

Fiber Based Packaging

Opportunities in a Circular Economy



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Executive Summary

Companies are in a constant state of disruption and evolution as they attempt to stay ahead of government regulations, competitors, and new market entrants. In this rapidly evolving world, they face numerous obstacles when it comes to maintaining and creating strong environmental commitments. The circular economy represents one of the biggest environmental and economic opportunities through which companies can lower their environmental footprint and represents an estimated \$4.5 trillion dollar additional economic output by 2030.¹

The circular economy moves away from the traditional linear consumption model and promotes the elimination of waste through the continual use of natural resources. This holistic framework allows companies to evaluate the environmental impact of their products from natural resource extraction to end-of-life product disposal. Adopting this framework can help companies elevate their existing sustainability commitments by focusing on optimizing natural resource use and minimizing waste. This framework is particularly salient for industries with limited product life cycles.

Images of plastic in the ocean, particularly wrapped around wildlife, created an instant uproar around the issue of plastic disposal. This debate quickly expanded beyond plastic and included all single use packaging. Packaging companies concerned by both public and regulatory scrutiny should consider how circular strategies can help them mitigate the improper disposal of their products. Fiber based packaging is a predominantly single use product model with a limited product life cycle. However, by adopting circular strategies the industry can extend the life of their products and minimize end-of-life waste disposal. The circular framework provides four major strategies: Resource Recovery, Product Life Extension, Circular Supply Chain, and Product as a Service through which they can address issues of inefficient resource use and improper waste disposal.

This report looks at how the industry is shifting away from the traditional linear consumption model by highlighting innovative strategies and products being adopted by leading players in the fiber based packaging sector. We evaluate the four circular strategies and address the challenges and opportunities associated with each of these models.

¹ Lacy, Peter and Rutqvist, Jakob. "Waste to Wealth: Creating Advantage in a Circular Economy". September 2015. <https://thecirculars.org/content/resources/Accenture-Waste-Wealth-Exec-Sum-FINAL.pdf>.

Introduction

The Circular Economy (CE) creates a paradigm shift away from a linear consumption model. Under CE, growth is decoupled from scarce resource use, which allows for economic development within our natural resource constraints. As defined by the Ellen MacArthur Foundation, CE is based on three key principles: designing out waste and pollution, keeping products and materials in use, and regenerating natural systems.² This framework encourages sustainable resource use, waste and leakage prevention, and the conservation of resources. The adoption of CE can serve as a risk mitigation tool and sustainability strategy for companies. In addition, the adoption of circular strategies represents a \$4.5 trillion economic opportunity by 2030.³ This innovative and disruptive framework has the potential to impact every single sector of the economy.

The global packaging market, currently valued at \$850 billion, is experiencing increasing demand as a result of rising e-commerce sales, a growing middle class population, and increasing demand in emerging markets.^{4,5} However, the industry is also at a critical juncture with decreasing margins and increasing demands for sustainability.⁶ These circumstances create the perfect environment for the industry to adopt circular economy strategies. Specifically, this adoption is being driven by four major factors: the regulatory landscape, shifting business principles, environmental issues, and changing consumer preferences. Each of these influences plays a pivotal role in propelling this shift and has influenced the type of strategies being pursued by the packaging sector.

2 “What is a Circular Economy?”. Ellen MacArthur Foundation. Accessed March 24, 2020. <https://www.ellenmacarthurfoundation.org/circular-economy/concept>.

3 Lacy, Peter and Rutqvist, Jakob. “Waste to Wealth: Creating Advantage in a Circular Economy”. September 2015. <https://thecirculars.org/content/resources/Accenture-Waste-Wealth-Exec-Sum-FINAL.pdf>.

4 “Global Packaging Market”. Metsa Board. Accessed December 17, 2019. <https://www.metsaboard.com/Investors/Global-packaging-market/Pages/default.aspx>.

5 Feber, David, Nordigården, Daniel and Varanasi, Shekhar. “Winning with new models in packaging.” McKinsey. May 2019. <https://www.mckinsey.com/industries/paper-forest-products-and-packaging/our-insights/winning-with-new-models-in-packaging>.

6 Feber, David, Nordigården, Daniel, Varanasi, Shekhar. “Winning with new models in packaging”. McKinsey. May 2019. <https://www.mckinsey.com/industries/paper-forest-products-and-packaging/our-insights/winning-with-new-models-in-packaging>.

MARKET MOTIVATORS	KEY INFLUENCES	LIMITATIONS
Regulatory Drivers	<ul style="list-style-type: none"> Increasing rise in recycling and waste disposal restrictions. Increase in Environmental Producer Responsibility legislation. Increase in local and regional single-use product bans. 	<ul style="list-style-type: none"> Regulations are region specific. Uncertainty regarding the depth and timeline of proposed regulations.
Business Drivers	<ul style="list-style-type: none"> Potential for revenue expansion through resource recovery initiatives, raw material 	<ul style="list-style-type: none"> Can require high upfront capital cost.
Environmental Drivers	<ul style="list-style-type: none"> Can help reduce the company's environmental footprint. Can help increase recycling, lower post-consumer landfilling, and increase utilization of products. 	<ul style="list-style-type: none"> Requires robust life cycle analysis to prevent greenwashing claims.
Consumer Drivers	<ul style="list-style-type: none"> Societal backlash to plastic pollution in the ocean and a growing aversion to single-use products. Consumers increasingly prefer brands that align with their social and environmental expectations. 	<ul style="list-style-type: none"> Lack of consumer willingness to pay higher prices for more environmentally friendly products.

Regulatory Drivers

Regulatory policies over the last few decades have increasingly targeted waste disposal issues through policy measures such as recycling and waste management laws, extended producer responsibility bills, and bans on single-use products. These measures represent a growing desire to improve current waste disposal practices, hold producers accountable for product take-back, and decrease unsustainable consumption patterns.

China's 2018 *National Sword Policy* completely upended the global waste and recycling disposal system. China had long served as the world's largest importer of waste and recycling for much of the developed world. However, the recycling and waste imports sent to China had increasingly high contamination levels. These levels created a situation where the management and processing of these materials was no longer economically profitable. Therefore in 2018, China implemented highly restrictive import standards as part of the National Sword Policy. This effectively banned the import of soiled and contaminated materials by mandating a contamination rate of .5% or less.⁷ By 2019 this resulted in a significant decrease in the amount of plastic (99%) and paper (33%) material imported to China.⁸ Initially, countries in Southeast Asia including Malaysia, Thailand, and Vietnam stepped in and

⁷ Javorsky, Nicole. "How American Recycling Is Changing After China's National Sword". City Lab. April 1, 2019. <https://www.citylab.com/environment/2019/04/recycling-waste-management-us-china-national-sword-change/584665/>.

⁸ "Piling Up: How China's Ban on Importing Waste Has Stalled Global Recycling." Yale E360. March 7, 2019. <https://e360.yale.edu/features/piling-up-how-chinas-ban-on-importing-waste-has-stalled-global-recycling>.

increased their waste imports. However, these countries were unable to scale their capacity to match China's previous import levels.⁹ In addition, some of these countries have decided to follow suit and plan to impose their own restrictions on the import of waste materials.¹⁰ The *National Sword Policy* and increasing regulatory scrutiny around waste disposal and contamination served as the catalyst for the reexamination of waste disposal practices in the United States (US). This regulatory environment has propelled the US waste and recycling industry to find innovative ways to decrease contamination levels, improve operational efficiencies, and expand domestic infrastructure and management capabilities.¹¹ In addition to increasingly restrictive global waste and recycling policies, there has been a flood of regulations targeting the source of consumer waste — product manufacturers.

