

TEAM 11

Sustainable Supply Chain





Overview

OBJECTIVE

Supply chain's carbon footprint has increased significantly due to the pandemic and e-market players prioritizing customer satisfaction and cost savings over carbon emissions. Our objective is to provide a **5-year time-phased plan** backed by data to nudge the members of NAWCI towards a carbon-neutral supply chain by considering efficiency and sustainability in all stages, hence helping India achieve its COP26 summit target.

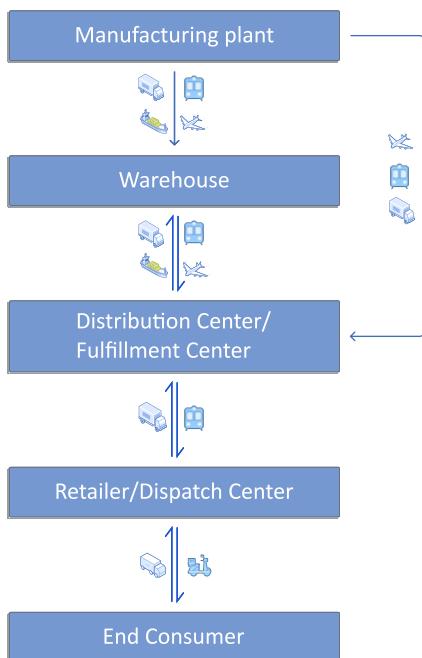
PROCESSES

We have identified stages of the current supply chain specific to the mentioned industries. The four domains-warehousing, returns, packaging, and transportation and their sub-stages were analyzed, revealing their interlinked effects on efficiency and sustainability.

