

THINKING BEYOND RECYCLING

A CASE STUDY OF CORRUGATED CARDBOARD SHIPMENT
BOXES THROUGH THE CIRCULAR ECONOMY LENS



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0. WHAT IS THIS REPORT ABOUT

SCOPE

This report studies the Indian supply chain and ecosystem w.r.t corrugated cardboard shipping boxes. This report compares the existing linear supply chain of packaging boxes with the circular economy approach and highlights challenges associated with the circular logistics – storage, retrieval, and tracking of packages in the closed loop. The report also presents the results of our circular logistics pilot case study conducted in Delhi-NCR. Though the case study presented in this report has been developed around shipment boxes, the **broad challenges related to reverse logistics infrastructure** are fundamentally similar across many other reusable product categories.

The report touches upon the need for a multi-stakeholder approach with the partnership and participation of small-scale industries, nonprofit organizations, and the informal sector to come together and take bold steps towards building circular logistics infrastructure in India.



WHY CORRUGATED BOXES?

Corrugated boxes are considered “eco-friendly” as they are recycled; however, **they are used only once before being discarded** most of the time. In other words, the supply chain that moves the shipment boxes is linear by design. We observed that the creation of the shipment boxes itself is not entirely aligned with circular economy principles, which eventually promotes single-use behavior.

Each year, millions of cardboard shipment packaging boxes are produced. But cardboard fibers can't be used indefinitely. A new fiber can survive seven pulping processes before becoming useless. This take-make-waste approach is characterized by poor circular logistics infrastructure that depletes the world's natural resources and produces waste and greenhouse gas emissions. In addition, the requirement to cover a constantly growing globalized demand sustainably implies adequate and efficient supply chain operations management.



1. A BRIEF INTRODUCTION

Corrugated boxes are most extensively used for goods packaging and transporting. With the massive growth of the retail market and supply chains, which employ packaging in a single-use model (for simplified logistics), shipment boxes have significantly grown over the last ten years. The primary raw material used for producing these boxes is wood and non-wood pulp extracted from – bagasse, bamboo, groundwood, straw, and waste paper—the ultimate source roots down to plants and trees.

Undoubtedly, the paper industry has demonstrated leadership in responsible production. Today most of the corrugated boxes in India are manufactured using recycled paper, which is an excellent first step toward sustainability; however, if we see through the lens of a circular economy, the shipment packaging industry seems to be quite far from achieving true circularity.

This report examines the following:

- Significant gaps in the existing recycling economy through a systems approach.
- The untapped potential of “ReUse.”
- Key barriers and challenges for achieving circularity.

Today, Corrugated cardboard boxes (CCB) carry approximately 95% of all products shipped in India.

Corrugated cardboard boxes are considered eco-friendly as they are ‘bio-degradable.’ What caught our attention was that it is always claimed that these CCBs are ‘recycled’ – which masks the fact they become ‘waste’ after a single use.



1.1 THE COST OF RECYCLING

Recycling as an industrial process has the following major costs and impacts:

A. COST OF PRODUCTION

Raw materials and energy costs represent over 75% of the total cost of corrugated boxes. Therefore it is indispensable for manufacturers to reduce the cost of the product at the early stages of product development while remaining competitive at the same time. On the other hand, enough raw material sources for paper are unavailable in India to meet the industry demand. Moreover, coal and electricity prices have risen to their highest levels in decades.

B. COST TO ENVIRONMENT

Indian paper companies import pulp and waste paper to compensate for the raw material deficit. This deficit can be mainly attributed to deforestation and increased wood demand from other industries like construction, plywood & MDF board, bio-energy plants, etc. Our estimates say 128 million trees are still being cut annually to meet the demand for tertiary-level corrugated packaging alone.

C. Cost to Economy and Society

The positive trend toward increasing dependence on imported resources and increasing demand from Indian consumers has raised a red flag. 50% of the corrugated box industry is still MSME or unorganized. Even a minimum disruption in this supply chain due to climate change-induced disasters and international trade policies has historically put this group under substantial financial stress.

