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A study of general U.S. recycling statistics and their application to the CHS recycling system

1. Introduction

Environmentally conscious disposal of waste has always been a difficult issue. As the global population continues to grow, the question of how to manage our ever-increasing garbage output becomes more and more pressing. While facing this question on a global level, the most effective course of action often proves to be taking local measures to ensure that one's own community is acting as efficiently and resourcefully as possible.

This paper is part of an attempt to take such measures at Community High School. After observing the chaotic contents of recycling bins in our building and a correspondingly chaotic understanding in myself and my peers of how recycling actually works, I felt this project was worth undertaking in the effort to improve the sustainability of CHS. In order to discern the most beneficial course of action moving forward, information beyond just the processes that we see happening in our building is necessary — where does our waste actually end up? How is it handled? What are the positives and the pitfalls of recycling in our larger society, the United States? How should it be done, and how can individuals prepare their recycling as effectively as possible to make future sorting and processing easier? Is it even a good idea to continue investing energy and money into it?

This paper aims to explain and answer these questions with the systems in place at CHS kept in mind. There is only so much we can do; let us carefully consider the decisions that we *can* make when it comes to creating a more resourceful, sustainable world.

2. Overall U.S. recycling statistics and roadblocks

While the annual output of municipal solid waste (MSW) in the U.S. is rising (and therefore so is the output of recyclables), the market value of recyclable materials has plummeted following the loss of major export markets, primarily China with its National Sword policy in 2018. China once was in need of large amounts of recycled material to help feed its manufacturing industries, but was eventually overwhelmed by large amounts of contaminated material that could not be processed into new products and had to be landfilled, much of it ending up floating in the sea off of China's coast. Thus, the National Sword policy was implemented.¹ This was not an outright ban of U.S. recyclables, but rather a reduction of the acceptable contamination rate from around 5% to 0.5%, an "effectively impossible [standard] to achieve," as Tom Outerbridge puts it, the general manager at Sims Municipal Recycling in New York. As such, U.S. recyclables exportation to China dropped a full 99% in the year following the new policy.²

¹ Cho, Renee. "Recycling in the U.S. is Broken. How Do We Fix It?" *Columbia Climate School*. 3/13/2020.

² CNBC. "Why China Stopped Buying U.S. Recycling." *YouTube* video, 14:22. 3/1/2020.

The U.S. continued to export plastic waste (though much less of it) to surrounding countries. When Vietnam, Thailand, and Malaysia also stopped accepting those materials, the U.S. then began exporting to Cambodia, Bangladesh, Ghana, Laos, Ethiopia, Kenya and Senegal. The amount of waste shipped to these countries, which do not generally have robust policies for environmental sustainability, is overwhelmingly pollutive and poses health hazards to the people living there as it builds up with no way to be processed.³

While there are domestic markets for many recyclables in the U.S., it is simply not enough to keep up with the current waste output; The Recycling Partnership states in a 2020 report on the state of curbside recycling that household curbside generation alone creates approximately 37 million tons of recyclable material annually. It also states that the total market value of all single-family curbside materials dropped from \$5.3 billion in March 2017 to \$2.7 billion in November 2019.⁴ However, the U.S. may be adapting to overcome these challenges — a 2020 CNBC report says that the U.S. has invested more than \$4.4 billion in improving, expanding, and re-opening domestic recycling facilities since China's ban.⁵

3. Understanding contamination

Despite the mechanical improvements mentioned previously, another major issue that recycling in the U.S. faces is contamination. Contamination occurs when a specific recyclable material is interspersed with different materials that the facilities built for the primary material are not able to process. This is generally an issue caused by non-recyclable materials placed in recycling bins and sent to these facilities. While sorting the waste does reduce the problem, there is only so much decontamination that can be ensured with the sheer amount of material being processed. According to The Recycling Partnership's study, the estimated national average contamination rate for inbound recycled materials is 17%. This means that in every group of 100 items sent to a recycling plant, about 17 of those items are not actually able to be made into a new product.

