Sugarcane Hot Cup Lid" from WebstaurantStore
2. "SANISERV 501 Countertop Medium Volume 22 Qt twist soft serve machine" from TundraFMP
3. "Carnival King 6 lb. Chocolate Soft Serve Ice Cream Mix" from WebstaurantStore
4. "Carnival King Royalty Vanilla Soft Serve Ice Cream Mix 3 lb." from WebstaurantStore
5. "Vollrath 46598 Orion 12 oz. Mirror-Finished Stainless Steel Cream with Lid" from WebstaurantStore
6. "1 Qt. Grade A Ultra-Pasteurized Half and Half Creamer- 12/case" from Webstaurant Store

Reduce the amount of syrup packets used in the dining halls

Replace syrup packets with 12 oz. refillable syrup containers.[1] Multiple containers should go on top of the food line. The dispensers should be filled with gallon jugs of syrup.[2] It would take 45 days to offset the initial cost of 40 syrup dispensers, at which point this recommendation would save about $2,760 per year.

Reduce the amount of plastic cutlery used in dining halls

Primary Recommendation 1:
Reduce the amount of unneeded cutlery used by moving the utensils to the end of the food line. Doing so will allow guests to take only cutlery they need once they have gotten their food, and improve meal line flow.

Primary Recommendation 2:
Ensure use of metal cutlery whenever possible by increasing cutlery washing capacity. Hiring more staff to wash dishes will allow metal cutlery to be used instead of disposable plastic alternatives more often.

Secondary Recommendation:
When disposable cutlery must be used, use bamboo utensils[3] instead of petrochemical or plant based plastic cutleries. These alternatives should be trialed with guests to ensure that they are suitable for guest's needs. This recommendation could increase cost by $16,500 to $23,100 compared to the current operation, meaning it is likely not feasible to entirely replace plastic cutlery with bamboo. Bamboo utensils should be implemented alongside recommendations aimed at reducing the amount of disposable cutlery used. As much disposable plastic cutlery as can be feasibly replaced with bamboo should be.

Reduce the use of plastic grocery bags

- Remove all plastic bags from the dining hall and general store. If guests complain about the lack of bags, only having bags available on request. Guests could then be encouraged to bring their own reusable bags or go without one.
- Replace all plastic bags in the dining hall and general store with paper bags. Make these bags only available upon request, encouraging guests to bring their own reusable bag or go without one.

1. "Tablecraft 1371CP 12 oz. Modern Glass Syrup Dispenser with Chrome Plated ABS Top" from WebstaurantStore
2. "Golden Barrel Pancake and Waffle Syrup 1 Gallon Container" from WebstaurantStore
3. "Bamboo by EcoChoice 6 ½" Compostable Bamboo Cutlery from Webstaruant Store

Housekeeping Recommendations

This section proposes our recommendations to reduce plastic in the Housekeeping department. A thorough exploration and discussion of alternatives can be found in Appendix H.

Decrease the number of single-use plastic gloves

Primary Recommendation: Switch to using more reusable Flock Lined Latex Gloves[1] instead of plastic vinyl gloves for housekeeping crews. These gloves should be used for 1-2 days per pair. Switching to reusable gloves can save the YMCA up to $2,160 each year.

Secondary Recommendation: Switch to disposable latex gloves[2] instead of plastic vinyl gloves for housekeeping crews. A smaller supply of vinyl gloves should be kept available for crew members with latex allergies. This change could cost up to $5,835.60 more per year.

Reduce the amount of individually wrapped plastic cups

Primary Recommendation: Remove cups from the lodge rooms entirely. Cups can be made available for guests who want them in lodge room lobbies. These cups should be left in the packaging they come in to communicate their cleanliness to guests. This suggestion should be tried during the summer periods. If guests complain about not having cups then Housekeeping should trial having only one or two cups per room. Eliminating cups entirely would save $2,530 in one year, while placing only one or two cups would save between $1,500 and $2,400.

Secondary Recommendation: If cups are not entirely eliminated, or before they are, Housekeeping should switch to paper cups[3] instead of plastic cups. To help employees distinguish used cups from new cups, a small tissue paper square should be placed on the underside of each cup, its presence indicating that the cup has not been used. This suggestion should be tried during the summer to see if guests complain about the tissue paper, and to see if it may be helpful to communicate why the tissue paper is there. Including the cost of the tissue paper, this change could save up to $675 per year.

1. already bought by the YMCA for cleaning cabins
2. already bought by the YMCA
3. "Solo® White Single Sided Poly Paper Hot Cup - 12 oz." from Western Paper

Reduce amount of trash bin liners used in lodge rooms

Primary Recommendation:
Remove the trash bin from the bedroom, leaving one trash bin in the bathroom. This recommendation should be tried to see if the smaller bathroom bins and liners are sufficient in size and strength for how much waste guests generate. If the smaller bins and liners are not sufficient, they should be switched for larger bins and liners. Using smaller bin liners saves between $2,265 and $970 per year. Using larger bin liners saves between $610 and $260 per year.

Secondary Recommendation:
Standardize the practice of only removing the bin liner when there is unsanitary or messy waste in the bin. If there is no unsanitary or messy waste, simply empty the waste bin directly into the large trash bag on the supply cart.

Reduce the amount of single-use plastic that is used to store and transport clean laundry

- Use a laundry cart cover instead of a large plastic bag to cover linens in lodge-bound laundry carts. Housekeeping should trial hard shell lids[1] as well as soft[2] stretchy shells to see which performs the best or is most cost-efficient.
- Alter the trash bag tying process for clean linens to increase reuse of these trash bags. For clean linen storage, tying bags to create two loops that are hooked together with a carabiner to close the bags will allow the bag to be more easily opened and emptied without tearing it, allowing it to be reused. If this is not feasible, the bag may be tied closed around a dowel, which can be removed to open the bag.

Decrease the number of soap refill bottles that get sent to the landfill

Reuse current lodge and cabin soap bottles by drilling holes in the top of the container. These holes allow soap bottles to be refilled with soap purchased in bulk, saving money and plastic usage. 3D printed caps can be used to block the hole to prevent spilling, at less than $0.10/cap. Using bulk hand soap,[3] this change could save at least $1,150 per year. The same change can be made with bulk shampoo[4] for shampoo dispenser in the showers.

1. "Lid for Basket Truck - 12 Bushel" from ULine
2. "Cover for Basket Truck - 14 & 16 Bushel" from ULine
3. "Bright Solutions® Cherry Apple Hand Soap - Gal." from Western Paper
4. "Spartan Lite'n Foamy Cranberry Ice Hand, Hair & Body Wash" from Western Paper

Recommendations in Other Departments

Reduce the amount of trash bags used by Conference Set up Services

Designate trash bins in event spaces as not open to food waste. Trash bags that do not contain food waste and are not full do not need to be emptied before new guests use the space. Event spaces in lodges should direct guests to dispose of food waste in one designated trash bin.

Conclusion

We spent 7 weeks at the YMCA of the Rockies - Estes Park Center immersing ourselves in the organization and understanding how sustainable, efficient, and beneficial change could be made. During our time here, we came to understand not only specific changes that could be made to reduce plastic waste but also a broader sense of what factors are required to implement effective institutional change for sustainability. Implementing sustainable change on an institutional level can be a complex and challenging process. However, employees across the board at the YMCA are passionate about sustainability and eager to help lessen the YMCA's impact on the environment. This passion has and will continue to jumpstart environmental movements at the YMCA and on a global scale.

The alarming increase in plastic use in recent decades is an urgent issue that calls for immediate change. This problem needs to be attacked on all levels, with both individual behavior and institutional practices. The work we accomplished for the YMCA of the Rockies will hopefully help them to produce effective and beneficial changes, both now and in the coming years as they work to execute their five-year plan for sustainability. We hope that the YMCA not only takes our recommendations regarding plastic use into consideration, but also carries our work forward, continuing to innovate and look for new ways to be more sustainable. Finally, our work can act as a model for other institutions to critically reflect on their current operations and contribute to a more sustainable world.

Further Research

During our project our team has identified additional areas of research to be carried out in the future. Some of these areas were beyond the scope of our project, while others were areas we looked into during our project and did not have time to fully address. The largest area for further research we identified is the feasibility of making a contract with a commercial contracting operation to compost products such as coffee cups, food waste and starch utensils that currently cannot be composted with the YMCA's waste management contractor. Doing so would require the creation of an entirely new waste disposal stream and likely significant changes to Grounds operation, things that could be addressed by either the YMCA or another student project. Creation of a composting stream could benefit the environment by repurposing organic materials and properly breaking down compostable products.

One area that our team looked into which could be investigated in the future to reduce plastic use is the plastic wrap used to cover food prepared by YMCA employees in the kitchens. Our team found that replacements would need to be investigated with food safety and shrinkage and cracking from heating and cooling cycles in mind. Another area our team looked into but did not have time to address is the possibility of using reusable laundry bags instead of trash bags for clean linens in the laundry rooms.

Finally, the YMCA should look further into the possibility of reducing the amount of plastic wrap used in firewood bundles. This could be addressed by changing suppliers to ones that use less plastic wrap or by buying unbundled firewood and bundling it in house or having guests bundle it themselves. Finding alternative suppliers was difficult as there are restrictions on where firewood can be sourced from and sold to in order to avoid the spread of pests that destroy trees. Our team had looked into the supplier used by Snow Mountain Ranch for use at the Estes Park Center, but its far distance raised environmental concerns from shipping, and was significantly more expensive due to recent price increases, which are prompting Snow Mountain Ranch to change suppliers.

