PROJECT UNTRASH

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TABLE OF CONTENTS

CONTEXT & PREFACE

The Problem of Waste

Packaging waste, especially single-use containers, is the most common waste type that is exerting detrimental effects on terrestrial & aquatic ecosystems, including human health. It is estimated that of all the plastic produced across the world, 80 percent has turned into waste; of this, 79 percent has been dumped in our landfills and dumpsites or has ended up in the water bodies and oceans; 12 percent has been incinerated, and a scanty 9 percent has been recycled; of this 9 percent, only 10 percent has been recycled more than once.[1] It is pretty evident that humans generate copious amounts of waste and our current waste management system is not well equipped to deal with the same.

While the awareness among the population has increased over the years on the topic of waste management, we often find our waste streams unsegregated & contaminated. With policy interventions & establishment of check systems, the overall recyclable collection has increased over the years but the quality, process & contribution is minuscule. With no incentive/ penalty for polluters & no standard operating procedures, we often find waste collection mixed in nature. Waste collected from individuals is often agglomerated and brought to intermediary sites where human labour is deployed to sort & collect valuables from heaps of trash. The current practice is unsustainable, inhumane, and collected recyclables are prone to contamination and lose value post-processing.

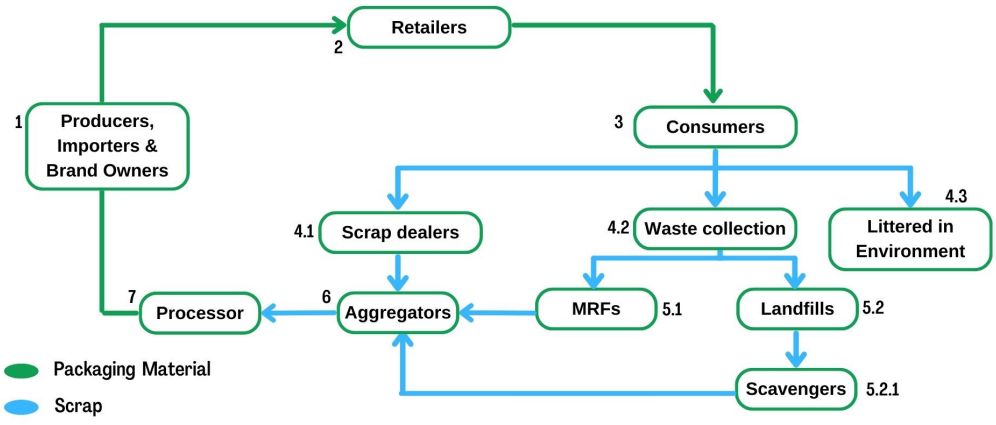


Fig: Material Flow - Current Scenario

The figure depicts the material flow of packaging from producers to the final endpoint. The figure is generalised making consideration of the value chains of multiple waste types. A bulk of our recyclables end up in the waste collection streams or are often found littered in the environment leading to very low material recovery.

Swachh Bharat Mission undertaken by the central government plays a pivotal role in spreading awareness & improving the waste management infrastructure. The Extended Producer Responsibility implementation has provided the struggling recycling industry with additional funds to promote recycling & other waste processing activities. The EPR policy mandates the brand to pay an additional cost to ensure the plastic generated by the producers is collected and processed by the waste industry. The cumulative EPR target of 1.86 million tonnes per annum assures that additional money is spent by brands ($24 to $60 per tonne) for supporting plastic waste management activities.[2] With the changing waste management landscape, the introduction of new sustainable materials, and the recent shift towards a sustainable & circular economy, the conditions are favorable for the introduction & establishment of a Deposit Refund Scheme (DRS).

A Deposit Refund System combines a tax on product consumption with a rebate when the product packaging is returned for recycling. A DRS system can be considered a type of Pigovian tax* that assists in curbing environmental pollution. Simply put, DRS is an additional cost that the consumer bears at the time of purchase that can be redeemed when the packaging material is returned back to the system.