2. THE BROKEN SUPPLY CHAIN

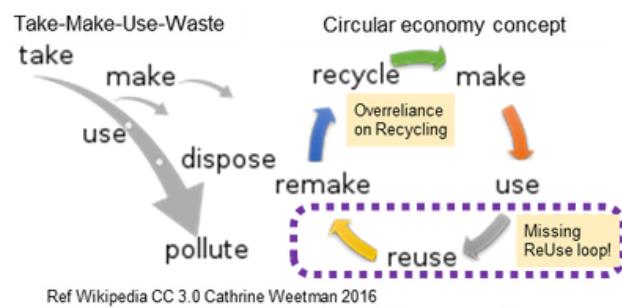
Shipment packaging is intended and applied as single-use. At the end of the delivery cycle, the material is treated as 'waste' and has only scrap value. i.e., 90% value of the packaging is lost at the end of the supply chain. We carried out a field study to understand the state of the current supply chain.

Our study found that 95% of the tertiary level packages are discarded after a single use; It is also estimated that around 5% of the packaging at the end of the chain is diverted for alternative use as it cannot be routed back to the manufacturer because of the absence or high cost of reverse logistics. These boxes are used commercially by movers and packers and in some closed supply chains. However, the scale of operations is tiny compared to the number of packages produced annually.

The packaging material discarded is mainly collected by rag pickers and aggregated at scrap dealers, from where 63% are routed to paper recycling mills. And the remaining end up in landfills.



Conventionally, Today's Shipment Packaging is intended as single-use. At the end of the delivery cycle, 90% of packaging value is lost.



Ref Wikipedia CC 3.0 Cathrine Wheetman 2016
with the Authors comments to illustrate the overreliance on recycling

Figure 1: comparing the take-make system with the circular economy concept, highlighted with the authors comments

In summary, the Supply chain today comprises of only the forward value chain from manufacturers to retailers to consumers, post which the material is 'waste'.

- 95% of CC Boxes are discarded (to scrap) after a single use. (the remaining also eventually end up as scrap)
- They constitute low-value waste, which Scrap dealers collect.

