PYXERA Global Metabolic

Powering Sustainability Through Circular Logistics

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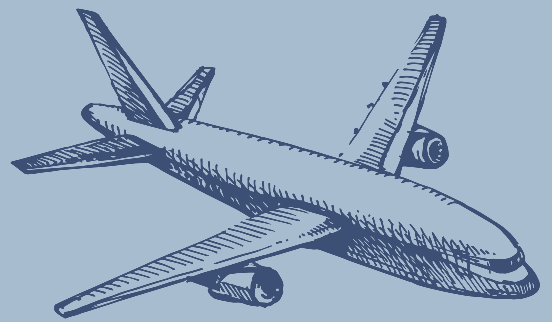
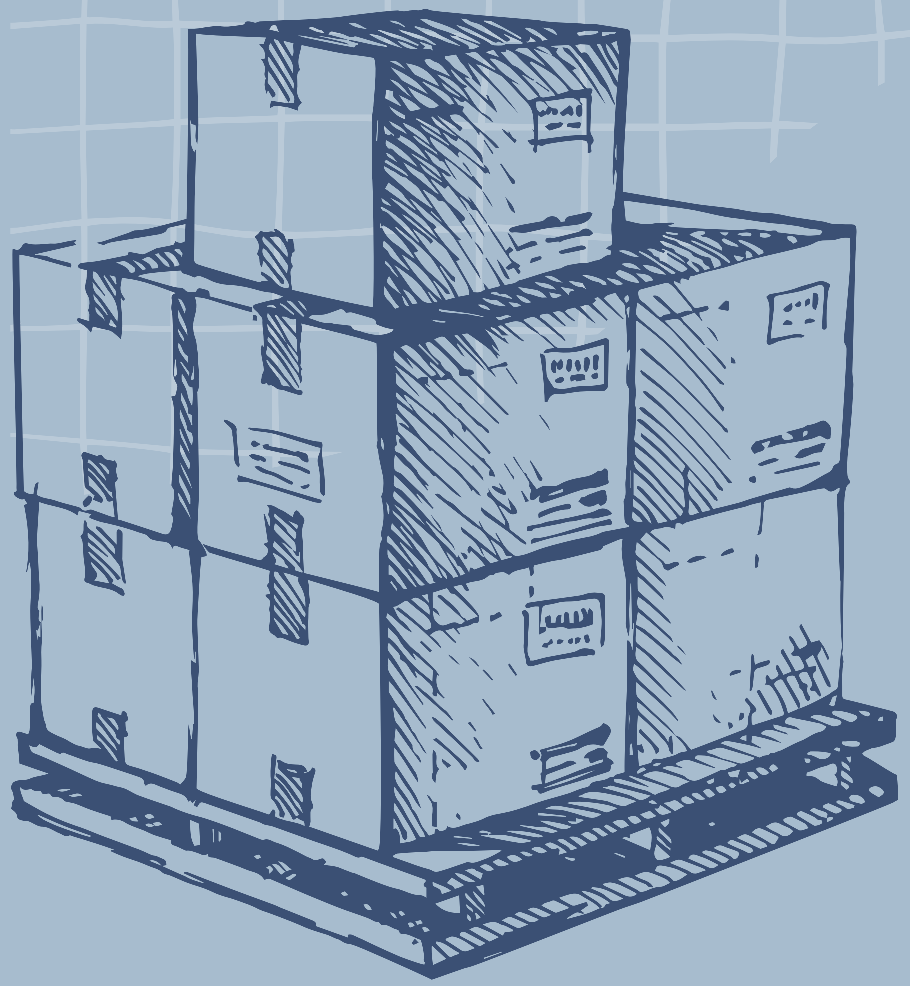
Introduction



The logistics industry plays a crucial role in our economy. Consumers demand the efficient and quick delivery of goods, relying on every form of transportation to execute, including rail, air, vehicles, and now drones. All of this results in a significant impact on the environment. However, with the world's population increasing and overconsumption habits common, this pattern of production and consumption is unsustainable in the long term.



Our economy in its current form is wasteful and unsustainable.

Introduction

Most businesses use a linear 'take-make-waste' supply chain, with a straight path from raw materials to production, distribution, consumption (use), and then disposal, often accounting for more than 90% of the business' greenhouse gas emissions and 50-70% of their operating costs.[1] This method extracts far too many resources and generates significant pollution at the production stage, all while creating waste during the consumption stage. The linear economy consumes 100 billion tons of materials a year, of which over 90% is disposed of or treated as waste after only one use.[2] This creates significant waste management issues with negative impacts on the environment such as air pollution, water pollution, soil contamination, and biodiversity loss.[3]

Furthermore, businesses face disruptions in the supply of raw materials or components,[4] unpredictable price fluctuations, and other risks associated with the supply chain, which will only increase as our resources are quickly depleted. The more that is wasted, the faster these vital resources are depleted.

The alternative to a linear supply chain is a circular, or 'closed-loop' supply chain, which forms the basis for a circular economy. With a goal to reduce waste and maximize the consumption of resources, the circular economy is a new economic model that aims to keep materials in use for as long as possible. One of the most difficult tasks in closing the material loops is the complexity of a circular supply chain.

In circular supply chains, resources are kept in a closed-loop system by reusing, repairing, and recycling them as opposed to discarding items. This is accomplished through circular logistics.

How does circular logistics differ from reverse logistics?

REVERSE LOGISTICS

The growth of e-commerce and the increasing focus on sustainability have elevated the importance of reverse logistics in supply chain management. Reverse logistics allows businesses to recover value from returned products and reduce waste. When a delivery fails to meet a customer's expectations, logistics providers pick up the parcel and return it to the company – for many in the industry, ‘reverse logistics’ is synonymous with ‘product returns.’ However, this often pertains to products that are unused or broken. In circular logistics, the scope is expanded to include all products, including those at the end of their first useful life.

CIRCULAR LOGISTICS

In a circular logistics system, all products and materials are collected after first use, transported to a sorting location, sorted based on the highest value for next use, and then distributed to a service provider for reuse, repair, refurbish, remanufacturing, repurposing, or recycling. By bringing products and materials back into the supply chain, or “closing the loop,” the product itself or its constituent materials remain in production and are not landfilled.