In most of Europe, deposit refund systems have proven to be very successful for the collection of large volumes of post-consumer wastes such as bottles, packaging wastes, batteries, etc. Germany's pfand DRS system boasts a collection percentage of 98% for plastic bottles. With a higher efficiency almost impossible to achieve. Most European DRSs achieve return rates above 90%, diverting significant quantities of beverage containers from disposal and keeping that material circulating in the economy.[3] For a scalable implementation of a DRS system, there is a need for a Digital DRS system that leverages blockchain technology to track all containers within the system in real-time as they move through the supply chain. An open DRS platform would power the economic system by providing a yield-bearing mechanism to set up and upgrade waste management infrastructure as well as an audit trail for the deposits through its activation, deactivation, verification, redemption, and reward.

1

[1] Siddharth Ghanshyam Singh 2021. Plastic Recycling: Decoded. Centre for Science and Environment, New Delhi.

[2] https://eprplastic.cpcb.gov.in/#/plastic/home/main_dashboard

* Pigovian tax is a tax on a market transaction that creates a negative externality, or an additional cost, borne by individuals not directly involved in the transaction. Examples include tobacco taxes, sugar taxes, and carbon taxes.

[3] Reloop Digital Deposit Refund Systems Fact Sheet | January 2022

DRS SYSTEM PILOT AT KEDARNATH, INDIA

Case Study

DRS is a fairly new concept in India. Recykal, a Hyderabad based start-up in collaboration with the district administration set up a closed loop DRS system in the holy shrine of Kedarnath to collect bottles & other packaging waste.
Kedarnath is a holy hindu temple in the middle of steep himalayan mountains that attracts over 15,000 visitors per day, 3,000+ ponies with escorts, safai sathis, security and disaster management teams, licensed shops with workers leading to an overall footfall of 35,000+ each year. Daily solid waste generation was recorded at 10,000 kgs per day and most of the waste was often found littered in the environment.

In this pilot, a scannable QR sticker was put on each bottle or plastic packet by shop owners for identification. An additional deposit of Rs 10 is charged to the consumers and collection centres were established to collect & return the plastic.
The system saw an increase in collection by 54% compared to previous year and was able to divert more than 20,000 items away from the environment. The locals participated actively in collecting the littered bottles and claiming the incentive amount reducing the overall environmental pollution.[4]

Fig: – An overview of Recykal's DRS system

[4] https://recykal.com/2022/06/13/sabka-sath-swachh-kedarnath-through-deposit-refund-system/

PROJECT UNTRASH

For a scalable implementation of a DRS system, there is a need for a Digital DRS system that leverages blockchain technology to track all containers within the system in real-time as they move through the supply chain. An open DRS platform would power the economic system by providing a yield-bearing mechanism to set up and upgrade waste management infrastructure as well as an audit trail for the deposits through its activation, deactivation, verification, redemption, and reward.

For the successful wide-scale implementation of a digital DRS system, the following requisites need to be fulfilled:

1

A multi SKU Model.

2

Tamper proof verification & accounting.

3

Ease of Access for consumers.

4

Incentives for all stakeholders.

5

Assistance from policymakers & administrators.

6

Awareness among consumers.

1

Our system accounts for each of the aforementioned points and provides a DRS system that includes all stakeholders & incentivizes smooth operations & a circular economy. The system is designed to be transparent, scalable, technology-driven, accessible, and self-correcting.

Our technology stack uses blockchain for minting, tracking, accounting, governance & reward disbursal. The DRS system often requires coordination between multiple stakeholders and needs to evolve with the changing landscapes. With the decentralized system methodology, we aim to build a transparent & audit-friendly system wherein the consortium of stakeholders governs and decides the updation of the system.

