



The Expansion of Recycling Within the Pembroke Community

Senior Project

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By

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The Expansion of Recycling within the Pembroke Community

Preface

I first became interested in creating a project revolving around recycling nearly two years ago when I realized that there were no recycling options present at the off-campus apartment complexes in Pembroke, North Carolina. Recycling on the University of North Carolina at Pembroke (UNCP) campus is extremely well established and, while living there, I became very accustomed to recycling with ease.

Unfortunately, outside of campus, there are few recycling options in the town of Pembroke. There is a large bin near the Pembroke Fire Department that has different compartments for various recyclables, and there are a few small bins at the front of the Food Lion for plastics and paper products only. I wanted to gather information about recycling in Pembroke and see if it was possible that recycling efforts could be expanded in the community. One day, it dawned on me how incredibly convenient it was that I had to complete a senior project for the honors college because I would be given the time, motivation, support, and resources I needed to kickstart this project idea that I had become passionate about.

Even though it may feel small-scale, recycling adds up over time. Between August 1st of 2020 and March 25th, 2022, I collected and recycled over 100 lbs. of plastic at my apartment. This was an average of 5.3 lbs., or nearly two 49.2-liter trash bags full of plastic taken each trip. This plastic came from me, my two roommates, and any friends that recycled when they came over. Imagine the amount of plastic that could be diverted from the landfills in Robeson County if the off-campus apartment complexes within Pembroke implemented recycling at their facilities.

The purpose of this honors project is to provide information about the benefits of recycling, the status of recycling and sustainability within Pembroke, the feasibility of expanding recycling efforts, and the proper way to recycle. Ultimately, it will be an evaluation of the value of recycling both as a whole and specific to the Pembroke community.

Introduction

In 2018, the United States produced 292.4 million tons of municipal solid waste (MSW) (EPA, 2021a). Of this tonnage, only 23.6%, or roughly 69 million tons, was recycled. Over 50% of the waste was landfilled and close to 12% was incinerated. The remaining waste was composted or disposed of in other alternative methods. The methods in which our waste is disposed impact the health of people and the environment as carbon dioxide emissions are produced through the transportation and management of waste (EPA, 2020). In addition to this, waste itself produces harmful emissions, such as methane, as it decomposes and when it is incinerated (CSS, 2021). Carbon dioxide and methane are not only unhealthy to breathe, but they also contribute to climate change as they trap heat in the atmosphere (Vasarhelyi, 2021). According to the EPA (2020), the practice of recycling can significantly reduce the amount of MSW that is directed to landfills. This means that recycling lowers the amount of methane and carbon dioxide emissions produced by the generation of MSW.

Recycling also reduces the amount of energy used to extract raw materials since it gives existing materials a longer life and lowers the demand for raw materials. Truelove and Katan (2019) emphasize this in their report by sharing that the carbon dioxide emitted by extracting and producing the natural gas required to produce virgin plastic is

estimated to be between 9.5 and 10.5 million metric tons per year. Natural gas is often collected through fracking - which is an underground drilling process that pollutes groundwater, requires millions of gallons of water, and has damaged at least 600,000 acres of land within the United States (Ridlington et al., 2016). Ultimately, the total amount of habitat lost to and damaged by waste management practices in the United States is incalculable. There are more than 3,000 landfills active in the United States that each average 600 acres of land (Vasarhelyi, 2021). Additionally, the amount of waste produced by humans will inevitably increase as the human population increases (Knickmeyer, 2020). Reductions to the amount of MSW sent to landfills are helpful in decreasing the stress placed on both waste management programs and the environment (Knickmeyer, 2020).

Recycling in North Carolina

In the state of North Carolina, declines in recycling systems have been observed since 2017 (Truelove and Katan, 2019). Between 2015 and 2017, North Carolina lost 15 local government programs for waste reduction and reuse. This is explained mostly by the fact that the U.S. was banned from exporting recyclables overseas in the beginning of 2018. Transporting recyclables over long distances was not fuel-efficient or environmentally friendly, but East Asian countries were a large part of the market for recycled materials. Truelove and Katan (2019) suggested that while this change in market for recycling may explain the declines in recycling, East Asian countries are not to blame for the lack of ability the U.S. has in handling recycling on its own.

In North Carolina, all 100 counties had some sort of recycling program operating or contracted as of the 2020-2021 fiscal year (NC DEQ, 2022a). However, within this

same year, 10 curbside recycling programs within North Carolina were terminated (NC DEQ, 2022b). These programs serviced over 28,000 households and, while residents of North Carolina may still take their recyclables to drop-off collection, curbside recycling programs are the most popular recycling method for North Carolina residents (NC DEQ, 2022a).

