SUSTAINABLE REVERSE LOGISTICS

Reducing Waste and Emissions in the Retail Supply Chain

WHITE PAPER

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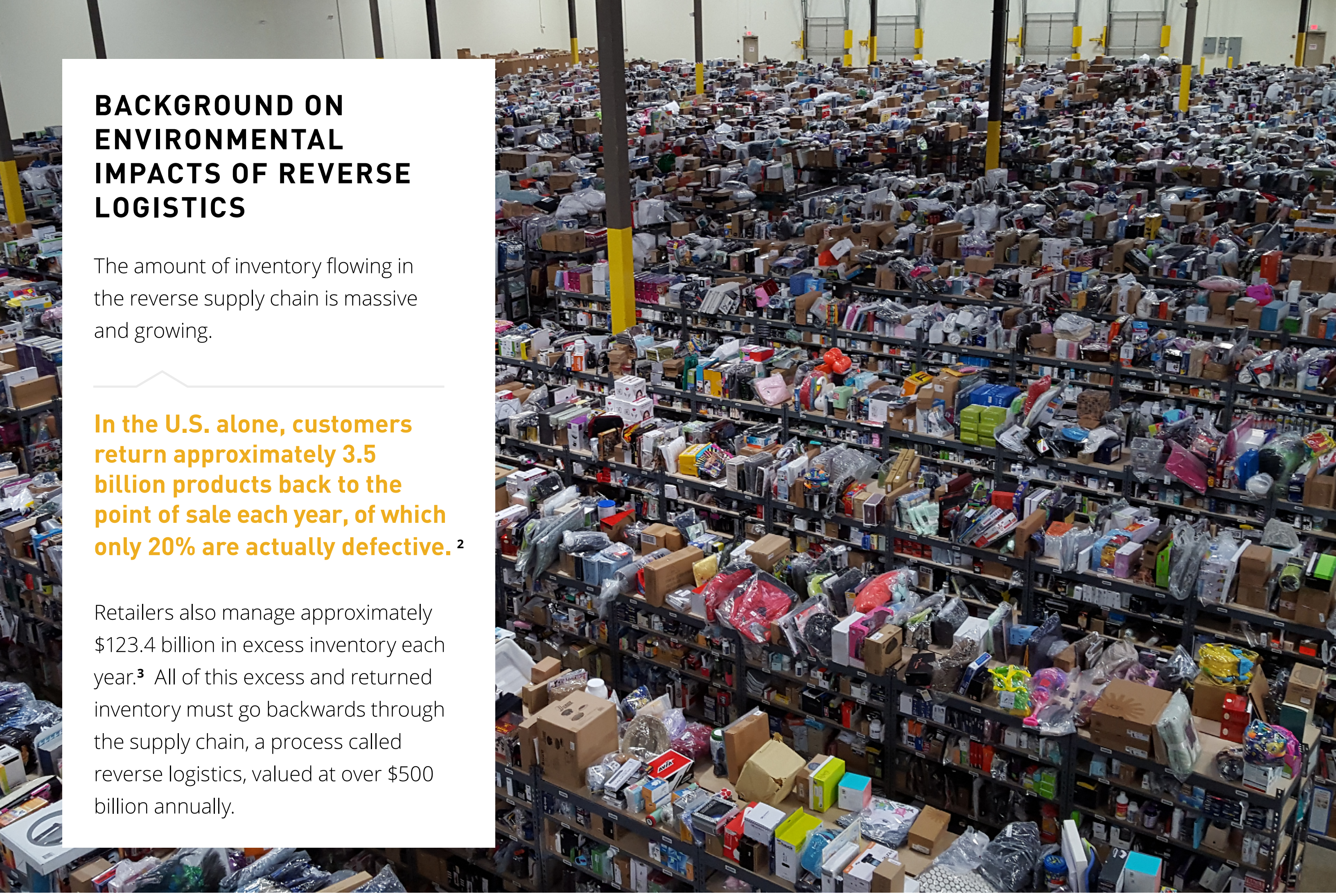
ABSTRACT

The retail industry faces a large and growing challenge in managing the 3.5 billion products consumers return every year, resulting in financial losses as well as environmental impacts, including 4 billion pounds of waste and 11 million metric tons of carbon emissions. [1]

Return rates at brick-and-mortar stores are nearly 9%, and the overall trend continues to grow, especially as return rates for e-commerce are even higher, between 10-20% of all sales. While painful for retailers, returns have been absorbed as a cost of doing business, and until recently the environmental impacts have been “out of sight, out of mind.” Savvy retailers now have the opportunity to improve their recovery and reduce environmental impacts through smart use of data and analytics to efficiently find interested buyers for returned and excess inventory.