One supplier that may be a possibility is United Wood Products Inc. in Longmont Colorado. They sell bundled firewood at a slightly higher price

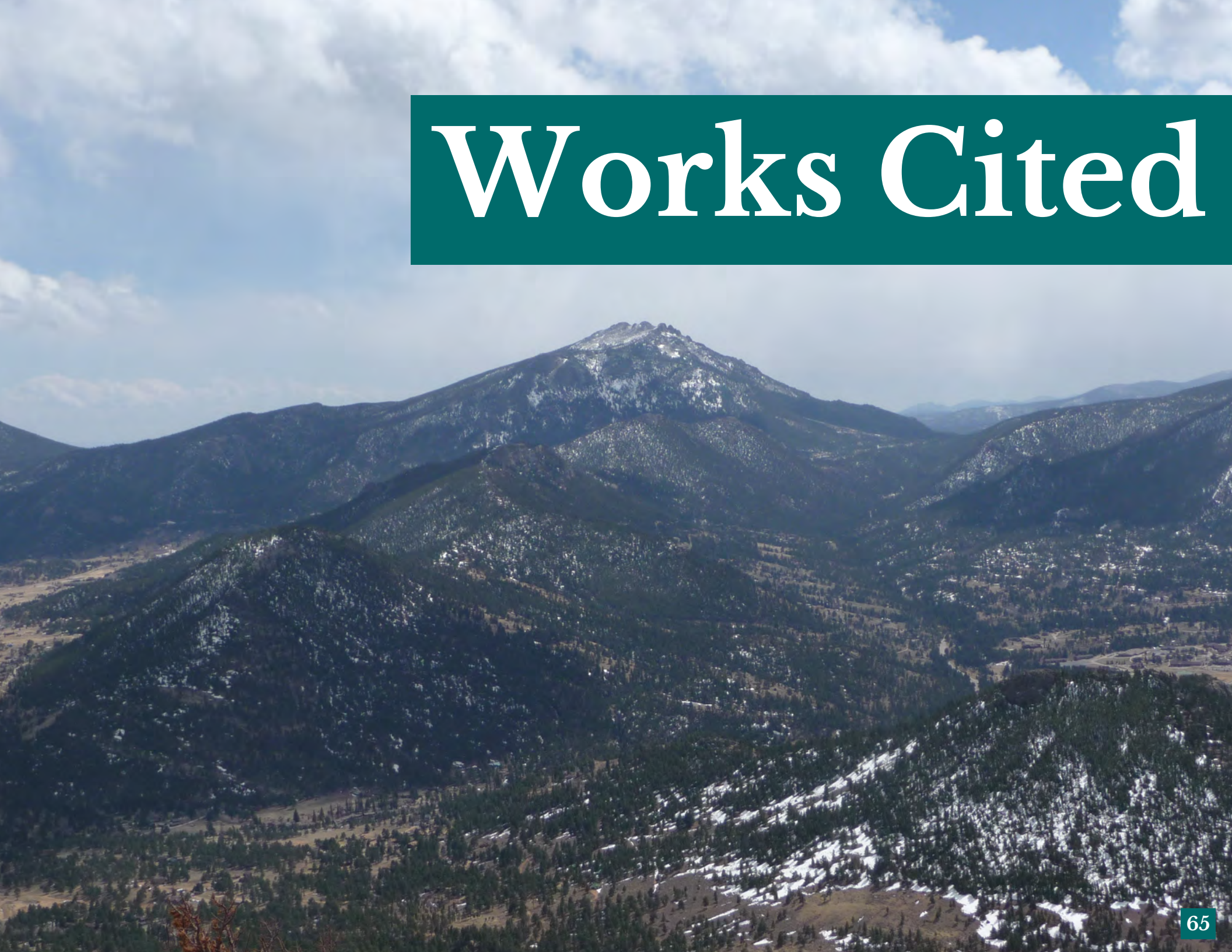
Figure 42 - An example of Snow Mountain Ranch's firewood

than the current supplier of the Estes Park Center as well as unbundled firewood but do not deliver. Their bundles use less plastic, but do still use plastic wrap. However, since the YMCA could be a large customer, they may be able to use their influence to make a delivery deal with this supplier. If they cannot, someone more familiar with the logistics at the YMCA would be able to ascertain if the YMCA could feasibly pick up this firewood.

Our research also determined that staffing shortages promoted plastic use over sustainable alternatives, and that sustainable alternatives often require more work. The complexity of attracting and budgeting for more employees is beyond the scope of our research. However, the YMCA should seek to bolster their workforce to provide enough resources to enact sustainable change.

Figure 43 - Our team at the YMCA

Works Cited



Benavides, P. T., Lee, U., & Zare-Mehrjerdi, O. (2020). Life Cycle Greenhouse Gas Emissions and Energy Use of Polylactic Acid, Bio-Derived Polyethylene, and Fossil-Derived Polyethylene. *Journal of Cleaner Production, 277* (124010). https://doi.org/10.1016/j.jclepro.2020.124010

Bhardwaj, Sharma, N., Sharma, V., Alam, T., Sahu, J. ., & Hamid, H. (2022). Assessing the consumer acceptance and storability of chitosan and beeswax coated cellulose packaging for whole wheat bread. *Food Control*, *133*, 108682. https://doi.org/10.1016/j.foodcont.2021.108682

Bratspies, R., Peréz, V. C., Craig, R. K., Griffin, L., Krakoff, S., Hirokawa, K., Kuh, K., Owley, J., Powers, M., Roesler, S., Rosenbloom, J., Ruhl, J. B., Ryan, E., & Takacs, D. (2021). Environmental Law, Disrupted by COVID-19. 17. https://scholar.law.colorado.edu/articles/1354.

Broeren, M., Kuling, L., Worrell, E., & Shen, L. (2017). Environmental impact assessment of six starch plastics focusing on wastewater-derived starch and additives. *Resources, Conservation and Recycling*, *127*, 246–255. https://doi.org/10.1016/j.resconrec.2017.09.001

Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science Advances, 4(6), eaat0131. https://doi.org/10.1126/sciadv.aat0131

Cho, R. (2017). *The Truth about Bioplastics*. Columbia Climate School. https://news.climate.columbia.edu/2017/12/13/the-truth-about-bioplastics/

Choi-Schagrin, W., & Tabuchi, H. (2022). *Trash or Recycling? Why Plastic Keeps us Guessing*. The New York Times. https://www.nytimes.com/interactive/2022/04/21/climate/plastics-recycling-trash-environment.html

Clark, E., Mulgrew, K., Kannis-Dymand, L., Schaffer, V., & Hoberg, R. (2019). Theory of planned behavior: Predicting tourists' pro-environmental intentions after a humpback whale encounter. *Journal of Sustainable Tourism*, *27*(5). https://doi.org/10.1080/09669582.2019.1603237

Cook, R. (2014). Dallas-based Snappy Salads opts for eco-friendly paper straws. *Green Source DFW*. https://greensourcedfw.org/articles/dallas-based-snappy-salads-opts-eco-friendly-paper-straws

Corcione, A. (2021). *What is greenwashing?* Business News Daily. Retrieved February 3, 2022, from https://www.businessnewsdaily.com/10946-greenwashing.html

Deloitte. (n.d.). *Estes Park, CO*. DATA USA. https://datausa.io/profile/geo/estes-park-co

Di, J., Reck, B. K., Miatto, A., & Graedel, T. E. (2021). United States plastics: Large flows, short lifetimes, and negligible recycling. Resources, Conservation and Recycling, 167, 105440. https://doi.org/10.1016/j.resconrec.2021.105440

Dobrosielski, C. (2019) "Marriott to Eliminate Single-Use Bathroom Amenity Bottles." *Hotel Management (Online),* https://www.proquest.com/docview/2281390237/abstract/F6266E0723334CB9PQ/1.

Environmental Protection Agency. (2021). *Sustainable Marketplace" Greener Products and Services.* EPA. Retrieved February 3, 2022, from https://www.epa.gov/greenerproducts/buying-green-consumers

Failey, T. (2016). Poor Communities Exposed to Elevated Air Pollution Levels. Global Environmental Health Newsletter. https://www.niehs.nih.gov/research/programs/geh/geh_newsletter/2016/4/spotlight/poor_communities_exposed_to_elevated_air_pollution_levels.cfm

Fetner, H. & Miller, S. (2021) Environmental Payback Periods of Reusable Alternatives to Single-Use Plastic Kitchenware Products. *The International Journal of Life Cycle Assessment*, vol. 26, no. 8, pp. 1521–37, https://doi.org/10.1007/s11367-021-01946-6.

Fossil Fuels & Plastic. (2021). *Center for International Environmental Law.* https://www.ciel.org/issue/fossil-fuels-plastic/

Haslam, F. (2012) The big problem of microplastics—University of Nottingham—The University of Nottingham. https://www.nottingham.ac.uk/connectonline/research/2018/the-big-problem-of-microplastics.aspx

IUCN. (2021). *Marine Plastic Pollution*. IUCN. https://www.iucn.org/resources/issues-briefs/marine-plastic-pollution

Kakadellis, S, Woods, J, & Harris, Z. "Friend or Foe: Stakeholder Attitudes towards Biodegradable Plastic Packaging in Food Waste Anaerobic Digestion." Resources, Conservation and Recycling 169 (2021). https://doi.org/10.1016/j.resconrec.2021.105529

Karidis, A. (2020). *Boston College Fosters Sustainability through Student Involvement*. Waste360 (Online). https://www.proquest.com/scitechpremium/docview/2447009135/abstract/CF2F8D09FB7746D0PQ/1

Lamp'l, J. (2019). *Sustainable Plastic Use in Your Garden and Landscape | Milorganite*. https://www.milorganite.com/blog/garden-landscape/sustainable-plastic-use-garden-and-landscape. Accessed 2 Feb. 2022.

Leet, A. (2021). "Sustainability at YMCA of the Rockies." *YMCA of the Rockies*, https://ymcarockies.org/News/Article/sustainability-at-ymca-of-the-rockies. Accessed 2 Feb. 2022.

Lindemann-Matthies, P., Hoyer, E., & Remmele, M. (2021). Collective Public Commitment: Young People on the Path to a More Sustainable Lifestyle. *Sustainability*, *13*(20), 1–18. https://doi.org/10.3390/su132011349

Lindh, H., Olsson, A., & Williams, H. (2016). Consumer Perceptions of Food Packaging: Contributing to or Counteracting Environmentally Sustainable Development?: Consumer Perceptions of Food Packaging. *Packaging Technology and Science*, *29*(1), 3–23. https://doi.org/10.1002/pts.2184

Loria, K. (2021). *The Big Problem With Plastic*. Consumer Reports. https://www.consumerreports.org/environment-sustainability/the-big-problem-with-plastic/

Mack, N., Woodsong, C., MacQueen, K., Guest, G., & Namey, E. (2005). *Qualitative Research Methods: A Data Collector's Field Guide*. Family Health International. https://pdf.usaid.gov/pdf_docs/PNADK310.pdf

M, K. (2019). *How Buena Vista University Built and Inviting and Efficient Dining Commons*. Food Service Equipment Reports. https://www.fermag.com/articles/9487-how-buena-vista-university-built-an-inviting-and-efficient-dining-commons/

Maness, P. (2016). How to Plan Successful Traffic Flow to Your Food Bar. *TriMark Blog*. https://www.trimarkusa.com/news-room/trimark-blog/2016/january-2016/how-to-plan-successful-traffic-flow-to-your-food-b

Marriott International (2019). Marriott International To Eliminate Single-Use Shower Toiletry Bottles From Properties Worldwide, Expanding Successful 2018 Initiative. Marriott International Newscenter (US). https://news.marriott.com/news/2019/08/28/marriott-international-to-eliminate-single-use-shower-toiletry-bottles-from-properties-worldwide-expanding-successful-2018-initiative.