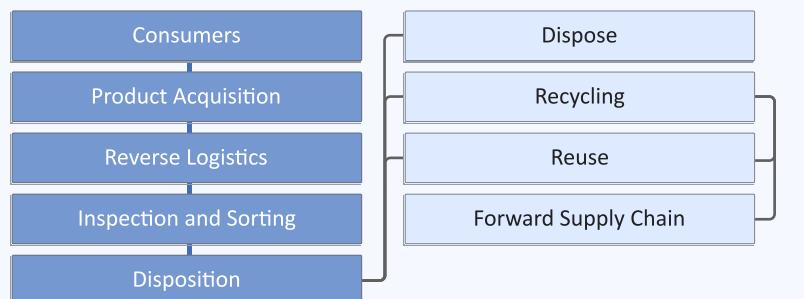
WAREHOUSING



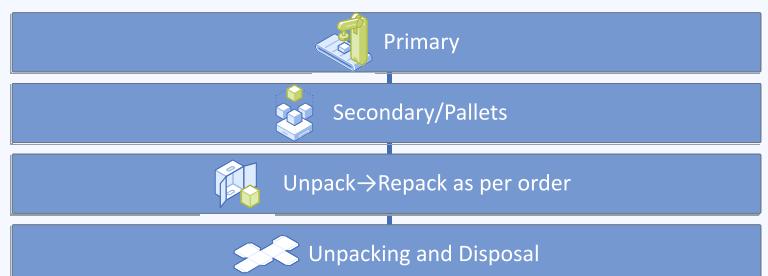
TRANSPORTATION



RETURNS



PACKAGING



SUPPLY CHAIN FLOW

The size of circles represent the relative carbon emissions



■ Warehousing ■ Transportation ■ Packaging

WAREHOUSING

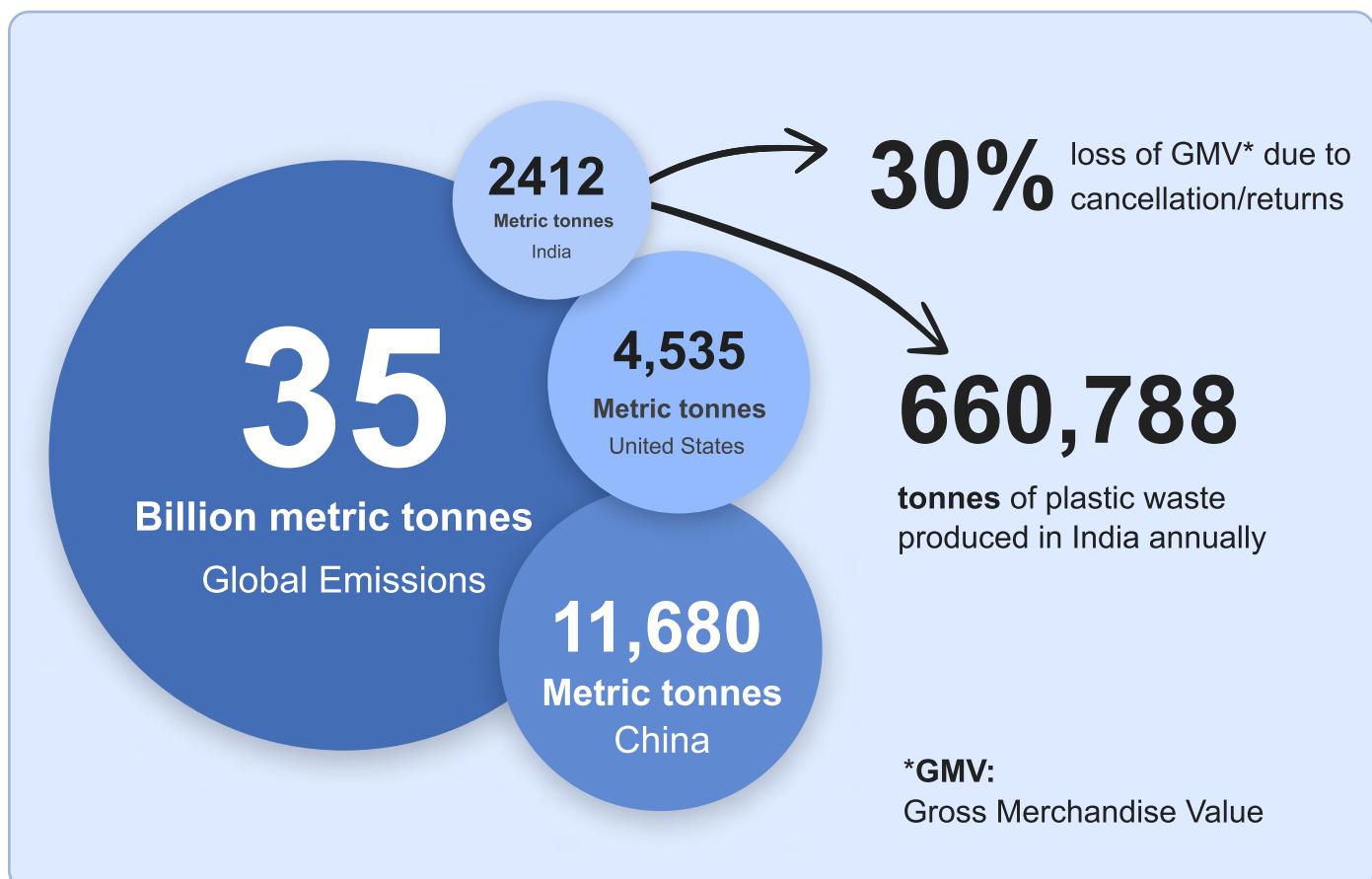
	LACK OF DIGITISATION	LACK OF AUTOMATION	IMPROPER STORAGE UTILISATION
Impact	As the scale of operation increases, productivity is lowered due to data errors.	Manually executed tasks take longer and often creates backlogs in loading and packing.	Lack of real-time data reduces operational efficiency by at least 10%.
Cost	Undigitised processes increase overhead expenses by up to 35%.	Automation at some level is required for most sizes, and can reduce workflow-related emissions by up to 45%.	Improper inventory management can result in expensive but avoidable losses (up to 75%, in energy, labour, etc.).
CO ₂	Physical documents increase operational costs and emit twice as much as digital records.	Stacking effects of human errors (increase in returns, slowdowns etc.) increase overall emissions per product.	Additional emissions of about 23% due to excess energy consumed.
Customer	Customers prefer timely updates that increase transparency, which is only possible through digital channels.	Automated tasks cause minimal damage, reduce product mismatch and provide better customer satisfaction.	Maximising storage utilisation can reduce the time interval between picking and dispatch.

