Recycling plastic: The untold story

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The consequences of plastics recycling are far more numerous than are often mentioned. The Colorado State University community focuses on the environmental benefits of recycling and often doesn't discuss its detriments. There are both environmental and human rights consequences stemming from the international recycling trade.

A brief overview of plastics and recycling

What is plastic? It seems almost silly to ask. Plastics have become such an integral part of 21st century life that it is easy to forget they were not always around. But "plastic" is a broader or more complex category than other recyclables such as paper or metal. The Plastics Division of the American Chemistry Council identifies seven general characteristics of plastics: they are resistant to chemicals, can be thermal and electrical insulators, are lightweight and relatively strong, can be processed to make thin fibers and intricate parts, can appear in a wide range of characteristics, and are usually made from petroleum.[1] At a basic level, then, plastics can be understood as versatile materials with limitless possible uses from a non-renewable resource (petroleum). Table 1 lists some of the most common plastics, their individual characteristics, and general uses for each.

Name	Characteristics	Common Uses
Polyethylene terephthalate (PET)	Clear, good gas and moisture barrier, high use temperature	Carbonated beverage and food containers
High density polyethylene (HDPE)	Good moisture barrier properties, high chemical resistance, not a good gas barrier	Milk jugs, non-carbonated beverage bottles, margarine packages, detergent and bleach containers
Polyvinyl chloride (PVC)	Transparent, high chemical resistance, good weatherability, stable electrical properties	Pipes, flooring, cable sheathing, synthetic leather, medical tubing
Low density polyethylene (LDPE)	Tough, flexible, transparent, low melting point, stable electrical properties	Flexible films, lids, and bottles
Polypropylene (PP)	Chemical resistance, high melting point, resistance to water, salt, and acid	Packaging, fabrics, large molded parts for cars, yogurt containers, medicine bottles
Polystyrene (PS)	Versatile, clear, hard, brittle, good thermal insulation	Medical and food packaging, take-out containers

Table 1: Common Plastics[1]

In 2012, it is hard to imagine life without plastic. We, as citizens of developed countries, press the plastic snooze button on our alarm clock, brush our teeth with plastic brushes, eat off plastic plates, drive in cars that have many plastic parts, walk on carpets made of plastics, type on plastic computer keys, sleep in blankets filled with plastic fibers… the list goes on almost infinitely. Consumerism is not the sole driver of plastic goods; plastic is often very functional, even integral, to the way we live.

Plastic has improved lives. It has advanced medicine not only by providing sterile instruments such as IV bags, but also allowing synthetic heart valves, shunts, and other lifesaving devices. Kevlar protects the lives of police and military forces. Fleece, Gore-Tex, and synthetic fiberfill have allowed people to withstand the cold—be it on a walk around town or climbing Mt. Everest. No one can deny that plastic has many respectable applications.

It gets complicated when discussing *disposable* plastic items. There are some plastic products that need to be disposable, like hypodermic needles. But what about a plastic water bottle or product packaging? There are perks to using plastic in disposables: plastics are cheaper to manufacture, lighter-weight, and more resilient. Interestingly, "the energy requirement for the production and manufacture of plastics products is usually around 10-80% of the amount of energy that would be needed to produce comparable products made of glass, paper, or metal."[2] This huge decrease in necessary energy for production is environmentally beneficial. In addition, plastics actually create less waste than other materials:

> Only 33 kg of plastics are needed to package 1 ton of yoghurt in 150 g units, while 573 kg of glass would serve the same purpose. Even at a recycling rate of 7%, 160 kg glass waste is created or, at an illusory reuse of 90%, 57 kg glass would still be created, compared to 33 kg of plastics. This assumes that the used plastics are not recycled at all.[2]

Plastic products can result in less waste than the same product made out of glass.

The tipping floor at the Franklin Street MRF. Photo courtesy of Katie Symons.

Plastic is often superior to other materials both in energy efficiency and reduction of resulting waste. Environmentally speaking, making disposable products out of glass, metal, and paper is often worse than making them out of plastic. But it also makes sense to recycle the plastic we do dispose of in order to keep it out of landfills, protect the environment, and keep production costs down. The significant downside to plastic disposables is that they will not break down in any useful time span. This is why it is important to recycle them; instead of living forever in a landfill, plastics can have secondary uses.

Recycling is a complicated process. First, recyclables need to be collected; this is often reliant on members of a community following through with curbside recycling, or even taking their recyclables to a community drop-off site. Next, the recyclables are driven to Materials Recovery Facilities, or MRFs, which "accept commingled curbside collected recyclables and separate them into their respective material categories."[3] I had the privilege to tour the Waste Management (WM) MRF in October of 2011. The director of communications for the facility prohibited me from taking photographs; she would send some stock photos that they used in promotional materials instead; those pictures are included here.

