TOMRA

Rewarding Recycling

Learnings from the World's Highest-Performing Deposit Return Systems

* During the United Nations Conference of the Parties in Basel, Switzerland in May 2019, the UN agreed to require consent from importing countries before exporting of mixed, unrecyclable and contaminated plastic waste can proceed.

** Deposit return systems are also known as container deposit schemes, "bottle bills", container deposit legislation, or beverage container deposit and refund programs.

1. Executive summary

A series of trends are disrupting recycling and waste management conversations worldwide. The first is a growing awareness that plastic waste is polluting even the far reaches of our planet. Scientists have determined that plastic waste including litter is leaking into the oceans at a rate of a garbage truck per minute, and forecast there will be more plastic in the ocean than fish by 2050 (by weight).[1] This has led researchers to review how much plastic has actually been recycled given current recycling systems in place. Scientists have determined that of all the plastic ever produced, only 9% has been recycled.[2]

The second trend is concerns raised by the Basel Convention* and the associated rising costs of collection, processing and recycling for parts of the world that used to rely on China, India, and many other Asian countries to buy and sort through mixed recyclables.

A third trend is a growing aspiration to shift the industrial model away from "take-make-waste" to a "circular economy", where resources are captured and utilized at their highest material value for as long as possible. This is most evident in the European Union's Circular Economy Package, which established legally-binding collection and recycling targets for common materials. Motivated by this confluence of trends, policy-makers, environmental organizations and businesses are actively evaluating solutions such as a deposit return system (DRS) for the sustainable management of single-use beverage containers.**

Deposit return systems add a small but meaningful deposit to the sale of each beverage, which is repaid when consumers return the empty containers for recycling. The key elements for a DRS are framed for stakeholders through statute and regulation. The policy is known for its effectiveness, with leading systems routinely recovering in excess of 90% of deposit containers sold.[3]

Figure 1:

Key design principles and legal elements of high-performing deposit return systems

All of the elements – when applied together – will address global waste challenges and advance a circular economy.

Circularity

1. Define recycling
2. Recycled content

Performance Targets

3. Return rate target
4. Capture all recyclable beverage containers
5. Meaningful deposit value
6. Compliance

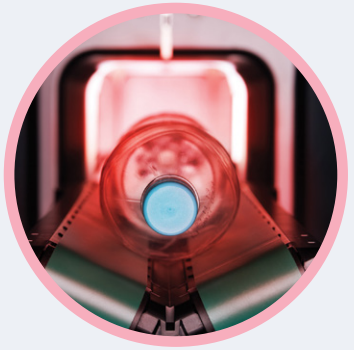
Convenient Refund

7. Make getting a refund immediate, accessible and accessible for everyone
8. Markings for consumers, barcodes to automate

System Management

9. Producers are able to reinvest unredeemed deposits and commodity revenue
10. Whether the DRS is Centralized or Decentralized, define clear roles and responsibilities

System Integrity



11. Register products with system operator(s)
12. Counting and reconciliation process
13. Transparent reporting to government regulators and the public

In 2019, the European Union adopted the Single-Use Plastics Directive, mandating that its member states collect 90% of plastic beverage containers by 2029. Experts say this will be difficult[4] to impossible[5] to achieve without a deposit return system in place, and these programs are on the rise.

Between 2017 and 2020, 22 states or countries have committed to update existing deposit systems or develop new systems.[6] In addition to this group, at least 12 states or countries are currently working on updating existing systems or developing new systems.[7] In 2019, nine US states proposed adopting deposit policies, which is "way more interest than we have seen in the past", according to the Container Recycling Institute, a non-profit that monitors deposit systems.[8]

TOMRA has over 50 years of experience working in deposit return systems, today working in 40 deposit markets, in every part of the value chain. TOMRA has unique first-hand insights based on its global experience in the field. Now is the right time to understand what makes some programs more successful than others. After analyzing global deposit systems and reflecting on its experience in those markets, TOMRA identified a series of "best practices".

Principles shared among high-performing deposit return systems include:

- **Circularity:**
  Financial incentives and penalties exist to ensure containers are effectively recycled not 'downcycled'.
- **Performance Targets:**
  Frame conditions set in statute ensure performance including targets for collection, recycled content and a minimum number of redemption points, plus a meaningful deposit and broad scope.
- **Convenient Refund:**
  The redemption system is easy, accessible and fair for everyone in every neighborhood.
- **System Management:**
  Producers finance and manage infra-structure and operations within the frame conditions set by Government; with use of unredeemed deposits and commodity revenues.
- **System Integrity:**
  Trust and transparency are built into the system's processes. Enabled by: product registration, data-management, a clearinghouse, and redemption specifications.