Optoro has developed an environmental impact model to quantify the environmental benefits retailers can achieve using sophisticated reverse logistics management systems. The model, built in partnership with a third-party consultant, Environmental Capital Group, and independently verified by specialists at the U.S. EPA and logistics provider C.H. Robinson, demonstrates waste reductions of up to 60% and savings in fuel-related carbon emissions of up to 31%. This white paper describes Optoro’s working model, including a case study with Groupon Goods, and explains how retailers of any size can assess the environmental impacts of their own reverse supply chains using this framework.

[1] Analysis of annual US environmental impacts by Environmental Capital Group and Optoro



BACKGROUND ON ENVIRONMENTAL IMPACTS OF REVERSE LOGISTICS

The amount of inventory flowing in the reverse supply chain is massive and growing.

In the U.S. alone, customers return approximately 3.5 billion products back to the point of sale each year, of which only 20% are actually defective. [2]

Retailers also manage approximately $123.4 billion in excess inventory each year.[3] All of this excess and returned inventory must go backwards through the supply chain, a process called reverse logistics, valued at over $500 billion annually.

UNLIKE THE FORWARD SUPPLY CHAIN WHERE INVENTORY IS CONSISTENT AND UNIFORM,

the reverse supply chain is dynamic and unpredictable; items come back to the retailer in a variety of conditions (e.g., new, open-box, used) and retailers have little information about which products will be returned or overstock. A handful of larger retailers have dedicated facilities to manage returned and excess inventory, but most rely on individual storefront locations, forward fulfillment centers, or third-party logistics providers (3PLs) to process and disposition inventory. Over 50% of retailers still use a manual system to track and manage returns.[4] Without physical and operational capacity, the majority of these products are liquidated, returned back to the manufacturer, or simply discarded. Furthermore, it is not uncommon for a manufacturer to instruct retailers to dispose of a returned product on-site for cost or brand protection reasons.

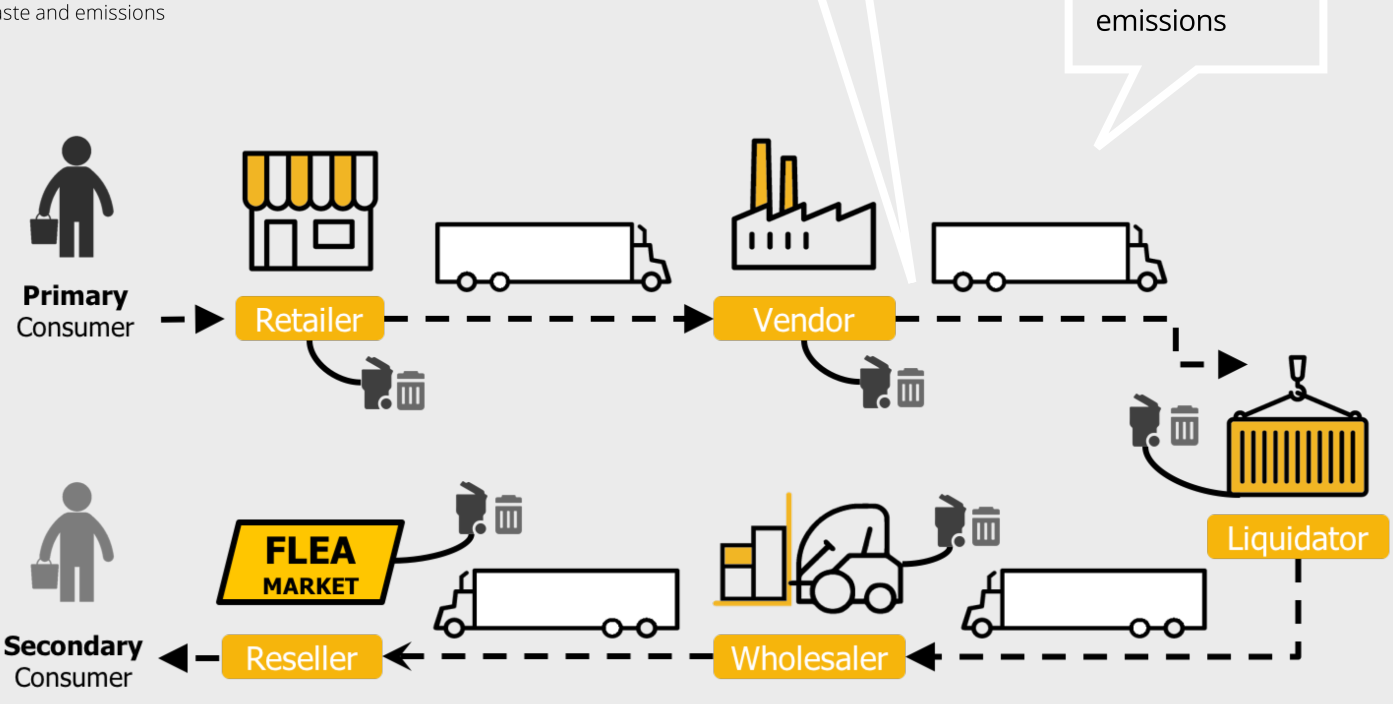
The best way to maximize the value of goods in the reverse supply chain is to route each product to its optimal channel based on its condition, value, and costs. Oftentimes, that best disposition is reselling individual units to a secondary market consumer through an online marketplace. On average, this direct-to-consumer sale of returned and excess inventory provides higher financial return than wholesale liquidation, which involves selling items in bulk at heavily discount prices. Other dispositions, such as donation and recycling can also add value and reduce waste. Despite the volume and potential value of products in the reverse supply chain, most retailers lack the core capacity to test and remarket excess and returned inventory and take advantage of multichannel dispositions that are available.