My tour began outside. My guide, Katie Symons, told me that the plant operates through wind, rain, snow, and blistering heat as we watched a WM truck back onto the tipping floor and dump recyclables onto the huge pile that was already cumulated. As the truck left, a front-loader went back to work pushing more and more of the pile into the facility.

The MRF is a large warehouse. Huge machines churned, connected by belts, stairs, and designated walkways. Everything was covered in dust, and it hung thick in the air. There was movement everywhere—the workers, in bright yellow vests, hard-hats, and other protective gear, moved quickly and efficiently, hundreds of aluminum cans dropped into a holding cage in front of us, and paper rushed down a conveyer belt into a machine that squeezed and strapped it into bales. We made our way to the first set of sorters, people who grabbed non-recyclables from fast-moving conveyer belts. This was the first line of defense to prevent contamination. As we watched, a worker pulled out half of a plastic kid's swimming pool; another extracted a cracked toilet seat; another grabbed handfuls of plastic bags, which can't be recycled at this facility. These items go in trash bins and will be landfilled.

Plastics are separated based on their resin. WM uses an optical sorting device that takes rapid pictures of the plastics on the belt to identify them and then uses bursts of air to push different resins into different compartments. It separates them into #1s and #2s, but lumps #3-#7 together. The separated plastics go into a baler to be pressed and strapped. A machine picks up each bale and takes it back outside, where bales are loaded into train cars. Then, the bales are transported by train to buyers.

After the tour, I was curious for more information. I e-mailed Katie some more specific questions in the hopes that she could ask the people that I wasn't able to talk to during my tour. She sent them along to the director of communications, who instructed her to reply with answers that I found both generic and frustrating. Most importantly, I had asked what I thought was a simple question: "Where does it go?" The answer I received was: "This is proprietary information" and nothing further. These vague answers, although frustrating, provided a base for further research. I was determined to find out where those plastics went. During the tour, Katie said that she thought most of their plastics went to local buyers, since Colorado plastics have no easy access to ports. The bales of separated

Workers sort through paper at the WM MRF. Photo courtesy of Katie Symons.

Bales of HDPE ready for shipping. To the right are bales of PET. Photo courtesy of Katie Symons.

plastics might stay in the region, but they do need to be processed and reclaimed before they are ready to become new products. There is a good chance that at least some of the plastics processed by the Franklin Street WM MRF end up overseas, especially in China.

American and European plastics are shipped to China because their secondary plastics market is strong: "China currently takes up about 70 percent of the world's used plastics."[4] Additionally, because of labor costs, it is "cheaper for the American manufacturers to bale up the discards and ship them to [China] than reprocess the material themselves."[5] Plastic waste from the manufacturing process and municipal plastic waste will, more likely than not, end up being cleaned, reprocessed, and manufactured into a new product in China.

Environmental consequences

Recycling is supposed to reduce pressure on the environment. It supplies materials for industry, thus preventing the overuse of virgin materials such as petroleum. It also reduces the waste put into ever-shrinking landfills. But it has some environmental costs that, although they may not cancel out the need for recycling on the whole, are problematic.

Energy and fuel

It takes an immense amount of energy to operate the heavy machinery, fast-moving belts, lights, ventilation systems, grinders, balers, and other technologies involved in the recycling process. The WM MRF in Denver runs nearly 365 days a year, for 18 hours a day.[6] That's a lot of energy, and their operations are probably powered by coal and other fossil fuels. Thousands of collection and processing plants operate around the country, contributing to greenhouse gas emissions and polluting the regions they are located in.

Additionally, transporting recyclables by truck, train, and ship uses a huge amount of fossil fuels. However, there is one bonus to sending plastic recyclables to China for processing and manufacturing: "ships arrive here packed to the gills with cargo but return with mostly empty holds."[7] Recyclables get a "free ride" back to China, from an environmental standpoint. But once they dock, they still need to be transported across the country by train and truck.

Contamination and litter

Contamination presents another environmental issue. Throwing unacceptable items—such as food waste, plastic bags, or Styrofoam—into a recycling bin results in contamination. According to Sheela Backen, program manager for CSU's Integrated Solid Waste program, the college has to maintain contamination lower than 10% in each outgoing shipment.[8] If recyclables are contaminated, workers have to throw it out.

At the WM MRF, workers send contaminants, such as plastic bags (which clog the machines), down garbage chutes to be landfilled. As a result, the contaminated or non-recyclable materials are shipped to the MRF with the recyclables, taking up space in the truck. Then, they need to be taken to the landfill, necessitating more trucks to transport contaminants from the MRF to the landfill. These contaminants use up more energy than if they had been properly cleaned or thrown into the garbage bin in the first place.