Extended Producer Responsibility (EPR) policies are another mechanism policymakers use to target product waste. Predominantly present in Europe, the EPR framework holds manufacturers accountable for the take-back of their products. These policies are based on Swedish academic Thomas Lindhqvist's research into how recycling and waste management systems could lead to sustainable production.¹² At its foundation, EPR is an environmental strategy with an objective to promote the design of sustainable and efficient products as part of a pollution prevention and waste minimization strategy. By forcing manufacturers to finance the disposal or take-back of their materials, policymakers create a steady stream of recycled post-consumer materials that can be reused. Most recently, the 2018 *Waste Legislation* revision by the European Union mandated that all Member States must have packaging EPR by 2024.¹³ Of the 28 Member States, 27 already have some form of packaging EPR.¹⁴ These regulations reflect some of the most progressive EPR policies in the world. Recently, US regulators attempted to replicate this system. In August 2019, US Senators Tom Udall (D-N.M.) and Alan Lowenthal (D-C.A.) released the *Producer Responsibility for Product and Packaging Waste* bill. This bill would result in a mix of phase-outs of certain single-use consumer products, EPR for certain products, and deposit or charge

9 Watson, Sara Kiley. "China Has Refused To Recycle The West's Plastics. What Now?" NPR.org. June 28, 2018. <https://www.npr.org/sections/goatsandsoda/2018/06/28/623972937/china-has-refused-to-recycle-the-wests-plastics-what-now>.

10 Cecil, Madison. "Southeast Asian countries restrict imported plastic waste". PSU Vanguard. July 15, 2019. <https://psuvanguard.com/southeast-asian-countries-restrict-imported-plastic-waste/>.

11 Kerssten-Johnston, Stephanie, et al. "The Bridge to Circularity". The Recycling Partnership. October 2019. <https://recyclingpartnership.org/download/29959/>.

12 "History of EPR". Multi-Material Stewardship Western. Accessed December 14, 2019. <https://www.mmsk.ca/residents/history-epr/>.

13 "Sustainable Products in a Circular Economy - Towards an EU Product Policy Framework contributing to the Circular Economy". European Commission. April 3, 2019. https://ec.europa.eu/environment/circular-economy/pdf/sustainable_products_circular_economy.pdf.

14 "Sustainable Products in a Circular Economy - Towards an EU Product Policy Framework contributing to the Circular Economy". European Commission. April 3, 2019. https://ec.europa.eu/environment/circular-economy/pdf/sustainable_products_circular_economy.pdf.

requirements at the consumer retail level.¹⁵ This bill would have major implications for the waste and recycling industry and illustrates growing regulatory frustration around waste disposal. These regulatory measures are forcing the packaging industry to consider product reuse and end-of-life disposal issues. Regulators, in addition to proposing take-back policies, are beginning to focus on unsustainable consumption through bans on single-use products.

There are a growing number of local, state, and federal regulatory policies targeting single-use products. The most common single-use product ban is on plastic bags. As of July 2018, the United Nations found that one hundred and twenty seven countries had adopted some form of legislation to regulate plastic bags.¹⁶ While twenty seven countries had bans on specific products, materials, or production levels.¹⁷ Regulators are quickly beginning to expand beyond plastic bag bans to other single-use products that are seen as environmentally harmful or wasteful. US State Legislatures are also beginning to adopt single-use product bans. In May 2019, Maine banned polystyrene foam containers with Maryland planning to follow suit.¹⁸ In September 2019, the California Senate introduced *The Circular Economy and Pollution Reduction Act*. The *Act* would have required manufacturers to reduce waste from single-use packaging by 75% and for all single-use packaging to be recyclable or compostable by 2030.¹⁹ While the *Act* was vetoed by Governor Newsom, due to expensive last minute additions, this is an indication that legislators are pursuing aggressive measures targeting single-use products.

Legislatures are creating an increasingly stringent regulatory climate around packaging waste. While these restrictive policies have been limited to environmentally progressive legislative bodies, this climate provides an opportunity for the industry to be proactive. Circularity is a natural fit for an industry that has continuously touted their member's sustainability initiatives as indicative of the need for minimal regulations. By focusing on sustainable and efficient design, product life extension, and resource recovery and reuse the sector can adopt strategies that will actively limit waste, promote sustainable consumption, and extend the longevity of their products. These assumptions have been confirmed by thought leaders in the sector who strongly believe that innovation and adoption of sustainable and cost effective products is critical to stay ahead of both regulations and competitors.

15 "Udall, Lowenthal Release Outline of Legislation to Tackle Plastic Waste Pollution Crisis". Senator Tom Udall Press Release. July 18, 2019. <https://www.tomudall.senate.gov/news/press-releases/udall-lowenthal-release-outline-of-legislation-to-tackle-plastic-waste-pollution-crisis>.

16 "Legal limits on single-use plastics and microplastics". United Nations Environment Programme. July 2018. https://wedocs.unep.org/bitstream/handle/20.500.11822/27113/plastics_limits.pdf?sequence=1&isAllowed=y.

17 "Legal limits on single-use plastics and microplastics". United Nations Environment Programme. July 2018. https://wedocs.unep.org/bitstream/handle/20.500.11822/27113/plastics_limits.pdf?sequence=1&isAllowed=y.

18 Smalley, Megan. "Year packed with packaging regulations". September 12, 2019. Recycling Today. <https://www.recyclingtoday.com/article/northeast-recycling-council-webinar-extended-producer-responsibility-packaging-laws/>.

19 "SB54: AB - 1080 Solid waste: packaging and products". California Senate Bill. September 9, 2019. https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB1080.

Business Drivers

Rising e-commerce sales, a growing middle class population, and increasing demand in emerging markets has resulted in a steadily growing global packaging sector.²⁰ However, the industry is also experiencing shrinking margins in the retail and fast moving consumer goods (FMCG) space.²¹ Given this environment, corporate leaders are increasingly seeing the adoption of circularity as vital to ensuring their future success.²² Circular strategies can provide many benefits including revenue expansion, competitive advantage, and attracting and retaining both employees and investors.²³

There are numerous opportunities for revenue expansion within circular strategies including resource recovery initiatives, raw material diversification strategies, and the product as a service model. Resource recovery can provide a steady stream of recycled materials that can be used either in place of virgin materials or in conjunction. Using recycled materials can oftentimes be cheaper than virgin counterparts. For over 20 years, uncoated recycled paperboard has had a cost advantage over virgin grades.²⁴ While not all recycled materials are cheaper, there have been recent and significant price reductions in recycled materials. Such as the cost of recycled linerboard, which as of December 2019, was \$90/ton cheaper than virgin alternatives.²⁵ These recent and historical trends illustrate the potential cost savings associated with recycled material usage. In addition to cost savings from cheaper product costs, using recycled materials can result in cost savings through reduced energy usage, water usage, and effluent discharges. Data from the National Council for Air and Stream Improvement found that while mill water usage and effluent discharge rates are dependent on the grade of linerboard produced, in general mills using recycled fiber discharge less effluent, use less water, use less fuel, and purchase less energy.²⁶ In general, the use of recycled fibers has the potential to provide cost

²⁰ Feber, David, Nordigården, Daniel and Varanasi, Shekhar. "Winning with new models in packaging." McKinsey. May 2019. <https://www.mckinsey.com/industries/paper-forest-products-and-packaging/our-insights/winning-with-new-models-in-packaging>.

²¹ Ibid.

²² "The New Big Circle". World Business Council for Sustainable Development and The Boston Consulting Group. January 23, 2018. https://docs.wbcsd.org/2018/01/The_new_big_circle.pdf.