Scaling a circular economy to its full potential

Transitioning to a circular economy is no longer a theoretical concept – it has gained considerable attention and traction from governments and business leaders across various industries, particularly in sectors dealing with high-value raw materials. Despite this, there are still roadblocks to scaling up the circular economy and making it a common practice. The most significant obstacle is the complexity of managing a circular value chain, which involves returning, recovering, and selling products in varying conditions, from multiple origin points to disparate destinations, and at different times.

While the logistics industry is considered instrumental to functional global supply chains, its critical role in the circular economy has not been sufficiently recognized. To meet its full potential, logistics needs to move beyond linear, one-way networks to include new activities such as collection, sorting, and redistribution. By enabling resource recovery and reuse through these value-add activities, logistics companies can play a pivotal role in the circular economy.

Waste as an environmental justice issue

The ‘take-make-waste’ economic model creates significant waste, which primarily affects marginalized communities.[5] Often with lower socioeconomic status and political power, these communities tend to be situated near landfills, waste treatment plants, and other formal or informal waste disposal sites.[6] This proximity results in increased exposure to harmful pollutants, toxins, and foul odors, which can have severe consequences on their physical health, including respiratory issues, cancers, and other illnesses. Additionally, property values in such areas are generally lower, limiting economic opportunities and perpetuating the cycle of poverty. Consequently, the burden of waste management disproportionately falls on marginalized communities, perpetuating disparities and further entrenching social inequities.[7]

The logistics of transporting goods and materials contribute to this unequal burden. People who live as far as 0.2 to 0.3 miles from a highway are at risk of asthma, impaired lung function, dementia, and early death from cardiovascular disease.[8]

Why logistics companies should engage in circular logistics

SOCIAL AND ENVIRONMENTAL BENEFITS

SHARED VALUE

DEEPENING CUSTOMER RELATIONSHIPS

Why logistics companies should engage in circular logistics

Social and Environmental Benefits

The environmental and social benefits of circular logistics are clear:

- Less pollution and waste
- Lower greenhouse gas emissions through increased product reuse, thereby reducing the need for new products [9]
- Recovery and reuse of critical resources [10]
- Increased jobs using a variety of skills [11]

Shared Value

Circular logistics provides supply chain companies an opportunity to create a bridge of innovation and collaboration between corporate social responsibility (CSR) teams and the core business units. By engaging in circular logistics, companies can support local communities, promote higher-paying jobs, and uplift social enterprises, contributing to sustainable economic development. CSR teams and business units should explore how to create demonstrable, simultaneous return-on-investment (ROI) along with social and environmental impact.

Logistics companies can distribute materials and products to social enterprise 'off-takers' that possess strong social and environmental values, prioritizing partnerships that closely align with ESG goals. One example of this would be closing the loop on materials needed for the electric vehicle supply chain to support the electrification of a logistics company's fleet.

This approach not only grants better control over the destination of goods but also ensures compatibility among all parties involved in adhering to shared sustainability goals. In addition, the jobs required for circular logistics are often more skilled and higher paying, such as repair technician, process operator, and demand planner,[12] supporting fair labor practices and providing opportunities for wage workers to benefit from a circular economy model.

These practices not only benefit the environment and communities, but they can also enhance brand reputation, reduce costs, and create new business opportunities within the rapidly evolving landscape of circularity.

Why logistics companies should engage in circular logistics

Deepening Customer Relationships

Many large multinationals have already begun transitioning their supply chains to closed-loop models.[13] By creating circular logistics networks, logistics companies help their customers achieve circularity goals and increase supply chain resilience, which in turn deepens customer relationships. Logistics companies that begin creating circular logistics networks can now be better prepared to profit during the transition to a circular economy.

Valuates Reports[14] announced in January 2023 that **the circular logistics market is projected to reach USD $921.6 billion by 2028 through growth in the returns process**. The surge in e-commerce sales has played a major role in this growth – as online shopping continues to expand, e-commerce platforms and online retailers are adapting their return policies and processes to accommodate the increasing volume of returned products. Additionally, customer expectations have shifted, with consumers now seeking hassle-free and flexible return options.

As a result, companies are investing in streamlined returns processes to provide a positive customer experience and gain a competitive advantage.

To reduce costs and enhance efficiency, logistics providers are actively optimizing their circular operations that bring products back through the supply chain. Companies are implementing technology-driven solutions such as leveraging automated returns management systems through robotics,[15] predictive analytics for inventory management, and efficient transportation networks for handling circular logistics effectively. At the same time, sustainability considerations have also become important, with a demand for options such as refurbishment, recycling, and reselling through secondary markets to minimize waste and contribute to the circular transition.[16]

This blueprint

Transitioning to a circular economy is a crucial step toward achieving a sustainable future. However, this can only be accomplished through collaboration in the value chain and the combination of resources and skills. Logistics providers acting as collectors, sorters, and redistributors must work closely with other value chain actors to establish circular logistics.

This report will highlight how, through circular logistics, these three roles can shape a sustainable economy for consumer products and provide concrete steps for companies to employ on the journey toward more circular practices. Finally, this blueprint will describe the key areas of opportunity for the industry.

The role for logistics companies

This blueprint will expound on three roles logistics companies can play in a circular economic system for consumer products.

01 **COLLECTION:** Collection refers to the process of gathering and demonstrating value in a product when it reaches the end of its first useful life cycle and keeping it in the supply chain.

02 **SORTING:** Sorting involves categorizing products and materials at a logistics hub so they can be redistributed to the most suitable markets for reuse, repair, or upcycling. If those options are not feasible, refurbishing, remanufacturing, or repurposing are considered, followed by recycling.

03 **REDISTRIBUTION:** Redistribution refers to reintroducing consumer-level products, whether new or used, back into a supply chain by sending the sorted goods and materials to the appropriate next-best-use location. This could be through a local or regional enterprise, or back to a manufacturer.

What is a circular economy?

“By embracing the principles of circularity, we have the opportunity to transform our economy into one that is regenerative, sustainable, and prosperous for all.”

Ellen MacArthur
Founder of the Ellen MacArthur Foundation

The opportunity of a circular economy

The circular economy is a new economic model that aims to reduce waste and maximize the use of resources by keeping materials in use for as long as possible.

In a circular economy, resources are maintained in a closed-loop system by reusing, repairing, and recycling them as opposed to discarding items. To make the circular economy a reality, products need to be recovered from the end of their first life of use and recirculated into the economy to be used repeatedly and in a variety of ways.