PACKAGING

	SINGLE USE PLASTIC	PACKAGING DESIGN	LACK OF CIRCULAR ALTERNATIVES
Impact	Despite carbon footprint being low, leaching into the ground and water is a key concern.	Current packaging design does not support reusing and is instead meant to be discarded.	Though over 80% of plastic packaging waste can be recycled, out of which over 90% is either incinerated or used for land filling.
Cost	Cheap material for packing, but recycling process is inefficient (9% is recycled)	Current packing materials are very cheap.	Recycling requires high upfront capital costs. Hence it's important to look for other circular methods.
CO ₂	Due to accumulative effects, single-use plastics account for 40% of plastic-related pollution annually.	Individual emissions are low; however high volume of production causes catastrophic effects.	Burning of plastics like PVC/HDPE/LDPE releases toxic gases like dioxins.
Customer	-	Current packaging are hard to open and reuse but customer prefers to reuse packages.	Circular alternatives like 'reuse' would extend the lifetime of the packaging material, saving energy.

TRANSPORT

	UNOPTIMIZED ROUTES IN LAST-MILE DELIVERY	UNUSED TRUCK SPACE	LAST MILE PICKUPS
Impact	Not being able to complete delivery on an already unoptimized route.	Transportation with less than truckload (LTL) will need more resources while shipping to ensure package safety.	As found in increased last mile emissions, pickup speed is prioritized over carbon efficiency.
Cost	Last mile delivery costs account for 53% of overall shipping costs.	Transportation charges can be higher by up to 33% due to low space utilisation.	Multiple driver trips are taken to maximize customer satisfaction and minimize value depreciation.
CO2	Due to the pandemic and surge in online sales, a hit and trial approach was followed, increasing the emissions by 25%.	Carbon emissions per product sold will be higher due to absence of full truck loads.	Reverse logistics lead to increased carbon emissions.
Customer	Customer retention is often driven by shorter delivery times.	-	Customer satisfaction is maximized. 92% of customers are retained if good returns experiences are provided.

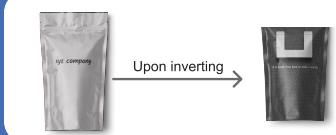




Convertible Delivery Bag

PROBLEM

Packaging materials are directly sent to landfills or are incinerated without recycling or reusing, which shows lack of a circular packaging supply chain.



IMPACT METRICS

Carbon Emissions

21%

curbed per delivery

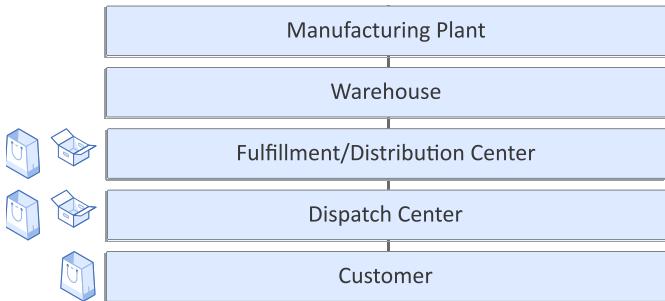
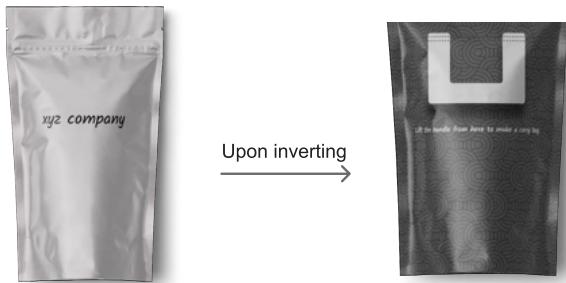
Costs

