WHAT A WASTE!

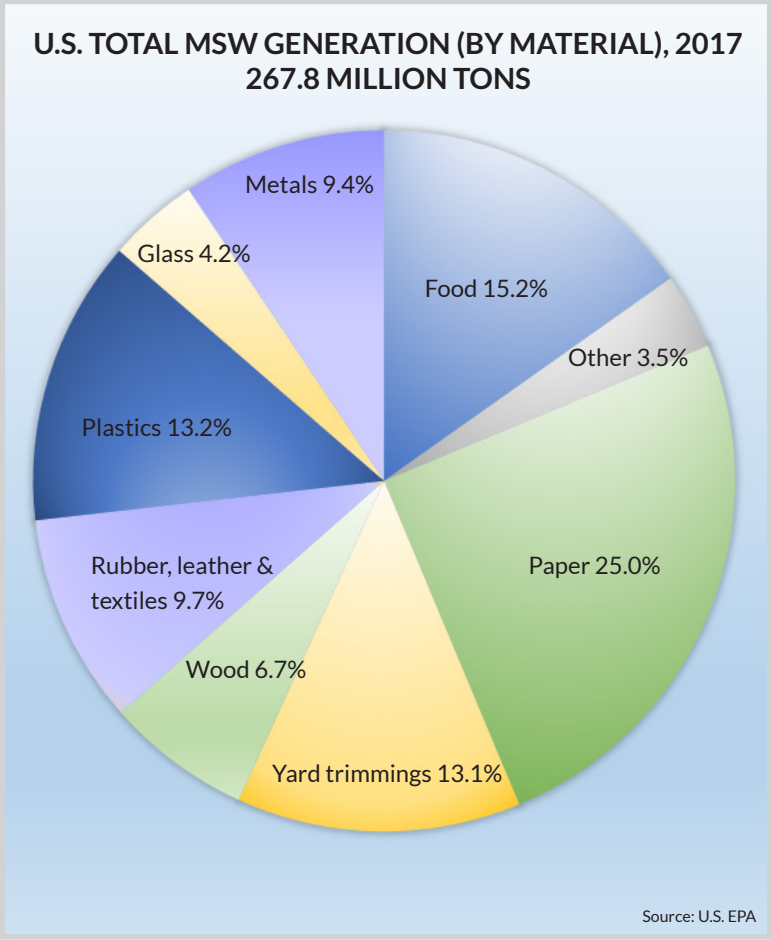
background reading | solid waste unit

EARTH matters
Studies For Our Global Future

As the global population continues to grow by 80+ million people each year, much of it in urban areas, the world must manage an ever-growing amount of **solid waste**. In fact, waste management already comprises the largest portion of most municipalities' budgets around the globe. Since the middle of the last century, we have become an increasingly disposable society, throwing away everything from diapers to food packaging to electronics that are frequently replaced. How discarded items are disposed of is, and will remain, a cornerstone of public health.

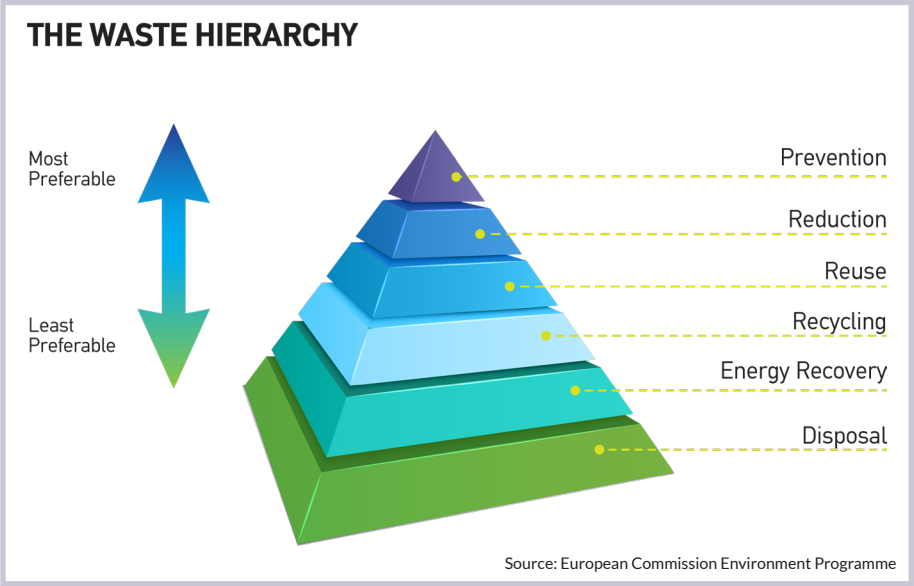
Solid waste generation is on the rise thanks to continued population growth (more people creating waste) but also to rising affluence around the globe (more waste generated per person). In 2016, urban residents generated over 2 billion tons of garbage (2.6 pounds per person).[1] By 2050, urban waste is projected to increase 70 percent, to 3.4 billion tons, due to urban and economic growth.[2] Urban residents produce, on average, twice as much waste per capita as their rural counterparts. As countries urbanize, their economic wealth increases. As standards of living and disposable income rises, so does the consumption of goods, resulting in an increase of waste.