The circular economy also has significant environmental, social, and economic benefits:

$4.5 trillion

ADDITIONAL ECONOMIC OUTPUT BY 2030 [17]

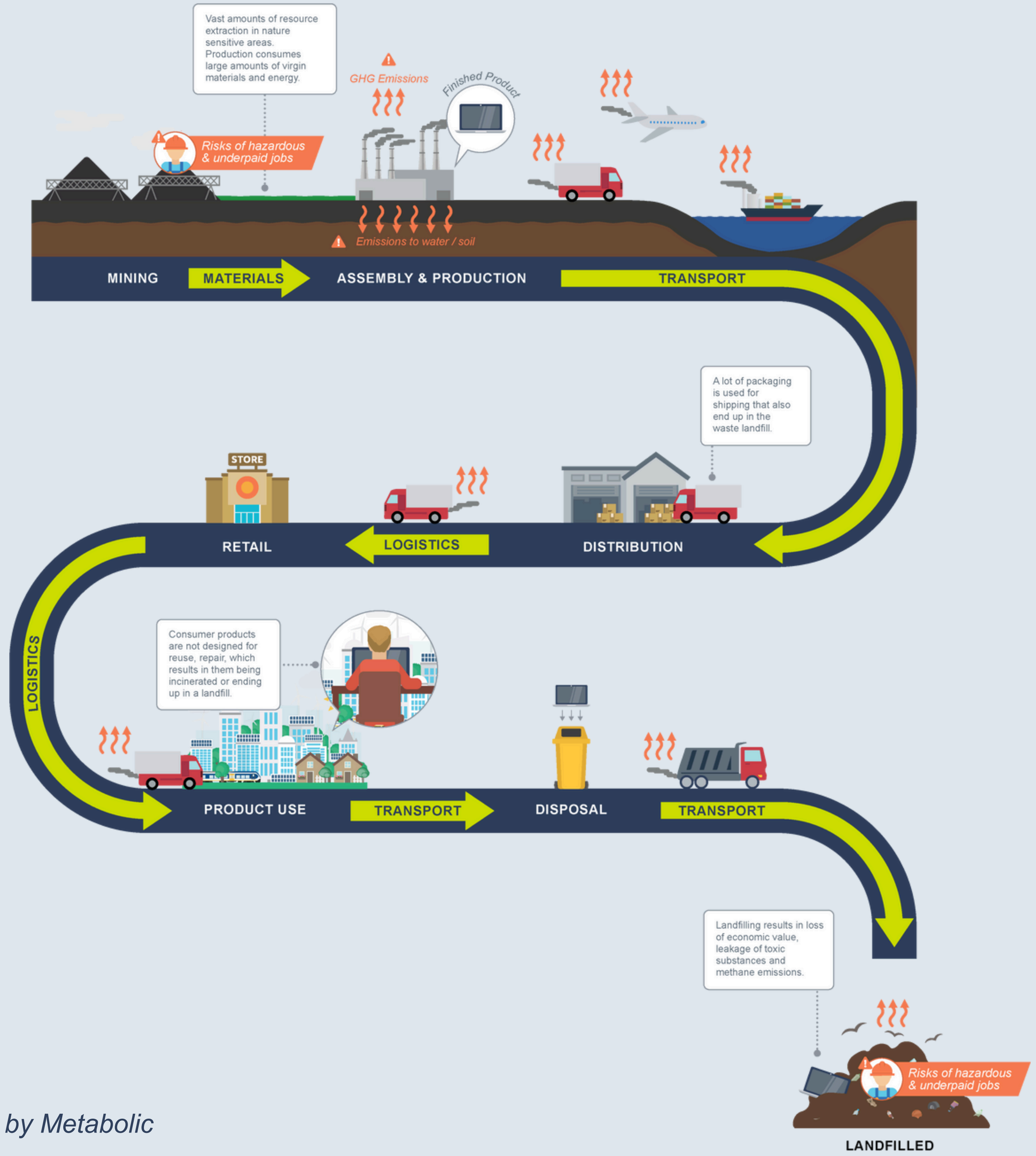
6 million

NEW JOBS [18]