In practice, these design principles are brought to life through 12 key policy or program elements. All of the elements – when applied together – will address global waste challenges and advance a circular economy. Prioritizing one but not the other will disrupt a deposit system's performance and cost effectiveness. As with all policies, local culture, infrastructure, and politics need to be factored in to shape the system that works best for each market.

The 12 key elements of high-performing deposit return systems include:

Circularity

1. Define recycling: If materials are merely

processed but not returned to the supply chain, then circularity has not been achieved. High-quality recycling processes that enable resource utilization over multiple cycles play a vital role in the circular economy, whereas incineration (with or without energy recovery) and landfills are hallmarks of a linear economy. To ensure the DRS is in line with the principle of circularity, targeted materials that are effectively collected, sorted, and reprocessed into secondary raw materials count toward recycling. Contaminated material that is collected but ultimately disposed does not. "Recycling" is defined as material used "as input to final recycling" rather than material delivered to a recycling facility. And the definition makes clear that disposing or incinerating material and using it for substantially inferior purposes like backfill or "alternative daily cover" do not count towards recycling.

2. Recycled content:

Since high-performing systems allow deposit system operators to retain revenue from the sale of containers collected, high and stable commodity values reduce overall system costs. Like many commodities, recycled materials experience volatile market prices, which creates risk for investments in collection, processing and recycling. For example, in January 2018 the price of foodgrade recycled PET in the US was 7% cheaper than virgin PET, but by mid-2020 it was around 35% more expensive.[9] While brand owners have recently set ambitious commitments to source more recycled content, companies have set similar targets in the past only to make minimal progress.[10] Mandates for beverage producers to use recovered materials, such as California's requirement that plastic beverage bottles utilize 50% recycled content by 2030, will stabilize recycled commodity values, thereby incentivizing high-quality recycling.[11]

Performance Targets

3. Return rate target: Setting a collection target establishes the policy's objective, and aligns producers to set incentives and provide convenient redemption options. For the purposes of this paper, "producer" means the company first selling the deposit container in the market (e.g. producer, importer or distributor). For a deposit system, the key performance metric is known as the "redemption rate", calculated by dividing the number of deposit containers returned for redemption by the number of deposit containers sold. Setting expectations through targets also grants a license for businesses to design the program with flexibility and responsiveness in mind.

4. Capture all recyclable beverage containers: The legislation clearly defines which beverages, material types and sizes will be included in the program. High performing programs make all recyclable beverage containers eligible for a deposit due to the increasing likelihood that the container will be recycled rather than littered or wasted. When New York expanded its DRS to include water in 2009, it doubled the amount of Polyethylene Terephthalate (PET) plastic containers captured by the system. Water containers now make up about 25% of all the containers that New Yorkers redeem for recycling. In addition, including more beverage types reduces consumer confusion at the redemption point, and leads to better economies of scale for the system.

5. Set a meaningful deposit value: Providing a financial incentive to recycle is what separates deposit return systems from other collection programs. Decades of redemption data show that meaningful deposit levels effectively drive more containers into the program. For example, Michigan uses a 10-cent deposit to historically achieve a return rate around 90%.[12] By contrast, Massachusetts' 5-cent deposit has not changed since 1978, when it was an engaging value.[13] The return rate has dropped from 81% in 2000 to 38% in 2021, making it the lowest return rate in the world.[14] High-performing systems establish a minimum deposit value at a meaningful level and allow producers to raise it as needed to reach performance targets.

6. Compliance: While much of a high-performing DRS allows private-sector companies to implement and manage the system, government plays an important role as a regulator to maintain performance, arbitrate violations and maintain a competitive "level playing field". Clear penalties that are higher than the cost of non-compliance reliably motivate stakeholders to comply, and also invest in making the system more efficient. Legislation also defines auditing protocols and the agency with enforcement authority. Effective enforcement includes Oregon's approach where the state mandated the deposit value increase should the redemption rate fall below 80% for two consecutive years. This occurred, so in April 2017 the deposit increased from five to ten cents. In three years the redemption rate increased from 64% to 86%.[15]

Convenient Refund

7. Make getting a refund immediate, easy, and accessible for everyone: High-performing deposit systems make redemption easy for the consumer. Consumers have a right to easily recoup their deposit money, and producers and retailers have an obligation to make that possible. High-volume redeemers and the informal economy also should be accommodated in the design of the redemption network. The most common and effective redemption model is known as "return to retail", where retailers who sell beverages must take back the empty containers. Nine out of 10 of the world's best-performing deposit return systems employ return-to-retail collection, achieving an average return rate of 91%.[16]

Germany, which has the highest-performing deposit system in the world with a return rate of 98%, leverages retailers in this way.