Just as living standards vary across the world, so do the types of waste and disposal challenges. Higher income countries produce the most garbage per person and much of that is made up of paper, plastics and other inorganic materials. Low-income countries have the highest portion of organic waste (food, yard and wood wastes). Most low- and lower middle-income countries dispose of their waste in open dumps, while higher income countries are more apt to use sanitary landfills, incinerators and recycling plants.



The waste management pyramid

Proponents of sustainable waste management promote an integrated approach to dealing with solid waste. It takes the form of an inverted pyramid with the most preferred waste management strategies at the top and the least preferred at the bottom. In this case, the top of the inverted pyramid is source reduction and reuse of materials, followed by recycling and composting. Moving down the hierarchy is energy recovery – creating energy from waste, usually through incineration. Finally, the bottom tip of the pyramid is treatment and disposal, mostly in sanitary landfills.



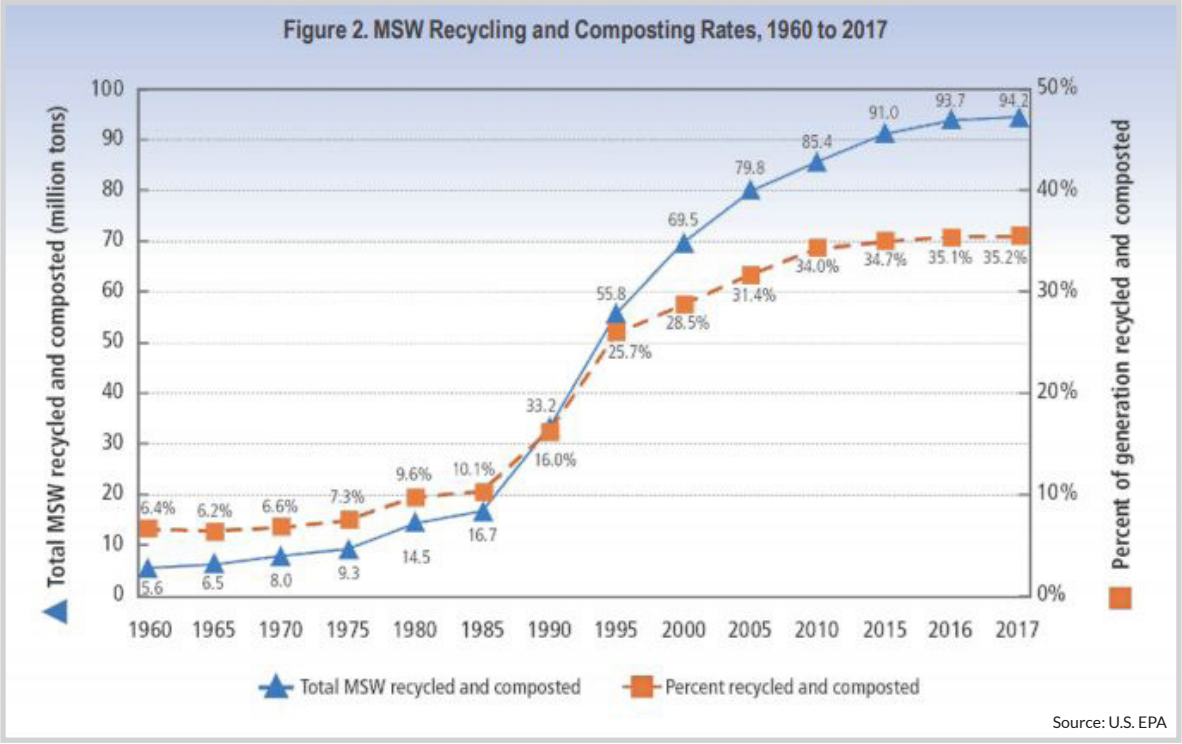
Source reduction (or waste prevention) involves practices that prevent waste from being generated in the first place. On a household level, this can include reusing items, donating items for others to use and buying in bulk to reduce packaging. Industries can redesign products to minimize waste. Aside from reducing waste, source reduction also saves natural resources, conserves energy, reduces pollution and saves money for consumers and businesses.