The primary cause of contamination is a general lack of education and understanding in the U.S. consumer base concerning which materials are cyclically viable and which are not, as well as how to prepare materials for processing (removing labels, washing off residue, etc.). Between the different guidelines for each municipality and the constant alterations in available information as new standards are released, it is often difficult for people to keep track of which types of waste they can place in the recycling bin. In addition to these factors, manufacturing companies have leaned into the vague notion of all plastic being recyclable — and the idea of recycling being a perfect solution to massive amounts of plastic waste output — in an effort to profit off of the growing sustainability movement by marketing their products as such, an issue that Greenpeace discusses in a 2020 report on the recyclability of plastics in the U.S.⁶

³ Cho, Renee. "Recycling in the U.S. is Broken. How Do We Fix It?" *Columbia Climate School*. 3/13/2020.

⁴ Mouw, Scott. "State of Curbside Recycling Report." *The Recycling Partnership*. 2/13/2020.

⁵ CNBC. "Why China Stopped Buying U.S. Recycling." *YouTube* video, 14:22. 3/1/2020.

⁶ Hocevar, John. "Circular Claims Fall Flat: Comprehensive U.S. Survey of Plastics Recyclability." *Greenpeace Reports*. 2/18/2020.

With this being said, it is important moving forward to establish a clear distinction between materials that should go in one's recycling bin, and those that should not.

3a. What can & cannot be recycled

One of the most widely recognizable aspects of recycling is the numbered plastic system. It is taught that there are seven different kinds of plastic, and while only some of them are acceptable as recycling in most areas, all of them are technically recyclable. The "technically" part is important; indeed, Greenpeace's 2020 report claims that only some #1 and #2 plastic products can be "legitimately labeled as recyclable in the U.S. today". While all types are theoretically able to be melted down and reconstructed into new material, there are very few facilities that are actually equipped to do so, and even when the materials can be processed, there is essentially no market for them, making the entire process a waste of energy and resources. As the report states,

Since a substantial portion of collected plastics are disposed of, incinerated or exported without verification of recycling, acceptance of a plastic item at a MRF alone is not sufficient and "reasonable" assurance to a customer that it will be manufactured into another item, as required by the FTC in 16 CFR 260. Sufficient market demand and domestic recycling/reprocessing capacity must exist for a plastic product to be considered "recyclable." Without market demand and domestic recycling/reprocessing capacity, the plastic material collected by the MRFs will not be bought by manufacturers and will not be recycled into another product.

Since most types of #1 and #2 plastics are accepted by 100% of recycling facilities in the U.S., the report decrees that these materials are safe for households to recycle, as there is "sufficient domestic municipal collection and reprocessing capacity to provide consumers with reasonable assurance that a collected item will be recycled into another product."

#1 plastic is also known as PET or PETE (polyethylene terephthalate) and includes things like water bottles, soda bottles, and peanut butter containers; these containers are the most widely recycled type of plastic in the world. #2 plastic is also known as HDPE (high-density polyethylene) and includes items like milk jugs, shampoo bottles, and five-gallon buckets.⁷

I. Disposing of Plastic

While both of these previously mentioned plastics are generally recyclable, it is important to remove any container lids or labels before recycling; these accessories are normally made of a different type of plastic and can cause contamination and render a bale of plastic unusable in high amounts, as the resin they are made of will react differently than the HDPE when melted down.⁸ Some container lids are made of HDPE or another recyclable plastic, but it is generally best practice to remove and discard them in the garbage as a precaution.

⁷ Hocevar, John. "Circular Claims Fall Flat: Comprehensive U.S. Survey of Plastics Recyclability." *Greenpeace Reports*. 2/18/2020.

⁸ "Why can't all plastics be recycled?" *Warwick Sanitation & Recycling*. Date unknown.

Any item of a plastic type #3-7 should also be discarded in a garbage bin. Unlabeled plastic items, such as plastic bags, straws, and food wrappers, should be discarded the same way. (This includes trash bags. Do not place recyclables in a trash bag when you are sending them in to be processed.)⁹

Styrofoam should always be discarded in the trash. It is a type of expanded polystyrene (EPS) and is technically able to be reprocessed into a new material, but there are not many facilities that can carry out this process, and even when it can be done, there is little market demand for the final product.¹⁰

II. Aluminum & Glass

Aluminum and tin cans are one of the most easily recyclable items in the world,¹¹ and should always be washed and recycled. So should glass jars, bottles, and other containers (on their own, not attached to their lids). Broken glass should never be put in the recycling bin.