From the Scrap dealers

- 63% is traded for recycling
- 32% end up in landfills

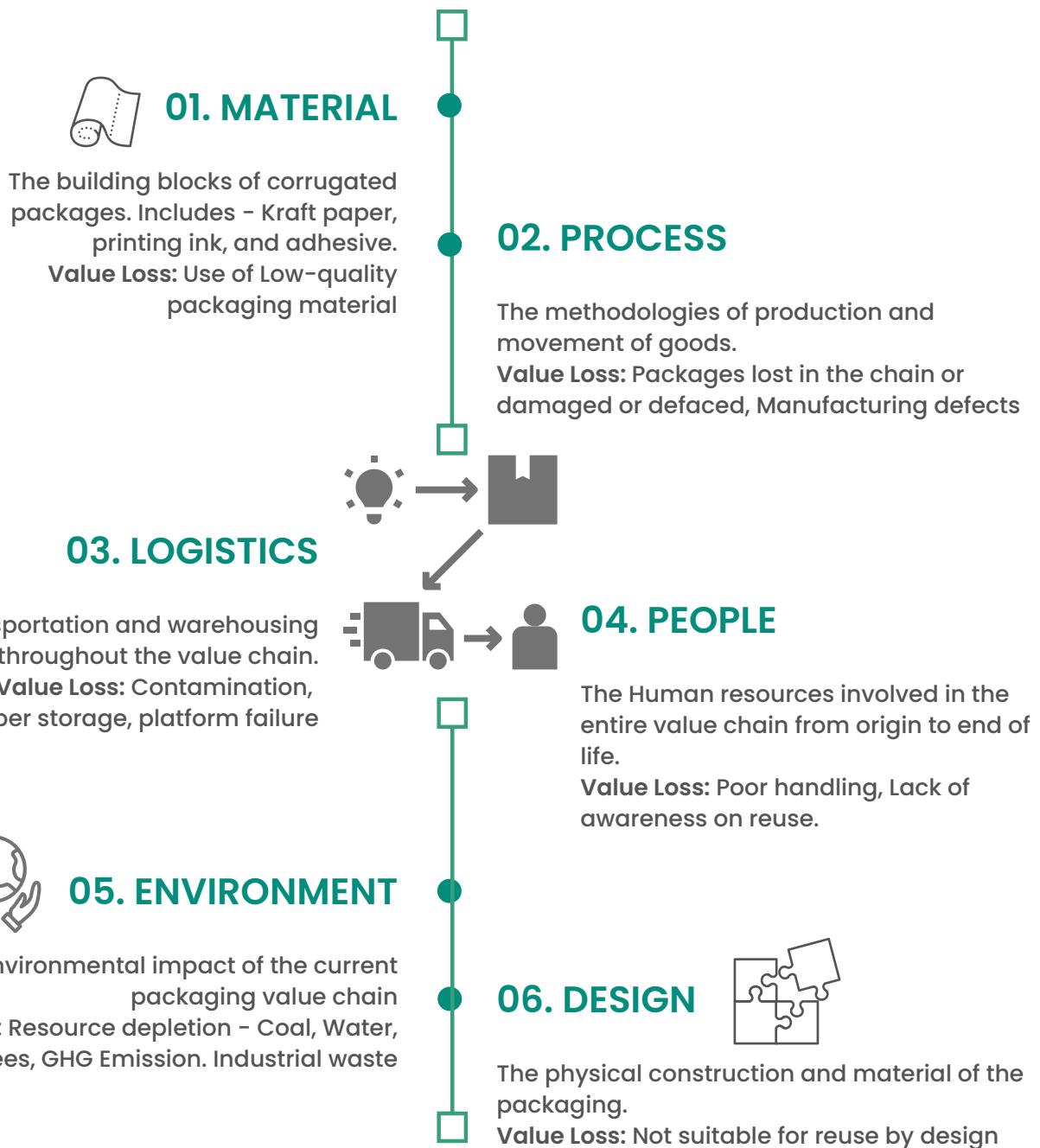
Hence, this supply chain is indeed a 'broken' one, as it (packaging material) ends up as 'waste' after a single-use. This 'waste' is then taken into the recycling process.

To address this 'broken supply chain' - the return loop or reverse logistics has to be activated that addresses the return of material for reuse rather than recycling.

Instead of developing a dominant recycling economy, waste avoidance should be activated through design for reuse and cost-effective circular logistics.

3. PACKAGING VALUE CONCEPT

6 key dimensions that contribute to packaging value and associated value loss potential are identified.



4. THE RECYCLING ECONOMY

We discuss the flow of material for manufacturing corrugated cardboard boxes, and its high reliance on recycling.

The current state of the material flow in the linear economy misses out on the core concept of waste prevention, which has been entirely ignored in the overall design of the value chain, in favor of recycling after a single use.

In manufacturing paper-based corrugated cardboard boxes, wood and non-wood-based pulp are the primary raw material when traced to their origin. However, in practice, the material supply chain relies highly on sourcing recycled material from domestic scrap and imports. Figure 2 depicts the current flow of material used in paper manufacturing and thereon to paper-based corrugated cardboard packaging. The packaging industry relies highly on the paper recycling mills for the input material. And at the other end, the disposition of used packaging as scrap is partly to recycling.