In managing the more than 2 billion tons of waste that the world's people generate, recycling and composting are the most sustainable strategies. **Recycling** involves sorting and processing recyclable products (e.g. paper, cardboard, glass, plastics and aluminum) into raw materials that can be used to create new products. **Composting** is the decomposition of organic materials, such as food scraps and yard waste, into usable, nutrient-rich fertilizer. Recycling and composting have a number of benefits to the environment. These practices prevent water and air pollution, save energy, supply raw materials to industry, create jobs, conserve resources and reduce the need for landfills and incinerators.

For trash that is not easily recyclable, **energy recovery** (often through combustion) offers a waste management option that reduces the volume of waste and provides energy generation. With energy recovery (sometimes called waste-to-energy), non-recyclable waste is converted into useable heat, electricity or fuel through a variety of processes. Using this energy in place of energy generated by burning fossil fuels reduces carbon dioxide emissions. The resulting ash (representing just 10 percent of the original waste volume) can then be disposed of in landfills but must be treated carefully, as it contains high concentrations of toxic metals such as lead. Despite careful pollution regulations on what **incinerators** release into the air, gaseous emissions frequently include toxic compounds called dioxins, as well as carbon monoxide and sulfur dioxide, all of which can be harmful to humans and the environment.


Photo Credit: zelikosantrac/iStockphoto.com

Waste that can't be recycled or converted to energy would be disposed of in landfills. **Landfills** are holes in the ground consisting of a liner made of clay or plastic to contain the wastes, pipes and pumps to remove water and other liquids that collect in the landfill, and a cover to keep water out and to prevent wastes from spilling over the sides. The pumping system is essential to prevent **leachate** (the liquid mix of rainwater and waste) from contaminating groundwater and surface water. Landfills can also emit hazardous, and sometimes highly flammable, gases such as methane if not built and managed with safeguards in place. Methane from landfills represent 12 percent of total global methane emissions.[3] Over the course of 100 years, methane has 34 times the impact of carbon dioxide.[4]