In China, contamination could be dumped into the countryside.[9] Plastic recycling pollutes the environment on both local and global scales. Although recycling may be a better option than landfilling, it is important to ensure that consumers know what can be put into a recycling bin and what can't—and that they follow these rules. Table 2 lists acceptable and unac-

Acceptable Items	Unnacceptable Items
• #1 & #2 narrow-necked containers, caps removed • Any container stamped #1 - #7 (except those listed under unacceptable items) • Wide-mouth containers stamped #1 - #7, snap-on lids okay • Yogurt containers stamped #1 - #7, snap-on lids okay • Clear clamshells stamped #1 - #7 • Rx bottles stamped #1 - #7 • Pails stamped #1 - #7, snap-on lids okay • Flower and garden pots stamped #1 - #7 • #7 Nalgene bottles	• Containers larger than 2.5 gallons • Containers that are not free of food debris • Frozen entree microwave trays • Food trays or party platters, even if stamped with #1 - #7 • Film (e.g. shrink wrap, Saran wrap, etc.) • Plastic bags • Automotive chemical containers, including motor oil and anti-freeze • Pesticide containers • Styrofoam containers • #5, #6, #7 compostable bottles or cups

Table 2: Acceptable vs. Unacceptable Items in Single-Stream Recycling[10]

ceptable items to put in the single-stream recycling bins at Colorado State University.

Human rights consequences

In addition to environmental effects, recycling has negative consequences on human rights. In China, workers are exposed to unsafe conditions for low wages. In a more global sense, developed countries often take advantage of developing ones to get cheaper products.

Workers' safety, health, and rights

Safety standards in countries importing plastic waste are notoriously poor. In many developing countries, "the minimal regulatory framework that exists… for environmental protection and occupational health and safety is not enforced."[11] Consequently, "solid waste workers… are directly exposed to health risk factors."[11] One of the many health risks plastic recyclers abroad face is exposure to carcinogens. Melting PVC releases known carcinogenic fumes. If workers are not wearing protective gear such as masks and gloves, as sometimes happens in developing countries like China, those fumes are directly inhaled, likely causing health problems.[9] In a *60 Minutes* exposé, journalists followed electronic waste from Denver to China, where "women were heating circuit boards over a coal fire, pulling out chips and pouring off the lead solder. Men were using what is literally a medieval acid recipe to extract gold."[12] Although this example pertains to recycling cathode-ray tubes in computer monitors, similarly unsafe working conditions occur in plastic recycling centers.

Furthermore, Chinese plastic workers make only about 200 USD per month, or $6.66 a day. For the same work, American laborers would make $200 a day.[7] According to Toland Lam (owner of a recycling plant in China), "It's not worth that kind of labor to separate [materials]. But in China we can do that."[7] Chinese workers are considerably underpaid compared to their American counterparts.

Another human rights concern surrounding the plastics recycling industry is the weakness (or lack) of child labor laws in developing countries. In China, "small children [go] through bags of shredded plastic for hours, sorting the tiny pieces by color."[9] Overworked children are deprived of their childhoods. The low price of plastic goods made in China result from the poor conditions, underpaid workers, and use of child labor in the country.

The bigger picture

On a larger scale, the international waste trade facilitates exploitation of developing countries by developed ones. Recycling in developed countries is expensive, so they look to export their plastic wastes elsewhere. Developed countries are taking advantage of the loose restrictions of developing countries where it is cheaper to manufacture plastic products because wages are not as high and safety measures are almost non-existent. The few regulations developing countries have in place to protect workers can be bent and broken to suit developed countries' monetary goals. This is an exploitive cycle: developed countries, restricted by domestic safety and workers' rights policies, send their waste plastic overseas where it can be manufactured cheaply. Then, citizens of developed countries buy these manufactured goods back from developing countries at a very low price—a price that is possible because of lax safety standards. Developed countries have been manipulating developing ones for hundreds of years, but in modern times these tendencies are swept under the rug. In the interest of human rights and dignity, the problems inherent in the international recycling trade should be public knowledge—in order to do something about it, people must first know that the problem exists.

Conclusion: What is to be done?

In school, our children are taught the three R's: reduce, reuse, and recycle. My own teachers in years past have stressed the importance of reducing waste first, reusing it if that fails, and recycling as a last resort. But as we grow, citizens of developed countries rely more and more on recycling to stymie their fears about the consequences of their consumption patterns on the environment. Recycling, however, is more complicated and has more negative effects than expected by many consumers. Research on this subject is woefully incomplete. In the future, I hope that more details emerge about the Chinese recycling industry, as well as a more complete picture of the transportation and processing costs of recycling. Perhaps with greater understanding, the problems inherent in recycling processes today can be solved in the future in order to protect both the environment and human rights.

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