²³ "Lacy, Peter and Rutqvist, Jakob. "Waste to Wealth: Creating Advantage in a Circular Economy". September 2015. <https://thecirculars.org/content/resources/Accenture-Waste-Wealth-Exec-Sum-FINAL.pdf>.

²⁴ "The Key Benefits of 100% Recycled Paperboard". Recycled Paperboard Alliance. Accessed March 10, 2020. <https://www.rpa100.com/why/benefits/>.

²⁵ "Recycled containerboard in US". Fastmarkets RISI. December 2019. https://info.risiinfo.com/rs/895-QPI-o89/images/USContainerboard_Fastmarkets_2019-09_info.pdf.

²⁶ "Environmental Footprint Comparison Tool". National Council for Air and Stream Improvement. 2013. http://www.paperenvironment.org/PDF/recycling/Recycled_Fiber_Full_Text.pdf.

savings from a material, energy, water, and effluent perspective. Beyond cost savings associated with recycled material usage, the product as a service model can create a recurring revenue stream. Beyond cost savings, companies have also been incentivized to adopt circularity because of the competitive advantage provided by these strategies.

Leading experts have cited the drive for a pragmatic, sustainable, and cost effective solution as being motivated by their desire to stay ahead of the competition. Having a competitive advantage is incredibly important for a sector with thin margins, numerous competitors, and an increasing demand for sustainable products. FMCGs, retailers, and fashion brands have publicly committed to providing more sustainable packaging.^{27,28} Therefore, the adoption of circular strategies can be a critical part of staying abreast of growing consumer demands and creating a competitive edge over peers. While competitive advantage can take many forms, a 2018 Nielsen report found that coffee brands with environmental sustainability claims had greater retail shelf placement over their peers.²⁹ Another direct response to this growing interest in sustainability has been the entrance of numerous startups who are all striving to create cutting edge circular solutions. Proactive leaders in the space have responded by partnering with these organizations. The most formal version of this process can be seen at the annual Packbridge Summit which provides startups with the opportunity to present their innovations to large packaging companies.³⁰ Industry leaders should continue efforts to partner with these smaller, oftentimes resource constrained, organizations to test and bring innovative solutions to the marketplace.

Circularity can also play a critical role in attracting employees and investors. The 2019 HP Workforce Sustainability Survey found that 61% of participants saw business sustainability as mandatory, with 46% only willing to work for companies with sustainable practices.³¹ As such, companies that can demonstrate the integral role of sustainability within their business strategy are more likely to attract and retain employees. Investors are another key stakeholder that has recognized the importance of sustainability. For over a decade, investors have incorporated Environmental, Social, Governance (ESG) factors into their decision making process. Most notably, this process was standardized by the 2006 UN-

27 Jolly, Jasper. "Tesco promises to ban brands that use excessive packaging". The Guardian. August 22, 2019. <https://www.theguardian.com/business/2019/aug/22/tesco-promises-to-ban-brands-that-use-excessive-packaging>.

28 Cernansky, Rachel. "Wasteful packaging is going out of fashion". Vogue Business. July 2, 2019. <https://www.voguebusiness.com/technology/eco-friendly-reusable-packaging-sustainability>.

29 "What's Sustainability Got To Do With It? Linking Sustainability Claims To Sales". Nielsen. 2018. <https://www.nielsen.com/wp-content/uploads/sites/3/2019/04/whats-sustainability-got-to-do-with-it.pdf>.

30 "Packbridge - About Us". Packbridge Connecting Ideas. Accessed April 7, 2020. <https://www.nielsen.com/wp-content/uploads/sites/3/2019/04/whats-sustainability-got-to-do-with-it.pdf>.

31 MacKenzie, Laura, Forbes, Vanessa. "HP global study establishes sustainability as a new workplace standard for successful businesses". HP Press Release. April 18, 2019. <https://press.ext.hp.com/us/en/press-releases/2019/hp-global-study-establishes-sustainability-as-a-new-workplace-st.html>.

backed Principles for Responsible Investment.³² This trend reflected the changing investor perspective on the importance of sustainability and long term financial returns. In addition to valuing ESG factors, some investors are beginning to see circularity as necessary for creating sustainable long term payoffs.³³ Specifically, investors entering this space have identified two key areas of value within the circular model. First, is the waste value proposition which considers the value of the product and costs associated with product disposal.³⁴ This information is used to assess the financial viability of implementing circularity. The second consideration is the feasibility of the product as a service model. This involves looking at the initial value of the product and the benefit of switching from a single transaction system to a recurring revenue stream.³⁵ Beyond incorporating these considerations into the valuation of circular investments, the most prominent display of investor engagement and commitment to circularity was the recent announcement from Blackrock about the creation of a \$24 million BGF Circular Economy fund.³⁶ While Blackrock is focusing on investing in established multinational companies that are adopting circularity, this could be the harbinger of a changing investor mindset that is looking to incorporate circularity into their investment portfolios. By proactively adopting circular strategies, the packaging sector can attract both employees concerned by climate change and investors who are increasingly considering circularity as part of their long term strategy.

Key components of circularity have played an important role in influencing businesses to adopt these strategies. These benefits include a tremendous economic opportunity, competitive advantage over peers and potential partnership with new entrants, attracting employees, and new avenues of investment. For companies to stay relevant and maintain competitiveness in a rapidly changing world, the adoption of circular strategies can be critical to their long term success.

Environmental Drivers

In the past decade, businesses have gone past environmental compliance to proactive environmental management systems. Companies have adopted corporate sustainability goals which are often focused on decreasing water, energy, chemical and raw material usage. Traditionally, these goals have been limited to the production process. However, this is rapidly changing as companies have recognized that

³² “About the PRI”. United Nations Principles for Responsible Investment. Accessed April 30, 2020. <https://www.unpri.org/pri/about-the-pri>.

³³ “The circular economy: an investment theme of the future”. BNP Paribas. January 10, 2019. <https://group.bnpparibas/en/news/circular-economy-investment-theme-future>.

³⁴ “Investing in sustainable transition”. Triodos Investment Management. June 20, 2019. <https://www.triodos-im.com/articles/2019/triodos-im-transition-themes---circular-economy>.

³⁵ Ibid.

³⁶ “BGF Circular Economy Fund”. Blackrock. 2019. <https://www.blackrock.com/ch/individual/en/products/310165/blackrock-circular-economy-fund>.

improved production efficiencies alone are insufficient to mitigate climate change.³⁷ This momentum towards a broader consideration of environmental impacts is backed up by the 2019 CDP report which found that on average, company's supply chains alone generate 5.5 times as many greenhouse gas emissions as their own operations.³⁸ As companies work to actively decrease their environmental footprint, circular strategies can specifically help target both supply chain and end-of-life disposal emissions. Companies should see circular strategies as a natural expansion of their current sustainability strategy.

Circular strategies provide numerous avenues for packaging companies to reduce their environmental footprint. For example, resource recovery targets work to reduce the amount of recyclable material that is landfilled or converted to energy. Creating targets, and ideally a market stream for these materials, ensures that they are reused which can also help to decrease the amount of virgin material needed. Another strategy is the materials exchange platform through which the packaging sector can upcycle traditionally discarded waste materials and find industrial waste that can be incorporated into their production process. Lastly, the product as a service model could help eliminate single-use packaging. Creating a durable package that can be reused would require more resources than traditional single-use packaging. However, if this durable package can be used enough times it will eventually reach a tipping point, where any use after will have a decreasing environmental footprint compared to traditional single-use packages. These strategies illustrate how circularity can improve upon the current sustainability management system by providing a more holistic approach to environmental impact management.