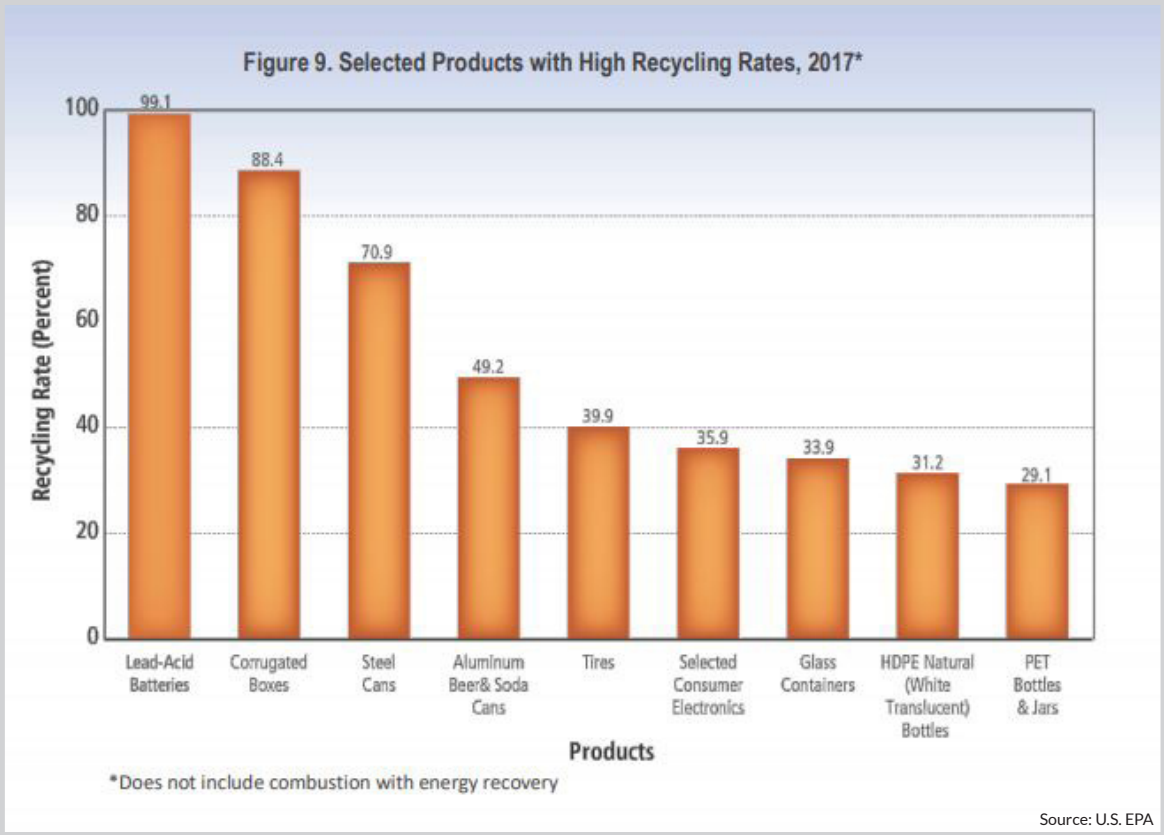
Environmental justice

It is important to note that more often than not, municipal waste incinerators and landfills in the United States are located in or near low-income communities and communities of color.[5] As a result, health issues related to such sites disproportionately affect these communities. Toxins from landfills can and do leak into the local water supply, resulting in cancer, birth defects, and other serious health issues.[6] In the early 1980s, residents in Warren County, North Carolina organized and protested a proposed PCB-contaminated landfill in their community, creating momentum for the modern-day **environmental justice** movement.[7]

According to the EPA, two goals of environmental justice are to ensure people have "the same degree of protection from environmental and health hazards" and "equal access to the decision-making process to have a healthy environment in which to live, learn, and work."[8]

Recycling in the U.S.

In most places, the hierarchy of integrated waste management is more an aspiration than reality. In the United States, more than half of solid waste ends up in landfills. About one-third is recycled and composted, and about one-eighth is incinerated. Out of the 4.5 pounds of garbage each U.S. resident generates, about 1.6 pounds is recycled or composted. Significant amounts of paper and yard trimmings are recovered (over 65 percent of each), but smaller amounts of other waste items are, such as food waste (6 percent), plastics (8 percent) and aluminum (16 percent).[9] Most of those items wind up in landfills. So even while the percentage of waste that is recycled has grown (it was just 10 percent in 1985 and was around 35 percent in 2017), success has been uneven.[10]



The benefits of increased recycling rates can't be overstated. When manufactured products use recycled materials, it reduces the need for virgin materials. This saves energy that would be required to extract and process the virgin materials, which includes the burning of fossil fuels. Every ton of paper recycled can save 322 gallons of gasoline. Recycling one ton of aluminum cans conserves the equivalent energy of 1,024 gallons of gasoline.[11] The materials recycled in 2014 alone, saved 1.1 quadrillion BTUs of energy – the amount consumed by 25 million households in a year.[12] Beyond energy savings, recycling more of our waste would reduce **greenhouse gas** emissions and conserve natural resources that are extracted and harvested at a cost to manufacturers and the environment. Over 40 percent of U.S. greenhouse gas emissions are associated with materials management (extraction or harvest of materials, production and transport of goods, provision of services and disposal). The 94 million tons of waste recycled and composted in 2017 reduced emissions by 184 million tons (equal to the

amount emitted by 39 million cars in one year).[13] Recycling also creates jobs to collect, sort, and process items. The EPA's most recent 2016 report on the economic benefits of recycling showed that in 2007, recycling created over 750,000 jobs and generated over $6 million in tax revenues.[14] At a state level, more recent data amplifies the economic benefits. In California, for every job in recycling, eight jobs are created to manufacture the recovered material into a new product.[15]