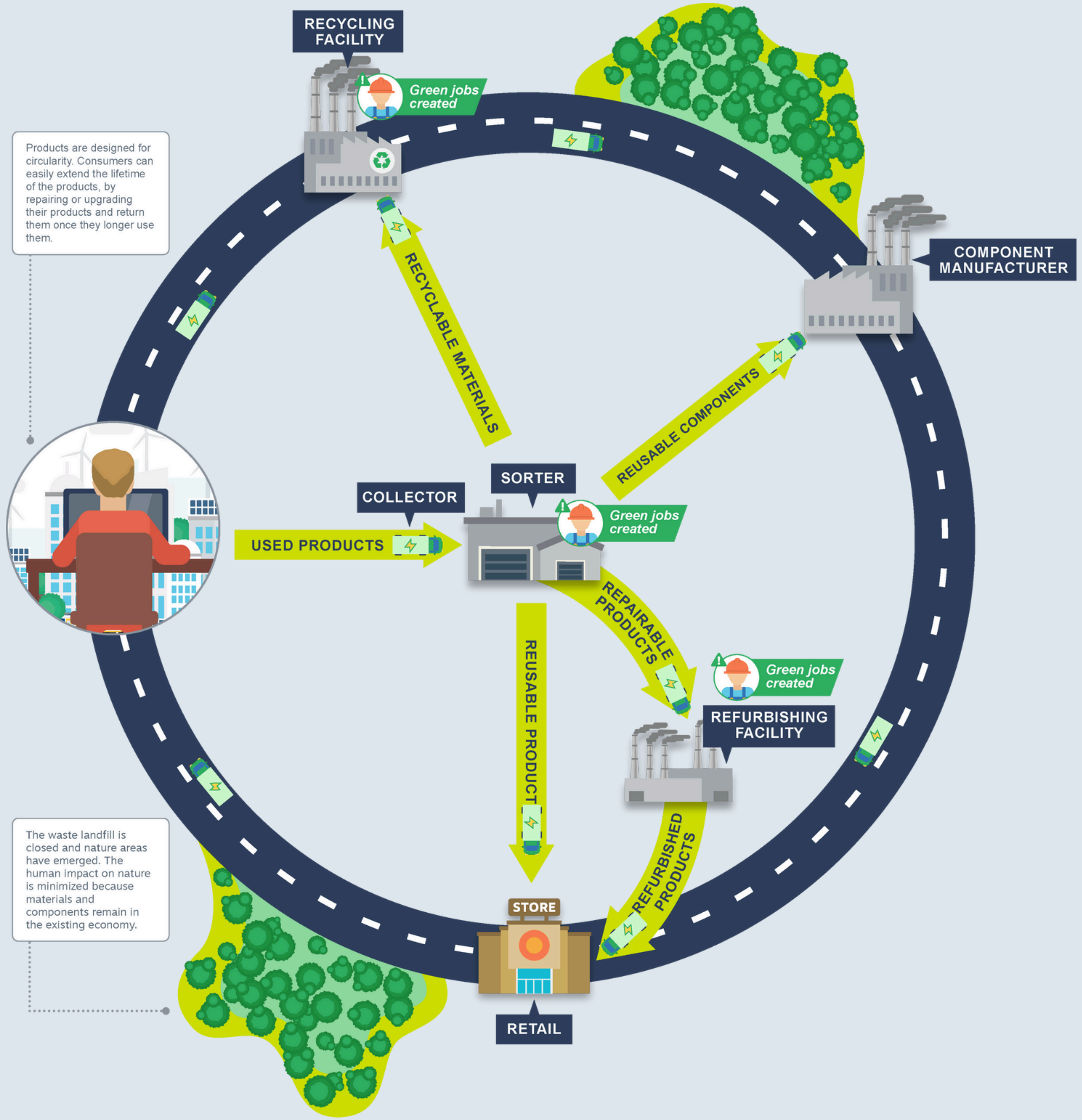
-39% reduction

POTENTIAL FOR GREENHOUSE GAS EMISSIONS [19]

Linear



Circular



Graphics by Metabolic

Value hill and "R strategies"

This diagram shows which R strategies can be employed at different lifecycle stages. The R strategies in the green boxes are higher R strategies, meaning they retain the highest embodied value of products. The R strategies in the clear boxes are lower R strategies that focus on reducing waste and are implemented further down the value hill where the embodied value is lower.

Graphic by Metabolic

Value hill and "R strategies"

The value hill is a useful diagram for understanding the role of circular practices in retaining the value of products and materials by reducing the creation of waste throughout the product life cycle.

In a linear economy, the post-use value of a consumer product is often zero because it retains no residual value after its use stage. In the context of the value hill, this product would "roll down the hill" after its moment of use, from its highest embodied value to zero value as it enters waste streams.

In a circular economy, "R strategies" are enacted to best retain the embodied value of a product. These strategies return post-use products back into the supply chain such that they can once again make their way up the value hill, thereby accumulating embodied value.

R strategies are central to the circular economy model. These strategies effectively reduce environmental impact and unlock new business opportunities based on the ability to extend the economic life of products, generating revenue through repair and refurbishment. Furthermore, R strategies increase profitability through reduced material and manufacturing costs, monetization of by-products, turning "waste" into valuable material, and increasing resource efficiency.

Higher R strategies focus on extending the life of products and parts after the product use stage. These include:

- **REUSE:** Use by another consumer of a discarded product that is still in good condition and fulfills its original function.
- **REPAIR:** Maintenance of defective products so they can continue to be used with their original function.
- **REFURBISH:** Restoration of an old product to bring it up to date.
- **REMANUFACTURE:** Use of parts of a discarded product in a new product with the same function.
- **REPURPOSE:** The use of a discarded product or its parts in a new product with a different function.

The Lower R strategy, **Recycling**, aims to find useful applications of materials with lower embodied value. Recycling processes materials to obtain the same (high grade) or lower (low grade) quality.

"Re-X" refers to a product or material being reused, repurposed, repaired, remanufactured, or recycled depending on which activity would return the highest value. This is based on the value hill's R-strategies.

Roles for the logistics industry

Circular logistics involves collecting products and materials after use, transporting them to a sorting location, sorting them based on the highest value for their next use, and then distributing them to a service provider for reuse, repair, refurbishment, remanufacturing, or repurposing.

By closing the loop, the product itself or its constituent materials remain in the economy and are not discarded in landfills. Below are detailed explanations of each point in the process, how to get started, barriers, opportunities, and the current and ideal states.

Collection → Sorting → Redistribution

Collection

Collection refers to the process of gathering a product or material when it reaches the end of its first useful life cycle, aggregating it with like materials, and keeping it in the supply chain.

Aggregation is the process of gathering and combining individual items or components to create a more efficient and manageable quantity for transportation, processing, or further utilization within the circular economy. Aggregation can occur at various stages of the logistics process, such as collecting used products from multiple sources and consolidating them at a central hub for sorting and assessment. By aggregating resources, logistics providers can optimize their operations and maximize the value derived from the circular supply chain.

CURRENT STATE

Today, the term "collection" in the logistics industry tends to be synonymous with product returns. As it stands, the return economy is a multi-billion-dollar industry.[20] Across the logistics industry, there are small-scale operations cropping up that more closely resemble collection for circular logistics, but they are disconnected and highly localized in nature. The reason for this is threefold: →

- **First-mile problem:** Logistics companies face the challenge of pulling consumer products from the household level back into a supply chain, as products are manufactured in centralized locations but used across vast distances. This makes the collection of used products and materials prohibitively expensive, as efforts must cover significant geographical areas to return products for reuse, repair, refurbishment, remanufacturing, or repurposing.[21]
- **Products are easy to discard in the trash:** For most consumers, disposing of used products in the trash is simpler and more accessible than participating in take-back programs,[22] which exist for certain products that still hold value, like electronics[23] or solar panels,[24] where brand-owners are attempting to get their own products back. This is inefficient and cumbersome – existing collection programs often require consumers to conduct research, travel to separate locations, and navigate differing rules and regulations across municipalities. Being "zero waste" can feel like a full-time job for consumers, and the public increasingly is experiencing “recycling fatigue” without being incentivized by local government or manufacturers for the product (or packaging), to be returned.
- **No high-value end market:** It is often unprofitable for companies to collect low-value material, as there are no high-value end markets to sell to; additionally, due to changes in international laws, significant fluctuations in commodity markets have occurred. Most consumer products are not designed for reuse in the first place: they are manufactured with low-quality, valueless materials. This results in most consumer products being left uncollected.