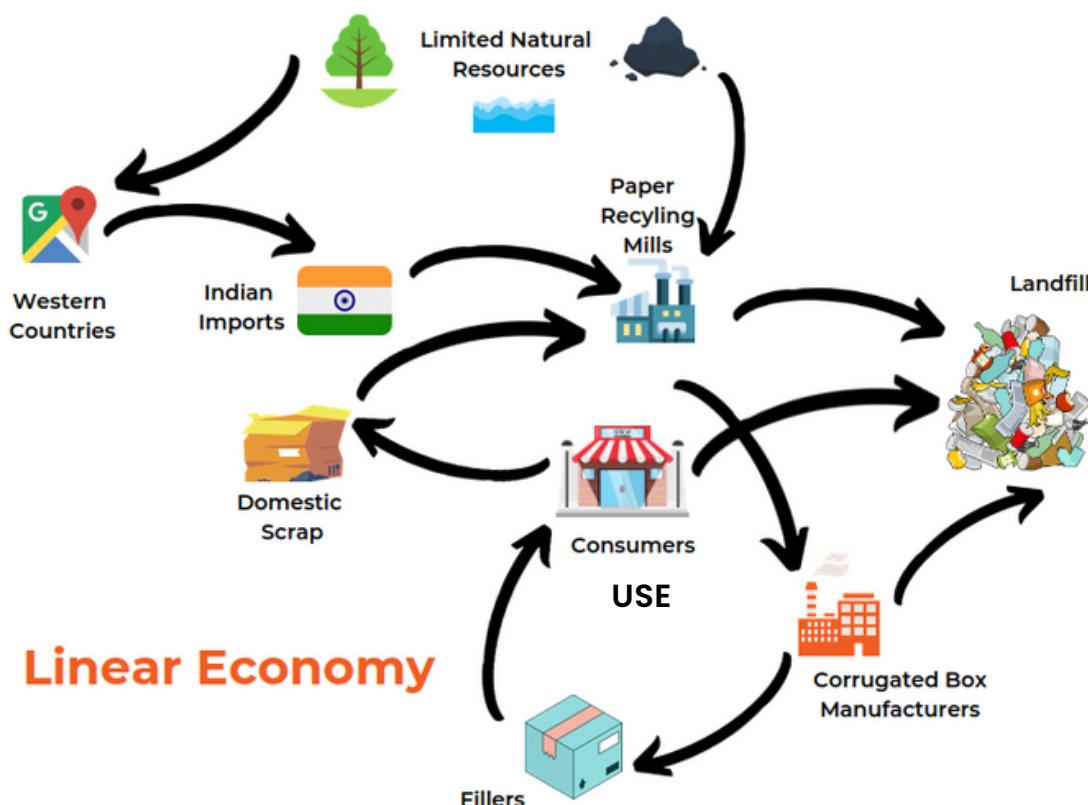


Figure 2: Flow of material (wood pulp) in linear economy

According to our conservative estimates, 37 % of the material in the value-chain for CCBs including the waste from recycling mills ends up as waste into the landfills or incinerated every year.

Further, as per our analysis, in the year 2020–2021, the corrugated box industry processed around 7.5 million tonnes of waste paper, manufactured 6.7 million tonnes of shipment boxes, consumed ~1148 million kWh of electricity, and 750 million cubic meters of water, which translates to about 58 million tonnes of direct CO₂ emissions. However, further study may be required to calculate the exact size of the problem.

5. THE CIRCULAR ECONOMY PERSPECTIVE

The circular economy is based on three principles:¹

- Eliminate waste and pollution
- Circulate products and materials (at their highest value)
- Regenerate nature

The current scenario with the high focus on recycling is unbalanced and far from circular. As discussed in section 1, the business of recycling is struggling in many areas. This may force brands to adopt other sustainable packaging options in the near future. For example, consumers are often unaware of how to take the extra steps needed to reuse or return packaging products or unwilling to change behaviors as there are no apparent benefits.