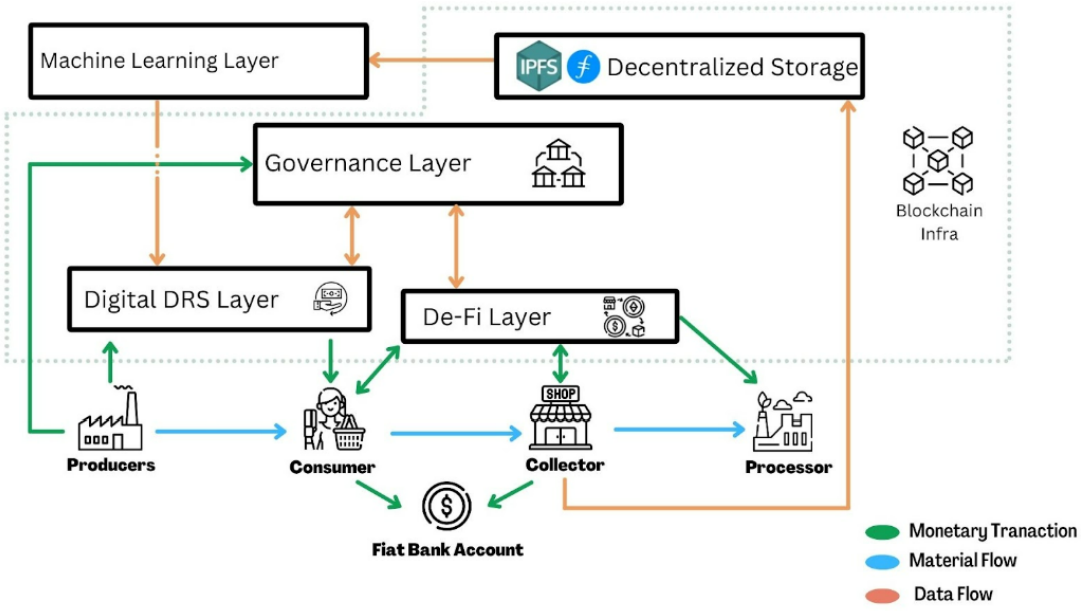


Fig: Untrash DRS System

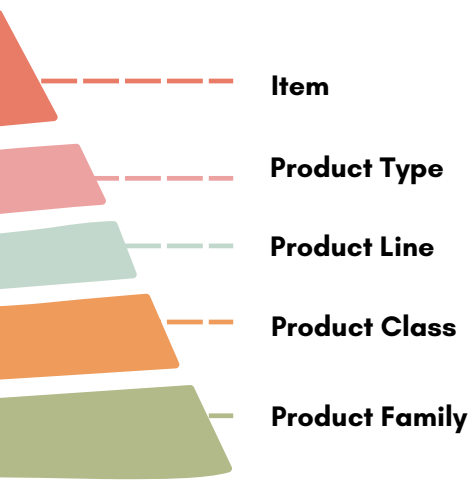
The diagram above visualizes the elements of a digital DRS system and various technologies used in the same. The Digital DRS Layer facilitates deposit & refund transactions. The Governance Layer consists of the producers that manage the validator nodes & incentive amounts. The De-Fi layer leverages the cash flows in the system to assist the waste management stakeholders to develop infra & provides yield-bearing incentives to the consumers. The verification of the material works on the basis of the computer vision model that is updated in real-time as more & more data flows into the system.

While blockchain infrastructure is perfect to host a DRS system, a purely digital system requires computer vision & AI to verify the deposits & ensure no malicious practices are taken. The mass adoption of digital payment interfaces in the country assists the system to disburse refunds seamlessly.

1

MULTI SKU SYSTEM

One system for all product types.



A multi-Stock Keeping Unit (SKU) system is a type of system that is designed to cater to multiple items with the same infrastructure and economic model. Such a system has the opportunity to scale efficiently and leverage the physical collection infrastructure and reverse logistics for ever-improving collection.