CURRENT STATE

One example of a successful reverse supply chain initiative is Call2Recycle,[25] a vendor in the electronics supply chain whose sole purpose is to collect and transport batteries from consumer electronics to battery processors in a traceable manner.

Call2Recycle's success lies in its ability to collect in small consumer batches, maintain supply chain transparency, and operate with an expansive network of partners as a nonprofit organization, helping to avoid pitfalls of market volatility. By servicing both consumers and businesses with one-time or ongoing shipping for any quantity of batteries, convenience, and expertise drives considerable value.

This winning combination demonstrates that it is possible for the logistics industry to overcome the challenges of reverse supply chain collection with innovative solutions and collaboration.

To move from product returns to full-scale collection, it is necessary to expand the types and volumes of materials being collected and enhance methods of safe and reliable collection. The logistics industry has a unique role to play in the brand-agnostic circular logistics space – but fully realizing that role will require deep collaboration and innovative thinking around system transformation.

IDEAL STATE

In an ideal state for a circular logistics system, used or unwanted products and materials would be collected using a variety of methods from various locations. The easiest and most convenient location for the consumer would be curbside pickups directly from consumers' homes, with pre-scheduled pickups and clear instructions on what can be collected.

One example of a company doing this successfully is Ridwell,[26] which picks up hard-to-recycle products from consumers' front doors. Integrating curbside pickups into a full logistics network would require optimization, such that the "last mile" drop-off for a consumer-ordered good becomes the "first mile" pickup for returned goods, eliminating empty miles.

In addition to curbside pickups, the circular logistics system would also employ collection bin pickups using a "milk run" model[27] at retail locations and centralized drop-off facilities. This approach involves gathering products and materials from multiple locations along a predetermined route, optimizing transportation resources, and reducing costs. Collection bins would be strategically placed in high-traffic areas, such as shopping centers, office buildings, or public spaces, and would be emptied regularly using the milk run model, servicing multiple bins on a single route. All of the collection methods would converge to aggregate products and materials into sorting for the next-use phase.

While a combination of curbside pickups and collection bin pickups using the previously mentioned milk run model can be an effective method for circular logistics, it cannot be overstated how collaboration and coordination will be essential to a functional collection scheme within a circular logistics network. Because logistics companies have deep, complex, and data-rich forward logistics networks, much can be gained by utilizing those same networks in reverse. This makes logistics companies—particularly those with global networks, infrastructure, and expertise in current state reverse logistics—key enablers for accelerating the scale-up of the circular economy and circular logistics.

BARRIERS TO THE TRANSITION

Challenges associated with transitioning from the current to the ideal state of circular logistics mainly revolve around financial barriers and consumer behavior:

Low profit margins: Most products are not designed for a circular system and therefore, after their first use, the remaining material often holds little economic value, which results in limited potential for profit from their collection. Determining who pays for transportation and collection in a circular logistics system will also be a challenge during the transition period. Starting with high-value end market products, such as electronics whose component materials hold inherent market value (lithium, cobalt, gold), will jumpstart a collection system that can later expand to cover products and materials with less value.

Consumer participation: High participation rates rely on consumer willingness. If consumers do not actively use various collection options, the system will not collect enough materials to retain value or be useful. Put simply, when consumers are presented with multiple options, they will choose the easiest, most convenient one. Logistics companies are uniquely positioned with consumers in that they are in neighborhoods and on doorsteps every day. Marrying easy participation with profitable business models for logistics companies is a winning combination for overcoming the barrier of lower consumer participation in Re-X practices.

Packaging: Another challenge is determining how to package products and materials for a Re-X system. Our current system is built on single-use packaging and is dominated by cardboard and plastic packaging materials that are destined for recycling or landfilling after just one use, as opposed to reuse. Additionally, the higher the Re-X product value, the greater the packaging requirements to reduce damage and maintain the value of the product during the transportation and handling process.

Tracking: Monitoring products and materials from various collection points, destined for different sorting and redistribution streams, is an additional challenge. Asset tracking systems will need significant enhancements, but much can be learned and retooled from what the logistics industry is already implementing in the form of highly sophisticated tracking systems for forward logistics deliveries.

Distances: The wide dispersal of collection points can create inefficiencies in collecting sufficient quantities of materials. Expansive geographic coverage and dispersed collection points can lead to increased transportation costs, longer collection times, and higher fuel consumption.

OPPORTUNITIES

There are key opportunities for logistics companies to retool existing infrastructure in innovative ways to engage in the collection portion of a circular logistics network.

Last-mile delivery networks could be reconfigured as first-mile pickups, with logistics providers picking up items from consumer households after delivering a different item. One successful example of this is the 'milkman model,' whereby empty packaging containers are picked up at the doorstep as new, filled containers are dropped off. Loop, a reuse company operating under the company TerraCycle, successfully implemented this model with major global brands and retailers such as Loreal, Unilever, Nestle, Danone, and many more, before moving to integrate the e-commerce model with existing customer programs (such as Walmart's home delivery program) and focusing on retail pickups and drop-offs.[28] Another example is The Rounds, which uses the same milkman model but refills empty containers using local products in the cities it operates.[29]

Other opportunities include consolidated returns programs,[30] which could be redesigned to allow for batch collection of specific products or materials, such as with Call2Recycle collecting batteries. Highly sophisticated tracking systems[31] can be extended beyond their current forward logistics purposes. Finally, reusable packaging can be utilized to transport items and materials back and forth from collection to sorting facilities. B2B reusable packaging like pallets, crates, bulk bins, and IBCs (intermediate bulk containers) have been used for years already[32] and can be repurposed to move back and forth within a logistics network's nodes. Many new innovations exist in reusable B2C packaging that can be utilized directly by the logistics industry for parcel-by-parcel packaging, such as Returnity[33] or Bound.[34]

Finally, logistics companies have an opportunity to jumpstart collaboration among the various stakeholders that would need to cooperate to address financing. Financing the return of products and materials back into the supply chain would be best shared among many of the stakeholders, from manufacturers, who will become more responsible for paying for their products' collection and end-of-life as Extended Producer Responsibility (EPR) laws become more commonplace, to consumers, who might pay a direct fee for a curbside pickup service (a retrofit of "pay-as-you-throw" fees) or a deposit-refund fee as part of a surcharge on products.