End-of-life product disposal has been largely overlooked in most corporate sustainability goals. Most corporate sustainability goals are limited in scope and focus primarily on actions the company has direct control over. As companies become more thorough, they are beginning to consider how end-of-life product disposal issues can be minimized. According to 2017 Environmental Protection Agency (EPA) data, of the 80.1 million tons of packaging and containers generated, approximately 50.1% was recycled, 23% was incinerated, and 23% was landfilled.³⁹ These numbers have likely decreased given the recent decline of market valuation of recyclables, which resulted in municipalities choosing to incinerate or landfill these materials.⁴⁰ These circumstances create the perfect incentive for companies to find alternatives to the current disposal model. Circularity can help address environmental problems that are

³⁷ Makower, Joel. "Circularity and the 45 percent climate solution". GreenBiz. October 8, 2019. <https://www.greenbiz.com/article/circularity-and-45-percent-climate-solution>.

³⁸ "Cascading Commitments: Driving ambitious action through supply chain engagement" CDP. February 6, 2019. https://6fefcbb86e61af1b2fc4-c7od8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/reports/documents/000/004/072/original/CDP_Supply_Chain_Report_2019.pdf?1550490556.

³⁹ "Containers and Packaging: Product-Specific Data". US Environmental Protection Agency. Accessed December 15, 2019. <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/containers-and-packaging-product-specific-data>.

⁴⁰ Esch, Mary. "Market forces put America's recycling industry in the dumps". AP News. October 10, 2018. <https://apnews.com/dd15ofd23aec4eb383f526048e127f69>.

outside the scope of traditional corporate sustainability goals. However, it is critical that the companies remain diligent in assessing their environmental impact and not automatically equate circularity with net positive environmental benefits.

Consumer Drivers

Society is demanding that companies act in an environmentally responsible manner. This shift can be attributed to increasing consumer concern about climate change and limited environmental regulations being pursued by national governments.⁴¹ These changing values are particularly seen in the younger demographic where 70% of those between the ages of 18 and 34 are worried about global warming.⁴² Companies that want to stay relevant must incorporate these values into their mission by producing sustainable products and work to minimize their environmental footprints.

Companies that refuse to incorporate sustainability into their mission run the risk of losing customers. Customers, especially millennials, have shown that they are willing to switch brands to purchase products from companies who match their ideals.⁴³ Therefore, companies wishing to stay abreast of these shifting trends must adopt clear environmental stewardship policies that illustrate their commitment to the environment. In addition to appealing to shifting consumer values, companies concerned with long term growth trajectories must produce sustainable products.

Consumer desire for environmentally responsible companies has also translated into purchasing decisions. While price is still a major contender in the purchasing decision, consumers are also increasingly putting an emphasis on product sustainability.⁴⁴ A 2018 study from New York University's Stern Center for Sustainable Business found that products marked as sustainable grew 5.6 times faster than their traditional counterparts.⁴⁵ This illustrates that product sustainability does influence

41 Robinson, Jennifer. "Millennials Worry About the Environment — Should Your Company?". Gallup. May 29, 2019. <https://www.gallup.com/workplace/257786/millennials-worry-environment-company.aspx>.

42 Ballew, Matthew et al. "Do younger generations care more about global warming?". Yale Program on Climate Change Communication. June 11, 2019. <https://climatecommunication.yale.edu/publications/do-younger-generations-care-more-about-global-warming/>.

43 "Cone Communications Research Confirms Millennials As American's Most Ardent CSR Supporters, But Marked Differences Revealed Among This Diverse Generation". Cone Communications. September 23, 2015. <https://www.conecomm.com/2015-cone-communications-millennial-csr-study-pdf>.

44 "CGS Survey Reveals Sustainability Is Driving Demand and Customer Loyalty". Global Newswire. January 10, 2019. <https://www.globenewswire.com/news-release/2019/01/10/1686144/o/en/CGS-Survey-Reveals-Sustainability-Is-Driving-Demand-and-Customer-Loyalty.html>.

45 Kronthal-Sacco, Randi and Tensie, Whelan. "Sustainable Share Index: Research on IRI Purchasing Data (2013–2018)". New York University Stern Center for Sustainable Business. March 11, 2019. https://www.stern.nyu.edu/sites/default/files/assets/documents/NYUSternCSB_SustainableShareIndex_2019.pdf.

consumer decision making and is an important factor for long term product success. Beyond an expectation of corporate sustainability and sustainable product preferences, consumers are also beginning to target specific products associated with problematic environmental impacts.

Plastics in the ocean is a huge environmental concern, with over 8 million tons entering the ocean every year.⁴⁶ Images of marine life tangled in plastic bags have provoked the ire of environmentalists, regulators, and consumers. As this issue continues to stay in the public eye, industries associated with plastic packaging are facing increasing consumer scrutiny. In response to negative media attention, major FMCG companies have publicly committed to using packaging that is recyclable, compostable, or biodegradable. While eco-conscious consumers are shifting their purchasing to companies that are addressing their plastic packaging issue.⁴⁷ As consumers and FMCGs continue to press for more environmentally friendly alternatives, the fiber-based packaging sector must take advantage of the demand for recyclable alternatives.

Consumers have clearly demonstrated that they expect companies to be environmentally responsible, prefer purchasing sustainable products, and are increasingly concerned with packaging waste. Fiber based packaging companies should take advantage of this climate and continue to promote and adopt sustainable and circular practices to illustrate their commitment to the environment.

Circular Strategies

Sustainability leaders in the packaging sector have taken notice of the opportunities afforded by the circular economy. Especially, as retail brands have begun to set increasingly stringent sustainable packaging goals. As such, this study aims to delve into the various circular strategies being adopted by the fiber based packaging sector.

As defined by the Ellen MacArthur Foundation, there are three key principles of CE which focus on waste reduction, product and material life extension, and the regeneration of natural systems. These principles have taken shape through the following circular strategies:

⁴⁶ “The Problem with Plastics”. Ocean Conservancy. Accessed December 17, 2019. <https://oceanconservancy.org/trash-free-seas/plastics-in-the-ocean/>.

⁴⁷ Shaner. “Why Conscious Consumers are Choosing the Environment Over Plastic”. My Planet Natural. April 26, 2019. <https://www.myplanetnatural.com/why-conscious-consumers-are-choosing-the-environment-over-plastic/>.

CIRCULAR STRATEGY	OPPORTUNITIES	CHALLENGES
Resource Recovery	<ul style="list-style-type: none"> • Reducing waste in the production process. • Reducing the number of substances used to make the end product. • Increasing the number of products that are recyclable. • Educating direct-end consumers on proper product disposal methods. • Improving processing of materials. • Increasing demand for recycled products. 	<ul style="list-style-type: none"> • Creating production efficiency can be capital and time intensive. • There are technological challenges with minimizing raw materials needed for production while maintaining product integrity. • Ensuring recyclability requires changing the raw materials used and taking into account the limitations of recycling facilities. • Improving consumer knowledge can require municipality specific educational campaigns. • Improving current waste sorting systems can be capital intensive. • Demand for recycled materials must be consistent and economically cost effective to ensure recycling facilities are incentivized to provide a clean regular stream of materials.
Product Life Extension	<ul style="list-style-type: none"> • Improving the quality of materials used to expand the traditional life of the product to allow for industrial reuse. 	<ul style="list-style-type: none"> • Packaging is primarily single-use, therefore this would only be targeting industrial packaging applications.
Circular Supply Chains	<ul style="list-style-type: none"> • Use the waste of other manufacturers to replace virgin materials. • Find channels to dispose of waste material from the production process to prevent landfilling or waste-to-energy disposal. 	<ul style="list-style-type: none"> • This requires the creation of sharing platforms to connect various product producers. • This requires a consistent stream of “waste” materials which can be used for production.
Product as a Service	<ul style="list-style-type: none"> • By creating highly durable, valuable packaging, producers or retailers are incentivized to own the package and establish a continuous use model. 	<ul style="list-style-type: none"> • Creating reusable packages can be capital intensive and requires a higher upfront investment. • Reusable packaging is only environmentally beneficial if it is used enough times to negate the environmental impact of the reusable package compared to its traditional single-use alternative. • This requires a shift in consumer behavior away from traditional use and throw behavior associated with packaging. • Having a continuous use model requires systems and infrastructure changes such as a delivery and pickup system and a sanitation processing plant.