[2] Greve, C. & Davis, J. (2012). An executive guide to reverse logistics: how to find hidden profits by managing returns. Greve-Davis.
[3] "Retailers and the Ghost Economy: $1.75 Trillion Reasons to Be Afraid." Dynamic Action. IHL Group, 2015.
[4] Greve & Davis, 2012.

WIDESPREAD RELIANCE ON LIQUIDATION IS A SIGNIFICANT SOURCE OF CARBON AND WASTE IN THE SUPPLY CHAIN.

Liquidators sell goods to middlemen, such as wholesalers and resellers, who transport goods thousands of miles, often in less-than-full truckloads, before they are finally resold to a consumer on a secondary market or thrown away due to shipping damage. Heavy trucks are responsible for 22% of transportation-related carbon emissions in the U.S., and each of these heavy truck trips in the reverse supply chain needlessly uses fuel and emits carbon into the atmosphere (Figure 1).[5]

Figure 1. Traditional Reverse Logistics: Multiple touches create a significant amount of waste and emissions



BUSINESS IMPACT	ENVIRONMENTAL IMPACT
• Inefficient process with multiple middlemen	• **4 billion** lbs. of waste
• Low recovery: **10 – 30% of COGS**	• **1.2 billion** gallons of diesel fuel
• Poor data & lack of transparency	• **12 million** metric tons of CO_2 from transportation

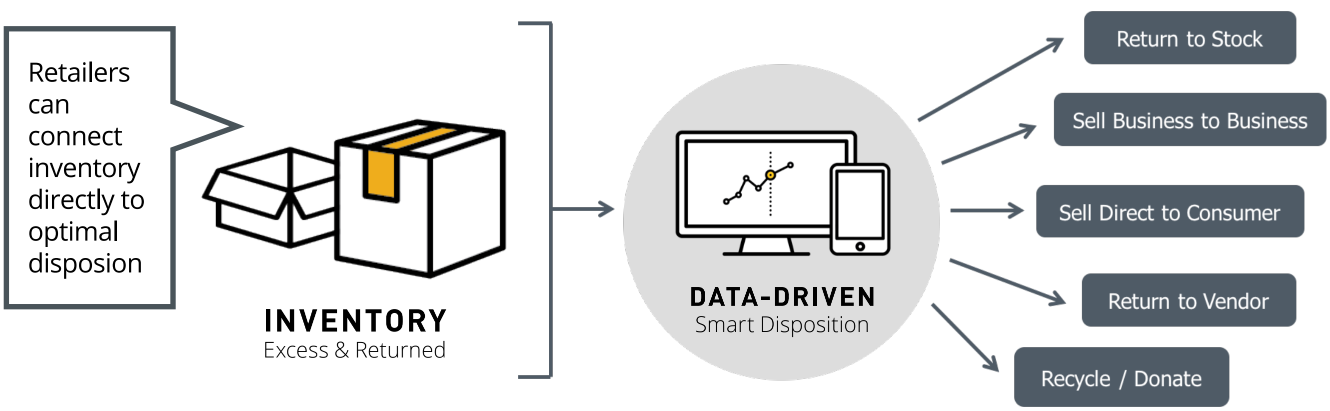
[5] "Fast Facts: U.S. Transportation Sector Greenhouse Gas Emissions, 1990-2011." Office of Transportation and Air Quality. Environmental Protection Agency, Sept. 2013.

USING TECHNOLOGY TO INCREASE EFFICIENCY & DECREASE IMPACT

As an alternative to the traditional process, retailers can opt to use an advanced returns management system (RMS) that provides the tools and analytics needed to sell returned and excess inventory directly to consumers.

This software is installed on-site at one or several centralized facilities (e.g. return center, distribution center, or 3PL). Once a returned or excess product arrives at the centralized facility from a retail storefront or online customer, it is scanned into the software system. First, the software categorizes goods by their condition, ranging from "New Sealed" (for overstock products or products that were returned without being opened) to "Used in Good Condition" (for products that were opened, used and returned). Next, data and real-time secondary market information is used to instantly match and market each product to its optimal disposition- be that direct to consumer, business to business, recycling, return to vendor, or donation (Figure 2).