Michelin Guide. (2020). *Going Green at Chez Panisse*. Michelin Guide. https://guide.michelin.com/us/en/article/sustainable-gastronomy/sustainability-green-star-chez-panisse

Monella, L. M. (2020). Will plastic pollution get worse after the COVID-19 pandemic? Euronews. https://www.euronews.com/2020/05/12/will-plastic-pollution-get-worse-after-the-covid-19-pandemic

NASA. (2022, April 18). *Climate Change: How Do We Know?* Global Climate Change Vital Signs of the Planet. https://climate.nasa.gov/evidence/#:~:text=This%20ancient%2C%20or%20paleoclimate%2C%20evidence,after%20the%20last%20Ice%20Age

NOAA. (2022). *A Guide to Plastic in the Ocean*. National Ocean Service Website. https://oceanservice.noaa.gov/hazards/marinedebris/plastics-in-the-ocean.html#:~:text=Unlike%20some%20other%20kinds%20of,wreaking%20havoc%20on%20marine%20ecosystems.&text=As%20the%20plastic%20is%20tossed,form%20of%20abandoned%20fishing%20nets

Parker, L. (2019). A Whopping 91 Percent of Plastic Isn't Recycled. *National Geographic Society*. https://www.nationalgeographic.org/article/whopping-91-percent-plastic-isnt-recycled/?utm_source=BibblioRCM_Row

Patel, M., Bastioli, C., Marini, L., & Wurdinger, E. (2005). *Environmental assessment of bio-based polymers and natural fibres*. https://doi.org/10.1002/3527600035.bpola014

Picchi, A. (2022). *A cause of America's labor shortage: Millions with long COVID*. CBS News. https://www.cbsnews.com/news/long-covid-labor-market-missing-workers/

Recycling Plastic: Complications & Limitations. (n.d.) https://www.alexandriava.gov/uploadedFiles/tes/solidwaste/info/RecyclingPlasticComplications.pdf

Rhone, Nedra. (2019). *Major Hotels Make Move to Bulk-Size Toiletries in Guest Rooms*. The Atlanta Journal-Constitution. https://www.ajc.com/business/major-hotels-make-move-bulk-size-toiletries-guest-rooms/Nm1MaNaQZstAz0Bz515RwI/.

Rosenbaum, S. (2018). *What the Woman Who Recorded the Heartbreaking Turtle Video Wants Companies to Know About Plastic Straws*. Time. https://time.com/5339037/turtle-video-plastic-straw-ban/

Shemitz, L., & Anastas, P. (2020). *Yale Experts Explain Microplastics*. Yale Sustainability. https://sustainability.yale.edu/explainers/yale-experts-explain-microplastics

Shrestha, A., van-Eerten Jansen, M. C. A. A., & Acharya, B. (2020). Biodegradation of Bioplastic Using Anaerobic Digestion at Retention Time as per Industrial Biogas Plant and International Norms. Sustainability, 12(10), 4231. https://doi.org/10.3390/su12104231

Slavikova, D., Moniatis, N., Kassinos, A., Michael, C., & Drousiotis, P. (2011). *Thomas Cook Ring Fenced Project Plastics Reduction in the Hotel Industry in Cyprus*. The Travel Foundation. https://s3-eu-west-1.amazonaws.com/travelfoundation/wp-content/uploads/2020/11/16124218/2011-Final-Results-Report.pdf

Starbucks. (2013). *Starbucks Global Responsibility Report*. http://web.archive.org/web/20140412025422/http://news.starbucks.com/uploads/documents/Responsibility_Report_2013.pdf

Starbucks. (2015). *Goals & Progress: Reusable Cups*. Starbucks. http://web.archive.org/web/20150214081113/http://www.starbucks.com/responsibility/global-report/environmental-stewardship/reusable-cups

Su, S., Li, Y., Maschal, E., & Ha, Y. (2015). *Plastic Reduction Case Studies* [Master's Project, Duke University]. https://hdl.handle.net/10161/9640

Sustainable Hospitality Alliance. (2021). *Single-use plastics*. https://sustainablehospitalityalliance.org/resource/single-use-plastic-factsheet/

Tabuchi, H., & Corkery, M. (2021). Countries Tried to Curb Trade in Plastic Waste. The U.S. Is Shipping More. The New York Times. https://www.nytimes.com/2021/03/12/climate/plastics-waste-export-ban.html

Tamburini, E., Costa, S., Summa, D., Battistella, L., Fano, E. A., & Castaldelli, G. (2021). Plastic (PET) vs Bioplastic (PLA) or Refillable Aluminum Bottles - What is the Most Sustainable Choice for Drinking Water? A Life-Cycle (LCA) Analysis. *Environmental Research*, *196* (110974). https://doi.org/10.1016/j.envres.2021.110974

Ted's Montana Grill. (2017). *Ted's Montana Grill Sustainability Story*. https://www.tedsmontanagrill.com/downloads/TMGSustainability.pdf

The Grey Plume. (2015). *Green Initiatives*. The Grey Plume. http://web.archive.org/web/20150206004949/http://www.thegreyplume.com/tgp_about_green_initiatives.php

The Origin of the Recycling Symbol | Middle Tennessee State University. (2021). https://www.mtsu.edu/cee/3Rs.php

US EPA, O. (2021). Frequently Asked Questions about Plastic Recycling and Composting (Water Bodies) [Overviews and Factsheets]. https://www.epa.gov/trash-free-waters/frequently-asked-questions-about-plastic-recycling-and-composting

US EPA, O. (2021). Plastics: Material-Specific Data [Collections and Lists]. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/plastics-material-specific-data

Vanapalli, K. R., Sharma, H. B., Ranjan, V. P., Samal, B., Bhattacharya, J., Dubey, B. K., & Goel, S. (2021). Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic. Science of The Total Environment, 750, 141514. https://doi.org/10.1016/j.scitotenv.2020.141514

Vance, R. J. (2006). *Employee Engagement and Commitment*. SHRM Foundation. https://www.shrm.org/hr-today/trends-and-forecasting/special-reports-and-expert-views/documents/employee-engagement-commitment.pdf

Wani, W. A., Pathan, S., & Bose, S. (2021). The Journey of Alternative and Sustainable Substitutes for "Single-Use" Plastics. *Advanced Sustainable Systems*, *5*(12), 2100085. https://doi.org/10.1002/adsu.202100085

WRCC. (n.d). *Estes Park, Colorado (052759)*. Western Regional Climate Center. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?co2759

WRCC. (n.d). *Winter Park, Colorado (059175)*. Western Regional Climate Center. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?cowint

Yale. (2020). Yale Experts Explain Microplastics. *Yale Sustainability*. https://sustainability.yale.edu/explainers/yale-experts-explain-microplastics

YMCA. (2016). *Estes Park Center* [Map]. https://apm.activecommunities.com/ymcarockiesepcprograms/ActiveNet_Home?FileName=onlineimapshow.sdi&interactive_map_id=1&facility_id=14

YMCA. (2014). *Snow Mountain Ranch YMCA* [Map]. https://mobilemaplets.com/showplace/1992

YMCA. (n.d.). *About the YMCA of the Rockies*. Colorado Conference Centers. https://www.coloradoconferencecenters.com/about-us/

Appendices

Appendix A: Employee Interview Protocols

Not all questions may be used in every interview. Prior to each interview the team will review which questions are expected to be relevant. Indented follow-up questions will be asked if deemed necessary. Additional needed questions may be created based on results of prior interviews. When employees fall under multiple categories, such as sustainability team and public relations, questions from each sub-appendix may be asked.

A.1 Informed Consent

Prior to Interview:

We are a team of students from Worcester Polytechnic Institute in Massachusetts. We are holding interviews with employees to understand how plastic is used and can be reduced at the YMCA, to understand the work experience of employees relating to plastic products, explore how the YMCA presents sustainability to visitors and determine the limitations and constraints around plastic alternatives. The goal of our research is to audit plastic use at the YMCA and suggest ways to reduce plastic use at the YMCA of the Rockies and the Snow Mountain Ranch. Your participation in this interview is completely voluntary and you may stop at any time. We expect this interview will take approximately 30 minutes. Your identity will remain confidential unless you give permission otherwise. No identifying information will appear in our project reports or publication unless you give us consent for that information to appear. We appreciate your participation in our research and for taking your time to talk to us.

Contact: gr-estesplastics-d22@wpi.edu

End of Interview:

Thanks again for taking part in this interview with us. Again, unless you decide otherwise no identifying information from this interview will be included in our final project. We greatly appreciate you helping us advance our research in this project.

A.2 General Questions

- What is your role/title?
- How long have you been working at the YMCA?
- Have you always worked in the same department?
- Do you work seasonal/part-time/full time?
- Do you use YMCA facilities for personal use?

A.3 Sustainability Team

- Previous sustainability projects:
  - What past projects has the YMCA done in your department to reduce plastic use?
  - What went well and didn't go well in those projects?
  - How have those projects been maintained?
- Do you have any goals for our project?
- Could you describe some of the difficulties the sustainability team has faced in enacting sustainable programs?
- How does the sustainability team reach out to other departments?
- How is employee suggestions or feedback incorporated into the sustainability team's actions?

A.4 Public Relations

- How advantageous to the public image of the YMCA are sustainability projects?
  - How do you advertise or make these projects known?
- How have you and your department interacted with the YMCA's sustainability team or any of their projects?
- Could we see an example of how previous initiatives or projects have been used to the public relations department's advantage?
  - What made these programs particularly beneficial to your departments? What did they do well?
  - Where did these programs fall short to your department?
- How is plastic used in your department?
- What changes would you like to see to make the YMCA more sustainable?