It should be noted that the machinery which sorts single-stream recycling occasionally registers flattened aluminum cans as an item in the "flats" category and places it with paper products, causing contamination; as such, cans should not be flattened too thoroughly, if at all.

III. Paper

Mixed paper, cardboard, and cardboard tubes can be recycled,¹² but it must be ensured that there are absolutely no organic stains or residues on the material. Paper towels, tissues, and similar paper products, as well as paper cups and plates, should not be placed in the recycling bin. Shredded paper should likewise be kept out of the recycling; the pieces are too small to be processed and can congest equipment. Cardboard frozen food boxes cannot be processed like normal cardboard, as they contain a plastic that prevents them from being recycled with other paper products.¹³

IV. Other guidelines

Any container — glass, aluminum, cardboard, or plastic — that carries residue or any organic matter should not be recycled before it is completely cleaned.

Scrap metal should not be sent to a facility through curbside recycling (i.e., do not put them in your recycling bin!), and instead should be dropped off at a specialized local site with designated depositories.¹⁴

One of the most dangerous contaminants are what are known as "tangles", i.e. garden hoses, holiday lights, and extension cords. These items can easily get caught in processing equipment and cause major damage to the facility; always place them in the trash.¹⁵

⁹ 2022. Boulder County. "Guidelines Poster: Recycling Contaminants." *Eco-Cycle*.

¹⁰ "Is Styrofoam™ Recyclable?" *The Recycling Partnership*. 5/16/2019.

¹¹ "Aluminum Can Recycling." *Cohen*. Date unknown.

¹² "Single-Stream Recycling Information." *Roanoke, VA*. Date unknown.

¹³ 2022. Boulder County. "Guidelines Poster: Recycling Contaminants." *Eco-Cycle*.

¹⁴ Mullen, Lauren. "Recycling's Most Common Contaminants." *Environmental Center - University of Colorado Boulder*. 4/15/2021.

¹⁵ "Most Common Contaminants." *Recycle Right - WM*. 2022.

4. Recycling at CHS

I. Where our recycling goes

Republic Services is Community High School's building's primary waste contractor, but does not take the building's recycling, only its garbage. The entire building is in possession of two recycling bins (one belonging to the city, the other belonging to us); Valley Curbside Recycling transports their contents primarily to the RDS (Recycling & Disposal Solutions) facility on Korte St., the larger of the two RDS facilities in Roanoke (the other of which is located on Enon Dr.). Their Korte St. location is the only materials recovery facility (MRF) in Southwest Virginia with an automated sorting line and the capability to process glass products.¹⁶

II. Issues concerning recycling at CHS

The primary issue that I and others have observed around recycling in our community is a lack of clear instruction (and therefore a lack of understanding) on which items are suitable for the recycling bin and how items should be prepared for disposal. I have taken weekly records of the contents of several of the bins throughout the school and have found several examples of items (often multiple per bin) that would be considered contaminants upon reaching a recycling plant. For example, an inspection of the bins on April 6 (about a month prior to this being written) shows items such as used paper towels, plastic cups with straws, plastic food wrappers, plastic bags, and plastic takeout containers. Another inspection a week later on April 13 showed similar items. To reduce our contribution to contamination as much as possible, more instruction is necessary.

III. Student survey on recycling

As a part of this project, a survey was conducted to gather information on the general student outlook on recycling at Community High School. The survey asked students about their familiarity with the materials that can be placed in recycling bins, the frequency with which they utilize the bins, whether or not they recycle at home, and if they would appreciate more instruction from the school on how to recycle effectively. 26 students participated anonymously. The results were as follows.