Resource Recovery

Background

Improper waste disposal and collection has serious environmental, social, and economic consequences. Environmental hazards can arise from waste leakage, poor waste sorting practices, and improper disposal. These issues can result in the release of toxic emissions and can potentially cause water contamination. Most often, the negative ramifications of these practices disproportionately impact vulnerable communities.⁴⁸ Beyond these environmental and social issues, improper practices also represent an economic and natural resource loss.

In 2017, the United States generated approximately 4.51 pounds of waste per person per day, resulting in 267.8 million tons of municipal solid waste.⁴⁹ Of which, approximately 30% represented container and packaging waste.⁵⁰ The amount of packaging waste generated is set to steadily increase with the continued rise of online shopping. While the majority of fiber based packaging is recycled, approximately 73.3 – 88.4%, achieving further improvements has proven to be challenging.⁵¹ Packaging that is not recycled is either landfilled or converted to energy, both of which represent a natural resource loss. Improper collection, sorting, and contamination all pose serious challenges to achieving higher recycling rates. Not only is higher recycling desirable to prevent natural resource loss, but using recycled material in the production process is often less resource intensive than virgin counterparts. Specifically, the usage of recycled cardboard requires approximately 75% less energy, 50% less sulphur dioxide, and 7,000 fewer gallons of water.⁵² Furthermore, the packaging sector has been working to achieve higher recycling and recovery rates in response to increasing demand from the FMCG sector. Major brands, such as PepsiCo⁵³

48 “What a Waste: An Updated Look into the Future of Solid Waste Management”. World Bank Group. September 20, 2018. <https://www.worldbank.org/en/news/immersive-story/2018/09/20/what-a-waste-an-updated-look-into-the-future-of-solid-waste-management>.

49 “National Overview: Facts and Figures on Materials, Wastes and Recycling”. US Environmental Protection Agency. Accessed March 25, 2020. <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials>.

50 “Containers and Packaging: Product-Specific Data”. US Environmental Protection Agency. Accessed December 17, 2019. <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/containers-and-packaging-product-specific-data>.

51 Pabern, Jared. “A closer look at container and packaging recycling rates”. Resource Recycling. December 3, 2019. <https://resource-recycling.com/recycling/2019/12/03/a-closer-look-at-container-and-packaging-recycling-rates/>.

52 “Amazing facts about cardboard recycling”. Cardboard Balers. December 19, 2017. <https://www.cardboardbalers.org/cost-agricultural-solar-panels/>.

53 “Packaging: Our Approach”. PepsiCo. Accessed March 29, 2019. <https://www.pepsico.com/sustainability/packaging>.

and The Procter & Gamble⁵⁴, have made public commitments to have fully recyclable, compostable or biodegradable packaging in the near future. This represents a tremendous opportunity and demand for the packaging sector to begin more rapidly incorporating recycled content into their packaging.

Production

There are three opportunities for the adoption of circular practices during the packaging production process.

REDUCING WASTE

Mills generate a variety of waste including chemical effluent, wastewater, scrap materials, and hazardous gases and waste materials. Circular strategies can be adopted to both minimize the amount of waste generated and divert the landfilling of these waste streams.

Water Usage Goals

The American Forest & Paper Association's 2018 Sustainability Report found that as of 2016 the industry used 10,540 gallons per ton of product created. The industry has long recognized the need to minimize their water usage and set a proactive goal for 12% reduction in pulp and paper mill water usage based on a 2005 baseline.⁵⁵

Waste Minimization

WestRock set a 2018 goal for establishing waste minimization teams at their largest facilities.⁵⁶ While progress is ongoing, this reflects the need for a holistic and region specific approach to minimizing production waste.

PRODUCT DESIGN

Industry experts have highlighted the need to incorporate lifecycle thinking into the design process to optimize product cost, functionality, and design for end-of-life recycling. Below are industry examples of material simplification and efficient design decisions which are critical to improving end-of-life recyclability and reducing product waste.

⁵⁴ "Procter & Gamble reveals packaging sustainability strategy". The Procter & Gamble. April 18, 2018. <https://www.packaging-gateway.com/news/procter-gamble-sustainability/>.

⁵⁵ "2018 AF&PA Sustainability Report". American Forest & Paper Association. July 24, 2018. https://www.afandpa.org/docs/default-source/default-document-library/2018sustainabilityreport_pages.pdf?sfvrsn=.

⁵⁶ "Sustainability". WestRock. Accessed April 21, 2020. <https://www.westrock.com/sustainability/>.

Material Simplification

- Ecologic Brands created inner liners that use fully recyclable non-laminated mono-polymers inside their 100% recycled cardboard packaging.⁵⁷ This alleviates challenges faced by recycling facilities that have trouble processing multi-layered materials.
- In 2020, Stora Enso introduced two new dispersion barriers Aqua and Aqua+, they are fluorochemical-free and replace traditional plastic barriers. The material is liquid and grease resistant while also breaking down in the recycling process.⁵⁸

Volume Minimization

Not only is empty space in packaging a waste of resources but it also reduces shipping yield and increases costs. WestRock addressed this inefficiency by creating Box on Demand which allows producers to design custom boxes for each of their products.⁵⁹

INCREASING RECYCLABILITY

Numerous industry efforts are underway to find more fiber based alternatives to replace single-use non-recyclable packaging.

Fiber-Based Alternatives

- The [NextGen Consortium](#), is a multi-year partnership in the foodservice industry working to address single-use food packaging waste. In 2018 they launched the NextGen Cup Challenge, an open design competition to find alternatives for single-use, hot and cold fiber cups. Winners of this challenge included WestRock who created the *Circular Cup Solution*, a compostable and recyclable paperboard cup.⁶⁰
- Reynolds Packaging created a 100% compostable flexible packaging using a blend of compostable polymers, thus providing a comparable alternative to flexible packaging, 95% of which is not recyclable.⁶¹
- International Paper developed *ClimaShield*, a recyclable water-resistant coating for corrugated packaging. This wax alternative ensures improves the recyclability of the entire package.⁶²

⁵⁷ “Tangibly Sustainable”. Ecologic Brands. Accessed April 22, 2020. <https://ecologicbrands.com/eco-bottle/#tangibly-sustainable>.

⁵⁸ “Stora Enso introduces new barrier boards to replace plastic in food packaging”. Stora Enso. February 18, 2020. <https://www.storaenso.com/en/newsroom/news/2020/2/stora-enso-introduces-new-barrier-boards-to-replace-plastic-in-food-packaging>.

⁵⁹ “Box on Demand”. WestRock. Accessed April 30, 2020. <https://www.westrock.com/products/automation/box-on-demand>.

⁶⁰ “WestRock Named One of 12 Winners of NextGen Cup Challenge”. WestRock. February 28, 2019. http://s21.q4cdn.com/975972157/files/doc_news/WestRock-Named-One-of-12-Winners-of-NextGen-Cup-Challenge.pdf.

