Inconvenient Sustainability: The Uphill Battle of Recycling in the U.S.

An STS Research Paper
presented to the faculty of the
School of Engineering and Applied Science
University of Virginia

by

Davis Young

March 14, 2024

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.

Davis Young

STS Advisor: Peter Norton

Inconvenient Sustainability: The Uphill Battle of Recycling in the U.S.

Of the 650 billion pounds of waste America produces each year, only a third is recycled (EPA, 2018). Recycling efforts in the US have significantly improved since the 1970s, when community recycling programs proliferated. Such programs were largely responses for "the massive amounts of waste produced during the second half of the 20th century" (Waste360, 2023). This shift directs sustainable waste disposal advocates toward sustainability damage control.

The public pressure to implement material conservation measures has led to rising tensions within the U.S. In the 1960s, the growing ubiquity of paper waste led critics to warn of a "throwaway culture" (Hinton's Waste, 2018). Recycling is promoted as an environmentally responsible practice, as greenwashing and single-stream recycling have decreased collection costs and increased recycling accessibility (Diffenderfer & Baker, 2011). Single-stream recycling attracts contaminated materials, boosts sorting costs, and impairs the quality of recyclable materials. As more materials are recycled, quality declines. Materials that cannot be recycled further must be diverted to a waste stream (Container Recycling Institute, 2009).

As waste continues to build up on mountains of trash and on the sides of roads, the battle of social implications of waste disposal and lack of waste infrastructure are at odds with one another (Reno, 2015). Advocates of sustainable waste disposal fight for sustainable recycling infrastructure and circular economies, critics seek to cut corners through greenwashing, and both advocates and critics battle on the implementation of reduce, reuse, and recycle.

Review of Research

Marino and Pariso discussed the divergence from the circular economy and the introduction of the linear economic system during the Industrial Revolution, as increased manufacturing input produced waste output on such an unprecedented scale that waste was dumped into landfills. Years of waste buildup reached unsustainable levels, now risking increased health risk exposure, decreased raw material availability, raw material price volatility, and supply and energy disruptions (2016).

The Scientific Applications International Corporation (SAIC) explained that an LCA analyzes the environmental impact of a product over the course of its life, typically from the time raw materials are collected to the time the product is disposed of, commonly known as a Cradle-to-Grave LCA (2006). Hauschild, Rosenbaum, and Olsen focused on the Cradle-to-Cradle LCA technique, which measures the environmental impact of a product from the collection of raw materials all the way back to the reuse of these raw materials for new product creation (2017).

Dahl presented the increased difficulty of a circular economy due to greenwashing, which is the miscommunication of sustainable recycling measures in packaging, advertisements, and legislature. The Federal Trade Commission (FTC) has taken steps forward by releasing the Green Guides, which outlines the illegality of marketing misdirection, but the document still has a lot of loopholes that marketers exploit (2010).

Hernández-Chea, Jain, Bocken, and Gurtoo proposed a business model that intertwines sustainable practices into the traditional business structure. Termed as a sustainability transition, businesses found that integrating green practices and advocating for environmental sustainability improved communication and coordination with businesses in different sectors and yielded increased stakeholder approval (2021). Though some businesses embrace the sustainability

transition, others question its motivations and unselfish nature. Hofmann posited that the circular business model (CBM) will have limited effects due to the structural inadequacies and stubbornness of businesses and society (2019).

Carlson explored how social norms influence people to recycle out of community pressures, financial impacts, and government influence (2001). Abbott, Nandeibam, and O'Shea researched how recycling is impacted by social norms and warm-glow, the personal satisfaction received from an activity independent of its impact, and how these two factors can motivate individuals to recycle more frequently if the quality of recycling facilities is improved. They concluded that social norms had a greater impact than warm-glow, and that the community had a greater influence upon recycling norms than government monitoring and enforcement (2013).

Dempsey and Palilonis discovered that a significant amount of excess and unused material, specifically printer paper, turns into waste. Through a paper collection study, they found that eight percent of pages in a college library were never claimed and left behind as unused waste (2012). Annamdevula, Nudurupati, Pappu, and Sinha delved into the theory of planned behavior (TPB) seeking to explain recycling behavioral intentions among youth, via perceived moral obligation (PMO). They found that though campaigns, social pressure, and that the influence of significant others motivated a higher level of sustainability practices (2023).