The diagram represents the product hierarchy wherein each SKU represents a product type that further needs serialization for each unit of packaging. In the current system, barcodes are used to distinguish between product types but lack a system to uniquely label individual items.

We propose a multi-party system with incentive alignment as a goal across all the stakeholders promotes decentralisation & extends the system to work beyond just plastic bottles & other beverage containers. The system should be transparent about where and when new units enter the system for a particular SKU and should be able to cross check the material entering into the system to the refund disbursal.

Incentive to Standardize

Packaging Materials

For a wide-scale DRS implementation, there is a need for standardization of products packaging materials & pricing parameters for DRS. The use of similar packaging materials by all producers & brand owners for specific SKUs minimizes the complexity of reverse logistics & maximizes processing output.

A good example for the same is the fact that after more than 60 years, Sprite is replacing its iconic green bottle with a white one that is able to be recycled more times and is kinder to the environment.[5]

Deposit Refund Pricing

Deposit prices need to be standardized for each SKU irrespective of producers to maintain fair market conditions for all brands. An approach similar to that of Europe can be taken wherein the price is set based on the following factors:

- **Container Volume**
- **Packaging Material**
- **Reusable or Single Use Type**

The goal of a balanced DRS system is to maximize the collection of used packaging without compromising on product sales & utility.

Reusability

As brands transition towards sustainable practices & reusable/ refillable packaging, a robust DRS system plays a pivotal role in the optimized collection.
A multi-use DRS system saves raw materials, energy, and less CO2 is emitted than with single-use counterparts. Glass bottles can be reused more than 50 times, and PET bottles up to 25 times.[5]

1

[5] https://www.npr.org/2022/07/28/1114242535/sprite-green-bottles-recycle

BLOCKCHAIN & ECONOMIC MODEL

Blockchains are the most useful tool we have for economic coordination in a digital world. Blockchain enables the creation of systems that reward constructive behavior and penalize destructive behavior. The blockchain ledger is a real-time view of the performance, efficiency, usage, winners, and losers in the entire system.

Our goal is to incentivize the increase of economic value created by the system and adoption by those for whom the system brings economic opportunities.

Fiat Token System

The fiat token system is built on top of the bedrock of 2 important properties of our system i.e. **Identification** & **verifiability**.

Because of the circular nature of the system, we aim to use machine learning for the identification of materials that are cycling through the systems. We use blockchain to create verifiable tamper-resistant records of the incentive distribution associated with the successful cycling of the material used in packaging. These two properties create a trusted system that can easily involve a number of stakeholders, ultimately creating a vibrant economy that adds to economic growth while improving on climate action.

We propose a fungible token model. Briefly,

- Token supply is increased in equal numbers to new units manufactured by the producers.
- New tokens are minted upon the successful collection of qualifying units.
- The value of each token is the refund deposit value set by a consortium of Producers, Importers & Brand Owners (PIBOs)
- Tokens are designed to be redeemed at any point by consumers who earn tokens from participation in the collection process.
- Each unique unit class will have its own token to accommodate varying refund deposits.

- Beyond the initial supply of both tokens and units in the market, each new token minted will represent the number of times a certain unit class has been recycled.
- Tokens can be staked with collectors who use tokens as debt capital to set up new nodes and are repaid from the yield generated at collection nodes.

This also implies that the entire journey of the material can be tracked and analyzed to improve the system. The entire goal of this system is to minimize environmental leakages and maximize recycling to incentivize the adoption of these materials in a broader sense in the economy.