GETTING STARTED

To transition from current collection methods to the ideal state, logistics companies should start small and local.

Large, global logistics companies will have different collection approaches in each geography they operate in.

Initiating a small-scale pilot for curbside pickups may involve:

1. Selecting a local hub
2. Choosing 3-4 trucking routes that emanate from that hub
3. Choosing a single product group that comprises high-value materials and has a known end market, such as smartphones

Consumers must then be made aware of the collection program through local outlets such as news, radio, or flyers.

Starting small allows for seamless pilot execution, as all staff and customers can be well-informed about the process and outcomes. Building confidence through tailored approaches is crucial for obtaining buy-in from company leadership and eventually implementing new business lines and process innovation on a company-wide level. However, the need for small-scale pilot testing should not hinder rapid scale-up, as transitioning to a circular economy must happen within the next few years to remain within planetary boundaries. Once a successful formula is determined, rapid replication and scaling are essential.

Collection → Sorting → Redistribution

Sorting

After products are collected, they are transported to a location for sorting. Sorting involves categorizing products and materials at a logistics hub so they can be distributed to the most suitable markets for reuse, repair, or upcycling.

If those options are not feasible, refurbishing, remanufacturing, or repurposing are considered, followed by recycling. Sorting may take place at various geographic points in a logistics system, with centralized sorting locations serving as collection points for larger volumes of products and materials from commercial or industrial sources.

CURRENT STATE

In a logistics network, products are sorted at strategic locations or "nodes," such as distribution centers or sorting facilities. These nodes serve as crucial points in the supply chain, where products are sorted based on criteria like destination, product type, size, weight, or priority.

Sorting is highly sophisticated and completed through a combination of workers and automated systems that can move tens of thousands of parcels through a facility per hour, each one entering and exiting the facility in just minutes. Most facilities avoid opening parcels to sort based on the contents inside, instead sorting based on the specifications and destination of the boxes.

Within facilities where the contents of the parcels are removed and diagnosed, staff lack product-level or component-level data, which means their ability to accurately diagnose products or parts and determine the appropriate Re-X step (repair, refurbish, or recycle) is limited. A large volume of old laptops, for example, may be returned to the supply chain due to a company downsizing; a sorting facility would be able to determine the age of the laptops, but they would not be able to assess the quality of each individual component and software. This limits the ability to know if certain parts can be sent to a remanufactured.

Complexities also arise from products not being designed for continuous reuse at the product or component level, leading to challenges in disassembly and recovery of usable components. Many products are not designed for disassembly, and this design flaw makes it expensive and challenging to take apart a product to recover usable components, often resulting in the entire product being sent to scrap instead. Additionally, since product manufacturers do not use the same components between product lines or companies, the sorting process requires more space, resources, and time due to the sheer number of individual components among products.

Despite these complexities, some logistics companies have developed capabilities to sort complex electronics products using advanced diagnostics, including product disassembly and repair, for a more efficient and accurate sorting process.

IDEAL STATE

In the ideal state of circular logistics, logistics companies would fully embrace their role as sorters in a reverse supply chain, capitalizing on their central position and existing interactions with products. By integrating efficient sorting processes for used products and materials, logistics companies can significantly contribute to a more sustainable and circular economy.

Products would be sorted based on quality at the earliest possible point in the system, allowing them to be directed towards the most suitable Re-X stream. At the same sorting facility, products unsuitable for reuse or repair would be sorted for remanufacture, repurpose, or recycling. Products would be equipped with transparency-enabling technology, such as digital product passports[35] or material passports,[36] to inform sorting facilities about product and component life cycles. This early-stage sorting would ensure that products and materials flow only to appropriate off-takers, minimizing waste and maximizing value recovery.[37] The digital language used in the circular supply chain would be codified to ensure data continuity for the logistics companies to accurately transport along the value chain.

By selecting off-takers and processors that prioritize social and environmental value, logistics companies would further enhance industry sustainability. This approach would not only contribute to a circular economy but also help build stronger relationships with environmentally conscious customers and stakeholders who demand greater transparency and responsibility from businesses.

BARRIERS TO THE TRANSITION

A major challenge in sorting for product quality is that without specialized equipment, it would be labor-intensive, requiring an elevated level of skill and attention to detail to accurately assess materials suitable for reuse, repair, refurbishing, remanufacturing, repurposing, and recycling.

Existing touchpoints in a logistics network may not have workforces with the necessary skillsets for early-stage sorting in the reverse supply chain. Sorting in circular logistics must be done quickly to meet consumer and manufacturer expectations and avoid additional costs from delays in processing time.

Transitioning to a circular supply chain, logistics companies face the challenge of sorting diverse products and materials. Centralized sorting facilities need ample space to handle large volumes of materials, which can be challenging in urban areas with limited space or in existing sorting facilities that only sort based on parcel size and destination. Sorting may also require specialized equipment, which logistics companies might need to purchase if existing equipment cannot be repurposed.

Downstream partners must be carefully chosen during the transition process based on their willingness to collaborate on the sorting process design. Tight coordination is required with downstream partners, so they only receive what they are prepared to use. This influences the sorting process by defining the scope of what can be sent to different Re-X streams. More hands-on collaboration may be necessary during the transition period to co-design sorting processes.

OPPORTUNITIES

By optimizing networks, products can be sorted for reuse or repair at smaller, local nodes before being sent long distances, enabling local enterprises to handle repair and reuse. Products can be sorted for refurbishing, remanufacturing, repurposing, and recycling at more centralized locations, allowing access to specialized skills and equipment. This also enables the correct packaging solution to be used based on a product's Re-X destination – high-quality, per-product packaging would not be required to protect a product that is ultimately destined to be disassembled for parts and materials. The logistics industry can utilize digital product passports, machine learning, optical sensors, and other forms of automation for sorting. As the industry grows, promoting workforce development and community ownership will ensure that everyone benefits. Existing warehouse spaces could be converted to sorting spaces for a more efficient and effective process.

GETTING STARTED

To embrace their role as 'sorters' in a circular logistics system, logistics companies should start with a deep internal analysis of where they are already conducting specialized sorting practices. Much of the ideal state as outlined above is happening in pockets and on a small, brand-specific scale within companies. Once advanced facilities and functions are identified, developing an intra-company knowledge exchange program, such as an internal fellowship, will allow for the transfer of skills and expertise throughout the network. An internal assessment followed by a knowledge-sharing program can demonstrate to company leadership the business opportunities available if the logistics industry were to fully embrace its role as a sorter in a circular logistics system.