Catlin and Wang discussed how recycling is not always the most sustainable option where the "rebound effect" occurs, where reduced costs and improvement in efficiency may yield unintended consequences of causing an increase in customer demand (2013). This research reveals that understanding the setting, people, and many factors at play when considering the most environmentally sustainable recycling measures will best inform and clarify the necessary and unnecessary recycling actions to and to not take.

Recycling Infrastructure and Circular Economies

The increased international emphasis on environmental sustainability has prompted the United States to advance its recycling infrastructure and macroeconomic sustainability system, at a slower pace than many trade associations, including the NWRA, desire. Begum and Ehsan found that the U.S. and other developed nations have started to change from a linear economy: make, use, and dispose; to a circular economy: make, use, and recycle (2020). The U.S. has adopted a recycling system to counter massive waste buildup, focusing on collection, processing, and remanufacturing, in line with the circular economy approach (EPA, 2023). America is still in the infancy of utilizing a circular economy, and is exhibiting the contradictory state of the Circular Value Chain Blind Spot. This blind spot is where the consumer recycling strategies are underrepresented, while the government and businesses take the primary emphasis of recycling enforcement and publicity, depicting the lack of complete circularity of America's recycling economy (Hunger, Arnold & Ulber, 2024). America's recycling system continues to progress slowly, prompting recycling advocates such as the National Waste & Recycling Association (NWRA) to taking action. The NWRA is a trade association that represents waste and recycling companies, manufacturers, and distributers in the U.S. For example, the NWRA applauded the reintroduction of bipartisan legislature that would "improve rural recycling accessibility and data collection for recycling and composting" (NWRA, 2023). The NWRA helps to point out Circular Value Chain Blind Spots, keeping America accountable for its recycling approaches.

As the U.S. government continues to adjust and improve recycling legislature and reform, advocacy groups, such as the Container Recycling Institute (CRI), are seeking further productive legislative change. In April 2023, two bills were introduced to the Senate to provide grants for the U.S. Environmental Protection Agency (EPA) to distribute to local communities for

improved recycling services and for recycling research. Senator Tom Carper stated, “With a national recycling rate of little more than 30 percent, it’s clear we can and must do better” (Quinn, 2023a). In September 2023, the EPA put this money to use as they allocated $105 million in Solid Waste Infrastructure for Recycling (SWIFR) grants which the EPA boasts as the “largest recycling investment in 30 years” (Quinn, 2023b). Senator Chuck Grassley discovered “obvious abuse of taxpayer dollars and faulty EPA oversight” through EPA grant allocation, bringing further questions to the surface on the true motives and qualifications of the EPA’s approach to the recycling crisis (Grassley, 2024). CRI is an advocacy group stepping up to the EPA, lobbying support for recycling legislature and leading recycling education across America, including “recycling deserts in the state” of California and the need for recycling accessibility (Pyzyk & Rosengren, 2020). The CRI and other advocacy groups are pleased that legislation is being passed, but ongoing frustration persists in the incapability of the U.S. government to appropriately create the recycling change needed.

By claiming to pursue a Cradle-to-Cradle business model, and by implementing practices that give the claim some credibility, Patagonia has bolstered its reputation among its customer base, where environmental values are important. Implementing sustainable recycling measures into business structures promotes business growth and sustainability advocacy. The transition framework proposed by Loorbach and Wijsman described how the initial societal sustainability push influences businesses to engage in sustainability transitions, which yield competitive market advantages (2013). Patagonia seized this sustainability transition concept through the efforts they put forth to achieve a circular economy design through their Common Threads Recycling Program. As they wrestled with creating a Cradle-to-Cradle circular business model, they found that “in a circular economy, it’s about generating more money from the same products

and leaning into materials like recycled wool that are actually cheaper than their virgin counterparts" (Patagonia, 2021). However, even Patagonia has fallen short of their desired goals, calling itself out at COP26, the United Nations Climate Change Conference, by no longer calling itself a "sustainable brand," as they recognized that they are "part of the problem" (Thoren, 2021).