To prevent further declines in recycling efforts, it is not only necessary for the state of North Carolina to invest in recycling programs, but also crucial to ensure that there is a market for recycled materials (Truelove and Katan, 2019). Without an end destination for recycled materials, the benefits of recycling vanish. This in turn leads to more virgin materials used, more solid waste ending up in landfills, and more incineration of solid waste.

Status of Sustainability and Recycling in Pembroke

Sustainability refers to the practice of conserving and preserving resources so that future populations may survive (EPA, 2021c). When efficiently done, recycling can enable the human population to be more sustainable as it helps conserve resources as well as the habitats they are gathered from. It is crucial for the human population to remain conscious of its behaviors so that resources are not depleted, habitats are not destroyed, and the balance of ecosystems is preserved.

On the campus of UNCP, there are recycling bins in nearly every building, along the walkways, and even in each individual classroom and dorm on campus. The university has single-stream recycling, which is recycling that does not have to be sorted before collection. This type of recycling practice encourages and increases participation because of its ease (NC DEQ, 2022b). The sorting process for single-stream recycling

happens at the recycling facility which means that every recyclable item can be placed in the same bin. The bin at the Pembroke Fire Department has different openings for different items, but it is ultimately single stream just like the university.

Pembroke Waste Collections picks up all the recyclables on the UNCP campus and within Pembroke weekly (*C. Maynor, personal communication*). In 2021, Pembroke Waste Collections diverted more than 190 tons of recycling from the landfill through recycling. After collection, the recyclables are transported to a recycling facility called Pratt Industries in Fayetteville, NC, where it is sorted and processed (*C. Maynor, personal communication*). According to Pratt Industries (2022), their most received products are cardboard and paper. Most of the processing is done in house, but Pratt Industries does send plastic to Clear Path Recycling Center, which is also in Fayetteville, NC. Any contamination, which is any material that is non-recyclable, is isolated and sent to nearby landfills.

While recycling at UNCP is well-established, it has changed over the years. The university previously had the Office of Energy Management and Sustainability Programs to monitor and promote sustainable practices, but this office is no longer present and functioning on the campus. Student clubs like the Biology Club and the Greener Coalition that would host events such as roadside cleanups, recycling information sessions, and the Recycle Mania Tournament, are no longer active. This lack of activity may be a result of the COVID pandemic, or even a lack of student interest. Regardless, activism for recycling and other sustainable practices is less evident.

There is information online about the Office of Energy Management and Sustainability Programs for recycling, but this information does not accurately reflect the

status of our university since these UNCP websites neglect to mention the closure of the Office of Energy Management and Sustainability Programs.

Additionally, the number of recycling locations on campus has appeared to decline in recent years. According to Resident Advisor, Ashley Arriaga (*personal communication*), there are fewer recycling bins in the residential halls than there have been in the past. In the 2021-2022 academic year, Oak Hall had two 95-gallon recycling bins, when in the past, this residential hall had at least four. At Village Apartments (on campus) there were no recycling bins for the residents living there to access during the 2021-2022 academic year despite bins being present in the past (*Resident H. Clubb, personal communication*).

Outside of campus, recycling options are much more limited. Information about recycling within the town of Pembroke can be found on the town's website (Town of Pembroke, 2022). For residents to recycle, they must drive to one of the two recycling sites in Pembroke. The signage for both locations is limited. There are road signs advertising and pointing to the direction of the Pembroke Fire Department location, but the instructions at this location may be unclear to some users because the signage is faded, missing, or not eye-catching. At the Food Lion, the only recyclable items are paper and plastic, and the bins are not incredibly large. Any obstacles or extra steps that complicate the recycling process reduce the willingness individuals have to participate in recycling programs (Knickmeyer, 2020). Ultimately, having to travel to recycle, or risk arriving at a bin that is full are obstacles that make recycling less accessible.

Despite any setbacks, obstacles, and negative trends, there is room for growth in recycling efforts within Pembroke, NC. According to the president of Pembroke Waste

Collections (*C. Maynor, personal communication*), the company has the capacity to collect more recyclables if individuals, residential areas, or local businesses were to implement their services. This means there is room for the expansion of recycling within the Pembroke community – even if several of the large apartment complexes were to implement their services.