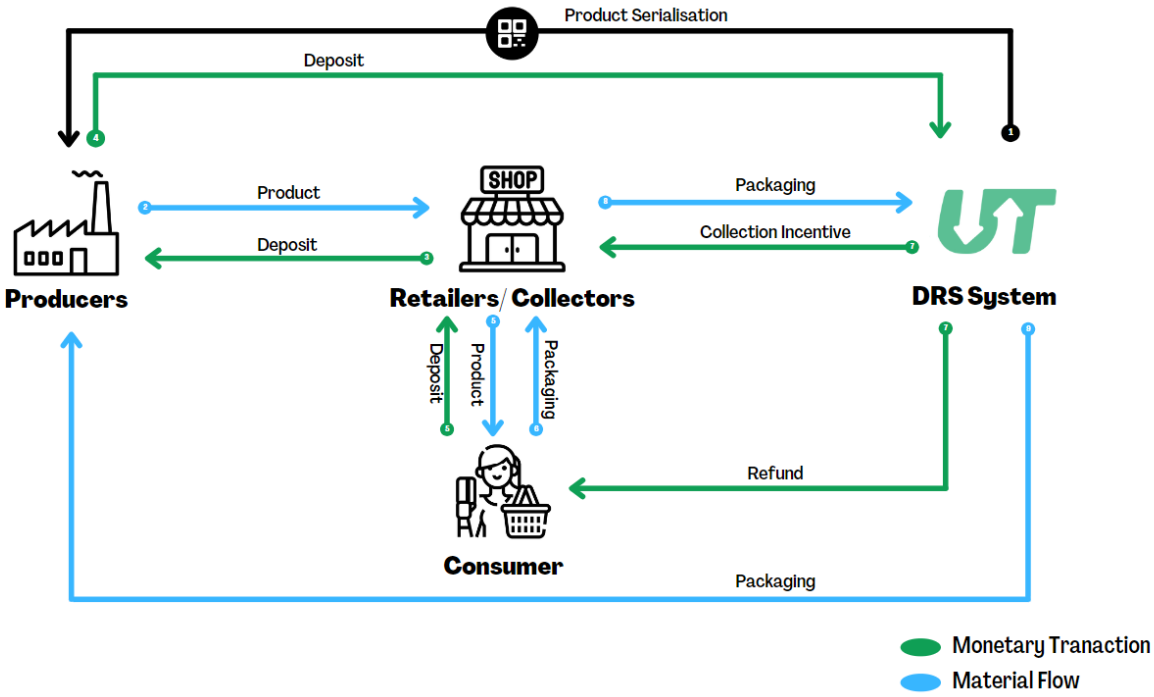


Fig: Working of Untrash DRS System

The diagram above illustrates the material & DRS Flow in the system. The chain starts with the unique serial generation for each product. The serial generation corresponds to the token minting. In the next step the product is sold to retailers with the deposit value. When a purchase is made by the consumer, the deposit transfers to the consumer. On return of packaging to the designated collection node, the minted token gets transferred to the consumer's account post verification. A percentage of the refund is given to the collector as a collection incentive. The system uses a third-party aggregator network to collect the packaging from the collection nodes at regular intervals and ensures the same reaches back to the producers.

All stakeholders can claim their token amounts in fiat currency whenever required. The system will be built on the CBDC framework adopted by the RBI and connected to UPI based payment system to enable quick digital transfers.

Economic Incentives

Incentive to consumers

Consumers are incentivized to collect & return the bottles to claim the deposit that was charged at the time of purchase. The system enables a behavioral change wherein the consumers consciously take care of returning the packaging waste. When the material is discarded elsewhere, the consumer loses the claim to deposit, and the same gets passed down in the chain. In the Indian context, a large population works for marginally low income. This includes the scavengers who sort the bulk of waste at landfills for very low returns.

Incentive to Collection Nodes

Each retailer/collection node will serve as a decentralized node that offers yield-generating opportunities to those who wish to take up the opportunity. All software running on the nodes will be open source along with documentation on how to set up a collection node. Collectors get a fixed percentage of the token reward for facilitating the collection, sorting, and storing of the returned units.

Incentive to Validator Nodes

Validator nodes will be rewarded for their maintenance of the overall network. In a Proof of Stake system, validators stake their tokens that act as collateral that can be destroyed if the validator behaves dishonestly. The validator is then responsible for checking that new blocks propagated over the network are valid and occasionally creating and propagating new blocks themselves.