So why aren't we recycling and composting more of our waste? Surveys show that most individuals want to be effective recyclers but sometimes lack current information on what can be recycled in their communities, or they don't have convenient access to recycling services. Because recycling is a $200 billion business globally, driven by supply and demand of raw materials in the marketplace, items that are being recycled can change.[16] To be effectively recycled, materials need to be of high quality, meaning that they are not contaminated by other waste. In order to drive up recycling participation, many communities have opted for "single-stream" recycling where all recyclables can go into one bin. While this makes it easier for households, single-stream recycling doubles the contamination rate, so that many items that we think we've recycled have to ultimately be discarded.

In 2018, China banned the imports of dozens of types of solid waste from abroad, including paper and plastics. For decades, China imported the majority of the world's scraps, from plastic shampoo bottles to junk mail. The U.S. is now scrambling to find ways to sort through and process the millions of tons of waste it previously sent to China each year. Some municipalities have started tossing recycling waste into landfills. Others are using advertising campaigns to better educate people about what can and cannot be recycled, in an effort to reduce the work needed to sort through all the waste.[17]

As far as high-income countries go, the United States is in the middle of the pack for recycling rates although the U.S. generates far more waste than it recycles compared to other high-income countries. Germany recycles and composts nearly twice as much (66 percent) of its waste. Other countries that recover more than half of their nations' waste include Wales, Singapore, South Korea, Taiwan, The Netherlands, Austria, and Slovenia.[18]