What our Recycled Materials Become

Recycled materials are turned into a variety of products depending on consumer needs and market demand. When individuals have an understanding about what their materials will be used for, they are more likely to recycle (Knickmeyer, 2020). They may also be more likely to purchase products made from recycled materials, which is an essential part of stimulating the market. At Pratt Industries (2022), cardboard and paper are made into packing materials for retail. The polyethylene terephthalate (PET) plastic that is sent to Clear Path Recycling Center is made into recycled polyethylene terephthalate (RPET) plastic flake. Roughly 75% of the flake is used for polyester fibers in carpet, PET resins, and other polyester products. The last 25% of RPET flake is then sold. The metal that arrives at Pratt industries is sold mostly to local buyers. Across the nation, metals like aluminum and steel are often made into common items such as cans, car parts, and nails (EPA, 2021b).

Financial Benefits

In addition to the environmental and human health benefits, there are notable economic benefits attributed to the recycling process (EPA, 2020). In the 2020 Recycling Economic Information (REI) Report produced by the EPA, it was revealed that recycling

created 681,000 jobs, which produced nearly \$38 billion in wages and \$5.5 billion in government tax revenue in 2012 (EPA, 2020).

Knickmeyer (2020) discussed how the cost of recycling services influences the participation in recycling programs. This is important to consider when investing in and establishing recycling programs since the cost of service could potentially be a deterrent for increasing participation.

According to the president of Pembroke Waste Collections (*C. Maynor, personal communication*), the annual collection fee in Pembroke, NC, for an 8-yard container of trash (non-recyclables) is \$2,280. The annual collection fee for an 8-yard container of recyclables is only \$1,200. This is attributed to the fact that Pembroke Waste Collections does not have to pay landfill fees for recycling. Last year, recycling saved them around \$7,800 in landfill fees. This means that an 8-yard container for recycling costs the customer \$90 less per month of service than an 8-yard container for trash. Customers that replace one 8-yard container for the landfill with an 8-yard container for recycling would save over \$1,000 yearly if there was no contamination. While contamination can be prevented, it may be unrealistic to anticipate that there would be none. Regardless, there is opportunity for residential areas with multiple 8-yard containers to reduce their annual fees if they can divert enough recyclables to replace some of their trash containers with recycling containers.

Pembroke Waste Collections does have \$75 contamination fees for 8-yard containers, but they do not currently have contamination fees for their 95-gallon recycling bins (*C. Maynor, personal communication*). Pembroke Waste Collections charges \$27.50 per month to service 95-gallon recycling and trash bins. All of this is

important for customers to consider when implementing recycling services as implementing recycling may alter their total service fees.

Recycling Instructions

To make recycling as efficient and beneficial as possible, it is crucial to do it correctly (Cashwell, 2016). Recycling information can be located on the university's website (UNC Pembroke, 2022b). However, there is an error in the information provided as it includes glass in a list of recyclable items when it should be listed with nonrecyclable items (Pratt Industries, 2022). The university's website should be adjusted to include this updated information to make users aware of all contaminants.

Recyclable items include paper products, cardboard, plastic jars and bottles, aluminum, and steel cans. Some examples of recyclable paper products are junk mail, computer paper, newspapers, and magazines. Recyclable aluminum products include aluminum cans, foil, and pie tins. There are also some specialty bins located around campus dorms in which clothing, shoes, electronics, batteries, compact fluorescent light bulbs, inkjet ink cartridges, and plastic bags can be recycled. When recycling, all items should be cleaned before being placed into bins to prevent any possible contamination.

Accurate and up-to-date recycling information should be made readily available on both the University's and the town's websites. Additionally, it would help to have adequate signage that is clear, eye-catching, and readable on every bin to reduce any confusion about the recycling process (Knickmeyer, 2020). All of this, when paired with recycling education, reduces the amount of contamination present in batches of recycling and will encourage and increase participation.

Contamination

Anything that is not able to be recycled at a facility is considered contamination. Within the town of Pembroke, this includes food and liquids, plastic bags, plastic tubs, plasticware, straws, Styrofoam, and glass. These contaminants inhibit the recycling process and can even damage the machinery used at Pratt Industries (Pratt Industries, 2022). Contaminants often require more transportation, which creates more negative economic and environmental impacts.

Recycling the proper items prevents damage to recycling equipment and reduces the amount of fuel needed to transport recyclables (Cashwell, 2016). This makes the process more efficient and is one of many reasons why educating the public about how to recycle is essential. Each facility may have different capabilities, and people should be informed on how to look up and comply with the rules their local recycling facilities have. To provide the best chance of proper recycling, it is important to provide adequate education about local recycling programs and post clear signage around recycling bins (Cashwell, 2016).