Redistribution

Logistics companies have mastered global product distribution through complex, interconnected networks and sophisticated tracking systems. However, current logistics networks focus on one-way movement of goods and products, with varying degrees of transparency depending on industry certification requirements.

CURRENT STATE

Current logistics networks rely on contracts established between manufacturers or suppliers and end users that dictate where goods should be delivered. This impartial approach allows logistics companies to focus purely on efficient transportation and delivery services without concerning themselves with specific product applications or requirements.

While logistics companies employ advanced tracking systems to ensure seamless product transportation from point A to point B, transparency challenges within the system remain, especially regarding disposal and chain of custody of materials after product use. Some certifications, such as the Recycled Claim Standard for textiles[38] or R2 certification for electronics,[39] have higher levels of transparency required in their reverse supply chains. However, certification systems only apply to specific industries and products. This limitation means that sectors without formalized certification systems may lack comparable traceability levels, leading to challenges in guaranteeing responsible sourcing practices, ethical labor standards, sound disposal practices, and minimized environmental impact across global supply chains.

IDEAL STATE

In an ideal state, the logistics industry would play a significant role in redistributing materials and products in a circular economy.

As global stores of high-value materials are depleted,[40] global procurement of raw materials will decrease, and local and regional circulation of used materials will need to be prioritized.

Logistics networks will be transformed to maximize local and regional transport solutions, and smaller logistics providers will be added to the global supply chain, reducing the industry's carbon footprint and promoting sustainable and equitable economic growth.

Place-based partnerships and co-location strategies will become more common, fostering collaboration between manufacturers, suppliers, ‘refurbishers’, remanufacturers, ‘repurposers’, recyclers, and end-users within geographically concentrated hubs. These synergies would reduce lead times and minimize long-distance travel for materials and products. Car companies are an example of these collaborative partnerships, with some companies co-locating battery recycling, battery production, and car assembly all in one hub.

Increased transparency after processing activities will become standard practice, providing all parties, including consumers, with real-time access to critical information related to a specific product’s lifecycle through digital product passports.[41] Logistics providers will see decreased warehousing requirements because products can be routed to their next stop immediately after one-touch sorting through codified data management, further reducing environmental burdens.

Lastly, the adoption of all-electric vehicles across logistics fleets would minimize environmental impacts associated with traditional combustion engines and positively contribute to broader clean energy transition goals.

BARRIERS

Redistributing material in a circular economy is critical for sustainability, but significant challenges exist. These include ineffective utilization of certifications, packaging problems, and ensuring a reliable supply of products for end users. These barriers need to be addressed for the successful implementation of a circular economic model.

- **Proper utilization of certifications:** Currently, certifications meant to ensure supply chain transparency, such as R2 for electronics, are implemented by operational staff in logistics companies. While they can ensure compliance with certification requirements, engaging strategic leadership would better promote the intended purpose of these certifications – incentivizing circularity. For example, R2 certification aims to keep electronic materials in use as long as possible, but it can become a barrier for downstream participants due to preference for R2-certified ‘downstreamers.’

- **Packaging Challenges:** Increasing circulation of products and materials may initially lead to more packaging. A crucial challenge in transitioning from the current to the ideal state in circular logistics is eliminating single-use packaging by developing systems that do not require packaging or utilize reusable packaging.

- **Ensuring a reliable supply of products for end users (e.g., remanufactured):** Maintaining a consistent supply volume will be challenging during the transition. Predictability of inputs will be difficult as various product types enter the reverse supply chain at different times and conditions. Downstream partners must be selected based on their ability to manage fluctuating inventory while new systems are implemented.

OPPORTUNITIES

Opportunities for logistics companies to engage in the redistribution element of circular logistics lie in the creation of new types of customer and partner relationships. Logistics firms could prioritize partnerships with companies that closely align with their ESG goals, providing them preferential access to transportation services. This approach not only grants better control over the destination of goods but also ensures compatibility among all parties involved in adhering to shared sustainability goals.

Another significant area with transformative potential involves the rapid transition of fleets to renewable energy sources, such as wind and solar, electric trucks, rail, and biofuel for airplanes. This change would reduce the lifecycle greenhouse gas emissions from all products and materials.

Smaller regional service providers, who may specialize in catering to specific industries or material functions, present additional opportunities for innovation. In a circular economy, one product can be transformed into many products or reused multiple times, circulating within a local economic system. Achieving this would require well-coordinated collaboration networks between different ecosystem partners, paving the way for new opportunities in sustainable, equitable local development.

Lastly, large multinational logistics providers can spur the growth of smaller, specialty, or regional logistics providers through intentional skills and knowledge-sharing. This collaboration could encompass network design, tracking infrastructure, sorting, and other areas, offering employee engagement opportunities within the company while simultaneously creating societal value by helping to scale up next-generation solutions.

GETTING STARTED

For logistics companies to effectively participate in the redistribution space, they must begin with well-executed, small-scale pilots. Localized teams within the company should identify a few social enterprise partners to receive secondary materials. These partners should ideally serve a social and/or environmental mission and offer a valuable service to the local logistics team. For example, the social enterprise partner could purchase a specific material from the logistics facility that was previously considered waste, turning a cost into a revenue stream.

Patience is required to prove the long-term viability and value of such partnerships. Materials should be directed to the partners over an extended period—at least a few months—to demonstrate the sustainability of the approach and adjust as needed. Local and regional partnerships are crucial to the success of redistribution networks; therefore, rapid replication, rather than scaling up, should be the immediate next step following a pilot.

Broader opportunities for change in the logistics industry

Opportunity #1: Make use of existing services and facilities for circular logistics

Logistics companies have deep and complex forward logistics networks, and there is much to be gained by utilizing those same networks in reverse. A successful transition to a circular economy will require creating many new systems, but there is vast opportunity in retooling old systems to work in new ways. For example, last-mile delivery could be retooled for first-mile pickup; warehouses could be transformed into sorting facilities; and a workforce skilled in diagnostics and repair on one product type or brand could be trained to work across products in a brand-agnostic manner.