Figure 2. Technology solutions give retailers the ability to sell direct to consumer in addition to selling B2B, returning to vendor, donating and recycling.



BUSINESS IMPACT	ENVIRONMENTAL IMPACT
• Eliminate middlemen & reduce touches • Higher recovery: **50 – 80% of COGS** • Dramatically better data & visibility	• Reduce waste by **up to 73%** • Cut fuel costs by **$850M** • Lower CO2 emissions by **2+ million metric tons**

Retailers that use technology tools to sell inventory directly to consumers from a centralized returns facility reduce and eliminate middlemen, resulting in higher financial recovery and a reduction in transportation and waste (Figure 2).

MEASURING ENVIRONMENTAL BENEFITS

To demonstrate the environmental benefits that retailers can achieve using smarter returns management, Optoro developed an environmental model that quantifies the fuel savings and waste reduction for any retailer's reverse logistics network.[6]

The goal of the model is to compare the environmental impact of the traditional reverse logistics process (Baseline Scenario) to an intelligent reverse logistics process (Results Scenario). The environmental model compares results using standard methods for supply chain analysis and carbon emissions, based on the best data and assumptions available.

The methodology used was developed by Optoro with a third-party consultant, Environmental Capital Group, and was independently verified by specialists at the U.S. EPA and logistics provider C.H. Robinson. Retailers of any size can use this model as a framework to measure carbon and waste savings achieved through advanced inventory management systems.

Using this model, it is now possible to evaluate the impact of reverse logistics programs and track progress toward increased efficiency. The model demonstrates that advanced returns management systems can lead to a 60% reduction in physical waste and a 27% reduction in carbon emissions. The following sections provide an overview of the methodology used in the model and a case study from one of Optoro's partners.

INVENTORY PATHWAYS

The model calculates waste and emissions for each of the pathways that a returned or excess consumer product may take, and then sums the impact of each pathway in the results and baseline scenarios. To calculate impact, flowcharts are created to map out the likely pathways that a retailer's inventory takes after it is returned or removed from inventory. Figure 3 shows the flow of returned inventory for a hypothetical retailer using traditional returns management processes.

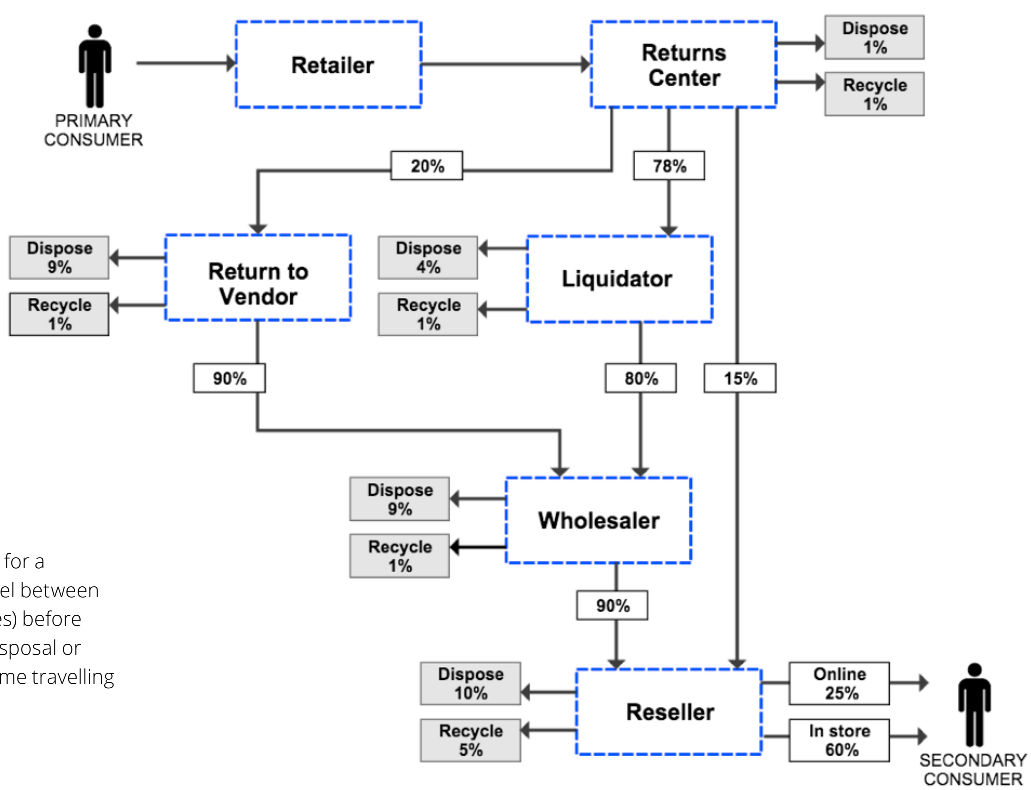


Figure 3. Baseline flow of goods for a hypothetical retailer: Products travel between a series of nodes (dotted blue boxes) before reaching a secondary consumer, disposal or recycling. Percentages denote volume travelling to each given disposition.