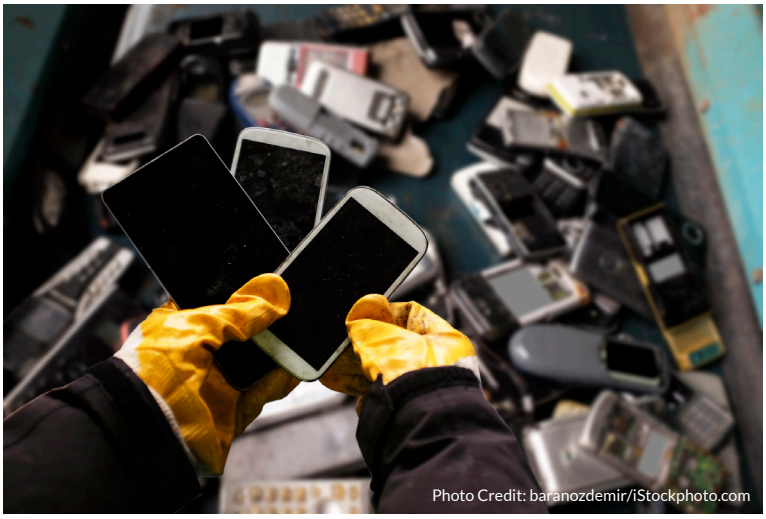


Photo Credit: baranozdemir/iStockphoto.com

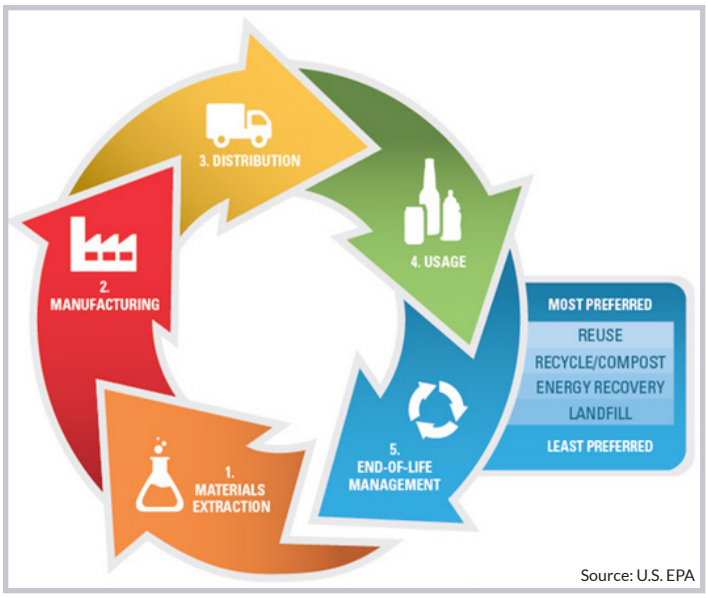
A global problem

Solid waste management is essential for maintaining public health and is one of the **United Nation Sustainable Development Goals (SDGs)**. However, solid waste is also one of the most harmful local pollutants worldwide. Uncollected garbage is typically the leading contributor to local flooding and air and water pollution. Even when garbage is collected, it is usually placed in unsanitary, open dumps. In poorer countries, where waste is dumped in low-lying areas and adjacent to slums, there is the potential for infectious medical and **hazardous waste** to mix with household garbage, contaminating groundwater and surface water supplies. Over 40 percent of the world's garbage is burned, which creates air pollution and countless health issues. For example, about 12 percent of the world's solid waste is plastic. When burned, plastic releases toxic fumes, such as dioxins, that settle on crops, soil, waterways, and then enter our food and bodies. Burning plastic also contributes to black carbon (soot) that fuels climate change.[19]

Per capita waste generation in lower income countries is considerably less than for high-income countries (about one-third of a pound per person per day in Ethiopia, for example, compared to nearly 5 pounds per person per day in the U.S.).[20] But because the world's poorest countries are experiencing the highest population growth rate, there is a lack of infrastructure needed to adequately deal with the growing problem of solid waste. Recycling programs in all but the most developed countries are virtually non-existent.

One of the newest challenges in global waste management is what to do with the burgeoning stream of electronic waste, or **"e-waste**," from discarded cell phones, computers, televisions, and other personal electronics. E-waste contains toxic materials such as lead, mercury, arsenic and chromium, all of which can threaten wildlife and human health. The world economy generated over 53 million tons of e-waste in 2019, and worldwide, only 17.4 percent was formally collected and recycled.[21] Much of the e-waste collected in the U.S. for alleged "recycling" or "reuse" is actually exported to less developed countries for unsafe salvage and metals recovery. Most of these receiving countries lack the capacity to safely recycle and dispose of discarded and used electronics, and as a result, face health risks from leeching chemicals. Discarded electronics also contain many raw metals, such as gold, silver, copper and platinum. In 2019, the value of raw materials from all e-waste had an estimated worth of $57 billion.[22] If all of this material was properly recycled and reused, it could reduce greenhouse gas emissions caused from extracting and processing virgin raw materials from the Earth.

The COVID-19 pandemic has shaken solid waste management practices as the demand for single-use plastic items, from face masks and latex gloves to takeout containers, has increased.[23] Despite this rise, many cities limited or halted their recycling and composting services. New York City suspended curbside compost pick-up until further notice, asking residents to instead discard food scraps with their trash. This means more solid waste ended up in landfills or was incinerated.



Source: U.S. EPA

The future of cutting waste

Landfills, incinerators, and recycling centers are the last stops in the lifecycles of all the products the nearly 8 billion of us use. The first stage starts with resource extraction and harvesting the raw materials – 97 billion metric tons annually – that then get manufactured into an astonishing array of goods. "The lifestyles of people in the richest nations are heavily dependent on resources extracted from poorer countries," the United Nations states.[24] Most of the extracted materials are nonrenewable resources – fossil fuels and minerals. Environmental costs weigh on every stage of this lifecycle of our disposable goods. In the long run, source reduction provides the most environmentally sound way of dealing with our growing solid waste problem. Even as the rate of global population growth declines, our rate of materials use continues to grow, as societies become more affluent. Finding ways to boost economies without producing more waste will be a challenge for individuals and businesses around the globe.