As an example, a logistics provider in the U.S. could decide that it wanted to use its vast trucking and warehouse network to set up a nationwide takeback program for e-waste from people's homes. This logistics provider is in neighborhoods every day dropping off packages; for each package that is offloaded, space opens on the truck. By the end of the day, the truck is empty (the logistics industry refers to this unused space as "empty miles").

If that same truck were to pick up various unwanted electronics from households at no cost to the consumer, it would bring back a truck full of products and materials that hold value. With the products now in the logistics companies' possession, it is possible to realize an untapped profit from the recirculation and recycling processes that follow.

While there is immense value to unlock from retrofitting existing systems for a circular economy, the process can come with many challenges and pitfalls. Keeping old systems means perpetuating old mindsets. To bring all stakeholders along and convince each level of an industry of the advantages that come with seeing existing systems in a new way, it is important to take a tailored, bottom-up approach to change.

Over the course of 18 months, Pyxera Global and its partner Metabolic worked with FedEx to design, develop, and execute a pilot project to retrofit distinct parts of the FedEx business in the U.S. for circular logistics. The pilot focused on keeping electronic devices and materials in circulation because of the inherent value these products hold. Electronics comprise high-value materials, many of which do not exist in large enough quantities in the natural environment to sustain global demand (e.g., lithium, cobalt). The pilot would not have been possible without insights and collaboration from FedEx operations. Overall, the pilot discovered an appetite for innovation, creative thinking, and change among team members and management at the local level. The FedEx pilot provided the basis for this Blueprint, as many observations outlined in this guide were discovered in the design, analysis, and execution stages. You can learn more about the pilot through the Closing the E-Waste Loop case study.

Opportunity #2: Improve the value chain by selecting off-takers that adhere to robust sustainability targets.

The logistics industry sits at the center of global commerce because it touches each material and product that moves through a supply chain from point A to point B. Within the current system, logistics companies exist to serve other industries' shipping needs, but businesses can and should think more broadly about the role the logistics industry can play. Changing the conception that logistics merely exists at the command of other companies can place more agency with logistics companies to capture untapped value.

Logistics companies can actively influence value chains by directing used products and materials, also known as secondary materials, to enterprises that have social or environmental value. Using the previous example, the logistics company now owns a vast array of electronics that were donated through a curbside pickup program.

Instead of selling those products to the highest bidder, the company can determine who the 'highest and best use off-takers' might be—for instance, local businesses that can repair the laptop, not recycle it for parts, until it has reached its true end of life.

The logistics industry can foster networks of sustainable enterprises and establish mutually beneficial partnerships by collaborating with local businesses as product and material 'off-takers'. Through the sorting process, these partnerships can contribute to closing the loop on products and materials, while simultaneously aligning with social, environmental, and financial considerations. By carefully selecting local enterprises that meet these criteria, a logistics company can effectively contribute to its own ESG targets. This collaborative approach ensures that sustainability objectives are achieved while fostering economic growth and positive social impact within local communities.

Opportunity #3: Influence the incentives to collect and redistribute used materials and goods.

Secondary materials face many market challenges when compared to raw materials. In the current system, secondary materials are often less available because there are no systematized sourcing mechanisms, they are more costly (often due to the sourcing issues), and they lack consistency in quality leading to deficient performance (partially because of poor design or cheap materials used in original production).[42] In the circular economy, value is placed in both monetary and non-monetary factors. Defining holistic value means accounting for cost, time, quality – and social and environmental outcomes.

To bridge the gap between secondary material use in our current system (minimal) with secondary material use in an ideal system (normalized, widespread), many actors will need to take an active and pioneering role to incentivize the application of used materials.

Examples of incentive frameworks include a raw material resource tax, reuse/repair tax relief, and a waste hierarchy tax at a product's end of life.[43] Lowering taxes on labor can incentivize labor-intensive processes like repair, maintenance, and recycling.[44] The logistics industry can actively advocate for these policy changes that would dismantle existing barriers and dramatically increase the use of secondary materials.

Additionally, the logistics industry can alter its own fee structures to incentivize the collection, sorting, and redistribution of used materials and products. For example, rather than fees for transportation based mostly on weight and distance traveled, logistics companies could scale fees based on 'what's inside the box' – explicitly making it cheaper to circulate and recirculate secondary products and materials and more expensive to circulate new ones. Determining the right incentive structure can be the subject of future testing.

Opportunity #4: Collaborate pre-competitively with peers and customers, and collaborate intra-company within business units that normally compete.

In our current economy, intellectual property and competitive intelligence reign supreme. In a circular economy, pre-competitive collaboration must be embraced to create efficiencies and outcomes that benefit everyone. Pre-competitive collaboration entails collectively investing in the required infrastructure and other assets beneficial to the circular economy and fairly distributing the associated risks and costs.

For a company to invest in a repair center, it needs a guaranteed inflow of repairable goods. This will create additional income for a logistics provider, and both parties could therefore agree to set up a joint venture or other partnership to realize the repair center.

Within large companies, it is often seen that intra-company competition unintentionally hinders growth. In a large technology manufacturer, for example, one business unit might be incentivized to sell as many laptops as possible, whereas another business unit might receive a directive to design a modular laptop that can be more easily reused and repaired, eventually leading to fewer sales of new laptops. It is critical that each organization take a holistic view to achieve sustainable growth.

Opportunity #5: Transfer logistics knowledge to local and regional logistics providers.

When a large company identifies a smaller company that is filling an industry gap in the traditional linear economy, it acquires that company. In a circular economy, power and profit will be more decentralized and continuous entrepreneurship is incentivized. While large logistics companies are realizing untapped value and profits by retrofitting their systems to work in a more circular manner, they can simultaneously spur the growth of small, specialty or regional logistics providers through intentional skills-sharing and knowledge-transfer. Smaller regional service providers – who might specialize in catering to specific industries or material niches (like construction waste) – should play a larger role in an ideal state of circular logistics. Such opportunities could be in network design, tracking infrastructure, and sorting.

The increased use of secondary materials will necessitate niche green jobs, including within the logistics industry. Circular logistics will also mean more local circulation of products and materials, which localized companies might be better suited to facilitate. These knowledge transfer efforts could provide large logistics companies with an opportunity for employee engagement for various roles within the company while simultaneously creating societal value by helping scale up next-gen solutions.

Thank You.

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