Greenwashing

The increased pressure to display environmentally friendly recycling principles has led many large companies to partner with TerraCycle, a recycling company who has been accused of greenwashing. TerraCycle, founded in 2002, has partnered with Coca-Cola, PepsiCo, Nestlé, Subaru, and many other large corporations, and claims to recycle many hard-to-recycle products (Owens, 2022). Subaru, an automobile manufacturer, partnered with TerraCycle starting in 2018 providing customers "opportunities to recycle with their local, participating Subaru retailer" (Subaru of America, Inc., 2023). Only a year after celebrating a five-year partnership between Subaru and TerraCycle, the partnership abruptly came to a close with one month notice per an email sent by TerraCycle to its subscribers (TerraCycle, personal communication, February 29, 2024). This comes in the wake of increased scrutiny of accused greenwashing of TerraCycle led by Changing Markets Foundation, a nonprofit foundation aimed at accelerating sustainability via market changes, who conducted an investigation revealing "a litany of misleading and mendacious claims from names consumers should be able to trust" through mislabeled packaging claiming to be recyclable when it is not (2022).

Community-based businesses and labor unions, through direct interaction with residents, hold significant influence over local recycling habits and norms, shaping them both positively and negatively. Waste Management (WM) consistently picks local communities' trash and

recycling as a waste management, comprehensive waste, and environmental services company. In 2023, they unveiled a new $30 million recycling facility in Ohio as they seek to “drive circularity and help give materials a second life” as part of their commitment to spend over $1 billion in recycling infrastructure by 2026 (WM, 2023). However, using ‘bait-and-switch’ greenwashing, where a company heavily emphasizes environmental sustainability attributes, yet covers up unsustainable or unethical practices, WM promoted their anti-greenwashing campaign, “For Tomorrow,” while covering up accusations of racial discrimination (Mullis & Finley-Brook, 2022). The International Brotherhood of Teamsters, known as the Teamsters, is standing up to this kind of treatment in the recycling industry. The Teamsters is a diverse labor union representing a large number of industries, including the Solid Waste and Recycling Division. The Teamsters signed a contract at Ridwell, a recycling startup in Seattle, increasing wages, improving work conditions, and providing paid time off. Though Ridwell is a small company now, the Teamsters highlight that they will “employ hundreds, if not thousands, of workers in the industry” and by signing this contract, Ridwell and the Teamsters set a healthy work culture precedent in the continual push for recycling sustainability (IBT, 2023). A healthy work culture promotes the real recycling change that happens in local communities and through social norms.

Verra implemented a plastic credits system for companies to offset their environmental impact, but some see this as another way to defer recycling accountability attributed to plastic waste. Zhang, Liu, and Medda proposed a smart-contract-aided plastic credit scheme, in which stakeholders will recycle the same amount of plastic produced according to a recycling index (RI). This index will approximate the plastic equivalent of recycled plastic and the authors propose that this design will foster a community aiming toward higher plastic recyclability without rigid industry standards (2023). Verra, a nonprofit that operates standards in

environmental and social markets, began the plastic credit standardization process in 2022 setting "out detailed procedures for quantifying the plastic waste collected and/or recycled as the result of a project activity and provide guidance to help project developers determine project boundaries, set baselines and assess additionality," finding great success in adding many stakeholders as part of their program, including the World Bank, Nestlé, and World Wildlife Fund (WWF) (Verra, 2024). The plastic credit system is in association of the Plastic Waste Production Standard (Plastic Standard), in which Nestlé Waters, a bottled water company, stated that the "Plastic Standard will help improve transparency on impact measurement and reporting" (Verra, 2021). #BreakFreeFromPlastic (BFFP) ardently disagrees. BFFP is an advocacy group uniting more than 12,000 organizations and individuals promoting reductions in single-use plastics. They found through their research that "by setting up plastic offsetting schemes, companies greenwash their image and avoid making real, substantive changes in the amount of single-use plastic they use." Nestlé, who has been collecting plastic from Brazil, has no accountability and verification process of plastic offsets, putting much scrutiny on Verra (BFFP, 2023). Verra's plastic credit scheme turned from promoting positive recycling change to a greenwashing scheme covering corporations' unrecycled plastic problems.