10-20%

increased

SOLUTION

- At the fulfilment centre, we put the product in a plastic bag inside a compressible, recyclable cardboard box while transferring the product from the warehouse/ fulfilment center to the dispatch center.
- The cardboard boxes are for extra protection for the forward journey.
- The cardboard boxes will go back to fulfilment centres in the return journey and will be used multiple times in a cycle before being recycled.
- The plastic bags with products in them are delivered from the dispatch centre to the customers which can be converted into reusable handbags by the customer by just inverting the package.
- Plastic bags will have an attractive design to lure customers into re-using them.
- If the product is somewhat fragile, we will add a layer of padding to ensure the product's safety.



STRATEGIC FIT

Feasibility and Adaptability

Financial:

- Invest in design and production of new plastic bags.
- Spend on educating customer to adapt our system.

Operational:

- Hiring and training workers to put plastic bag into the cardboard box and later separate the bag from the cardboard.
- Delivery person has to collect the returned bags.'
- Management of returned cardboard boxes.

Flexibility

In case of a financial crunch, companies may hesitate to spend on an extra layer of packaging.

Sustainability

With regular R&D, we can keep improving and reducing expenses to inculcate more sustainable materials.

Impact on market

- Customers get an attractive, durable bag. Green Points can be availed for various benefits by returning it to the delivery man after usage.
- Extra effort and cost goes into separating the bag from the cardboard package and then sending the carboard back.

Ease of integration

- Cardboard boxes are brought back to the fulfillment center by placing them in trucks returning from the dispatch centre.
- Workers need to ensure proper and efficient unpacking so that cardboard can be reused multiple times.
- Extra effort goes into packing a product in 2 packs (once in plastic bag and then in cardboard box) at the warehouse/fulfillment centre.
- Extra effort goes into separating the bag from the cardboard at the dispatch centre. Initially, the customer and delivery guy will have to adapt to the new system of returning and reusing the packaging.



Last Mile Optimization



PROBLEM

- Delivery drivers are racking up more miles which leads to higher carbon production.
- Drivers face an increase in **idle time**, a high number of missed deliveries due to **unavailability of consumers** at a given slot.

IMPACT METRICS

Carbon Emissions Reduced

20-25%

Cost Savings

17%

Net Increase in Profit

26%

Unfulfilled Deliveries

100%

avoided (cancelled at doorstep)

SOLUTION

- Customers are allowed to choose a time slot for delivery when ordering.
- They are notified via WhatsApp about the delivery time a day before, thus allowing them to confirm or change their preference.
- It also gives a pick-up-at-dispatch-center choice.
- Missed WhatsApp notifications are pushed for another day and order gets automatically canceled after asking for confirmation through an automated call on the 3rd day.
- An AI-based routing and scheduling software allocates work dynamically by re-routing delivery orders of a given day based on customer preferences, roadblocks and traffic congestion.
- This ensures accurate deliveries, reduces failed deliveries and saves fuel.

IMPACT

- Delivery optimisation software helps the delivery managers keep track of the whereabouts of delivery executives and quickly gain insights into KPIs like delivery success rates, number of delivery delays, and more.
- It boosts the productivity of drivers, keeps tab on their performance and of the number of tasks/jobs they need to accomplish in a given day.
- Modern delivery management software makes logistics operations transparent for customers, and keeps customers abreast with the delivery proceedings through alerts and notifications.