[6] This model estimates carbon emissions from transportation only. Additional emissions are created at warehouses and storefronts used to store this inventory, but these sources are outside the scope of this research.

Each item has a known routing of locations (nodes), represented by dotted blue boxes, and transportation modes (links) represented by black arrows. In the baseline scenario, 78% of the inventory is sold to a liquidator. From the liquidator, goods are exchanged between a number of nodes before reaching a final end point. Appendix A has a list of all nodes and links used in the model.

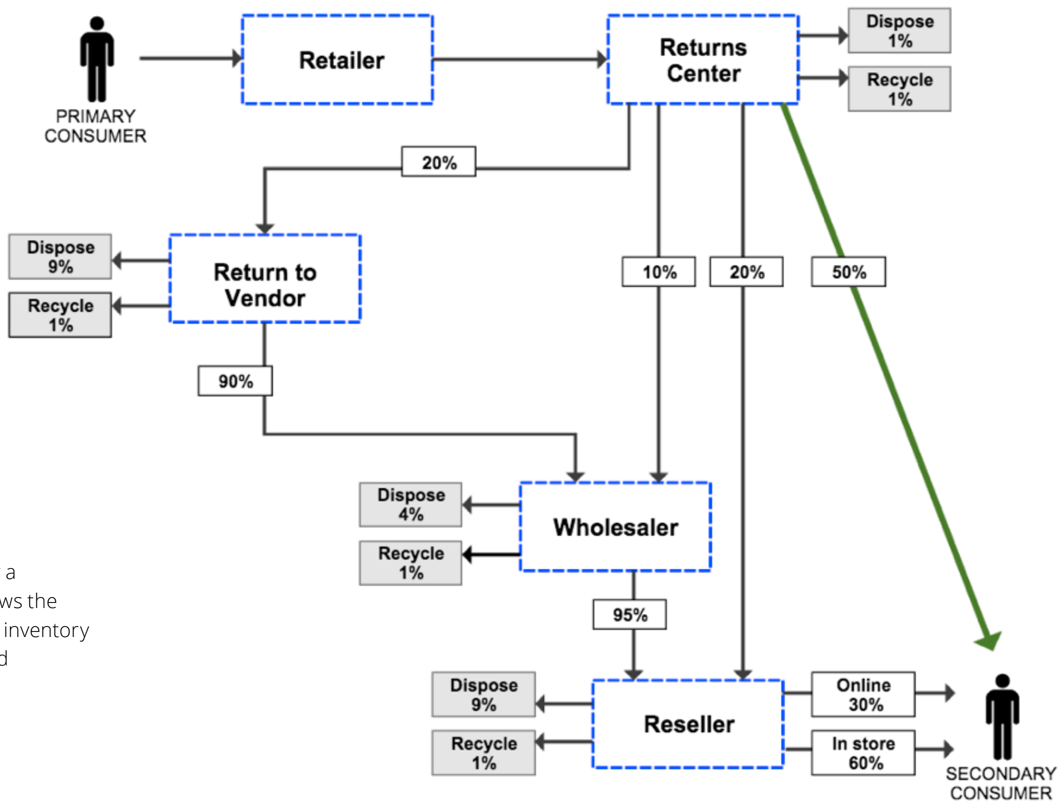


Figure 4. Results flow of goods for a hypothetical retailer: Technology allows the retailer to add a disposition that sells inventory direct-to-consumer (green arrow) and eliminates the need for liquidation.

Analyzing the flow of goods before and after the use of a returns management system allows retailers to measure improvements in carbon emissions, waste, and overall efficiencies in the reverse supply chain.

CARBON EMISSIONS

Transportation of consumer goods in the retail supply chain requires a vehicle to travel from one location to another. Fuel consumed by each vehicle produces emissions of carbon dioxide (as well as other pollutants). Each link in the flow diagram corresponds to a certain distance and a specific vehicle type with known characteristics of fuel economy and cargo loading. Each item, with a known size and weight, occupies a particular share of a cargo load, and is therefore allocated a share of fuel use and emissions in proportion to its share of each load. A list of transportation links used in the model is located in Appendix B.

In the hypothetical figures above, carbon emissions are quantified for all items starting at the return center and ending with either a secondary consumer, disposal or recycling.[7] Figure 5 provides an example calculation for how the model measures carbon per item in the reverse supply chain. Step-by-step carbon calculations used in the model are listed in Appendix C.