Reduce, Reuse, Recycle . . . and Landfill

As waste accumulation skyrockets in America, Nestlé and other major corporations that rely on plastic packaging, often unrecyclable, are receiving dissent from younger environmentally conscious Americans seeking plastic reduction. Reduce, reuse, and recycle have echoed through America since the 1970s, with recycling getting most of the spotlight, but the reduction of the immense waste produced contains a more sustainable path to environmental conservation reducing recycling needs (Wilcox, 2022). John Caturano of Nestlé felt that the

pressure on how plastic has become “socially not very acceptable to the young folks, which scares me” (Joyce, 2019). Nestlé is highly dependent on plastic as a vessel, so the concept of reducing, or even eliminating the material is a heavy blow. Nestlé has committed to pursuing “recycling options where feasible,” in order to make 100% of the packaging recyclable or reusable by 2025 (Nestlé, 2019), but switched its 2025 goal to 95% in 2022 (Nestlé, 2023). Greenpeace, a nonprofit made up of independent campaigning organizations mainly focused on sustainability, stated that “corporations like Coca-Cola, PepsiCo, Nestlé, and Unilever have worked with industry front groups to promote plastic recycling as the solution to plastic waste for decades. But the data is clear: practically speaking, most plastic is just not recyclable. The real solution is to switch to systems of reuse and refill (Greenpeace, 2022).” The face of Nestlé is designed to look environmentally sustainable, but behind the scenes, the expectations for plastic reduction proves a significant challenge.

Stryker utilizes hospital waste to implement reuse strategies for medical devices to have a longer life. The lack of item reuse despite years left of utility boils down to laziness. People prefer to do something else, and determine that their time is not most aptly spent on cleaning a slightly dirty pasta sauce jar or fixing a wobbly table leg (Hubbe, 2023). The hospital amplifies this concept because it is one of the last locations in America that has lower recycling sustainability requirements due to the priority of human life. Physicians revealed that the UVA Health “pediatric surgery division performs approximately 1,100 surgeries per year” resulting in “almost $50,000 in waste of SUSSS [single-use, sterile surgical supplies] each year.” Surgical instruments and supplies are provided for physicians performing surgeries at the beginning of the day in a preset package. The unused items removed from the package are deemed no longer sterile and are thrown away at the end of the day, without ever being used (Meyer et al., 2022).

Stryker, a medical device reprocessing company, has seized the opportunity to reuse medical devices thrown away after one or zero uses. Stryker collects these disposed of medical devices, sterilizes them to medical standards, and replaces any broken or suboptimal medical device parts, creating devices that can be used again in hospitals. This practice "not only reduces healthcare costs but, also minimizes the environmental impact associated with the production and disposal of single-use devices," providing an innovative solution to reuse in a health care setting (Stryker, 2024).

Elementary school students in Illinois and California are part of a hands-on and creative recycling education planning for a greener and more sustainable future. A study conducted by Williams explained how "young generations of today will be the ones who in the future inherit the environmental problems that have been created," emphasizing how these students will be the ones with the potential to enact recycling change. Williams found that the recycling education in Fox Creek Elementary School in McLean County, Illinois positively impacts students' recycling "knowledge, behaviors, and attitudes" (2011). Teachers at Almaden County Day School in California implemented Project Based Learning (PBL) and the engineering design process into their recycling curriculum, which included hands-on designing, building, and presenting of their projects. Kitagawa, Pombo, and Davis found that the students began turning "STEM knowledge into action, plastic pollution into a solution, and negative human impact into a positive" (2018). As crucial as this recycling education is, "recycling is a service that competes - and unsurprisingly often loses - for local funding that is also needed for schools," says professor Kersten-Johnston at Columbia University. For decades, the U.S. shipped much of its plastic to China to be recycled, but in 2018, China refused to receive any more plastic, upending the U.S. recycling industry, and recycling education funding (Cho, 2020). The lingering disorder from

China's 2018 ban may have a much longer lasting impact than a short-term recycling solution inhibiting young Americans' education on the recycling crisis.

The landfill is the unspoken word hidden under the reduce, reuse, recycle motto, yet continues to increase in size, quantity, and hazardous environmental impact. America generates an estimated 292.4 million tons of waste per year, half of which goes to landfills (EPA, 2018). Though the government and private contractors attempt to hide landfills away from sight, local communities, such as in Bristol, Virginia, are experiencing drafts of "noxious and toxic fumes, including hydrogen sulfide, volatile organic compounds, and other gases," causing babies to "[wake] up all [through] the night coughing and gagging," and a U.S. Army Veteran to wear "a gas mask to sleep" (Wade, 2021). As materials placed in the landfill begin to decompose over longer periods of time, the waste emits toxic gases, primarily methane. Richburg proposed harnessing these gases through a method of landfill gas capture (LFG), capturing the escaping gases and converting them into renewable energy (2023). Waste Connections, the fourth largest waste management company in the world, implemented LFG through their Landfill Methane Outreach Program (LMOP) at Front Range Landfill in Colorado and LRI Landfill in Washington, "seeking to harvest landfill gas for renewal natural gas and electricity" (Waste Connections, 2020). In Colorado, Waste Connections has partnered with Aria Energy, one of the largest energy companies in the LFG sector, and United Power, a smaller rural electric cooperative, both "providing reliable – low cost – renewable energy to the citizens of Erie and Colorado," in the words of Richard DiGia, President of Aria Energy (Waste Connections, 2011). Waste, often seen as an environmental nuisance to society, provides the potential to transform the recycling industry into a lasting positive environmental impact.