A.5 Finance, Executives, Management, and Department Heads

- What purchasing information would you be able to share with us?
- What information do invoices contain? (cost, number of units, number of units per shipment, etc.)
- How are invoices organized?
  - Are they organized by department or type of product or in multiple ways?
  - In the future could we reach out about invoices/data for specific products?
- Are there any difficulties related to vendors we should be aware of (have to have them set up/predetermined)?
- What factors go into determining budget limitations for environmental improvements?
  - Labor costs, maintenance costs, etc.
  - Are there any specific limits that we should know about?
- What are the climate limitations of the YMCA? Does the cold and/or snow provide difficulties in implementing new programs or materials?
- Would you be able to review and/or share purchasing data on plastic materials with us?
  - How are plastic products bought (in bulk or more regularly)?
  - What kind of relationship do you have with the supplier?
    - Could they be asked to use more sustainable or returnable packaging?
    - What kind of requirements does the YMCA look at when selecting/communicating with suppliers?
      - Ethical/sustainable sourcing, lack of single use plastic, returnable containers?
  - How has the state of the supply chain during the pandemic affected availability of materials from suppliers?
    - How has it affected their costs?
- How much of, if any, added costs from sustainability programs are passed on to visitors?
- What is your approach to communicating sustainability programs to your employees?
- How do you take them into consideration in developing these programs?
- How would you rank different criteria for plastic reducing programs? These include: recyclability, decomposition time, durability, resources required to produce the material, material costs, shipping cost, added labor time/costs, ease of use for both employees and customers, and customer satisfaction (further criteria may be identified in interviews)

A.6 Food Services

- How could food safety considerations limit our ability to reduce plastic use?
  - Are there any uses of plastic that you think would be difficult to replace or reduce plastic due to food safety practices?
  - What requirements do alternatives to plastic have to fulfill to maintain food safety?
- How is plastic used in your department?
- What past projects has the YMCA done in your department to reduce plastic use?
  - How have customers reacted to them?
  - How well/effectively have customers participated in them?
  - Do you know (person on the sustainability team we think they're most likely to know) and their role on the YMCA sustainability team?
  - How has the sustainability team interacted with you/you interacted with them?
  - How has the sustainability team impacted your work?
- Are there any areas of plastic use in your job that you feel are unnecessary or over the top?
  - What are some ways that you think plastic could be reduced at the YMCA?
  - How has leadership responded to suggestions and input from employees?
- Can you tell us about what may make it harder to switch to plastic alternatives?
- Can you tell us about what may make it harder to reduce the use of plastics products that are already used?
- We'd like to get your opinion on some plastic alternatives that we have identified that may be relevant to the YMCA. They are _____
  - What are some issues you think there might be with this approach?
  - How do you feel this would fit into your work/department?
  - How do you think consumers would react to/participate in something like this?

A.7 Housekeeping

- How is plastic used in your department?
- What past projects has the YMCA done in your department to reduce plastic use?
    - How have customers reacted to them?
    - How well/effectively have customers participated in them?
    - Did the implementation of the “That’s a Wrap” initiative have a large impact on your daily job operations?
    - Do you know (person on the sustainability team we think they’re most likely to know) and their role on the YMCA sustainability team?
        - How has the sustainability team interacted with you/you interacted with them?
        - How has the sustainability team impacted your work?
- Are there any areas of plastic use in your job that you feel are unnecessary or over the top?
    - What are some ways that you think plastic could be reduced at the YMCA?
    - How has leadership responded to suggestions and input from employees?
- Can you tell us about what may make it harder to switch to plastic alternatives?
- Can you tell us about what may make it harder to reduce the use of plastics products that are already used?
- We’d like to get your opinion on some plastic alternatives that we have identified that may be relevant to the YMCA. They are _____
    - What are some issues you think there might be with this approach?
    - How do you feel this would fit into your work/department?
    - How do you think consumers would react to/participate in something like this?

A.8 Grounds

- How is plastic used in your department?
- What past projects has the YMCA done in your department to reduce plastic use?
    - How have customers reacted to them?
    - How well/effectively have customers participated in them?
    - Do you know (person on the sustainability team we think they're most likely to know) and their role on the YMCA sustainability team?
        - How has the sustainability team interacted with you/you interacted with them?
        - How has the sustainability team impacted your work?
- Are there any areas of plastic use in your job that you feel are unnecessary or over the top
    - What are some ways that you think plastic could be reduced at the YMCA?
    - How has leadership responded to suggestions and input from employees?
- Can you tell us about what may make it harder to switch to plastic alternatives?
- Can you tell us about what may make it harder to reduce the use of plastics products that are already used?
- We'd like to get your opinion on some plastic alternatives that we have identified that may be relevant to the YMCA. They are

  _____
    - What are some issues you think there might be with this approach?
    - How do you feel this would fit into your work/department?
    - How do you think consumers would react to/participate in something like this?

Appendix B: Guest Survey Questions

YMCA of the Rockies Plastic Use Survey

We are a team of students from Worcester Polytechnic Institute in Massachusetts. The goal of our research is to audit plastic use at the YMCA and suggest ways to reduce plastic use at the YMCA of the Rockies and the Snow Mountain Ranch. Your participation in this survey is completely voluntary and you may stop at any time. We expect this survey will take approximately 5 minutes. Your identity will remain confidential. We appreciate your participation in our research and for taking your time to participate in this survey.

Contact: gr-estesplastics-d22@wpi.edu

Demographic Questions

What is your age?
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65-74
- 75-84
- 85+

What is your gender?
- Female
- Male
- Nonbinary
- Prefer no to say
- Other

Where are you from?
- each of the 50 states
- outside of the US

Have you been to the YMCA of the Rockies before?
- No
- Yes, once
- Yes, more than once

In this visit, how long have you been at the YMCA of the Rockies?
- 0-3 days
- 4-7 days
- 1-2 weeks
- 2-3 weeks
- 3 weeks or more

If you are staying at the YMCA are you staying at a lodge or a cabin?
- Lodge
- Cabin
- Not staying at the YMCA

Plastic Questions

How important is reducing plastic to you personally?
- (1) Not at all important
- (2)
- (3)
- (4) neutral
- (5)
- (6)
- (7) very important

Does the YMCAs push for environmentally sustainable programs to reduce plastic use make you more or less likely to stay at the YMCA?

- (1) Make me much less likely to stay
- (2)
- (3)
- (4) Have no effect
- (5)
- (6)
- (7) Make me much more likely to stay
- N/A I am not aware of this push

How easy/difficult would it be for you to participate in the following plastic reducing actions at the YMCA?

- Scale
  - Very Easy
  - Easy
  - Neutral
  - Difficult
  - Very Difficult
- Actions
  - Recycling plastic products
  - Using a reusable water bottle
  - Using bulk condiment dispensers instead of taking packets
  - Using a milk dispenser instead of milk bottles
  - Not having plastic lids for the hot cups in the dining hall
  - Having non-plastic cups in the lodge rooms
  - Having a soft-serve machine instead of ice cream cups

Are you willing to pay more for more sustainably packed products at YMCA cafes and food to go locations?

- Yes (you can specify how much more you are willing to pay if you choose this option)
- No

Willingness to Pay

This section only shown if Yes was selected on the previous question

You said you were willing to pay more for sustainably packaged products at YMCA cafes and food to go locations. How much more are you willing to pay?

- 0-10%
- 11-20%
- 21-30%
- 31-40%
- 41-50%
- 51-60%
- 61-70%
- 71-80%
- 81-90%
- 91-100%
- >100%

Thank You!

Do you have any additional comments/suggestions about reducing plastic use?

Appendix C: Greenwashing and Bioplastics

In recent years, the media has begun to emphasize the climate change crisis and pose an urgent call to action. The action is an immediate change that seeks to reduce our harmful effect on the environment around us. The words “sustainability”, “eco-friendly”, and “green” are used to describe any and all items associated with this intention. “Greenwashing” is a practice heavily used in marketing; Adryan Corcione for Business News Daily describes it as when an organization or company spends more of their time and money on marketing themselves as “eco-friendly” and “green” than they do on minimizing their environmental impact (Corcione, 2021). For example, many plastic alternative products are labeled as “compostable” or “biodegradable”, without much of a disclaimer of how slowly the product will degrade, should it find itself in a landfill. A majority of these products do not go to their intended waste management system, rendering the “compostable” or “biodegradable” aspects of the product useless. For this reason, a great amount of care should be taken when choosing alternatives to traditional plastic products to ensure that they will benefit our environment.

The Environmental Protection Agency reports that ecolabels are a tool that can help consumers identify the environmental effect of products (EPA, 2021). Government agencies, nonprofit environmental advocacy organizations, and private sector entities established these labels to identify specific levels of performance to be able to deem a product or service as “environmentally preferable”, allowing the customer to make informed decisions.

Bioplastics are one commonly greenwashed product, so much so that the name itself is misleading. The term “bioplastic” can be used to refer to any plastic that is bio-sourced, biodegradable, compostable, or some combination of the three. However, just because a plastic is bio-sourced, biodegradable, or compostable, doesn’t necessarily mean it is better for the environment. In a “cradle-to-grave” life cycle analysis conducted by Tamburini, E. et al. (2021), PET (a traditional petroleum-based plastic) was compared to PLA (a bioplastic) using ten different environmental impact categories. It was found through this study that the PLA actually had a greater negative environmental impact than the PET, showing that bioplastics can sometimes even be worse than their petroleum-based counterparts.

This is because bio-sourced bioplastics are often made from crops like corn, which have a detrimental environmental impact due to the large agricultural land use along with the herbicides and pesticides that release harmful chemicals into the environment (Cho, R. 2017). In addition to this, the process of converting bio-products into plastics can use a lot of energy, contributing to the environmental impact of bioplastics like PLA (Cho, R. 2017).

One of the more positive impacts of some bioplastics is their ability to biodegrade, meaning that they are able to break down into purely organic substances like water and carbon dioxide. This can lead to the plastics being carbon-neutral since the carbon dioxide which is released during their degradation is equal to that which was absorbed from the atmosphere during the production of raw materials. However, this biodegradation can only happen under special conditions that typically only exist in specialized commercial facilities (Kakadellis, Woods, Harris, 2021). These commercial facilities are not easily accessible everywhere, and so most bioplastics end up in landfills instead (EPA 2021). Additionally, bioplastics are typically not recyclable. When they do end up in recycling, they can contaminate recyclable plastic, leading to these materials being rejected and sent to landfills (Cho, R. 2017).