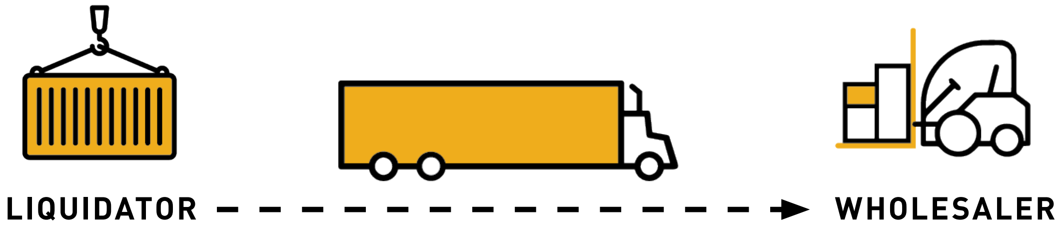


Figure 5. Calculating fuel use for one link in the baseline scenario

Inputs

Link = Liquidator to Wholesaler
Number of units = 65,819
Average unit weight = 4.7 lbs.
Distance = 564 miles
Mode = 53’ truck
Loading = 10,824 lbs.
Fuel efficiency = 6 mpg

Calculations

Fuel Consumption per Truckload = 564 miles / 6 mpg = 94 gallons diesel
Carbon Emissions per Truckload = 94 gallons x 10.13 kg CO_2/gallon = 952.2 kg CO_2
Average Unit Load Share (%) = 4.7 lbs. / 309,349 lbs. = 0.0015%
Impact per Unit = (952.2 kg CO_2 x 0.0015%) = 0.0145 kg CO_2

The model measures fuel use for each pathway and then aggregates fuel use for all pathways to estimate total impact for a given scenario.

In the hypothetical flowcharts, 60% of the units bought by the secondary consumer are made in a physical storefront. In-store purchases are a major cause of fuel-related emissions, since consumers buy as little as a single item, whereas truckload shipping efficiently shares the load with thousands of items. The model assumes typical consumer purchasing behavior based on existing studies. Sensitivity analysis was performed to evaluate results with differing assumptions on the breakdown of end consumers purchasing in store versus online. Results of the sensitivity analysis indicate substantial reductions in emissions even with modified assumptions.

WASTE

Waste occurs at nearly every node in the reverse supply chain; items are damaged in shipment, and buyers and sellers dispose of inventory that is expired or unsaleable. Data on the actual amount of inventory that is thrown away in the reverse supply chain is very limited; salvage dealers and retailers do not disclose this information. The estimates used in the impact model are based on interviews with supply chain and wholesale experts, discussions with major retailers, and responses from a survey of bulk buyers aimed at collecting information on waste in the supply chain. The estimates take into consideration the average price point of the unit, the type of good (e.g., electronics, hardlines, softlines), and the buyers and sellers involved at each given node. If additional data on the amount of inventory discarded in secondary markets become available, it will be incorporated into the model.

[7] The emissions from the links between the primary consumer and retailer, and the retailer and the returns center would not be included since they are the same in both the results and baseline scenarios. Impact calculations begin at the Returns Center as that is the node that represents a point of convergence.

CASE STUDY

GROUPON Goods™

In 2014, Optoro and Groupon Goods partnered to manage returned and excess inventory. Prior to implementing reverse logistics software in its own warehouse, Groupon sent all returned and excess inventory to liquidators. Groupon now manages a large portion of its reverse logistics in-house using Optoro's returns management system (RMS).

Optoro applied Groupon's data to the environmental impact model to evaluate changes in waste, fuel consumption, and related carbon emissions. The 'results' scenario uses actual shipment data from six months of activity in 2015, including item weights and destinations using Optoro's platform. The 'baseline' scenario assumes the identical set of merchandise, using the flow of goods determined based on information from the retailer.

The analysis demonstrated a significant reduction in waste and fuel use in the reverse supply chain. **Here are three findings from the analysis:**

FINDING #1:

Waste Decreased by 60%

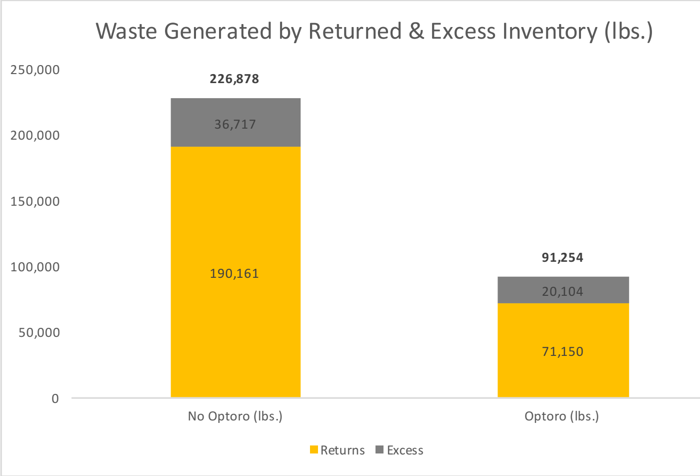


Figure 7. Total waste produced in reverse supply chain before and after Optoro's software

Decreasing the reliance on liquidators reduced the number of shipments, which in turn reduced the likelihood of shipping damage and the likelihood that products expired or became obsolete. During a six month period, this reduced waste in the reverse supply chain by 68 tons.