Conclusion

Recycling has evolved from simply placing a plastic water bottle into a recycling bin. The specific plastic of the water bottle, the accessibility to a recycling facility, and the final destination of the plastic are only a few factors that surround a single piece of potentially recyclable material. Recycling advocates realize that there is no one size fits all solution and that local communities, advocacy groups, and large governments all have a unique, yet critical part to play in implementing a lasting sustainable recycling infrastructure that is devoid of deceptive greenwashing. Reduce, reuse, and recycle help to encourage people to think in environmentally sustainable ways, yet no one factor is effective in isolation. Further data is needed on the integration of recycling habits across a multitude of industries, hobbies, and governments to motivate and reassure that the plastic water bottle placed in a recycling bin will actually be recycled.

References

Abbott, A., Nandeibam, S., and O'Shea L. (2013, Jun.). Recycling: Social norms and warm-glow revisited. *Ecological Economics 90*, 10-18. Web of Science.

Annamdevula, S., Nudurupati, S., Pappu, R., and Sinha, R. (2023, Feb. 28). Moral obligation for recycling among youth: extended models of the theory of planned behaviour. *Young Consumers 24*, 165-183. Web of Science.

Begum, R.A., and Ehsan, S. (2020, Dec. 17). Economics of Waste Minimization, Recycling, and Disposal. *Oxford Research Encyclopedia of Environmental Science*.

BFFP (2023, Nov. 16). #BreakFreeFromPlastic. New Report on Plastic Credit Schemes Reveals Industry 'Smoke and Mirrors' In The Fight Against Plastic Pollution (press release). https://www.breakfreefromplastic.org/2023/11/16/press-release-smoke-and-mirrors/

Carlson, A.E. (2001). Recycling Norms. *California Law Review 89*, 1231-1300. JSTOR.

Catlin, J., and Wang, Y. (2013, Jan.). Recycling gone bad: When the option to recycle increases resource consumption. *Journal of Consumer Psychology 23*, 122-127. JSTOR.

Changing Markets Foundation (2022, June 30). Brands exposed for 'misleading and mendacious' packaging claims (press release). https://changingmarkets.org/wp-content/uploads/2022/06/Greenwash.com-packaging-press-release.pdf

Cho, R. (2020, Mar. 13). Recycling in the U.S. Is Broken. How Do We Fix It? *Columbia Climate School*. https://news.climate.columbia.edu/2020/03/13/fix-recycling-america/

CRI (2009, Dec.). Container Recycling Institute. Understanding economic and environmental impacts of single-stream collection systems. https://www.container-recycling.org/assets/pdfs/reports/2009-SingleStream.pdf

Dahl, R. (2010). Greenwashing: Do You Know What You're Buying? *Environmental Health Perspectives*, 246-252. JSTOR.

Dempsey, M., and Palilonis, A. (2012). Reuse, recycle … reduce: a greener library with print management. *Library Hi Tech 30*, 408-417. ProQuest.

Diffenderer, M., and Baker, K. (2011). Greenwashing: What Your Client Should Know to Avoid Costly Litigation and Consumer Backlash. *Natural Resources & Environment 25*, 21-25. JSTOR.

EPA (2018). United States Environmental Protection Agency. National Overview: Facts and Figures on Materials, Wastes and Recycling (case study). www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials#:~:text=Of%20the%20MSW%20generated%2C%20approximately,percent%20recycling%20and%20composting%20rate

EPA (2023). United States Environmental Protection Agency. The U.S. Recycling System. https://www.epa.gov/circulareconomy/us-recycling-system#:~:text=U.S.%20Recycling%20System%20Overview,-Learn%20More&text=Collection%3A%20Recyclable%20materials%20are%20generated,recovery%20facility%20or%20paper%20processor.

