

**Assessment of the Status Quo and Post-Ban Solid Waste
Management System at the University of Virginia**

(Technical Paper)

**Determining Equitable Alternatives to Single-Use Plastics for
Historically Marginalized Communities**

(STS Paper)

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

When the SARS-CoV-2 outbreak began in 2020, the waste streams around the world saw significant changes. While the University of Virginia's waste significantly declined when students left, much of the world was inundated with a surge in plastic waste from single-use plastics. An estimated 1.6 million tons of single-use PPE alone has been generated each day since the onset of the outbreak (Nsikak, 2021). This influx of waste threatens to hasten the impacts of climate change and environmental and ecological degradation. However, this damage will not affect all persons equally. Environmental racism is an issue that has existed long before the COVID-19 outbreak, and marginalized communities around the world will continue to be the most severely endangered by the impacts of plastics (Fussstetter, 2021). As we consider solutions to the ever-growing issue of plastic pollution, those that are the most affected must be at the forefront of all solutions.

In modern conversations regarding the growing concern with plastic waste, too much emphasis is placed on the contribution of the individual to the crisis. This narrative does not represent the true reality of plastic waste around the world. Data from the World Bank show that over 242 million tons of plastic were created in 2016 across the globe. Of this plastic waste, only 20 companies produce roughly 55 percent of it and the top 100 companies produce 90 percent (Breslow 2021). With the urgency of climate change and the future of waste management around the world, mitigation of these issues is more pertinent now than ever. With policies being enacted to reduce plastic use around the world (World Bank 2021), my technical project will analyze the efficacy of waste management systems at the University of Virginia and propose successful alternatives to single-use plastics (SUPs) as a statewide ban takes effect. My STS work will analyze alternatives for SUPs that will not worsen the existing environmental conditions and can

be implemented in many places around the world. It will emphasize the importance of developing creative and accessible solutions that will not bar any persons from accessing sustainable alternatives based on their socioeconomic status.

Solid Waste Management System at the University of Virginia

How can the University of Virginia implement an effective waste management system while adhering to its sustainability goals and a statewide single-use plastic ban?

While the sheer volume of plastic waste produced every year is concerning enough to implement change, the lasting impact of this waste on environmental and human health is far more alarming. Unlike many of the detriments of climate change, plastic is not one that has an immediate or simple solution. Once it is in the environment, it is virtually impossible to eliminate it (Parker 2020). According to the Department of Energy, single-use plastics account for the largest portion of all plastics found in landfills in the United States, and they are not easily recyclable. In response to growing concerns over plastic waste and climate change concerns, former Governor Ralph Northam of Virginia signed an order stating that all state agencies were to immediately discontinue the purchase and distribution of single-use plastics and completely phase out their use by 2025. As a public institution of higher education, the University of Virginia must adapt its waste management strategy to comply with this executive order.

In response to the executive order signed earlier this year, UVA has begun enacting changes to eliminate SUPs from grounds. The most significant change thus far to university operations was the modification from take-out containers and plastic cutlery to compostable materials. Although this shift seems like a positive change, it has raised concerns over the

efficacy of UVA's current composting system and inspired questions over how the system should be improved to accommodate the foreseen influx of compostable materials in the waste stream rather than plastic ones. The UVA Sustainability 2020-2030 Plan is another important factor when assessing successful potential alternatives. The University aims to reduce the produced solid waste to 30% of the 2010 tonnage by 2030, while simultaneously striving to make university operations carbon neutral by 2030 and fossil-fuel-free by 2050.

The 2021-2022 "Un-fantastic Plastics" capstone project team consists of seven members committed to addressing these challenges on behalf of the University of Virginia Office of Sustainability and Facilities Management by April 2022. The team members involved in this project are advisors Dr. Lisa Colosi Peterson and Dr. Lindsay Ivey-Burden and University students Madeleine Alwine, Madison Crouch, Taylor Donches, Shannon Hepp, and Geneva Lanzetta (myself). The primary objective of this technical project is to analyze the solid waste management (SWM) system that is currently used at the university and how well it is currently reaching relevant goals, determine potential changes to the system that would improve performance, and complete a comparative analysis of the current system and the proposed alternatives.

To achieve the objectives of the project, the team will work throughout the year to develop a model that analyzes and addresses assumptions about the status quo and future SWM systems. The parameters that we will focus on as the most pertinent to the University's goals are land-filled mass in tonnage, composted mass in tonnage, global warming potential (GWP) in kg CO₂-eq, energy in MJ, and cost in U.S. dollars (USD). The vacation of students from grounds at the start of the pandemic resulted in inconsistent data records of SWM over the past few years, so the team will estimate values for the mentioned parameters using ranges of historical and

projected data. To create a model to represent the status quo (pre-ban), the target parameters will be drawn from 2018 data. The post-ban parameters will be drawn from 2021-2022 data, as the shift to compostables began in July 2021. The model will be optimized in Spring 2022 and the deliverable will be a presentation of viable, alternative waste stream options to UVA Facilities Management.