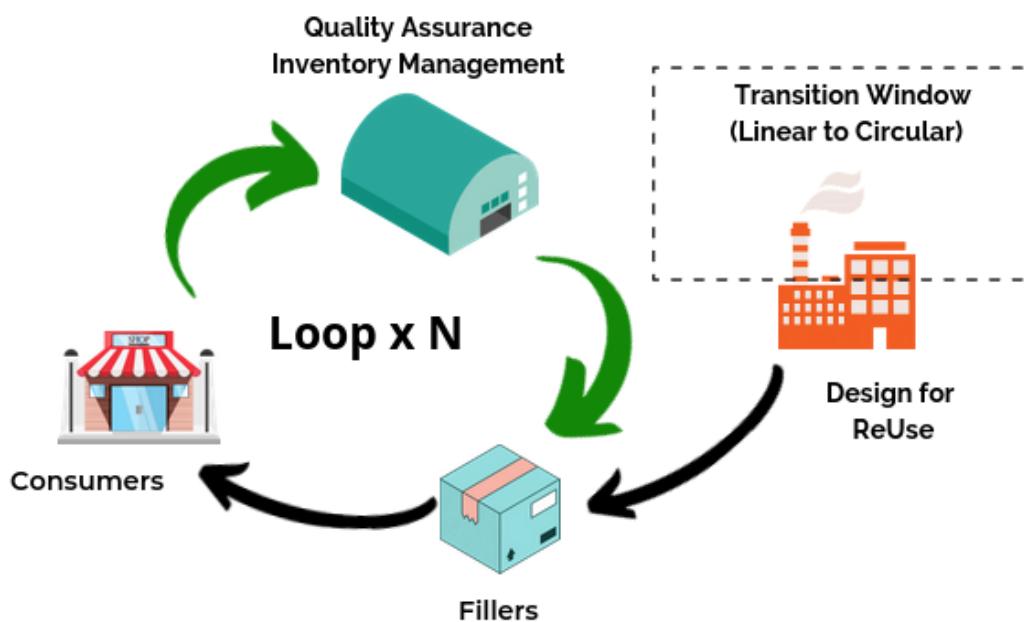


Figure 3: Looping shipment boxes in circular economy

To shift to a circular economy, the circular logistics infrastructure is vital. The adoption of circularity also has to be sustained by design. As depicted in figure 3, a circular transition period called "Transition Window" is required to achieve a circular economy of shipment boxes. During this transition period, shipment boxes are designed to last longer than standard boxes intended for single use. To circulate the packages to their highest value, all the stakeholders in the value chain must agree to adopt ReUse as a standard practice.

The limited diffusion of packaging as a service model is due to high reverse logistics costs and the absence of infrastructure to support the large-scale exchange of quality assured packaging. However, building a circular logistics infrastructure has its challenges discussed in section 8. These challenges can be addressed when the industry looks at sustainability through a systems approach (involving multiple stakeholders in the value chain) instead of a material-centric view. However, this would also mean making a fundamental shift in market behavior and consumer perception.

The business impetus for enabling the circular approach: Changing the circular economy by retaining the material value is potentially gainful for the business. However, to facilitate the return and reuse and sustain it, it has to share and incentivize the stakeholders, including the informal players in the current scenario, like the scrap dealers and ragpickers working in the society.

6. A CIRCULAR LOGISTICS PILOT

We conducted a pilot study to simulate a circular logistic network in operation, with the return and ReUse of shipment boxes.

The objectives of this study were:

- 1) To measure the efficiency of the return and ReUse loop.
- 2) To perform a comparative analysis of the performance of
 - a) packaging "as-usual" (normally single-use) versus
 - b) packaging with minor improvement boxes.



The circular logistics pilot worked as follows:

- Forward loop: The boxes were filled, loaded, shipped, and unloaded (emptied);
- Return loop: The empty boxes were flattened and returned back.
- Returned packaging was quality checked to eliminate damaged and non-fit-for-reuse.
- The forward-return loop was repeated three times. The ReUse rate (% of boxes return and ReUsed) was measured.

The results of the pilot are indicated in figure 4.