STRATEGIC FIT

Feasibility & Ease of Operation

Financial:

Company needs to spend on technology for app upgrades(delivery person), algorithm integration and cloud storage.

Operational:

- Backend changes in consumer app to include WhatsApp notifications.
- Changes in delivery management technology used by 3PLs and delivery personnel.
- Challenges with internet failure, integrable with consumer app and habits.

Flexibility

Environmental Crisis

Can withstand pandemics because of its digitalised approach.

Financial Crisis

In case of losses, companies may hesitate to spend for data centers and tech on customer satisfaction.

Adaptability

- Driver needs to get accustomed to app changes and real time changes in drop-off locations.
- Customers may find the second notification annoying and question its use.

Impact on market

- Optimized delivery ensures increased profits because of maximum deliveries per day and improved customer acceptance because of informed deliveries.
- Expenses on fuel and labour goes down due to decreased human error.

Sustainability

Regular updates in software need to be implemented immediately at a cost.



Automating Warehouse and Inventory



PROBLEM

- As the processes are labor-intensive, the movement of goods occurs at slower rates leading to accumulation.
- Inability to find the optimal location to store goods, empty shelves, obsolete inventory, external damage of goods, and zoning and slotting systems optimization concerns hampers productivity.
- Picking constitutes > 55% of the labor costs, and inaccuracy in retrieving the product results in additional expenses.

IMPACT METRICS

Carbon Emissions

2x less

than that of manual management

Cost Savings

30%

due to forecasted demand

Efficiency

35%

improvement in labour utilisation

Data Accuracy

99%+

in picking and labelling

SOLUTION

A personalised, interoperable warehouse and inventory management system that considers storage capabilities, inventory levels, supplier lead times and schedules, seasonal trends, and future campaigns is deployed.

This system would have the following functionalities:

Path Optimization Systems

Generates optimum paths for putaway and picking.

Package Sizing

Suggests optimum dimensions while packing products.

Demand Forecast

Predicts the future stock demand.

Replenishment

Creates alerts for movement between reserve & forward area.

Product Positioning

Finds an optimum position in the warehouse for a specific product considering its type of movement (fast/slow), dimensions, existing quantity, ease of picking.

Performance Tracking

Monitors product performance and creates expiry alerts. Follows a FEFO (First Expired First Out) mechanism to indicate which product should be released first.

WMS can generate algorithms and rules to perform warehouse tasks such as goods allocation, route picking lists and order division.

STRATEGIC FIT

Feasibility

Financial: Cost of IoT devices and cloud storage services, reskilling employees to facilitate easy adoption.

Operational: Additional research on strategic design problems, and relevant data should be incorporated into the training model to suggest the best possible results.

Adaptability

Employee reskilling for the new management system and a complete understanding of better performance rates.

Flexibility

Financial: The model may not be profitable for small scale businesses and might need to be reconfigured if the company opts to change its business model.

Sustainability

The model is sustainable and will provide better carbon savings with increasing demand.

Impact on market

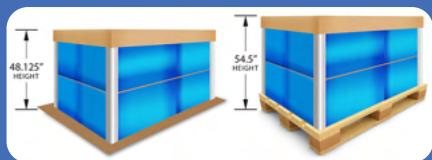
- Customer satisfaction is improved by reducing the cases of product mismatch and increasing product availability.
- WMS allows the management team to integrate processes, provide the best growth strategy with real-time information about buying trends, and make recommendations for improvement.
- Guided systems and paperless operations allow warehouse operators to expedite shipping. Implementing the solution requires less workforce, resulting in layoffs.

Ease of integration

Integrable with supply chain processes like transportation, packaging. Existing machinery in the warehouse can be leveraged to improve operational efficiency.



Sustainable Tertiary Packaging



PROBLEM

- Inefficient utilization of storage space (Transportation & Warehouse), as pallets occupy a large volume (**14.43%**) in transportation trucks.
- Wooden Pallets are heavy and bulky, which adds to the transportation costs.