Although there is a lot of research being conducted on improving the environmental impact of bioplastics, there is still a lot to be done. According to Renee Cho, a writer for the Columbia Climate School, “right now, it’s hard to claim that bioplastics are more environmentally friendly than traditional plastics when all aspects of their life cycle are considered” (2017). This is supported by case studies of life cycle conducted by Tamburini, E. et al. (2021), Benavides, P. T. et al (2020), and Patel, M. (2005).Since it is not clear whether or not bioplastics are actually better for the environment, it is best to avoid recommending bioplastics in replacement of petroleum-based plastics when setting up plastic-reducing programs.

Another plant-based plastic alternative is starch-based plastics. These plastics are made by converting starch into a thermoplastic and then mixing it with co-polymers and additives to achieve certain material properties. A life-cycle analysis case study by Broeren, M et al. (2017) evaluated the environmental impact of 6 different starch based-plastics in comparison to the traditional petroleum-based plastics. The study found that starch based plastics had lower greenhouse gas emissions and required less non-renewable energy than the petroleum-based plastics. Though, the eutrophication potential and agricultural land use were both higher for the starch-based plastics in comparison to the petroleum-based ones. The study also explored the difference in environmental effects between starch-based plastics made with virgin starches versus reclaimed starch. Broeren et al. found that the reclaimed starches had less negative environmental impacts for all categories. In this case, eutrophication decreased by up to 41%, agricultural land use decreased by up to 62%, greenhouse gas emissions decreased up to 24%, and nonrenewable energy use decreased up to 5.2%. Another life-cycle analysis case study conducted by Patel M., et al. (2005) claimed that starch-based plastic alternatives were better than biobased plastics in terms of both energy usage and greenhouse gas emissions. However, it is still difficult to draw conclusions about the overall environmental impact of the starch-based polymers due to a lack of full life-cycle analyses and assumptions that have not been fully investigated yet.

Appendix D: Customer Flow

Typically, self service food bars use one of three flow types to create optimal customer flow. These are: a circular flow with the food in the center of guests, a single file line with food, or a line with guests on either side of the food bar (Maness, 2016). The Estes Park Center employs the approach of a line with guests on either side. They also follow recommendations from Tri Mark, a large food service supply company, that items like desserts and beverages are partitioned in other areas. The reason Tri Mark recommends these items be placed separately is to keep the central line moving more quickly, and that customers can get them only if they need them. Items like condiments fit this description as well, so condiment dispensers should also be partitioned away from the central food line. Currently the Estes Park Center places condiment packets on top of the food line, and has select communal condiments near the deserts and coffee.

In our personal experience as WPI students, we know that the WPI dining hall utilizes two condiment dispenser stations in different locations. Each dispenser is stationed after the end of the main food line. A similar design philosophy is evident in the congestion reducing redesign of Buena Vista University's dining hall. In their new design the college employed tables for beverages, desserts, cereals and waffles, separate from the food lines, with condiment dispensers approachable from either side of the table (M, 2019). In all cases studied, designs prioritized avoiding congestion and cutting down lines.

Appendix E: Guest Survey Responses

Total Respondents: 12

Demographic Information

What is your age?
- 35-44 (4 responses)
- 25-34 (3 responses)
- 45-54 (3 responses)
- 55-64 (1 response)
- 65-74 (1 response)

What is your gender?
- Female (7 responses)
- Male (5 responses)

Where are you from?
- Colorado (8 responses)
- Wyoming (2 responses)
- New York (1 response)
- North Carolina (1 response)

Have you been to the YMCA of the Rockies before?
- Yes, more than once (6 responses)
- No (3 responses)
- Yes, once (3 responses)

In this visit, how long have you been at the YMCA of the Rockies?
- 0-3 days (11 responses)
- the other guest surveyed was a former guest not currently staying at or visiting the YMCA

If you are staying at the YMCA are you staying at a lodge or a cabin?
- Lodge (6 responses)
- Not staying at the YMCA (4 responses)
- Cabin (2 responses)

How important is reducing plastic to you personally? (scale of 1-7)
- (7) Very important (7 responses)
- (6) Important (4 responses)
- (5) a little important (1 response)

Does the YMCAs push for environmentally sustainable programs to reduce plastic use make you more or less likely to stay at the YMCA? (scale of 1-7)
- (6) Make me more likely (5 responses)
- (4) Have no impact on (4 responses)
- (7) Make me much more likely (3 responses)

How easy/difficult would it be for you to participate in the following plastic reducing actions at the YMCA?
- Recycling plastic products
  - Very Easy (6)
  - Easy (6)
- Using a reusable water bottle
  - Very Easy (10 responses)
  - Easy (2 responses)
- Using bulk condiment dispensers instead of taking packets
  - Very Easy (9 responses)
  - Easy (1 response)
  - Neutral (1 response)
  - Difficult (1 response)
- Using a milk dispenser instead of milk bottles
  - Very Easy (5 responses)
  - Easy (3 responses)
  - Neutral (2 responses)
  - Question blank (2 responses)
- Not having plastic lids for the hot cups in the dining hall
  - Very Easy (5 responses)
  - Easy (4 responses)
  - Difficult (2 responses)
  - Question blank (1 response)

- Having non-plastic cups in the lodge rooms
  - Very Easy (6 responses)
  - Easy (4 responses)
  - Difficult (1 response)
  - Question Blank (1 response)

How easy/difficult would it be for you to participate in the following plastic reducing actions at the YMCA? (continued)

- Having a soft-serve machine instead of ice cream cups
  - Very Easy (8 responses)
  - Easy (2 responses)
  - Neutral (1 response)
  - Difficult (1 response)

Are you willing to pay more for more sustainably packaged products at YMCA cafes and food to go locations?

- Yes (12 responses)

You said you were willing to pay more for sustainably packaged products at YMCA cafes and food to go locations. How much more are you willing to pay?

- 11-20% (4 responses)
- 0-10% (3 responses)
- 21-30% (3 responses)
- 31-40% (1 response)
- 41-50% (1 response)

Additional comments/suggestions about reducing plastic use

- Thinks plastic recycling needs serious overhaul, the clarity of information. Also mentioned as less fuel is used in cars more of the oil may be used in plastic
- Wondering about compostable food waste and the compostable cups. eleven to twenty percent more if they knew the reason for the price increase
- Group comes twice a year- they usually do ceramic dishware- talking about the plastic switch- felt better about it when ceramic and metal
-
- Some options depend on sanitation of dispensers- worry that they might get messy or unclean
- Hard time finding the places to refill water bottles
- A comment about trash islands in the ocean

Appendix F: Invoice Analysis Summary

Irrelevant invoice findings have been left out
When totals are reported they are for the span of April 1, 2021 to March 31, 2022

Food Services- Estes Park Center

Ice cream cups, chocolate: $4,053.80 spent on 9,216 cups (4 oz. each) or 36,864 ounces
Ice cream cups, strawberry: $3,292.95 spent on 7,584 cups (4 oz. each) or 30,336 ounces
Ice cream cups, vanilla: $8,903.18 spent on 20,880 cups (4 oz. each) or 83,520 ounces
Chocolate Milk Bottles (1%): $44,519.76 spent on 63,048 bottles (7 oz. each) or 441,336 ounces
Regular Milk Bottles (1%): $40,619.64 spent on 58,848 bottles (7 oz. each) or 441,936 ounces
Chocolate Milk Cartons (strawless): cost $19.08 for 70 8 oz. bottles
All Metal Knives: $817.68 spent on 1824 knives
All Plastic (non starch) Knives: $954.68 spent on 58,000 knives
Plant Starch Knives: $61.13 spent on 1,000 knives
All Metal Spoons: $316.03 spent on 2,412
All Plastic (non-starch) Spoons: $1,285.22 spent on 66,288 spoons
Plant Starch Spoons: $137.60 spent on 2,000 spoons
All Metal Forks: $412.23 spent on 2,268
All Plastic (non starch) forks: $1,794.71 spent on 81,096 forks
Plant Starch Forks: $149.41 spent on 2,000 forks
ALL Plastic (non-starch) Cutlery wrapped cutlery kits: $2,202.63 spent on 3,672 kits
Plant Starch Cutlery Kits: $71.61 spent on 250 kits
Balsamic Vinaigrette Dressing Packets: $3,981.20 spent on 12,300 packs or 18,450 ounces
Italian Dressing Packets:$4,387.37 spent on 13,860 packs or 20,790 ounces
Caesar Dressing Packets: $4,372.00 spent on 12,360 packs or 18,540 ounces
Ranch Dressing Packets: $9,768.92 spent on 3,516 packs or 5,365.80 ounces
Ranch Buttermilk Dressing Packets: $385.40 spent on 1,200 packs or 1,800 ounces
Raspberry Vinaigrette: $58.41 spent on 180 packs or 270 ounces
Bleu Cheese Dressing: $107.40 spent on 360 packs or 540 ounces
Ketchup Packets: $2,649.73 spent on 109,000 packets or 981,000 grams

Mayonnaise Packets: $1,262.85 spent on 12,630 packets or 5,289.9 ounces
Mustard Packets: $980.53 spent on 29,900 packets or 5,861.37 ounces
Creamer Packets: $3,483.82 spent on 86,400 packs or 30,356.37 ounces
Syrup Packets: $4,165.38 spent on 29,200 packs or 44,740 ounces
Grape Jelly Packets: $314.07 spent on 5,200 packs or 2,600 ounces
BBQ Sauce Packets: $8,262.69 spent on 20,200 packs or 22,335.27 ounces
Honey Packets: $1,087.52 spent on 5,800 packs or 53,700 grams
Peanut Butter: $322.27 spent on 496 packs or 444 grams
Dasani packs of 12, 33.8 oz. each: $411.84 spent on 288 bottles or 9,724.4 ounces
Dasani packs of 24, 12 oz. each: $4,246.80 spent on 9,168 bottles or 110,016 ounces
Dasani packs of 24, 20 oz. each: $463.56 spent on 504 bottles or 10,080 ounces
Smartwater packs of 12, 33.8 oz. each: $1,562.94 spent on 924 bottles or 31,231.2 ounces
Smartwater packs of 24, 23.7 oz. each: $1,207.84 spent on 912 bottles or 21,614.40 ounces
Hot cup Lids: $9,898.70 spent on 88,000 lids
Plastic Film, 18”*3000’ boxes: at least $3,873.93 spent on 80 rolls or 240,000 feet of plastic film
Aluminum foil, 18”*1000’ boxes: cost $133.74 per roll of 1,000 feet