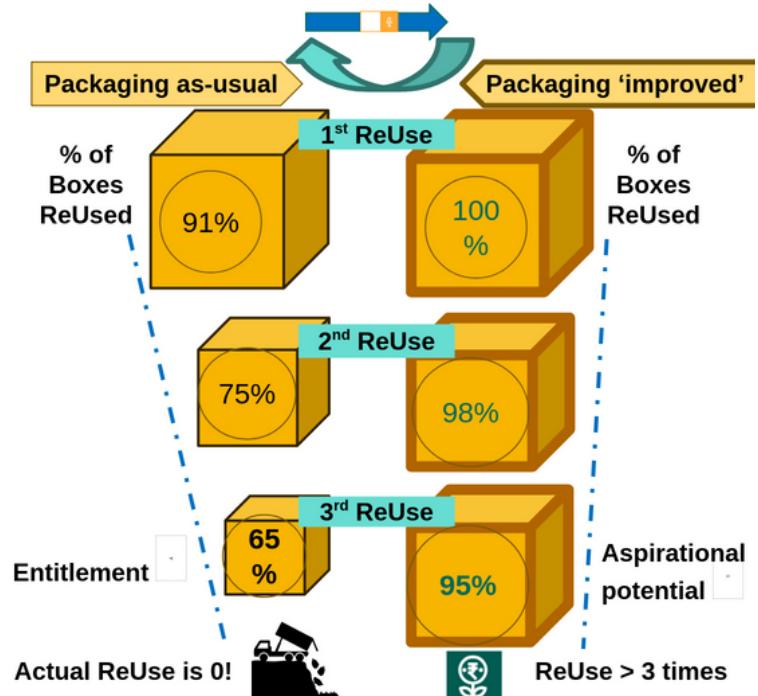


Figure 4 : Summary of the Circular logistics pilot and Comparative analysis of packaging performance

Entitlement level with Packaging-as-usual by ReUsing is at least 65%, More than 3 times.

With simple Packaging-improvement for ReUse, 95% can be ReUsed more than three times - this is the aspirational potential.

The pilot demonstrated the performance of shipment boxes in a closed circular loop and proved its feasibility and the entitlement level, an opportunity which is being missed in as-is scenario.

7. CHALLENGES TO CIRCULAR LOGISTICS

The major challenges faced in implementing a circular logistics system.

1. QUALITY CONTROL

Screening every returned as per respective industry standards.

2. HANDLING

Returned packages are often damaged during loading/unloading

3. TRANSPORTATION

Wide geographic dispersion of returns increases the transportation cost

4. STORAGE AND RETRIEVAL

Design of storage layout and retrieval mechanism for returned goods is a challenge

5. DESIGN FOR REUSE

The general design of the shipment boxes has not evolved over the past 40 years.

6. INVENTORY OPTIMIZATION

Inventory management of returned products to optimize cost

7. LACK OF INCENTIVE FOR REUSE

The Stakeholders in the system lack sufficient incentive to return & reuse the packaging. The current scrap-value system is very low value, and oriented toward recycling.

8. KEY POLICY ACTIONS

Policy action in key areas is needed for driving the transition to circular economy by enabling the circular logistics.

Circular Logistics (CL) is the lifeblood of a circular economy that can keep products and materials in use for as long as possible. Developing CL infrastructure across all sectors and value chains will be crucial to building resilient, net-zero cities.

The challenges associated with implementing CL are also unique. For example, we have identified three policy areas that need immediate attention for a smooth circular transition of shipment boxes.

Policies to encourage the reuse of shipment packaging in trade & commerce and industry.

Policies to incentivize brands and manufacturers to adopt qualitative and design measures for durable and reusable shipment packaging aligned with the circular economy principles.

Policies to bring down the cost of circular logistics.

Policies to promote innovation and R&D in circular logistics and circular product-packaging design.

Establishing a 'circularity index' to track and monitor the performance, and sustain it.

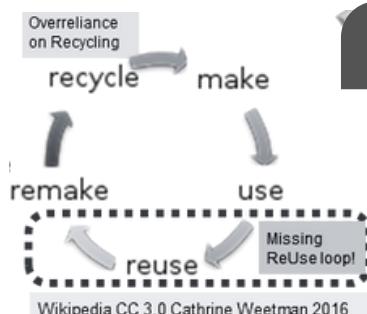
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The circular economy model is designed as to retain as much value as possible from resources and products by allowing for long life, optimal re-use, reduce, refurbish and remanufacture.