[1] The World Bank. (2019). Solid Waste Management [brief]. Retrieved from https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management

[2] Wahba, S., Kaza, S. & Ionkova, K. (2019, November 12). A new phenomenon – realizing economic growth while cutting waste. HOW? World Bank blog. Retrieved from https://blogs.worldbank.org/sustainablecities/new-phenomenon-realizing-economic-growth-while-cutting-waste-how

[3,4] Project Drawdown (n.d.) Landfill methane capture. Retrieved from https://www.drawdown.org/solutions/landfill-methane-capture

[5] Mohai, P. & Saha, R. (2015). Which came first, people or pollution? Assessing the disparate siting and post-siting demographic change hypotheses of environmental injustice. Environmental Research Letters,10(11). Retrieved from https://scholarworks.umt.edu/environstudies_pubs/7/

[6] Vrijheid, M. (2014). Health effects of residence near hazardous waste landfill sites: A review of epidemiologic literature. Environmental Health Perspectives, 28(1). Retrieved from https://www.epa.gov/sites/production/files/2014-03/documents/health_effects_of_residence_near_hazardous_waste_landfill_sites_3v.pdf

[7] U.S. Department of Energy (n.d.) Environmental justice history. Office of Legacy Management. Retrieved from https://www.energy.gov/lm/services/environmental-justice/environmental-justice-history

[8] U.S. Environmental Protection Agency. (2019). Environmental justice. Retrieved from https://www.epa.gov/environmentaljustice

[9,10] U.S. Environmental Protection Agency. (2017, November). Advancing Sustainable Materials Management: 2017 Fact Sheet. Retrieved from https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management

[11] U.S. Environmental Protection Agency. (2019). Frequent questions on recycling. Retrieved from https://www.epa.gov/recycle/frequent-questions-recycling

[12] U.S. Environmental Protection Agency. (2016, November). Advancing Sustainable Materials Management: 2014 Fact Sheet. Retrieved from https://www.epa.gov/sites/production/files/2016-11/documents/2014_smmfactsheet_508.pdf

[13] U.S. Environmental Protection Agency. (2019). Sustainable Materials Management Basics. Retrieved from https://www.epa.gov/smm/sustainable-materials-management-basics

[14] U.S. Environmental Protection Agency. (2016, October). Advancing Sustainable Materials Management: 2016 Recycling Economic Information (REI) Report. Retrieved from https://www.epa.gov/smm/2016-recycling-economic-information-rei-report-and-methodology

[15] Stanford University (n.d.) Frequently asked questions: benefits of recycling. Retrieved from https://lbre.stanford.edu/pssistanford-recycling/frequently-asked-questions/frequently-asked-questions-benefits-recycling

[16] Hook, L. & Reed, J. (2018, October 25). Why the world's recycling system stopped working. *Financial Times*. Retrieved from https://www.ft.com/content/360e2524-d71a-11e8-a854-33d6f82e62f8

[17] Chaudhuri, S. (2019, December 19). Recycling rethink: What to do with trash now that China won't take it. *The Wall Street Journal*. Retrieved from https://www.wsj.com/articles/recycling-rethink-what-to-do-with-trash-now-china-wont-take-it-11576776536

[18] European Environmental Bureau and Eunomia (2017, March 13). Recycling – Who Really Leads the World? (Issue 2). Retrieved from https://www.eunomia.co.uk/reports-tools/recycling-who-really-leads-the-world-issue-2/

[19] United Nations Environment Program. (2019, May 19). Plastic bag bans can help reduce toxic fumes. Retrieved from https://www.unenvironment.org/news-and-stories/story/plastic-bag-bans-can-help-reduce-toxic-fumes

[20] The World Bank. (2020). What a waste 2.0. A global snapshot of solid waste management to 2050. Retrieved from https://datatopics.worldbank.org/what-a-waste/

[21,22] Forti V., Baldé C.P., Kuehr R., & Bel G. (2020). The global e-waste monitor 2020: quantities, flows and the circular economy potential. Bonn/Geneva/Rotterdam: United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR) – co-hosted SCYCLE Programme, International Telecommunication Union (ITU) & International Solid Waste Association (ISWA).

[23] Meidl, R. (2020, April 14). Pandemic, plastics and the continuing quest for sustainability. *Forbes*. https://www.forbes.com/sites/thebakersinstitute/2020/04/14/pandemic-plastics-and-the-continuing-quest-for-sustainability/#6b6801e377b4

[24] United Nations. (2020). SDG report goal 12. Retrieved from https://unstats.un.org/sdgs/report/2019/goal-12/