FINDING #2:

Emissions Decreased by 27%

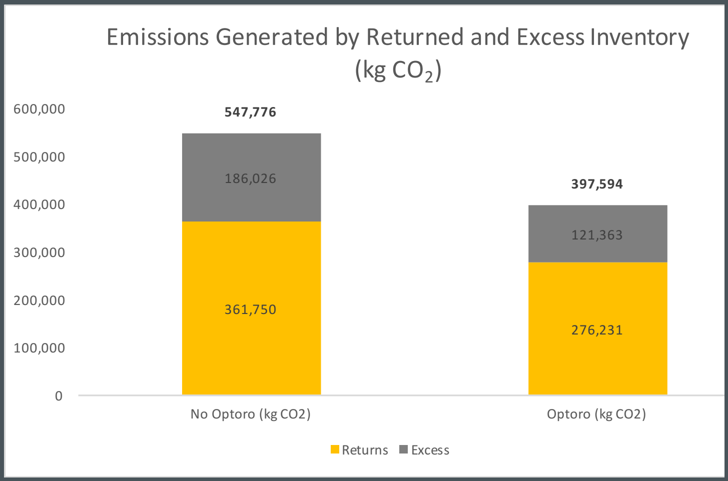


Figure 8. Carbon dioxide emissions measured before and after using Optoro's software.

Transportation efficiencies reduced fuel use by 30% and carbon emissions by 27%. By selling more goods directly to consumers, Optoro cut out the extra touches involved when reselling to wholesalers or resellers. With Optoro, fuel used in the reverse supply chain decreased by 18,161 gallons, the equivalent to 357,844 miles driven by passenger vehicles.

FINDING #3:

Over 15% more goods were sold to consumers

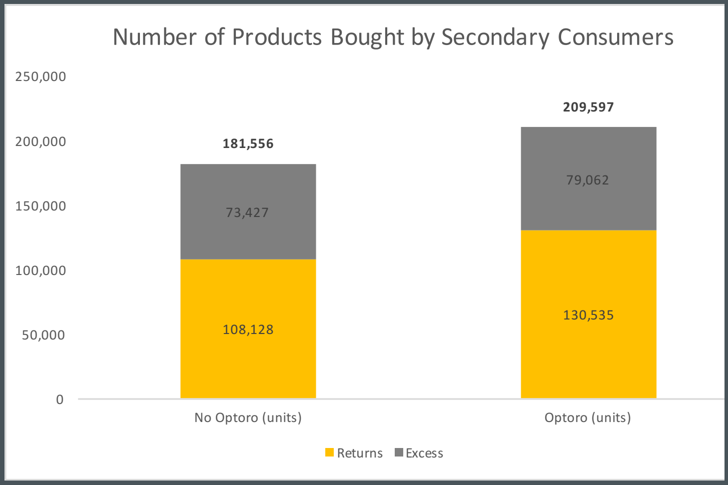


Figure 9. The number of products that ended with a secondary consumer before and after using Optoro's software

In the baseline scenario, 21% of inventory was disposed of or recycled. Using software, 91% of the returned and excess inventory was resold to secondary consumers. Putting products in the hands of consumers means a longer product lifespan and less landfill waste.

CONCLUSION

The status quo for managing returned and excess inventory in the retail space is a source of significant waste and inefficiency in the supply chain.

The traditional returns process creates over 4 billion pounds of waste each year in the US alone; given the increasing volume of returned and excess goods, that number is sure to grow steadily in years to come. With new technology now available, retailers have a huge opportunity to update processes and systems for managing reverse logistics and to reduce these environmental impacts. Optoro has demonstrated its ability to reduce waste in the reverse supply chain by up to 60% as outlined in the case study above. The analytical modeling tools are flexible enough to measure carbon and waste savings for retailers of any size.

Sustainability professionals working in the retail and manufacturing space are encouraged to engage with warehouse and reverse logistics professionals to begin examining downstream impact of returned and excess inventory. Greater financial recovery, less waste, and lower emissions are all potential benefits of better technology and efficient processes. A holistic system to manage this inventory is a critical part of supply chain sustainability.