8. Markings for consumers, barcodes to automate: For consumers to easily identify containers eligible for a deposit, high-performing systems require standard text or a logo to be printed on each beverage container. A visual marking also allows redemption locations that process

containers manually to easily recognize containers eligible for deposit. Barcodes serve a similar purpose in that they enable automated redemption technology to recognize and count each deposit container. This provides accurate payments to consumers, a baseline level of security, and fair, transparent financial accounting by keeping track of each brand. Unique deposit marks and market-specific barcodes prevent fraudulent redemption of non-deposit containers, and reduce costs. Before the deposit system was launched in New South Wales, Australia, beverages sold together in what is known as "multi-packs" did not have individual barcodes. This would have created a situation where one container sold individually would be accepted by an automated reverse vending machine (RVM), whereas those sold in "multi-packs" would be rejected in many cases. Due to concerns about consumer confusion, the government updated labeling requirements to add individualized barcodes before the deposit system was implemented.

System Management

9. Producers are able to reinvest unredeemed deposits and commodity revenue: Incorporating the principles of Extended Producer Responsibility (EPR), successful

deposit return programs engage producers and retailers to manage the environmental impact of a product back into the packaging production cycle. Producers cover the net costs and influence the design of their package for recyclability. A "license to operate" is granted to producers in exchange for using the unredeemed deposits to reinvest in the system, and with the additional commodity income reduce their own net costs. Norway, with its 89% return rate, provides a notable example. In 2019, the unredeemed deposits and material revenue were enough to cover more than 90% of Norway's DRS costs: 49% of system costs were offset by unredeemed deposits, 35% from material sales, and 8% from other revenues (mainly interest) – only 8% needed to be covered through an Extended Producer Responsibility (EPR) fee from producers.[17] In the case of aluminum beverage cans, those income streams are even high enough to avoid any additional EPR fee from producers. In fact, the EPR fee per aluminum can was negative, meaning NOK 0.08 was actually rebated to producers (US$0.008).[18]

10. Whether the DRS is Centralized or Decentralized, define clear roles and responsibilities: All deposit systems include a similar set of responsibilities in order to function, such as container pick-up, clearing of deposits and handling fees, product registration and more. Assigning these responsibilities to stakeholders should be based on an assessment of conflicts of interest in order to ensure the purpose of the program - collecting and recycling more beverage containers - remains paramount. High-performing programs establish the government agency with enforcement authority, define the convenience standards (e.g. universal retailer participation) and deposit values in statute. They may task producers with specific responsibilities such as fraud management if seen as necessary for government involvement. The German government, for example, established DPG which tasks the beverage industry with defining and implementing a unified approach to fraud management. The remaining aspects of the German DRS are decentralized, meaning producers have the freedom to meet their compliance obligations how they see fit. If statute allows the beverage industry to manage more of the deposit system it is critical meaningful return rate targets, enforcement provisions, and convenience requirements are also in statute to ensure a minimum level of performance.

System Integrity

11. Register products with system operator(s): Without product registration, producers can act as "free riders" in the system where other producers are unfairly charged the cost of redemption for products they did not sell. To alleviate this, deposit legislation requires producers to register their products complete with a Universal Product Code (UPC barcode) to either the regulator or Reverse Vending Machine system operators. In Maine, the regulator has the authority to remove products from the shelf until producers register their products.

12. Counting and reconciliation process: Deposit systems manage billions of containers and millions of dollars in refunds and fees. Clearly defined processes to count and verify sold and redeemed containers ensures financial integrity and prevents fraudulent activities. High-performing systems require that products be registered with the system operator(s), use barcodes to interface with technology, and use reverse vending technology to validate counts, collect data, and facilitate reconciliation.

13. Transparent and public reporting:
Reporting keeps regulators and the public informed about the performance of the program, measuring progress towards goals. Education and Marketing raises awareness among the public about how to participate in the deposit program, which improves the public's confidence and support for the recycling program.

Conclusion

Scientists estimate there is already more than 150 million tons of plastics in the ocean today[19] and this is expected to triple by 2040 if no action is taken.[20] The UN is rising to the challenge. In 2017 the UN Environment Assembly passed a resolution encouraging members to adopt "innovative" approaches to marine pollution, like container deposit systems.[21]

After identifying the patterns between the world's highest performing deposit systems, it's clear there is a blueprint for success. By adopting a thoughtful approach – one based on the principles of Performance, Circularity, Convenience, System Management and System Integrity – the next generation of deposit systems can build on past learnings and take one step closer to a circular economy.