⁶¹ “Packaging for the future NOW”. Reynolds Packaging. Accessed December 16, 2019. <https://reynoldspackaging.com/eco-friendly>.

⁶² “ClimaShield”. International Paper. Accessed April 28, 2020. <http://www.internationalpaper.com/products/na/corrugated-packaging/practical-innovation/climashield/product-detail/climashield>.

- Boxed Water is an example of a recyclable alternative to single-use plastic, with nearly 75% of their product made of fully recyclable paper.⁶³

End-of-Life Disposal

Before diving into specific strategies being adopted by the industry addressing product disposal, it is necessary to differentiate between commercial and industrial recycling. Industry experts overwhelmingly agree that commercial recycling is a more complex and challenging problem. This is reflected in the lower rates of recycling and higher rates of product contamination. Commercial recycling also presents a unique challenge by requiring consumer behavior change as well as dealing with different collection systems across municipalities. Therefore, this section will focus solely on efforts being adopted as they relate directly to commercial recycling efforts.

There are two key touch points in the commercial packaging disposal process. First is the direct end-consumer. In the United States, municipalities determine the type of recycling available to consumers, whether it is single stream, dual stream, or multi stream. These varying options can have a huge impact not only on the overall recycling rate but on the contamination levels of the recycled materials. These differences pose a challenge when educating consumers on which products are and are not recyclable.

CONSUMER EDUCATION

Launched in 2012 How2Recycle is an example of a successful industry effort to create more transparency and provide clear information to consumers on how to properly dispose of products.⁶⁴ Programs like this are essential for providing consistency across markets and are critical to improving the quality and quantity of recycled materials. How2Recycle is one of many attempts made by the FMCG and packaging industry to work on changing consumer behavior and preventing improper disposal and decreasing contamination levels.

Material Recovery Facilities

In the United States, beginning in the early 2000s, a majority of commercial recycling shifted from multi-stream to single stream. While this transition resulted in the quantity of recycled materials increasing, it also resulted in a decrease in the quality due to the improper disposal of non-recyclable content. In 2018, the contamination rate of recycled materials in the United States was at 25% which

⁶³ “Our Products”. Boxed Water. Accessed April 22, 2020. <https://boxedwaterisbetter.com/pages/our-product>.

⁶⁴ “About Us”. How2Recycle. Accessed March 30, 2020. <https://how2recycle.info/about>.

creates tremendous problems for Material Recovery Facilities (MRF).⁶⁵ MRFs are responsible for receiving, sorting, and processing commercial and industrial waste. These multimillion dollar facilities use labor and equipment to sort commingled materials for shipment to domestic and international recycling facilities. High contamination levels in the recycled material has made it increasingly challenging for these facilities to sort and process high quality recycled content. In response, leading packaging companies have come up with creative solutions to improve the recyclability of contaminated waste streams.

WASTE COLLECTION & PROCESSING INITIATIVES

Collection

- In 2009, the industry formed the Carton Council to help improve carton recycling rates in the United States. The Council works with municipalities and MRFs to promote recycling technology and local collection programs. Over the last decade, the Council has expanded access to carton recycling from 18% to 60% of all US households.⁶⁶
- In 2019, the Recycling Partnership launched the Pathway to Recyclability initiative. The project aims to help packaging suppliers address and navigate recycling system challenges.⁶⁷

Processing

Another strategy has been the adoption of technology to improve material processing. AMP Robotics is an example of a company that is using artificial intelligence to identify materials to be sorted to a granular level which MRFs are currently unable to achieve.⁶⁸

Contamination

- In 2013, Georgia Pacific launched *Juno* to help processes contaminated commercial solid waste into reusable material.⁶⁹ This process sanitizes waste to remove contamination, sorts valuable recyclable material such as paper fiber, plastic and metals, and converts the remaining organic material into biogas. This allows for landfill diversion and helps Georgia Pacific achieve a more circular pathway for their materials.
- As of 2019, eight WestRock facilities are able to recycle foodservice packaging. Traditionally, these materials are difficult to recycle as a result of technical constraints at MRFs. WestRock

⁶⁵ Bell, Brent. "The Battle Against Recycling Contamination Is Everyone's Battle". Waste Management, April 2018. <http://mediaroom.wm.com/the-battle-against-recycling-contamination-is-everyones-battle/>.

⁶⁶ "About". Carton Council. Accessed April 30, 2020. <https://www.recyclecartons.com/about/>.

⁶⁷ "Press Release: The Partnership Announces First Investment in Pathway to Recyclability Initiative". Recycling Partnership. November 6, 2019. <https://recyclingpartnership.org/press-release-the-partnership-announces-first-investment-in-pathway-to-recyclability-initiative/>.

⁶⁸ "Municipal Solid Waste". AMP Robotics. Accessed April 8, 2020. <https://www.amprobotics.com/msw>.

⁶⁹ "What is Juno Technology?" Georgia Pacific. Accessed March 30, 2020. <https://juno.gppackaging.com/>.

was able to come up with a technical process to aid the removal of the thin polyethylene coating from the package, thus allowing these products to be recycled.⁷⁰

CONSISTENT DEMAND

Companies are increasing the amount of recycled content in their packaging thereby creating a more consistent demand for post-consumer materials.

Innovation

The Corrugated Packaging Alliance has been working to increase the amount of recycled content in existing products. In 2015, they reported new advancements in technology which allowed for the average corrugated box to be made with 48% recycled content.⁷¹

Demand

In September 2019, Sonoco announced the *EnviroSense* packaging initiative which focused on providing a range of packaging products that were designed to reduce environmental impact, increase efficiency, and increase the use of recycled content.⁷²

Conclusion

Resource recovery has grown increasingly important as leaders in the packaging sector consider how circular strategies can be adopted. It is important to recognize that while fiber based packaging enjoys high recycling rates, there are still significant areas for improvement.

The industry has primarily focused on increasing collection, improving sorting, designing for end-of-life, and creating a consistent demand stream for recycled materials. Each of these strategies presents unique benefits and challenges, but the industry must pursue a holistic approach to improving overall resource recovery. Most importantly, as the industry pursues these strategies they must exhibit caution when discussing the environmental implications of their initiatives. Resource recovery does not automatically translate to lower environmental impacts, therefore to prevent claims of greenwashing companies investing in these strategies must conduct thorough life cycle assessments to determine their net environmental impact.

⁷⁰ Karidis, Arlene. "WestRock Accepting Foodservice Packaging at Paper Mills". Waste 360. April 11, 2019. <https://www.waste360.com/business/westrock-accepting-foodservice-packaging-paper-mills>.

⁷¹ "Corrugated Packaging – A Recycling Success Story". Corrugated Packaging Alliance. August 2016. https://www.corrugated.org/wp-content/uploads/PDFs/White_Papers/CPA_Recycling_White_Paper_August2016.pdf.

⁷² "Sonoco Introduces EnviroSense™ Sustainable Packaging Development Initiative". Sonoco. September 9, 2019. <https://investor.sonoco.com/news-releases/news-release-details/sonoco-introduces-envirosensetm-sustainable-packaging>.

Product Life Extension

Background

Product life extension is focused on extending the duration and use rate of products. When products are used once and thrown away, they represent an energy and resource loss to the system. Therefore, ensuring longevity and use of the products is critical not only to minimizing waste but to preserving and retaining resources in the system. Typically, this involves incorporating repairability, reuse, and remanufacturing into the design process. Another critical component of this process is optimizing product life spans not maximizing them. It is important that the products' lifetime is not longer than the user needs.