Grassley, C. (2024, Feb. 22). Grassley Report Exposes Unchecked Waste Of Taxpayer Funds In EPA Environmental Justice Program (press release). https://www.grassley.senate.gov/news/news-releases/grassley-report-exposes-unchecked-waste-of-taxpayer-funds-in-epa-environmental-justice-program

Greenpeace (2022, Oct. 24). Plastic Recycling Is A Dead-End Street—Year After Year, Plastic Recycling Declines Even as Plastic Waste Increases. https://www.greenpeace.org/usa/news/new-greenpeace-report-plastic-recycling-is-a-dead-end-street-year-after-year-plastic-recycling-declines-even-as-plastic-waste-increases/#:~:text=Plastic%20recycling%20was%20estimated%20to,it%20was%20burned%20or%20dumped.

Hauschild, M., Rosenbaum, R., and Olsen, S. (2017, Sep. 2). *Life Cycle Assessment: Theory and Practice*, 605. Springer.

Hernández-Chea, R., Jain, A., Bocken, N., and Gurtoo, A. (2021, May 21). The Business Model in Sustainability Transitions: A Conceptualization. *Sustainability 13*. Web of Science.

Hinton's Waste (2018, Nov. 13). History of Recycling [Timeline]. https://hintonswaste.co.uk/news/history-of-recycling-timeline

Hofmann, F. (2019, July 1). Circular business models: Business approach as driver or obstructer of sustainability transitions? *Journal of Cleaner Production 224*, 361-374. ProQuest.

Hubbe, M. (2023, Nov.). Reuse, a neglected "R" word in "Reduce, Reuse, and Recycle. *BioResources 18*, 6737-6740. ProQuest.

Hunger, T., Arnold, M., and Ulber, M. (2024, Feb. 10). Circular value chain blind spot – A scoping review of the 9R framework in consumption. *Journal of Cleaner Production. 440*. https://www.sciencedirect.com/science/article/pii/S0959652624003007

IBT (2023, July 11). International Brotherhood of Teamsters. Teamsters Ratify First Contract at Ridwell (press release). https://teamster.org/2023/07/teamsters-ratify-first-contract-at-ridwell/

Joyce, C. (2019, Aug. 20). U.S. Recycling Industry Is Struggling to Figure Out a Future Without China. *NPR*. https://www.npr.org/2019/08/20/750864036/u-s-recycling-industry-is-struggling-to-figure-out-a-future-without-china

Kitagawa, L., Pombo, E., and Davis, T. (2018, Mar.). PLASTIC POLLUTION TO SOLUTION: Second graders turn knowledge into action as they engineer solutions for a real-world problem in a school makerspace. *Science and Children 55*, 38-45. JSTOR.

Loorbach, D., and Wijsman, K. (2013, Apr.). Business transition management: exploring a new role for business in sustainability transitions. *Journal of Cleaner Production 45*, 20-28. Web of Science.

Marino, A., and Pariso, P. (2016, May). From linear economy to circular economy: research agenda. *International Journal of Research in Economics and Social Sciences 6*, 270-281.

Meyer, M., Chafitz, T., Wang, K., Alamgir, N., Malapati, P., Gander, J., Ward, D., and Gandhi, S. (2022, May). Surgeons' perspective on operating room waste: Multicenter survey. *Surgery 171*, 1142-1147. Web of Science.

Mullis, C., and Finley-Brook, M. (2022, Mar. 2). Waste Management's 'bait-and-switch' sustainability continues to harm communities. *Virginia Mercury*. https://virginiamercury.com/2022/03/02/waste-managements-bait-and-switch-sustainability-continues-to-harm-communities/

Nestlé (2019, Jan. 15). Nestlé accelerates action to tackle plastic waste (press release). https://www.nestle.com/media/pressreleases/allpressreleases/nestle-action-tackle-plastic-waste

Nestlé (2023). What is Nestlé doing to tackle plastic packaging waste? https://www.nestle.com/ask-nestle/environment/answers/tackling-packaging-waste-plastic-bottles

NWRA (2023, June 30). National Waste & Recycling Association. NWRA's Northern New England Chapter Commends Vermont Governor for Veto of Bottle Bill Expansion (press release). wasterecycling.org/press_releases/nwras-northern-new-england-chapter-commends-vermont-governor-for-veto-of-bottle-bill-expansion

Owens, J. (2022, Sep. 1). Is TerraCycle sustainable or greenwashing? *Ethical Consumer*. https://www.ethicalconsumer.org/home-garden/terracycle-sustainable-or-greenwashing#:~:text=Accused%20of%20%E2%80%9Cdeceptive%E2%80%9D%20recycling%20claims,were%20not%20accessible%20or%20transparent.