The first question asked how comfortable students were with determining which waste products should and should not be put in recycling bins. Eight students (30.8%) said that they felt very comfortable with it and capable of informing their peers about it. Nine students (34.6%) said that they felt fairly comfortable with it, but would find more information useful. Nine students (34.6%) said that they knew the basic trifecta of plastic, paper, and metal, but would not be able to elaborate if asked.

The second question asked how often students discarded items in the recycling bins. 13 students (50%) said that they use the recycling bins every time they have suitable waste. Nine students (34.6%) said that they use them some of the time that they have suitable waste. One student (3.8%) said that they almost never use them, and three students (11.5%) said that they do not use the recycling bins.

¹⁶ "Roanoke VA Locations." *Recycling & Disposal Solutions*.

The third question asked if students recycle at home. 16 students (61.5%) answered yes. 10 students (38.5%) answered no.

The fourth question asked if students would find it beneficial for CHS to provide more direction on how to recycle in the building. 21 students (81.8%) answered yes. Five students (19.2%) answered no.

In the section for additional comments, there were several requests for clearer labeling on the CHS recycling bins in order to differentiate them from trash cans.

From this survey it can be concluded that, while many students already practice recycling in their everyday lives, there is still a desire for further understanding of the process and how to perform it efficiently, and therefore more education around recycling in our community would be beneficial to our sustainability.

5. Recommended future course of action

Following my research, I have several items to recommend for the school's consideration to improve efficiency and reduce contamination when we recycle.

I. Reducing & reusing before recycling

As an educational establishment, the paper waste output at CHS is significant. Things are often unintentionally misprinted or printed in excess, and printed material used in class is discarded by the end of the semester. Mixed paper (i.e., non-cardboard paper) is the largest category of recyclable municipal solid waste generated in the U.S., making up 39.4% of recyclable household materials generated in 2020, according to The Recycling Partnership. While, of course, it is preferable to recycle this paper rather than send it to a landfill, the most desirable outcome is that the material's lifespan can be extended and it can be reused in place of a new material (another piece of paper, in this instance). While it will still end up being discarded at some point, this practice cuts down significantly on overall waste production.

a. Community scrap paper bin

To reuse more of our waste, I propose that we implement a community scrap paper bin at a high-traffic, easily accessible location within our campus; a classroom would be the least ideal location as students would not be able to access it when class is in session. The scrap paper bin could be a place for teachers to leave misprinted or excess class handouts, and anything else acceptable, given that at least one side of each piece of paper is fully blank. From this pile, teachers and students could then have access to blank paper for their own printing, drawing, and writing purposes without having to use completely new resources.

I acknowledge that a scrap paper depository could get unmanageable in size, and even "contaminated" with paper lacking adequate blank space, and this is why it would be important to have proper labeling of the bin and to perform brief routine inspections of the bin to ensure that it is not becoming too unwieldy or collecting too much "contamination" — the easiest solution in my opinion would be for a student on Trash Club duty to attend to it roughly once a week.

II. Improving and maintaining signage on & around bins

As mentioned earlier, during the survey conducted for this report, multiple students suggested that it would be helpful to have clearer labeling regarding which bins are for recycling. Not only does this require the creation of said labeling in the first place, but also its maintenance; signs are often very liable to being knocked down, and, if not repositioned in time, usually stepped on, crumpled, and discarded. The creation of these signs will be handled within the breadth of this very project; this is written as less an actual recommendation and more a confirmation that these signs will be implemented, and a request to replace a sign if it is missing. (I will make enough copies to have back-ups.)

III. Yearly sustainability orientation

Education of the community on recycling is the largest goal of this project. Announcements made during this semester and posters and signs hung up near recycling bins will be a benefit, but ultimately the ideal method of carrying out this education is to have a yearly briefing at the new student orientation on how recycling should be handled at CHS, so that future students may come to understand the guidelines just as well as present students. The briefing would be ten minutes at most and would cover the basics of which items are acceptable to deposit in a recycling bin and the reasons behind these rules, as well as where our recycling goes and what happens to it after it leaves our campus. I believe that this refresher would greatly assist the confidence of the student body in discerning between recyclable and non-recyclable waste, reduce contamination, and bolster environmental stewardship and awareness.

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