Implementing product life extension into the packaging sector requires nuance and flexibility. Consumer packaging is inherently single-use and serves primarily to protect and preserve items in transit. Even though the benefits of product life extension do not strictly translate for consumer packaging, there are still opportunities the sector should take into consideration. First is the potential for fiber based packaging to serve as an alternative to non-recyclable packaging. Providing a recyclable alternative not only minimizes the amount of non-recyclable material entering the waste stream but with good recycling practices ensures these resources remain in use for longer. Second by establishing a reverse logistics system packaging manufacturers can help extend the useful life of industrial packaging. Design improvements, fiber based alternatives, and industrial partnerships can help the industry promote product life extension and illustrate their commitment to the environment.

Production

The key functions of packaging are physical protection, convenience, information transmission, marketing, barrier protection, and security. Plastic packaging has been ubiquitous because it offers these functions while also being cheap. As such, companies hoping to replace plastic packaging have been innovating new fiber-based packaging that can meet these qualities while also being price comparable. This has been done by improving the design of existing packaging and exploring redesign options using nontraditional materials. Below are a few examples of such efforts.

DESIGN IMPROVEMENTS

Stora Enso created *Performa Brilliance*, the first folding boxboard product enhanced with microfibrillated cellulose. This renewable, recyclable and biodegradable fibre-based material creates a lighter, stronger and more sustainable package.⁷³

73 "Boardpaper: Stora Enso Consumer Board Newsletter". Stora Enso. January 2019. <https://www.storaenso.com/-/media/Documents/Download-center/Documents/Product-brochures/Paperboard-materials/Board-Paper-2019-1-en.pdf>.

FIBER BASED ALTERNATIVES

WestRock created *CanCollar*, which replaces traditional plastic multi-pack rings by providing a paperboard-based solution. The wet-strength *CarrierKote* material used is laminated and helps to reinforce the pack against moisture and rough handling.⁷⁴ This alternative is particularly notable due to the moisture resistant nature of the paperboard-based material.

Industrial Partners

Industrial packaging is used during various stages of the supply chain for the transportation, distribution, and storage of materials. Extending the life of industrial packaging, which is not prone to the same single-use tendencies as consumer packaging, can lead to potential pathways for reuse. Below are examples of companies addressing challenges associated with industrial packaging reuse.

FIBER DRUMS

Fiber drums are not only made of recyclable materials but they are cheaper and lighter than their steel and plastic counterparts.⁷⁵ Yet these drums are difficult to recycle and reuse due reverse logistics and regulatory challenges. This is where companies have stepped in to provide services to ensure the reuse of these materials. Consolidated Container Company has set up a service to collect, prep, and reuse these fiber drums, thus extending their useful life.⁷⁶

WOODEN PALLETS

Wooden pallets are mostly commonly used for the delivery of materials to manufacturing sites. While facilities are able to recycle these pallets, finding a way to refurbish them and extend their useful life would be more environmentally beneficial. Generated Materials Recovery is a company that collects and refurbishes industrial wooden pallets for resale and recycles those beyond repair.⁷⁷

Conclusion

Product life extension is challenging for an industry predominantly consisting of single-use consumer packaging. Industry leaders see few opportunities for how this principle could be applied to packaging.

⁷⁴ “CanCollar”. WestRock. Accessed April 23, 2020. <https://www.westrock.com/products/folding-cartons/cancollar>.

⁷⁵ “Refurbishing Your Fiber Barrel: Everything You Need to Know”. Container Exchange. May 24, 2019. <https://blog.containerexchanger.com/refurbishing-your-fiber-barrel-everything-you-need-to-know/>.

⁷⁶ “Recycling Program”. Consolidated Container Company. Accessed April 26, 2020. <https://www.containerexperts.com/recycling-program.html>.

⁷⁷ “How Wood Pallet Recycling Works”. Generated Materials Recovery. May 29, 2019. <https://generated.com/how-wood-pallet-recycling-works/>.

However, while the scope of possibilities is limited, there are still feasible strategies they should consider. While a bit circuitous, by improving the design of fiber based packaging and supplanting non-recyclable alternatives, this helps to decrease the amount of single-use packaging being landfilled. Second and more straightforward is the creation of reverse logistics systems to increase the refurbishment and reuse of industrial packaging. The industry can and should learn from these initiatives while also recognizing the limitations and challenges that exist with implementation for single-use products.

Circular Supply Chain

Background

Circular supply chains encourage the utilization of traditionally discarded materials. This works to both minimize waste and reduce the use of virgin raw materials. Companies use the industrial waste and byproducts from other manufacturers as an alternative raw material stream. This process is called industrial symbiosis and the most renowned example is the Kalundborg Symbiosis model. In 1972 eleven companies in Denmark formed a public private partnership which enabled the exchange of energy, water and materials in a closed loop system.⁷⁸ In addition to improving resource utilization, the Kalundborg model, as of 2015, was found to save 24 million euros annually.⁷⁹ Thus, circular supply chains can offer both environmental and economic benefits.

A current analysis of industrial symbiosis partnerships in the United States found limited implementation in spite of the potential benefits. Challenges associated with implementation included a lack of information sharing, upfront capital costs, the absence of regulatory incentives, and inconsistent waste supply streams.⁸⁰ While establishing and creating long term partnerships can be difficult, industry associations have created material exchange platforms and companies have created innovative new products.

⁷⁸ Chertow, Marian, and John Ehrenfeld. (2002). Industrial symbiosis: The legacy of Kalundborg. *A Handbook of Industrial Ecology*. 334–348.

⁷⁹ Danielsson, Stefan E, Per Moller, and Lisbeth Randers. “Modelling Co2 savings and economic benefits for the Kalundborg Symbiosis”. Kalundborg Symbiosis. June 2018. <http://www.symbiosis.dk/wp-content/uploads/2018/06/KalundborgSymbiosisPaperLCA2018-06.pdf>.

⁸⁰ Neves, Angela & Godina, Radu & Carvalho, Helena & Azevedo, Susana & Matias, João. (2019). Industrial Symbiosis Initiatives in United States of America and Canada: Current Status and Challenges. 247–251. 10.1109/ICITM.2019.8710744.

Production

MATERIAL EXCHANGE PLATFORM

These platforms play a critical role in promoting information sharing and help lower the transaction costs associated with the repurposing of industrial waste.

- In 2015 the United States Business Council for Sustainable Development developed state specific Materials Marketplace programs to facilitate cross-industry collaboration. Working with state agencies in Ohio, Tennessee, and Michigan they launched platforms which allow company to company industrial reuse opportunities.⁸¹

PRODUCT INNOVATIONS

- EcoEnclose created a *Recycled Corrugated Bubble* as an alternative to bubble wrap and packing peanuts. This 100% recycled cardboard is made entirely from post-consumer and post-industrial waste.⁸²
- Lush launched a line of cork pots as part of their larger initiative to have 90% of their packaging made from recycled materials. These pots are made from biodegradable cork and contain approximately one kilogram of CO₂e⁸³.
- In 2010, Ecovative Design developed *MycoComposite*, a mushroom-based packaging material. The product is made from agricultural byproducts including hemp, husk, oat hulls, and cotton burrs. In 2019, Ikea became the first major brand to announce they would replace all of their styrofoam packaging with MycoComposite.⁸⁴

ACADEMIC RESEARCH & DEVELOPMENT

- In 2017, researchers at Pennsylvania State University created a compostable polysaccharide polyelectrolyte complex. This material is made of cellulose pulp from wood or cotton and chitosan, thus providing an environmentally friendly alternative to plastic barrier coatings.⁸⁵

⁸¹ “Materials”. United States Business Council for Sustainable Development. Accessed April 28, 2020. <https://usbcsd.org/materials>.