Pyzyk, K., and Rosengren, C. (2020, Jan. 22). California Senate Votes Against EPR. *Waste Dive*. www.wastedive.com/news/california-senate-advances-epr-changes-struggling-bottle-bill/570808

Quinn, M. (2023, Apr. 19). Federal bills for recycling infrastructure grants, composting strategies make a comeback. *Waste Dive*. ProQuest.

Quinn, M. (2023, Sep. 13). EPA announces recipients of $105M in grants for recycling infrastructure. *Waste Dive*. ProQuest.

Ram, A. (2021, Mar. 10). Our Quest for Circularity. *Patagonia*. https://www.patagonia.com/stories/our-quest-for-circularity/story-96496.html

Reno, J. (2015). Waste and Waste Management. *Annual Review of Anthropology 44*, 557-572. JSTOR.

Richburg, M. (2023, Aug.). Assessing Option for Reducing Greenhouse Gas Emissions and Increasing Energy Production from Municipal Solid Waste Utilizing EPA Models. *University of North Dakota*. ProQuest.

SAIC (2006, May). Scientific Applications International Corporation. Life Cycle Assessment: Principles and Practice. https://people.cs.uchicago.edu/~ftchong/290N-W10/EPAonLCA2006.pdf

Stryker (2024, Jan. 18). Quality you can count on: Four quality standards in medical device reprocessing. https://www.stryker.com/us/en/sustainability/news/quality-you-can-count-on--five-quality-standards-in-medical-devi.html

Subaru of America, Inc. (2023, April 3). Subaru of America Celebrates Fifth Year of "Subaru Loves the Earth" Community Recycling Program and Announces Major New Milestone. *PR Newswire*. www.prnewswire.com/news-releases/subaru-of-america-celebrates-fifth-year-of-subaru-loves-the-earth-community-recycling-program-and-announces-major-new-milestone-301787716.html

TerraCycle (2024, Feb. 29). Personal communication. https://deal.town/terracycle/program-closure-notice-P3JETFWZE4

Thoren, B. (2021, Nov. 2). Patagonia doesn't use the word 'sustainable.' Here's why. *Fortune*. https://fortune.com/2021/11/02/patagonia-doesnt-use-the-word-sustainable-cop26/

Verra (2021, Feb. 10). New Plastic Stewardship Initiative Creates Incentives for Companies to Reduce Plastic Waste (press release). https://verra.org/new-plastic-stewardship-initiative/

Verra (2024, Feb. 16). Plastic Program Details. https://verra.org/programs/plastic-waste-reduction-standard/plastic-program-details/

Wade, S. (2021, Dec. 1). Air pollution from a Virginia landfill is making residents sick. Officials won't call it an emergency. *Southerly*. https://southerlymag.org/2021/12/01/air-pollution-from-a-virginia-landfill-is-making-residents-sick-officials-wont-call-it-an-emergency/

Waste360 (2016, Nov. 16). A Look at the History of Recycling in America. ProQuest.

Waste Connections (2011). Landfill Green Energy Project. https://www.frontrangelandfill.com/green-energy-project/

Waste Connections (2020). Landfill Gas-to-Green Energy (press release). https://cdn.wasteconnections.com/cms/lri-services/LRILandfill.pdf

Wilcox, B. (2022, Feb. 25). Reduce. Reuse. And Then, When All Else Fails, Recycle. *Columbia Climate School.* https://news.climate.columbia.edu/2022/02/25/reduce-reuse-and-then-when-all-else-fails-recycle/

Williams, H. (2011, Nov. 28). Examining the Effects of Recycling Education on the Knowledge, Attitudes, and Behaviors of Elementary School Students. *Illinois Wesleyan University*. https://digitalcommons.iwu.edu/cgi/viewcontent.cgi?article=1008&context=envstu_seminar

WM (2023, Sep. 15). Waste Management. WM Unveils New $30 Million State-of-the-Art Recycling Facility in Cleveland (press release). https://mediaroom.wm.com/wm-unveils-new-30-million-dollar-recycling-facility-Cleveland

Zhang, X., Liu, C., and Medda, F. (2023, Mar.). A Smart-Contract-Aided Plastic Credit Scheme. *IEEE Systems Journal 17*, 1703-1713. Web of Science.