The technical project will span over the course of two semesters alongside the CE 4990 and CE 4991 courses. In the spring semester, Solid Waste Management (CE 3120) and Microbiology & Biotreatment (CE 4160) will be taken to contribute a wealth of information about the project scope. A waste audit will be conducted in the former class in the spring (COVID-allowing), which will contribute current information that would be relevant in building the post-ban model. The team will meet privately each week and with the project advisors weekly to discuss progress and receive feedback. In the private meetings, the team will work collaboratively to conduct research on the existing or comparative components of the project and develop project models for assessing the efficacy of the status quo and proposed future waste management methods. During the project, the team will meet with Jesse Warren of UVA Sustainability and members of Facilities Management to discuss more detailed aspects of the status quo model and ensure that the project proposal will ultimately align with the goals of the university.

Equitable Alternatives to Single-Use Plastics in Marginalized Communities

How can we develop a system to provide more equitable access to single-use plastic alternatives considering emerging policy changes?

Plastic waste is a significant contributor to climate change and poses a threat that is nearly impossible to eliminate. The growing recognition that the world is on the precipice of a complete climate disaster has inspired policy changes from many known companies and over 60 countries to reduce plastic packaging and other single-use plastic materials (Gray 2018). However, the issue is more complex than simply signing new legislation. Many of the proposed solutions will not only inevitably increase the cost of production and goods but are also not be as environmentally conscious as they seem (Gray 2018). One great objective challenge will be in assessing the benefits and detriments of each potential alternative.

For many companies, the obvious alternatives to SUPs are recyclable plastics, compostable materials, or glass. However, many countries lack the infrastructure and capacity to process the waste that would still be generated (World Bank 2021). Glass may then seem like an attractive solution, but it is not the environmental savior that people believe it to be. Although it can be reused more times than plastics, the weight of the glass alone as a material poses environmental threats, requiring “40% more energy, producing more polluting carbon dioxide [than plastics]..., and increasing transport costs by up to five times per bottle” (Gray 2018). The existing widespread solutions are potentially unsuccessful ones. That being said, the growing market for plastic alternatives has encouraged many new companies to develop products that exist entirely outside the options discussed above. Some of the leading ones are made from naturally occurring materials such as oceanic microorganisms, olive seeds, algae, mushroom roots, seaweed, and recycled plastic; most of which produce plastic-like materials that are biodegradable (Townsend 2020). These designs are innovative and would achieve many waste elimination goals if they were widespread enough, but will not tackle the issue of economic accessibility.

To approach this complex problem, more research needs to be conducted into the feasibility of implementing these alternatives in various communities. In addition to conducting this research, I will analyze the efficacy of meeting the presented conflicting goals of waste management, plastic alternatives, and environmental protection. Specifically, I will compare the benefits and detriments of using standardized alternatives (recyclables, compostables, and glass), the creative solutions, and a simpler solution of using more durable plastics instead of SUPs. The most relevant measurements for the technical portion of this project will be the reduction of land-filled waste, the capacity to recycle or compost alternatives, the feasibility of implementation on a global scale, and the environmental consequences of each proposed solution.

As of today, I expect my STS topic to be loosely coupled with the topic of my technical project. My technical project will focus primarily on composting as an alternative to single-use plastics specifically at the University of Virginia. My STS project will explore how other alternatives can be implemented on a global scale without excluding entire populations from accessing them. Rather than focusing on a single institution or forcing the emphasis on individual choices, the STS project will be an analysis ideally for some companies that have contributed most to plastic waste recently.

Plastic waste is ultimately harmful to both the environment and human health. Yet, environmental degradation has and will continue to most influentially impact people of color and low-income communities (Breslow 2021). Most existing solutions to the crisis of plastic waste threaten to perpetuate this disproportionate attack. The general topic area of my STS research project pertains to the socio-economic and environmental implications that coincide with the shift away from single-use plastics. Specifically, I will focus on how the biggest waste-producing

companies can minimize their plastic waste footprint by implementing solutions accessible to most of the global population. I hope to examine how an equitable alternative to SUPs can be effectively implemented without contributing to further environmental degradation.

Conclusion

The single-use plastic ban in the Commonwealth of Virginia poses a challenge that has prompted a thorough examination of the existing SWM system at the University of Virginia. Through our work, we hope to find the best solution for handling new kinds of waste at the university that aligns with the sustainability goals outlined by UVA Sustainability. Challenges with plastic waste are not a phenomenon exclusive to the university, and they must be addressed with urgency globally. Economic and social disparities only worsen the crisis for marginalized communities, and this must be a consideration as policy changes are enacted. Creating equitable solutions to an already polarizing issue is of utmost importance for moving forward and navigating the world of single-use plastics.

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