Optoro, Inc. is a technology company that is transforming the way retailers process, manage, and sell their returned and excess inventory. Through comprehensive, world-class data analytics, Optoro's software platform determines the best path for returned and excess goods, maximizing recovery value, enabling consumers to get great deals, and reducing environmental waste. Optoro, BLINQ™, and BULQ are trademarks of Optoro, Inc. and may be registered in certain jurisdictions. Founded in 2010, Optoro is based in Washington, D.C. and Maryland.

For more information, please visit **www.Optoro.com**
and follow us on Twitter at **@optoroinc**.

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APPENDIX

A. NODES

The nodes in the model include the following:

Distribution Center: a centralized facility where a retailer or manufacturer collects, sorts, and distributes inventory.

Liquidator: a person or entity who buys large quantities of goods directly from a retailer, usually in mass quantity and at heavily discounted prices.

Wholesaler: a person or entity that buys large quantities of goods from vendors or liquidators and sells them to resellers.

Vendor: the original manufacturer of the product. Retailers often have contracts that allow them to return a portion of returned and excess inventory back to the vendor.

Reseller: a company or individual who purchases goods with the intention of selling them rather than consuming or using them.

Storefront: a physical location where consumers purchase goods.

Secondary consumer*: an item is purchased either “in store” or “online” by a customer.

Dispose*: the item is discarded and sent to a landfill.

Donate*: the item is given away for charitable purposes and/or to benefit a cause

Recycle*: the item is not resold, but sent to a processor to be converted into a reusable material.

***** These nodes represent end nodes. Any impact that the product has after an end node is outside the scope of the model calculations.

B. TRANSPORTATION LINKS

Below is a list all of the transportation modes used in the model and their associated typical loading (weight) and fuel efficiencies (miles per gallon).

Personal vehicle: Automobiles that have an average fuel efficiency of 23.4 [8] mpg. Each personal vehicle has a loading capacity of 2 unit.

Parcel: An intermodal method of transport comprised of delivery trucks, dry vans, and/or airplanes. The average weight of a typical load across these modes is 3 tons. The average fuel efficiency across modes is 8 mpg.

Full Truckload (FTL): A 53” dry van containing 24 pallets and weighing an average of 5.4 tons. [9] The fuel efficiency of this heavy truck is 6 mpg.

Less than Truckload (LTL) : A 53” dry van containing 24 pallets from a variety of freight shippers. The typical load is 4.1 tons [10] and the average fuel efficiency is 6 mpg.

Straight Truck: A 26” truck used for local (<200 mi.) deliveries. Also known as a box truck, this vehicle has a typical load of 2.7 tons and fuel efficiency of 6 mpg.

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[8] Federal Highway Administration, "Highway Statistics 2013, Table VM-1," January 2015 http://www.fhwa.dot.gov/policyinformation/statistics/2013/vm1.cfm

[9] The typical loading of a full truckload used in the model is 5.4 tons (24 pallets X 451 lbs. per pallet). The pallet weight estimate is based on historical data of inbound shipments and outbound shipments from Optoro’s shipping facility in Lanham, MD. The EPA Smartway data estimates a typical load at 17.9 lbs. The difference in loading is due to the lightweight retail merchandise that is being modeled.

[10] EPA Smartway data reports LTL loads as being 27% lighter on average than full truckloads. We apply this same proportion, to factor down our full truck load weight to reach an average LTL load of 4 tons.

APPENDIX (CONT'D)

C. METHOD FOR CALCULATING CARBON EMISSIONS

Step 1: Calculate fuel consumption

The basis for estimating emissions from fuel use starts with a calculation of fuel consumption (gallons) by dividing the vehicle distance traveled (miles) by the fuel efficiency (mpg) of the vehicle type:

Fuel Consumption (gallons)=(Vehicle Distance (miles))/(Fuel Efficiency (mpg))

Step 2: Convert fuel consumption to carbon emissions

Next, to find the total emissions for each link, the fuel consumption is factored by the rate of emissions for each gallon of fuel combustion:

Emissions (CO_2)=Fuel Consumption (gallons) x Emissions Factor (CO_2/gallon)

Step 3: Assign fraction of fuel use and emissions to each item

The emissions estimated in steps 1 and 2 are for the transport of the entire vehicle and its cargo. In the final step, the emissions are allocated to each unit of cargo on board based on the relative share of the total cargo loading.

Fuel (gallons) x Load Share (%)= Fuel per item (gallons per item)

Emissions (CO_2) x Load Share (%)= Emissions per item (CO_2 per item)

The load share is calculated for each item based on the most logical metric for each retailer, either tons, volume, pallet loading, or units per vehicle. This approach provides greater transparency and flexibility compared to using an off-the-shelf "ton-mile" factor.

Load Share (%)=(item count)/(items per vehicle)

(note: Load Share is calculated similarly based on either weight, size, or count)