Housekeeping - Estes Park Center

Trash liners for Bathroom trash cans in lodges and cabins: $1,752.09 spent on 1,460 rolls of 50 bags or 73,000 bags
Trash liners for clean linens: $3,880.16 spent on 408 rolls of 25 bags or 10,200 bags
Blue Trash Liners for cabin recycling: $717.86 spent on 170 rolls of 25 bags or 4,250 bags
Individually Wrapped Plastic Cups (9 oz.): $2,103.89 spent on 29,000 cups
Trash liners for kitchens in cabins and bedrooms in lodges: $6,470.27 spent on 2,910 rolls of 25 bags or 72,750 bags
Trash liners in lodge lobbies: $8,495.77 spent on 3,630 rolls of 10 bags or 36,300 bags
Yellow Latex Gloves for cabin kitchens: $131.64 spent on 66 pairs
15*18*6” Blanket Zipper Vinyl Bags: $332.00 spent on 288 bags
15*18*5” Blanket Zipper Vinyl Bags: $4,800.00 spent on 5,760 bags
Vinyl Gloves, Large: $3,107.98 spent on 34,100 gloves
Vinyl Gloves, Medium: $2,198.20 spent on 24,000 gloves
Vinyl Gloves, Small: $59.88 spent on 600 gloves
Vinyl Gloves, XLarge: $256.06 spent on 3,100 gloves
Dial Hand Soap refills: $1,727.87 spent on 35 units of 6 packs of 15 oz. each, or 3,150 ounces

Hand soap yearly totals were gathered but not used as representative because this year Housekeeping used pre-ordered soap on reserves as they could not order soap for much of the year

Buildings & Grounds - Estes Park Center

Blue Trash Bags for Recycling bins: $2,412.28 spent on 2,600 bags
Gray Trash Bags for Trash bins: $11,009.47 spent on 13,300 bags
Firewood: $19,987.20 spent on 7,872 1.0 cubic ft. bundles

Appendix G: Exploring Alternatives to Plastic Use in the Food Service Department

Alternatives to Traditional Plastic Cutlery

Reusable Metal Dishware

The most sustainable option for cutlery in the dining hall would be to use reusable dishware. Since metal cutlery is reusable, it would result in nearly no landfilled waste. The Food and Dining managers prefer to use all reusable dishware when possible since it is the most sustainable option and would save the YMCA money in relation to ordering large amounts of disposable products. However, staffing issues have been the biggest obstacle to maintaining the use of metal cutlery. During the time of our stay at the YMCA, there were only one to three employees running the dishwasher, compared to the six employees that are needed to use the dishwasher during the busiest season. The lack of staff is a primary reason why the Dining Department has turned to single-use items since it can be difficult to keep up with washing high volumes of dishware.

Starch-Based Cutlery

Starch-based cutlery, while not the optimal option, is more environmentally sustainable than traditional plastic, at least in the sense of reducing greenhouse gas emissions and non-renewable energy use (see Appendix C for more information about starch-based plastics). Michael Kingston, the head of Food Service at the Estes Park Center, expressed that he would prefer to purchase Eco-Products starch-base cutlery when possible since the option is both more environmentally friendly and a more sturdy material. Although starch-based cutlery is about 2.5 times more expensive compared to traditional plastic cutlery, price is not an obstacle for this alternative, since cutlery is such a small portion of the Food Service's budget already. The major challenge to maintaining this alternative is that Shamrock Foods, the supplier, often runs out of Eco-Products stock, making it difficult to consistently order those products, especially for the scale at which the YMCA operates. It would be helpful for the YMCA to have several suppliers that are able to provide similar products.

Wooden and Bamboo Cutlery

Another option when washing metal cutlery or starch-based utensils are not feasible would be to use bamboo or wooden disposable cutlery. Bamboo is a more environmentally sustainable option than starch-based plastic since it is made out of completely renewable resources, is biodegradable, and contains no plastic (unlike starch-based plastic, which usually contains some percentage of petroleum-based copolymers).

According to Michael Kingston, the price of bamboo cutlery would not be prohibitive. The plastic cutlery the YMCA uses costs roughly $17 per 1000 for each type of utensil (forks, knives, spoons). Bamboo cutlery would cost between $98 and $116 per 1000, depending on the number of cases bought at a time [1]. The cost differences are summarized in the following table over a whole year. Since this option is so much more expensive than traditional plastic cutlery, it would not be feasible as a primary recommendation. However, it could be used in addition to starch-based or metal cutlery.

One possible drawback of bamboo cutlery is that it may not be as high of quality and could lead to customer dissatisfaction. However, it would be worthwhile to do a trial run of bamboo cutlery to gauge guests' attitudes.

Utensil	Knife	Spoon	Fork	Total
Added cost for utensils (if bought in quantities of 50 cases)	$4,723	$5,312	$6,504	$16,540
Added cost for utensils (if bought in quantities of 10-49 cases)	$5,797	$6,539	$8,004	$20,339

Table 5 - Cost analysis for bamboo cutlery compared to traditional plastic cutlery

Moving the Cutlery Stations

Currently in Aspen dining hall the cutlery is at the beginning of the food line. Since guests do not always know what food they will take, they sometimes take unneeded utensils or return to the front of the line after getting food to pick up cutlery they did not get earlier. These behaviors increase cutlery use and congestion in the dining hall. Moving the cutlery stations to the end of the food line would allow guests to take cutlery once they already know what utensils they need, greatly reducing the number of wasted utensils. This adjustment would not affect the cost, employee workload, or customer experience significantly.

1. Bamboo by EcoChoice 6 1/2" Compostable Bamboo Cutlery from Webstaruant Store

Alternatives to Plastic Coffee Cup Lids

Replacing Plastic Lids with a Reusable Alternative
A possible alternative is to encourage guests to bring their own reusable coffee thermoses which would be filled at the dining hall or the Rustic Cafe. While this could reduce plastic use, it may be difficult for guests who stay in lodges since they would not have access to kitchens to wash their thermos. This would also be less convenient for guests in general since they would need to remember to carry and wash their own thermos.

Replacing Plastic Lids with a Paper Alternative
One option may be to replace plastic coffee lids with paper lids[1]. This option would greatly reduce plastic waste from coffee lids while still providing guests with the same convenience. Paper coffee cup lids would cost less than the currently used plastic lids (about $0.068 per lid), saving nearly $4,000 over the course of a year.

Not Providing Cup Lids in the Dining Hall
Another option may be to entirely discontinue the use of cup lids in the dining hall or only have them available upon request. This may help to greatly reduce if not entirely eliminate plastic cup lid consumption. Not providing lids could be done in conjunction with the paper lid alternative, in which paper lids are available upon request. However, this option has the potential to increase congestion and staff workload in the dining hall, especially during the busier season, since guests would need to ask an employee each time they need a lid.

Alternatives to Plastic Bags

Replacing Plastic Bags with a Reusable Option
One option may be to encourage customers to bring their own reusable grocery bags or tote bags when they come to get take-out meals. This would be the most environmentally friendly option since it would eliminate the need for plastic bags entirely by encouraging guests to use bags that they already have. The major challenge to this would be the decrease in guest convenience since they would need to have their own bags and remember to bring them. If guests were told of the environmental initiative ahead of time they might be more likely to participate knowing that their actions are helping the environment. Customers could also be incentivized to bring their own bags if the YMCA charged for plastic bags, as is commonly done in states where plastic bags are banned. This way, the disposable option is still available to guests, but they are encouraged to participate in the alternative.

1. "White Compostable Sugarcane Hot Cup Lids" from EcoChoice

Replacing Plastic Bags with Paper

Another option may be to provide paper bags instead of plastic. This would cut down on plastic bag use entirely, while still providing customers with equivalent convenience. Paper bags could also be used in combination with encouraging guests to bring their own bags.

Alternatives to Condiment Packets

Dining Hall Style Bulk Condiment Dispensers

One solution would be to have condiments available in refillable bulk-condiment dispensers instead of in packets. The sticking point, however, is the added workload for employees, since that style of condiment dispenser requires considerable maintenance to comply with food safety codes. In order to prevent bacteria growth and fermentation, the condiments would need to be refrigerated every night and the dispensers would need to be emptied, cleaned, and refilled each day. With the current staffing issues at the YMCA, this may be difficult to maintain.

If two dispensers are used for each major condiment (ketchup, mayonnaise, barbeque sauce, and mustard) there will be an upfront cost of $1,270 for eight dispensers[1]. Using 1.5 gallon condiment pouches, these dispensers would save $7,700 per year and eliminate 171,700 condiment packets. Assuming an equal amount of each condiment is used per day of the year, cost savings would be reached in 60 days.

Syrup Dispensers

To replace syrup packets, refillable glass and metal syrup containers could be used along with gallon containers of syrup to refill them. The refillable dispensers are reusable over such a long period of time that their higher environmental impact of production could be offset. The jugs of syrup are plastic, but would each replace 138 plastic syrup packets, thus resulting in a decrease in plastic. Bulk syrup costs $26.49 per case[2] (which includes four gallons of syrup), one-third of the price of syrup packets. Syrup dispensers[3] only cost $8.18, a small upfront cost that would reach cost savings quickly. This would increase employee workload somewhat as employees will need to replace, refill, and clean the syrup dispensers. This has the potential to decrease customer satisfaction since the syrup dispensers could general queues in the dining hall.