Conclusion

Recycling is beneficial and worthwhile within the Pembroke community. Not only does it give new life to tons of MSW that would otherwise be sent to landfills, but it also reduces the amount of virgin materials and fossil fuels required to meet consumer demands (CSS, 2021; EPA, 2020). Because of this, increasing the amount of recycling in Pembroke would allow the community to become more sustainable.

One major step UNCP can take to increase recycling on campus and demonstrate that sustainability is important to the university would be to prioritize reestablishing the

Office of Energy Management and Sustainability Programs. Through this office, the university could help provide guidance to student organizations such as the Greener Coalition and the Biology club. This assistance would help these organizations thrive again and provide a forum for students passionate about the environment to get involved with sustainability on campus.

Additionally, recycling education should be promoted within the community as well as on UNCP's campus. The students at UNCP and residents of the Pembroke community would benefit from being informed about how to recycle properly, why recycling is an important practice, and where their recycling goes. Each year there is an array of university and town events - such as sporting events, homecomings, and festivals - that could easily share information to increase environmental consciousness about waste management. One great opportunity for UNCP to promote recycling and sustainability is through information sessions that could be held during freshman seminar courses. Any promotional events revolving around sustainable practices like recycling within the town of Pembroke will create more advocacy.

References

- Center for Sustainable Systems (CSS), University of Michigan. (2021). Municipal solid waste factsheet. <https://css.umich.edu/publications/factsheets/material-resources/municipal-solid-waste-factsheet>
- Cashwell, H. (2016). Getting the good stuff. North Carolina Environmental Quality. <https://deq.nc.gov/about/divisions/environmental-assistance-and-customer-service/recycling/data-annual-reports-and-publications/recycling-related-articles-deacs-staff>
- Clear Path Recycling. (2022). Clear path recycling - Products. <http://www.clearpathrecycling.com/products.html>
- Environmental Protection Agency (EPA). (2020). Recycling economic information (REI) report. US EPA. <https://www.epa.gov/smm/recycling-economic-information-rei-report>
- Environmental Protection Agency (EPA). (2021a). National overview: Facts and figures on materials, wastes and recycling. US EPA. <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials#NationalPicture>
- Environmental Protection Agency (EPA). (2021b). Recycling basics. US EPA. <https://www.epa.gov/recycle/recycling-basics>
- Knickmeyer, D. (2020). Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas. *Journal of Cleaner Production*, 245, 118605. <https://doi.org/10.1016/j.jclepro.2019.118605>

NC DEQ. (2022a). Recycling works newsletter spring 2022. North Carolina

Environmental Quality. <https://deq.nc.gov/about/divisions/environmental-assistance-and-customer-service/recycling/programs-offered/recycling-business-assistance-center/news-and-publications/recycling-works-newsletter/recycling-works-newsletter-spring-2022>

NC DEQ. (2022b). Waste management legislative reports. North Carolina Environmental

Quality. <https://deq.nc.gov/about/divisions/waste-management/science-data-and-reports/waste-management-legislative-reports>

Pratt Industries. (2022). [About Pratt – Pratt Industries](#)

Ridlington, E., Norman, K., & Richardson, R. (2016). Fracking by the numbers.

Environment America. <https://environmentamerica.org/reports/ame/fracking-numbers-0>

Town of Pembroke. (2022). Waste pickup. Pembroke.

<https://www.pembroke.com/waste-pickup>

Truelove, A., & Katan, C. (2019). The state of recycling in North Carolina. Environment North Carolina.

https://environmentnorthcarolina.org/sites/environment/files/reports/The%20State%20of%20Recycling%20In%20North%20Carolina%20%28Final%29_4.pdf

UNC Pembroke. (2022a). BIO clubs & societies. The University of North Carolina at

Pembroke. <https://www.uncp.edu/departments/biology/student-resources/bio-clubs-societies>

UNC Pembroke. (2022b). Waste and recycling. The University of North Carolina at

Pembroke. <https://www.uncp.edu/resources/sustainability/operations/waste-and-recycling>

UNCP Serve. (2022). Greener Coalition.

https://serve.uncp.edu/agency/detail/?agency_id=82974

<https://www.facebook.com/greenerco/>

Vasarhelyi, K. (2021). The hidden damage of landfills. Environmental Center.

<https://www.colorado.edu/center/2021/04/15/hidden-damage-landfills#:~:text=The%20average%20landfill%20size%20is,of%20habitat%20have%20been%20lost.>