1

VERIFICATION SYSTEMS

Verification systems refer to the backend technology that ensures DRS runs smoothly & malicious activities are minimised throughout the system.

Blockchain

The blockchain architecture ensures that the entire journey of the material can be tracked and analyzed to improve the system.
Distributed Ledger Technology (DLT) enables nodes in a network to securely propose, validate and record state changes to a synchronized ledger that is distributed across the network's nodes. In the context of payment, clearing, and settlement, DLT enables entities, through the use of established procedures and protocols to carry out transactions without necessarily relying on a central authority to maintain a single "master copy" of the ledger.

Computer Vision

Image classification algorithms can be used efficiently to identify the returned unit. In smart bins/ Reverse vending machines this task can be performed autonomously before the disbursal of the reward.
For retail & other manual collection nodes, a mobile application needs to be developed to capture the image. The collector can capture the image of the returned unit before storing it to input the same in the blockchain ledger.

Artificial Intelligence

A reinforced learning model can assist the image classification model to work efficiently & ensure proper classification. As new SKUs are added to the DRS system, the same can be updated to the overall model to cater to the same.
As the system captures the images to trash & cross-refers with the unique identifier code, we aim to create an open-source model that can be used by different waste management entities for efficient sorting & recycling processes.

Unique Product ID

Product serialization generates a unique code for each product and creates an opportunity for brands & local authorities to perform a wide range of tasks efficiently & transparently that is even beyond the scope of a DRS system. Product serials can store data representing the entire value chain. Products that are prone to counterfeits and mismanagement often use unique serial numbers to check for authenticity.

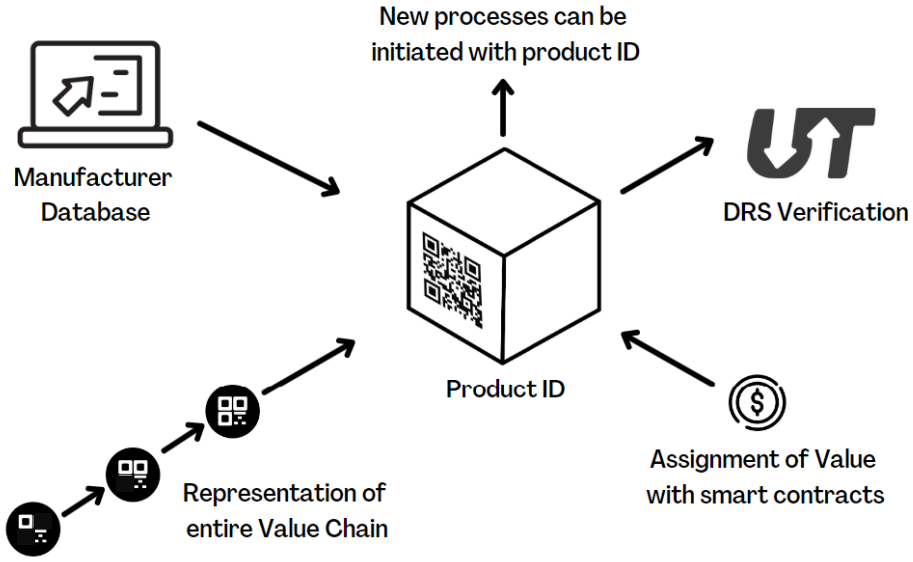


Fig: Using blockchain for creation of Product ID & its applications

From a DRS system perspective, serialization provides a unique code for each container and is required in a DDRS to prevent the user from scanning the same container multiple times to fraudulently claim extra deposits. By having uniquely serialized codes, each deposit is linked to a single specific container and can only be redeemed once. Unique Identifier code will assist in performing seamless verification & transaction, as well as help consumers, identify the eligibility of a product in the return system.