”

9. CONCLUSION

The Report covers Insights about the current take-make-waste scenario with CCB shipment packaging and what if and how to turn towards a Circular Economy.



1

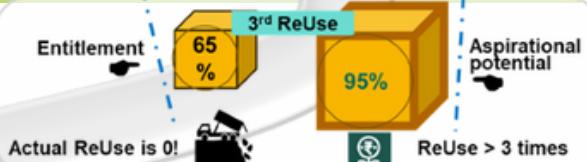
Recycling is over-relied upon as a 'sustainable' solution. ReUse', one of the Primary loop of the circular economy framework is missing in today's scenario.

2



The What if case for ReUse with Circular logistics

The pilot done for circular logistics with reuse proves that it makes business sense:
•Cost Advantage + Sustainability impact



3

The Turn towards Circular economy

Circular Logistics can redefine behavior along the value chain.

- realize "Value," not "Waste,"
- generate buy-in to ReUse
- focus on design for ReUse.

Fundamental shift in market behavior and consumer perception

4

Need: Policy framework and Incentivization to support the transition to Circular Economy.

- Mandate Design for 'ReUse'
- Promote ReUse and Circularity
- Incentivize ReUse



5

The Business impetus for circularity

- Adopt Design for 'ReUse'
- Generate Savings from ReUse
- Brand premium
- Incentivize & Share Rewards

6

Monitoring and assessment framework is needed to measure sustainability actions and impact..

- 'Circularity index'



7

The Report has insights on the case of shipment packaging and makes the case for promoting circular logistics and reuse.

Further, these insights have potential to be applied across a broader canvas.

THE WAY AHEAD

Potential for Action to drive across all Markets, Business models, and Products.
The Alarm is ringing and calls for action across the Globe.

10. WAY AHEAD

Climate change is real and severe - and it's happening at an alarming rate. For example, the Indian subcontinent witnessed an unprecedented heatwave, leading to around 60 degrees celsius over several pockets in the first week of May 2022. Moreover, such changes and weather anomalies, and catastrophic events have been happening across the World. The escalating trajectory of climate change-induced disruptions severely affects global supply chains. Moreover, it threatens material security across several major material categories (not just paper!).

Therefore, a shift from material-centric sustainability to a system-centric approach toward sustainability is the need of the hour. Governments, industries, and institutions must act decisively and cohesively for the circular economy shift. In this context, Sankalp Circular For Zero Foundation contributes to this by working as a **catalyst for developing circular logistics** models for Indian industries.

Actioning on the findings from the report and insights from the pilot run, CFZO has launched a **Circular Logistics Innovation (CLI) program** to drive the circular economy transition in India.

11. CALL TO ACTION

The objective of CLI is to enable brands to rethink shipment packaging and incentivize stakeholders in the value chain.

In this context, we invite the **stakeholders from industry, academia, government, and non-government institutions, as well as start-ups, corporates and motivated individuals** to support and participate a joint action program undertaken in three stages.

Initiate: Following up on the report, CFZO invites feedback and suggestions on the findings and concepts discussed in the report. In addition, it seeks to engage deeper industry players to address actionable steps and develop the approach.

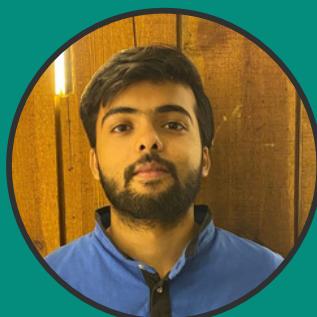
Launch the action-program pilots with key stakeholders to enable circular logistics in the supply chain. Further, catalyze innovation in packaging design—especially design for reuse.

Evolve the program to optimize the model and expand the circular logistics network. Showcase and drive awareness and provide the impetus for adopting circular economy solutions across industry.



12. RESEARCH TEAM

Our passionate and intrepid research team and change-makers



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