1. "Nemco 10950 Asept Black Plastic Countertop Pump Dispenser for 1.5 Gallon / 6 Qt. Pouches", "French's 1.5 Gallon Ketchup Dispensing Pouch with Fitment", "Heinz 1.5 Gallon Yellow Mustard Dispensing Pouch with Fitment", "Heinz 1.5 Gallon BBQ Sauce Dispenser Pouch with Fitment", and "Heinz 1.5 Gallon Mayonnaise Dispenser Pouch with Fitment" from WebstaurantStore

2. "Golden Barrel Pancake and Waffle Syrup 1 Gallon Container" from WebstaurantStore

3. "Tablecraft 1371CP 12 oz. Modern Glass Syrup Dispenser with Chrome Plated ABS Top" from WebstaurantStore

Disposable Condiment Bottles
Another option would be to use disposable condiment bottles, which would still generate some plastic waste. A 14-ounce bottle of ketchup would replace about 45 nine-gram ketchup packets. These bottles would be recyclable, but would likely have to be cleaned first. This would save $157 per year for ketchup. Since these bottles would be disposable, they would not need to be emptied and cleaned every day like the refillable containers. However, some condiments, such as ketchup, require refrigeration, which would require employees to refrigerate the bottles after each service. Taking individual bottles to a refrigerator is easier than removing pouches from condiment dispensers, and no cleaning is required. This means there would likely not be significantly more employee workload than the packets that are currently used unless the bottles are recycled.

Exploring Alternatives to Plastic Milk Bottles

Milk Cartons
One option to replace the plastic milk bottles may be to switch to milk cartons. Milk cartons would cost significantly less than milk bottles ($0.27 per carton compared to about $0.70 per bottle). Over the course of a year, milk cartons could save around $52,100.
One of the main difficulties with this approach is the shelf life of milk cartons. While the milk kept in plastic bottles typically has a shelf life of one month, the cartons have a shelf life of only one week, meaning that if using the cartons, the Dining staff would potentially need to restock the fridges more often. Some milk carton alternatives can have the same shelf life as bottles. However, this option is about twice as expensive and may not be viable because of cost limitations and the large quantities of milk purchased. This option would also not completely eliminate plastic, since each carton comes with a plastic straw.

Food service staff also claimed that milk bottles are more attractive to guests than cartons. This is in part because cartons can be difficult for people to open, while the bottles have caps that are easy to remove.

Figure 44 - Milk Carton with Extended Shelf Life

Milk Dispenser
Aside from switching to milk cartons, another option to replace the plastic bottles would be to implement a milk dispenser that is refilled with milk bags. We learned from Michael Kingston that about 20 years ago the Estes Park Center Aspen Dining Hall did use milk dispensers, which could be refilled using 3 or 5-gallon milk bladders. However, the dining hall stopped the use of these devices because it was difficult for some workers to lift these bags to shoulder height to refill the machines. We found that, at Snow Mountain Ranch, they are able to use milk dispensers by having two people help refill the machine, instead of one.

Purchasing a milk dispenser would cost about $3,200[1]. A milk crate accessory for this machine could be used to more easily change the milk bags in the machine. This accessory would cost $138[2]. While the milk dispenser would be a high upfront cost, buying the milk in bulk for the dispenser would be cheaper than buying the individual milk bottles. We were not able to find exact prices for this cost savings, but we expect the savings would be large, due to the amount of milk that the dining hall typically uses.

Exploring Alternatives to Single-Serving Plastic Creamer Cups

Refillable Coffee Creamer Dispenser
One alternative would be to replace the coffee creamer cups with reusable insulated coffee creamer dispensers[3]. Large creamer cartons[4] would then be bought and used to refill the dispenser each day. Since these dispensers would be insulated, they could be left on the counter, near the sugar, tea, and coffee area. This would be the most environmentally sustainable option since it would completely eliminate plastic waste from coffee creamers. However, this option may add to employee workload, since the dispenser would need to be emptied, cleaned, and refrigerated each day. The customer convenience would only be slightly affected, since this option would require customers to stop and put cream in their coffee, rather than grabbing creamers to use at their table. Creamer cartons are $0.089 per ounce, slightly less than the $0.115 per ounce for creamer cups. With ten creamer dispensers from WebstaurantStore (more than enough to have one dispenser per coffee and tea station in dining halls) this option would take about 120 days for cost savings from creamer to offset the cost of the dispensers, assuming that an equal amount of creamer is used each day. Once cost savings are reached this change would save about $783 per year.

1. "Silver King SKMAJ2/C4 Majestic Double Valve Bulk Milk Dispenser" from TundraFMP
2. Silver King 35904 Milk Crate from WebstaurantStore
3. "Vollrath 46598 Orion 12 oz. Mirror-Finished Stainless Steel Cream with Lid" from WebstaurantStore
4. "1 Qt. Grade A Ultra-Pasteurized Half and Half Creamer- 12/case" from WebstaurantStore

Disposable Bulk Coffee Creamer Cartons

An0ther option to replace single-serving coffee creamer would be to purchase bulk bottles or cartons of coffee creamer. These creamer containers could be left in the refrigerator for customers to take their desired amount of creamer. Cartons are a more sustainable option than packets since they would produce very little to no plastic. This option would also not require extra employee work, since the bottles would not need to be emptied and cleaned each day. It would have a slightly larger effect on customer convenience than the reusable dispenser, since customers would need to stop by the fridge to put creamer in their coffee, also increasing congestion in dining halls. Using the same creamer cartons as above, this option would save $783 per year.

Alternatives to Plastic Food Packaging

Supplier Changes

The best solution for this issue would be for the supplier to change their food packaging practices. If suppliers were able to package the fish and other items in bulk, rather than individually, this would not only reduce plastic waste but also reduce employee labor. Michael Kingston is continuously working with suppliers to try to reduce the amount of plastic they receive from manufacturers.

Making Items In-House

For some pre-made items such as cookies and sandwiches, making these items in-house could avoid some plastic use since the YMCA could package the items in their own materials, like wax paper or foil. The main issue is that this option would create much more work for employees, which may not be feasible considering the staffing limitations of the Dining Department as well as the scale that the YMCA operates.

Additionally, purchasing the materials to sustainably package the products may be too expensive, since wax paper and aluminum foil are both more expensive than simply using plastic wrap.

Exploring Alternatives to Plastic Ice Cream Cups

Soft-Serve Machine
One option which could reduce the plastic use from ice cream cups would be to implement a soft-serve machine in the dining hall. Customers would then be able to self-serve their ice cream in either a cone or a reusable bowl. While this option would be convenient for customers as well as environmentally friendly, it could increase employee workload since workers would need to clean and refill the machine frequently. It would have an upfront cost of just over $22,000[1] but would save money over time. Soft serve ice cream mix would be less than half the cost[2] of ice cream bought in cups and could save the YMCA about $9,000 per year. It would take around two and a half years to offset the cost of the ice cream machine, not including maintenance costs. There is also the concern that an ice cream machine may cause queues in the dining hall, especially in the summertime when they serve the highest volume of people. One consideration that may help this is to place the ice cream machine away from the main food line, which could help the flow of customers through the dining hall (see Appendix D).

Non-Plastic Single-Serving Ice Cream Cups
One potential alternative would be to switch out the plastic ice cream cups with a non-plastic alternative such as paper. This would cut down on plastic use greatly, since the packaging would use very little to no plastic. It would also not add any extra employee workload, since the restocking process would be the same as the currently used cups. However, our team was unable to find a supplier offering ice cream packaged in this way.

Exploring Alternatives to Plastic Wrap on Food Trays

Aluminum Foil
One alternative we considered is aluminum foil. This option would be more environmentally sustainable than plastic, since it would be a recyclable alternative to plastic wrap. However, price is a huge barrier, since aluminum foil is around nine times as expensive as plastic wrap. Additionally, in order for this material to be recycled, it would need to be cleaned and dried first, adding to employee workload. If the aluminum is not recycled, it may actually have a bigger environmental impact, considering the energy-use to harvest metals.

1 "SANISERV 501 Countertop Medium Volume 22 Qt twist soft serve machine" from TundraFMP
2 Carnival King Soft Serve Ice Cream Mix from WebstaurantStore

Reusable Covers
Reusable covers for trays of prepared food would be one option that could dramatically cut down on single use plastic wrap. However, there are several considerations that would need to be taken into account. For instance, reusable covers would require cleaning between every use and require extra storage space, which would be difficult considering both the limited staffing and storage available in the kitchen. The lids may also become warped or brittle over time due to the cyclic heating and cooling, causing them to not properly fit the trays. In order for reusable covers to be a feasible alternative, more research would need to be done into food safety considerations.

Alternatives to Single-Use Plastic Water Bottles

Non-Plastic Water Bottles
Selling water packaged in boxes, such as is offered by 'Just Water' would significantly decrease the amount of plastic used in water bottles. These water bottles have paper sides and sugarcane plastic caps. The Rustic Cafe already sells these, but single-use plastic water bottles in the nearby vending machine are much more visible. Based on our cost analysis, this option would cost about $5,501 more per year. However, the prices we were able to find were based on non-bulk purchases, so we assume that this is an overestimate of cost since bulk prices are typically lower. Michael Kingston has already been attempting to switch to non-plastic water bottles but has been constrained by the contract with Coca-Cola. The contract does not allow for non Coca-Cola branded products to be used in their vending machines, and Coca-Cola does not carry non-plastic water bottles.

Encouraging guests to use refillable water bottles
If guests were to use more reusable water bottles, filling them with tap water or water bottle fillers, the number of plastic water bottles would be reduced. It is difficult to say by how much encouraging guests to refill water bottles would decrease the use of plastic water bottles, but this approach would not require significant expenditure, simply decreasing plastic use and money spent on plastic water bottles. From our observation, some members of our cohort initially purchased single-use plastic water bottles, since they were unaware if the tap water would be safe to drink. If guests could be informed of the quality of water available at the YMCA it may be possible for them to use fewer plastic water bottles.

Appendix H: Exploring Alternatives to Plastic Use in the Housekeeping Department

Alternatives to Individually Plastic-Wrapped Plastic Cups

Paper Cups
Instead of providing individually wrapped plastic cups in lodge rooms housekeeping could provide paper cups.[1]

Paper cups have lower impacts of production and disposal than plastic cups, as they are compostable. They do contain a polymer lining, which contributes to plastic waste, but in much smaller quantities than the cups currently being used. The polymer lining also means these cups cannot be recycled. If they purchase the same amount, the paper cups would cost $1,800; $300 less. However, it should be mentioned that the price of the plastic cups from Western Paper has increased to $87.19 per thousand as of the last order at 3/22/22 from $52.82 on 4/4/2021. The paper cups, on the other hand, would cost $62.23 per thousand from Western Paper. If each price remains constant, and the same amount is bought the YMCA would save about $725 over the course of a year. Hospitality regulations do not require the cups to be wrapped, however, some guests may worry about the cleanliness of the cups if they are not individually covered. Individual plastic wrapping on cups allow employees to quickly know if it has been used. Since the paper cups would not be plastic wrapped, tissue paper squares (10,000 1 inch squares commonly available under $20), can be placed on top of each paper cup when Housekeeping staff places them. This will help determine if a cup is still clean, as the tissue paper will no longer be there if it has been used. These tissue papers would cost less than a cent per cup, a negligible cost over the course of a year.