⁸² “Corrugated Bubble”. EcoEnclose. Accessed April 28, 2020. <https://www.ecoenclose.com/shop/paper-cushioning-void-fill/corrugated-bubble/>.

⁸³ “Lush Cork Pots”. Lush. Accessed December 17, 2019. <https://uk.lush.com/products/shampoo/cork-pot>.

⁸⁴ Steffen, Andrea D. “IKEA Starts Using Compostable Mushroom-Based Packaging For Its Products”. Intelligent Living. June 6, 2019. <https://www.intelligentliving.co/ikea-mushroom-based-packaging/>.

⁸⁵ Mulhollem, Jeff. “New biomaterial could replace plastic laminates, greatly reduce pollution”. Pennsylvania State University. September 20, 2017. <https://news.psu.edu/story/483742/2017/09/20/research/new-biomaterial-could-replace-plastic-laminates-greatly-reduce>.

- The Wyss Institute at Harvard developed the *Shrilk*, a degradable bioplastic made from chitosan. Material found in shrimp shells and silk protein. Chitosan has been approved by the FDA allowing for the use of this material in food packaging.⁸⁶

NON-FIBER PRODUCT INNOVATIONS

- LimeLoop created *Smart Shippers*, an innovative packaging made from upcycled billboard vinyl. This product is lightweight, waterproof, and lasts up to 10 years.⁸⁷

Conclusion

Implementing circular supply chains is challenging and can be a complex undertaking. While the fiber-based packaging sector has the benefit of using a renewable raw material stream, there are still opportunities for the industry to help minimize industrial waste. Materials exchange platforms offer a great avenue for industry players to identify existing industrial waste streams and find potential partners for collaboration. Additionally, there is an abundance of research and development into new innovative product lines and new uses for traditional industrial waste. Most importantly, working towards a circular supply chain requires collaboration and open communication.

Product as a Service

Background

Product as a Service (PaaS) is a service based model where manufacturers retain ownership of products and sell services to consumers. This model allows for the continued utilization of products beyond one consumption cycle. In traditional PaaS models manufacturers retain ownership of the product thereby being responsible for product delivery, reverse logistics, maintenance, quality assurance, and sanitation. This requires a complete paradigm shift in the current consumption model by requiring durable reusable products, higher upfront capital investment, and consumers forgoing ownership of products. Additionally, the typical use cycle of PaaS assets is much shorter than in traditional leasing models. Therefore this model is particularly useful for products that have short usage cycles, are single-use, are underutilized, and serve a limited term purpose.

Implementing a PaaS system requires a fundamental change to the current consumption model. Increasing the durability and longevity of the asset increases will increase its value. Since manufacturers retain ownership of the product, they are financially motivated to maximize the assets utilization.

⁸⁶ “Shrilk: Biodegradable Plastic”. Harvard University Wyss Institute. Accessed December 17, 2019. <https://wyss.harvard.edu/technology/chitosan-bioplastic/>.

⁸⁷ LimeLoop Reusable Shippers”. LimeLoop. Accessed December 17, 2019. <https://www.thelimeloop.com/>.

Which requires consumers to return assets at the end of their use period. Retrieval from consumers will require a reverse logistics system which must also sanitize the product before it can be used again. In order for this model to be cost effective and environmentally net positive, each asset must be used beyond its resource breakeven point. Determining the breakeven point requires a thorough life cycle assessment. This model is undoubtedly complex and challenging, but has the potential to revolutionize the current linear consumption paradigm and companies are eager to determine its economic viability and environmental potential. Below are examples of innovative companies executing packaging based PaaS models.

Innovative Models

- In May 2019 Loop launched a pilot in New York City and Paris. Their online platform sold products from leading FMCG brands which were delivered to consumers in reusable packaging. Customers were charged with a refundable one-time deposit on the packaging, thus incentivizing returns. Loop served as the reverse logistics coordinator by collecting used packaging, cleaning the material, and returning them to brands to be refilled and sent out to customers.⁸⁸ This model illustrates the broader company goal of eliminating single-use packaging.⁸⁹
- Surgere, a US based supply chains solution company, offers clients *Packaging as a Service* which provides businesses with containers, racks and other packaging assets. This model allows companies to avoid large up-front investment in packaging, capitalizes on reusable containers, and avoids container loss.⁹⁰
- Nefab Group, a global industrial packaging manufacturer, has a line of returnable packaging. They offer a range of packaging suitable for the transportation and handling of a variety of materials. Plus the packages are designed to be collapsible to lower the cost of return shipping.⁹¹

Conclusion

PaaS represents a truly circular economy where products are utilized to their highest potential before being refurbished or recycled. However, in order to work effectively it requires dense population centers, deposit systems that ensure product returns, sanitation and maintenance infrastructure, and shipping and transportation infrastructure. The examples above reflect nascent attempts by the industry to test the viability of packaging as a service and will help demonstrate the long term viability of the model.

⁸⁸ “How it works”. Loop. Accessed December 17, 2019. <https://loopstore.com/how-it-works>.

⁸⁹ “The Idea”. Loop. Accessed December 17, 2019. <https://loopstore.com/the-idea>.

⁹⁰ “Packaging as a Service”. Surgere. Accessed April 30, 2020. <https://surgere.com/innovations/paas/>.

⁹¹ “Returnable Packaging”. Nefab Group. Accessed April 30, 2020. <https://www.nefab.com/en/packaging-solutions/packaging-products/returnable-packaging/>.

Conclusion

Sustainability is a core part of the fiber based packaging sector and circularity is a natural continuation of this ethos. Companies can and should look to the three key principles of circular economy as guideposts on their sustainability journey. The four main circular strategies play a critical role in designing out waste and pollution, keeping products and materials in use, and regenerating natural systems. As companies consider and adopt these strategies it is pivotal to remember that circularity is not automatically environmentally net positive. The onus remains on companies to perform thorough life cycle assessments to determine and verify any potential environmental benefits. With that in mind, below are a set of recommendations on how companies can navigate the implementation of the four main strategies.

Resource Recovery

Resource recovery is a fundamental part of achieving a closed loop resource system. To date, packaging companies have primarily focused on minimizing waste and resource use during production and improving recycling rates. While this is a critical part of increasing the supply of reused materials, this only addresses a small portion of the resource recovery process. There must be increased efforts to design for end-of-life recovery, increased use of recycled content while maintaining product integrity, and technological innovation to sort and process highly contaminated materials.

Product Life Extension

Product life extension is focused on achieving higher utilization rates. Using a broad interpretation as it applies to single-use consumer packaging, the industry should focus on product design improvements that can help fiber based packaging replace non-recyclable alternatives. Additionally, the industry should focus on improving refurbishment and reuse of industrial packaging by setting up reverse logistics systems with their industrial partners.

Circular Supply Chains

Circular supply chains are important to decreasing industrial waste and ensuring that resources remain in use for longer. Achieving circular supply chains requires open communication, information transparency, and cross sector collaboration. Creating a materials exchange platform for industries to correspond raises concerns about privacy and proprietary information. As such, the feasibility of these platforms rests on the integrity of the organization creating these systems. Therefore, industry trade associations and governmental agencies should step up and establish trustworthy and open materials exchange platforms.

Product as a Service

Establishing a PaaS model for a low value single-use product such as packaging is challenging. Creating reusable packaging while potentially beneficial for its ability to improve resource utilization, requires a massive change in the traditional consumption model and consumer behavior. As such, this represents the most challenging strategy discussed and requires further research to determine the viability of such a model for the packaging sector.

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