IMPACT METRICS

Carbon Emissions

20%

reduced because of fuel efficiency

Costs

88.33%

Expense reduced due to pure price of slip sheet

Transport Cost

15%

Transportation cost reduced

Space Utilisation

17%

Increase in the number of corrugated cartons per trip

SOLUTION

- Slip sheets made from recycled cardboard could serve as a functional substitute for pallets.
- Slip sheets can be reused, which increases the circularity of the product & allows replacement of stretch film roll with degradable materials.
- This saves **99.1%** of volume as the thickness of a slip sheet is **1/16th** of a pallet and reduces loading and unloading time by **50%**.
- Nonrecyclable carton stack packing is replaced with recyclable and biodegradable PLA film.



Slipsheet

STRATEGIC FIT

Feasibility

Financial: Purchase of attachments for converting into a push-pull forklift.

Operational: Training workers to operate push-pull kind of forklift.

Impact on market

As load per trip increases and onloading and offloading time decrease, stock available for sale increases, and the number of orders completed increases.

Adaptability

Effect on delivery per Stakeholders

Forklift Operators: Workers can quickly adapt to the new forklift with a one-week training program.

Warehouse Staff: Warehouse Staff needs to be trained on the usage of slip sheets.

Sustainability

Using repurposed cardboard ensures no constraint in slip sheet production. Palettes that were eliminated from transport usage are later repurposed for warehouse storage.

Ease of integration

- The stacking of similar-sized shipping cartons on slip sheets is similar to palettes.
- The slip sheet is pushed or pulled by a special attachment, which can be easily added to any forklift truck.
- Extra safety must be ensured in pairing slip sheets with reused pallets to store goods in warehouses.
- Spacious aisles(6-7 inches wider) are needed for modified forklifts to move.

Flexibility

Environmental Crisis

Environmental crises like COVID demand increased sanitization resulting in moisture content damaging the fiberboard slip sheets.

Financial Crisis

Owing to the economic prices of slip sheets compared to the Wooden Pallets, a financial crisis won't impact the usage of slip sheets.



Systematic Waste Management



PROBLEM

- Inefficient disposition of dead stocks, returns and waste generated.
- Average 20% deadstock in FMCG contributes to 16 million tonnes of annual carbon emissions in India.

IMPACT METRICS

Carbon Credits

3.5 tonnes/km of road made

SOLUTION

Repurposing HDPE and LDPE into roads

- Company sends its waste collection from returns and deadstock to the government in exchange for tradable carbon credits.
- While repurposing HDPE and LDPE into roads, 1 km of a road requires 1 ton of plastic waste.
- Road surfaces remain smooth, require lower maintenance, and absorb sound better. They do not absorb water and have better flexibility and better wear resistance.
- Plastic roads last 3x longer than conventional roads.

Flowchart explaining product-wise disposition processes

Food and Beverages		
Packaging is recycled and product is disposed.		Intact deadstock is donated.
Personal Care, Household supplies, Health supplements		
Mostly returnless refunds.	Returns are disposed. Packaging is recycled.	Cleaning products are consolidated and then sold in bulk to warehouses, laundry places, etc.
Paper and Stationery		
Unopened deadstock and returns are resold in secondary marketplaces.	Damaged stationery products can be recycled into roads, fibers, etc.	

STRATEGIC FIT

Feasibility & Ease of Integration

Financial: Expenditure on transport for collection of waste.

Operational: Sorting mechanism needs to be paid for. Waste collected needs to be transported to government centers.

Flexibility

Environmental Crisis

Use Protective Equipment for transport.

Financial Crisis

Transport & sorting are not likely to happen in financial crises.

Political Crisis

Priority roads will be remade using plastic because of time benefits depending on available plastics.

Impact on market

Companies repurpose plastic into cost-efficient roads, receive tradable carbon credits from government and are appreciated by consumers.