This change would eliminate 29,000 plastic cups and 29,000 plastic cup wrappers per year. With each plastic cup being 4 inches, stacked on top of each other that amount of cups would be around 1.8 miles.

Ball Aluminum Cups
Instead of providing plastic or paper cups, Ball aluminum cups could be provided in lodge rooms. They are highly reusable and 100% recyclable. However, employees do not have the time to wash them, rendering their reusability useless.

Aluminum cups would not change employee workload. They cost $269.99 for 600 cups, or $0.45 per cup compared to the average of $0.07 per plastic cup, meaning they would be over 6 times more expensive for a direct replacement.

1. "Solo® White Single Sided Poly Paper Hot Cup - 12 oz." from Western Paper

Reducing Amount of Plastic Cups
The amount of plastic cups used by Housekeeping could be significantly reduced by providing fewer in lodge rooms or removing them entirely. If cups are removed, they could be provided on request or placed in lobbies, where there are currently additional cups for guests who want them. Guest surveys show that some guests were not aware of the cups in their rooms at all. For guests that do use them and do not wish to share cups, this may be a more difficult change. This change would not generate additional work for employees.

The volume of plastic reduction from such an initiative is variable based on how many cups are provided to guests and the average pillow count per lodge room. The Housekeeping department estimated the average pillow count per room to be about five. Assuming the latest cost for plastic cups ($87 per 1,000 cups), if one less cup is put in the rooms, 5,800 cups and $360 is saved. If no cups are put in the rooms, then 29,000 cups and $1,800 is saved.

Alternatives to Bin Liners in Lodge Rooms

Remove the Bedroom Trash Bin From Lodges
Removing bedroom trash bin liners from lodge rooms would reduce the amount of bin liners used in the lodges by up to half. There are no environmental downsides to this approach. Such an initiative would reduce employee workload by reducing the amount of bins that need to be emptied. It may be slightly more difficult for guests, but from our observations these trash bins are not used often, so the guest impact would likely be minimal.

The bedrooms use large bin liners, while the bathrooms use small liners. If the bedroom bins are removed, it may be necessary to use large bins and liners in the bathroom. This could save between $970 and $2,265 if using the small bin liners in the bathroom, or $260 and $610 if using the larger bin liners. This range is significant because if a variable number of guests stay in cabins instead of lodges, the benefits of only making changes to the lodges varies. This would also free up significant amounts of trash bins for the YMCA to use in other places. This could reduce between 10,900 and 25,500 bin liners.

Only Putting Bin Liners in One Trash Bin
Bin liners could be removed from the trash bin in the lodge bedrooms, with the bedroom trash bin being designated for non messy waste only. Doing so could reduce the amount of bin liners used while not reducing the amount of waste receptacles available to guests. This has no environmental downsides. We estimate that this could save between $970.54 and $2,264.59 and reduce between 10,913 and 25,463 bin liners. This approach may generate more work in emptying and cleaning the bin if the system is misused. This approach would also require educating guests.

Emptying Trash Bins Without Replacing the Liner
If trash bags are only replaced when there is messy waste inside of them, the amount of trash bags used could be reduced. Bins with non-messy trash could be emptied directly into the large trash bag on the supply cart without replacing the bin liner. This would reduce the number of bin liners used, with no environmental downsides. Emptying trash bins without replacing the liner could add a very small amount of time to employee workloads. This method would not be used when there is a large amount of waste, so there should not be much change in labor. This would not affect consumers, assuming this can be done sanitarily. This would save the YMCA $0.09 per liner not reused. The amount of plastic this approach could reduce is highly variable.

Alternatives to Disposable Gloves

Switching to Reusable Latex Gloves Instead of Vinyl Gloves
By examining and gauging the use of reusable latex gloves at Snow Mountain Ranch, we can conclude that they would also apply well to the Estes Park Center. These gloves are usually used for one to two days before they are replaced. Reusable gloves do require more material to be made, increasing impacts of production, but overall reducing environmental impact when gloves are used multiple times. Each pair cost $1.12 at their most expensive ordered price. The current, disposable gloves, cost $0.17 per pair, thus the reusable gloves would need to be used the equivalent of just over 6.5 uses of the disposable gloves in order to break even. However, we have learned that each team member replaces disposable gloves between 8 and 12 times in one day, showing that the reusable gloves would be a viable alternative with little to no effect on employee work. Switching to reusable gloves could save the YMCA up to $2,162 per year. If reusable gloves are used at the rate required to break even on cost, roughly 25,000 pairs of gloves would be saved each year.

Switching to Single-Use Latex Gloves over Vinyl Gloves but increase costs by nearly $6,000 per year
Latex gloves, which are made from natural materials from rubber trees, have lower environmental impacts of production and disposal than plastic vinyl gloves. However, using disposable gloves is still a large product consumption, which could affect the environment in other ways. There is no change in the reusability, recyclability or compostability of latex gloves compared to vinyl gloves. Single-use latex gloves ordered by the Snow Mountain Ranch from Western Paper are about twice as expensive as the vinyl gloves. If all vinyl gloves at the Estes Park Center were replaced with latex, this would cost $11,457.72, about $5,835.60 more than strictly vinyl. This is a significant price change, which would make fully

switching difficult (with the exception of vinyl for allergies), but cost savings from other alternatives may be able to be used to offset additional cost. This would have no effect on customers, and may be easier for workers as latex gloves are stronger than the vinyl ones.

Alternatives for Bathroom Soap Bottles

3D Printed Caps
Soap refill bottles can be drilled and covered with a 3D printed cap to avoid spilling. Once they have a hole, soap refills can be refilled with bulk soap,[1] saving large amounts of plastic caused by disposing of the smaller bottles. 3D printing caps for these bottles can cause a slight increase in PLA usage, but negligible to the amount saved by not disposing of the bottle. The cost saving of this alternative would be large, allowing the YMCA to purchase bulk soap, which cost $0.049 per ounce, vs the smaller refills, which cost $0.41 per ounce. The cost of the PLA 3D printed caps would cost an estimated $0.10 per cap. We cannot estimate the typical yearly cost savings because of the YMCA's sourcing issues over the last year. However, based on the amount that they did buy last year, this change would save at least $1,145 per year. This alternative would add an increased level of labor, requiring employees to drill each soap bottle as they become empty. This would only happen once for each bottle.

Alternatives to Plastic Bags Used to Store Clean Linens

Altering Tying Method to Reuse Trash Bags
These bags could be reused if they are not torn open to be emptied. If the top of the bag were to be carefully tied into two loops and closed with a carabiner, the bags could be reused. Using a carabiner may not be the most secure closure, so reusable closure techniques should be tried. This would reduce the amount of plastic trash bags used in the laundry department as less bags would have to be ripped open. If a new material such as a carabiner is used, these should be able to be reused over such long periods that their environmental impact would be offset.

This change would save $0.38 per time the bag is reused, and have no effect on guests. It may alter employee workload to develop a new alternate closure system, but little to no change should occur once the system is standardized.

The amount of plastic that could be reduced by this change is dependent on how many times a bag could be reused before breaking with this method. If each bag could be reused just once, this change would save 5,100 trash bags from the landfill and save $1,950 per year.

1. "Bright Solutions® Cherry Apple Hand Soap - Gal." from Western Paper

Alternatives to Laundry Cart Bags

Laundry Cart Covers
Instead of using large plastic bags in laundry carts to protect the linens inside, the laundry cart's top could be protected with a reusable cover. A multi-use cover, either hard or soft shell, would stop the YMCA from needing to use a new single-use bag for each use, greatly reducing the plastic usage. While the covers do need more material and energy for production, the overall environmental effects would be much smaller as they can be used multiple times.

For laundry cart covers, we have identified two possible options. First, hard shell lids[1] cost $205 for purchases of 3 or more. These would be considerably more durable than the single-use plastic bags, while performing the same function to protect the linen and towels from weather. Second, soft shell,[2] stretchy covers would also perform the same function at a lower price. Each cover cost $29 when bought 3 or more, but would last shorter duration, possibly for a few dozen uses.

1. "Lid for Basket Truck - 12 Bushel" from ULine
2. "Cover for Basket Truck - 14 & 16 Bushel" from ULine

Appendix I: Exploring Methods to Increasing the Success Rate of Recycling

Increase Information About How to Properly Recycle that is Readily Available to Guests

To increase the success rate of recycling, we believe the YMCA should create and distribute better materials to educate guests on how to properly dispose of their waste. The sign is located on the recycling dumpsters of what can and cannot be recycled with the YMCA's waste contractor. This signage could act as a starting point for the YMCA to create this educational material. We also have drafted an informational sheet that should be adjusted to YMCA branding and distributed. Putting educational materials regarding what can and cannot be recycled directly by the waste disposal areas in cabins, common areas, and lobbies can provide the information needed to properly dispose of waste. Providing this information where it is most relevant will be most effective. Educational material should also be posted on cabin fridges and provided in orientation packets, a location guests are likely to see the material often. These materials will include what can and cannot be recycled, as well as how to use the recycling system at the YMCA.

There would be added costs to the YMCA to create educational material. Employee labor would be required to place all the educational materials, but should require low amounts of upkeep once set up. Some guests may feel like the educational material clashes with the aesthetic of the cabin room, however the presence of other YMCA fridge magnets in each cabin suggests that this is not usually an issue.

Add a Designated Recycling Bin into Lodges and Cabins

Adding a bin that is designated for recycling in lodges and cabins increases recycling and decreases the amount of landfilled waste. However, in lodge rooms, this alternative would require more work from Housekeeping employees as it would add another bag for recycling that would need to be carried on the supply cart. If customers misuse the recycle bin with messy waste, the bins may have to be cleaned. Employee labor would also be required to place the recycle bins, mark them as recycling, and possibly to replace the blue recycling bags in cabins. The bins that were removed from cabin bedrooms last year should be repurposed into recycling bins, so as not to incur any new costs or plastic production.