1

Geo location Data

For efficient reporting & impactful operation, the DRS system needs to track the scrap collection & drop-off for the entire value chain. Geolocation data will be used for the same. Geotag data will be essential for mapping the collection nodes for efficient collection by aggregators. Correlating DRS data with the geotags provides insights for brands pertaining to consumptions, collections, etc.

OPERATIONS

Instead of relying completely on reverse vending machines like European DRS systems do, we aim to onboard the retail points to function as drop points for the units. Retail points act as access points for consumers as well as for scavengers & waste collectors to deposit the SKUs into the system. The collection node will not be limited to retail points and can bring external parties to set up collection systems. For logistics, the current system has an existing aggregator network that can be used to collect the materials from the retail points & transport the same to processing points.

Retail Stores as Collection Nodes

For effective & easy collection at scale, there is a need to use the retail store infrastructure as collection nodes for the unit collections. An additional incentive needs to be introduced to onboard these collection nodes. This incentive will be a part of the overall deposit value paid by the consumer at the Point of Sale (PoS). These collection nodes will use the mobile application to verify the deposit & then store the same for the aggregator to pick up.

The consumer application can be linked to the bank account for deposit withdrawal. Furthermore, an ecosystem can be developed for In-app purchases & brand discounts to promote new products & brands.

Smart Bins for Reverse Vending

For other places, Trashnet's smart bin infrastructure can be deployed to autonomously collect the units. The smart bin system is designed for public spaces and uses computer vision to segregate the trash without human intervention. (patent pending).

The smart bins cost 3-5 times less than the Reverse Vending Machines (RVM) & can work well with multiple SKUs as compared to RVMs that cater to a single type of SKU.

Img: Binvent - Smart Bin that uses CV to identify & sort waste at source.

POLICY & SUSTAINABILITY

For successful early adoption, policy intervention is required by local govt. bodies. Governing bodies need to be included as a stakeholder in setting up the DRS price & implementing the same.

If higher taxes on “dirty” products are passed on in higher prices for these products, compared with lower-taxed “green” products, this will tend to alter consumer choices, leading to a direct switch to greener products. The scale of this change in consumer purchasing will depend on the level of the environmental product tax and on the relative pre-tax prices of green and dirty products.

Furthermore, with the new EPR norms for plastic waste, brands are liable for their packaging and required to file compliance for the collection & recycling of their post-consumer waste. In the current scenario, the number of registered recyclers is limited to 1071 while the number of registered brands is 2361.[2] This has led to a shortage of credits and requires brands to look for alternatives to minimize post-consumer waste.

With over 40 states and countries having deposit return schemes (DRS) in place, and more set to follow in the coming years, Such systems will play a key role in boosting collection rates, improving the quality and quantity of recycled materials, and helping companies to adhere to legislation on packaging waste.[6]

- DRS is the only proven way to ensure the separated, high-quality collection of more than 90% of the materials from the end consumers.[7]
- When properly implemented, DRS for refillables generate 50% less CO2 emissions than DRS for single-use items.[7]
- The polls conducted by Reloop suggest that 82% of the public is in favor of introducing and/or expanding deposit legislation, while 84% are in favor of existing deposit legislation.[8]
- With high-profile brands like Starbucks, Burger King, & Coca-Cola committing to schemes that encourage consumers to return packaging for reuse via a deposit, consumers may become more used to these systems and more aware of how they can fit into everyday habits, especially in countries where DRS has yet to be implemented.[8]

[2] https://eprplastic.cpcb.gov.in/#/plastic/home/main_dashboard

[6] https://www.tomra.com/en/discover/reverse-vending/feature-articles/rising-demand-for-deposit-return-schemes

[7] Digital Deposit Return Systems: What You Need to Know | Reloop Fact Sheet January 2022

[8] https://packagingeurope.com/features/what-does-drs-offer-as-part-of-local-and-global-responses-to-plastic-waste/8662.article

There is no time to waste. We need to act fast and solve the problem of global waste management collectively.

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