Adaptability

- Company needs to divert transport from landfill to government centers.
- Government needs to create space as plastic received increases.

Sustainability

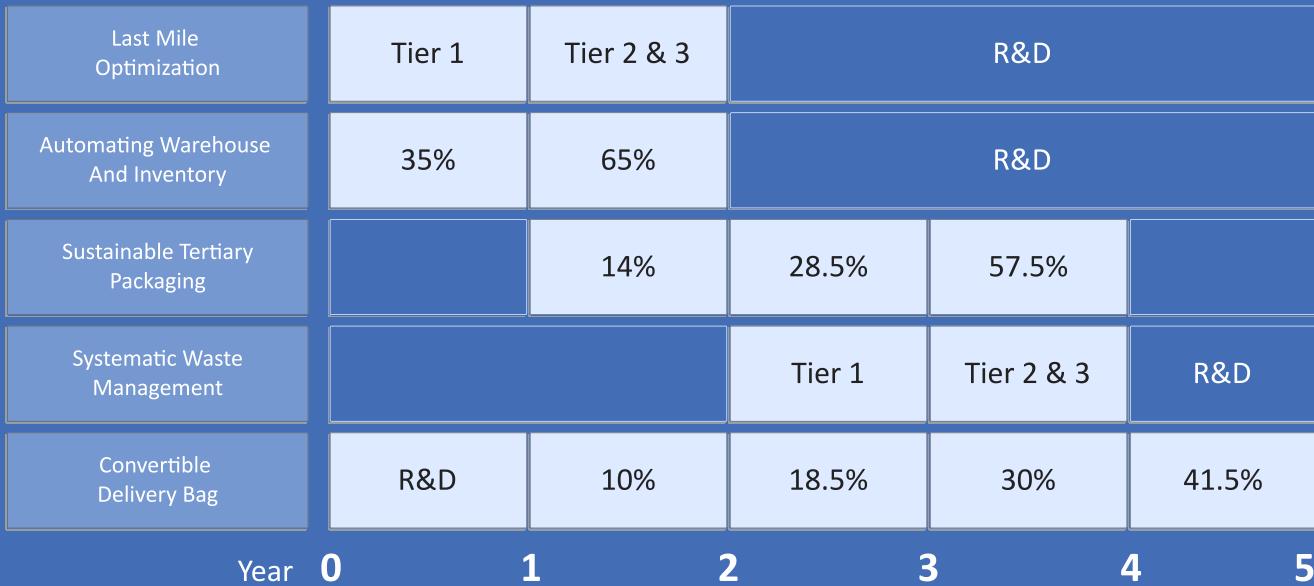
- The components of the road, once laid, are not intact.
- First rain triggers leaching, plastics form a sticky layer.



Timeline



Solution



IMPLEMENTATION PLAN

Sustainable Tertiary Packaging

Year	Grade A 35%	Grade B 50%	Grade C 35%	Total
1	40%	-	-	14%
2	60%	7.5%	-	24.75%
3	-	92.5%	100%	61.25%

Convertible Delivery Bag

Volume Basis/ Year	Type 1 50%	Type 2 35%	Type 3 15%	Total
1				Research And Development
2	20%	-	-	10%
3	30%	10%	-	18.5%
4	40%	20%	20%	30%
5	10%	70%	80%	41.5%

Automating Warehouse and Inventory

Year	Grade A 35%	Grade B 50%	Grade C 35%	Total
1	100%	-	-	35%
2	-	100%	100%	65%

CONCLUSION

An in-depth analysis of the processes in a supply chain was conducted which helped identify the respective problems in them. Priorities were assigned to the problems and the ones with the most pronounced impact were solved. The solutions focused on moving the entire ecosystem towards carbon efficiency with optimizations that have big impact and rethinking core processes of the supply chain. The breakeven points for the solutions were also considered. Overall carbon emissions were reduced while the additional cost expenditure was kept at a minimum.