2. About TOMRA

We are living in an age of unprecedented consumption. This is pushing us beyond the boundaries of what our planet can sustain. TOMRA seeks to disrupt this paradigm with solutions that help to transform waste into resources. We believe TOMRA's contributions of sensor- based technology, and over 50 years' experience working with private, public and civil sector stakeholders around the world, can help the entire value chain optimize resource productivity. To do this, TOMRA has invested primarily in two business areas:

TOMRA Collection

Founded in 1972, TOMRA provides reverse vending solutions for Clean Loop Recycling, collecting aluminum, plastic and glass beverage containers to be continually reused and recycled back into new bottles and cans. With approximately 80,000 installations across more than 60 markets, TOMRA's reverse vending machines capture over 40 billion used beverage containers every year toward a closed loop. This reduces reliance on raw materials, and ensures fewer containers end up in our streets, oceans and landfills. TOMRA's reverse vending machines, digital solutions and service make recycling easy for the industry, system owners, retailers and consumers to contribute to a more sustainable planet.

TOMRA Recycling

TOMRA Recycling designs and manufactures sensor-based sorting technologies for the global recycling and waste management industry. Over 7,400 systems have been installed in more than 100 countries worldwide. Responsible for developing the world's first high-capacity near infrared (NIR) sensor for waste sorting applications, TOMRA Recycling remains an industry pioneer with a dedication to extracting high purity fractions from waste streams that maximize both yield and profits. TOMRA Recycling and TOMRA Collection are owned by Norwegian company TOMRA Systems ASA, which is listed on the Oslo Stock Exchange. Founded in 1972, TOMRA Systems ASA has a turnover of around $1B and employs ~4,300 globally. For more information visit TOMRA.com or follow us on LinkedIn, Twitter or Facebook.

Endnotes

1 New Plastics Economy: Rethinking the Future of Plastics," World Economic Forum. January 2016

2 "Production, use, and fate of all plastics ever made," Geyer, Jambeck, Law. 2017.

3 "Global Deposit Book 2020," Reloop. 2020.

4 "A Deposit Refund System for the Czech Republic," Eunomia. 2019.

5 "PET Market in Europe: State of Play," Eunomia. 2020.

6 "22" refers to governments who have already committed to updating or creating new systems: Scotland, England, Republic of Ireland, Luxembourg, Portugal, Latvia, Slovakia, Romania, Georgia, Greece, Turkey, Singapore, South Korea (coffee cups), Guadeloupe, Victoria, Tasmania, New Zealand, Netherlands (expansion to small PET bottles), South Australia, Quebec, British Columbia, and Germany (expansion to juice)

7 "12" refers to those who have pending legislation or we are certain will see bills filed in the coming months: New Jersey, Florida, Illinois, Pennsylvania, Rhode Island, US federal government, Connecticut, Massachusetts, New York, California, Iowa, and Michigan.

8 Susan Collins, Container Recycling Institute, President. NAPCOR Webinar. July 2020.

9 Communication with Alasdair Carmichael, Program Director, National Association of PET Container Resources (NAPCOR). November 2020.

10 "Closing the Loop on the Circular Economy," Reloop. 2018. Accessed via:
https://www.reloopplatform.org/wp-content/uploads/2018/06/RELOOP_POSITION-ON-RECYCLED-CONTENT_June-2018.pdf

11 "Plastic Minimum Content Standards (AB 793)," CalRecycle.ca.org. Accessed on February 9, 2023.

12 "Michigan", BottleBill.org. 2019.

13 "Massachusetts," BottleBill.org. 2021.

14 "Global Deposit Book 2020," Reloop. 2020.

15 "Oregon," BottleBill.org. 2019.

16 Calculation based on "Global Deposit Book 2020," Reloop. 2020.The top 10 highest-performing container deposit systems in the world as of 2019 are, in order: Germany (98%), Netherlands (95%), Finland (93%), Denmark (92%), Lithuania (92%), Palau (90%), Norway (89%), Croatia (89%), Michigan (89%), Estonia (87%) and Iceland (87%). All employ a return-to-retail model with the exception of Iceland and Palau, which utilize a return-to-depot model due to their extremely small population and minimal retail infrastructure.

17 "Annual Report 2019," Infinitum. 2020.

18 "Cost Calculator," Infinitum.no. Accessed on November 12, 2020 via https://infinitum.no/kostnadskalkulator

19 "New Plastics Economy: Rethinking the Future of Plastics," World Economic Forum. January 2016.

20 "Breaking the Plastic Wave," Pew Charitable Trusts, SystemIQ. 2020.

21 "Marine Litter and Microplastics UNEP/EA.3/Res.7," United Nations Environment Assembly of the United Nations Environment Programme. December 2017. Accessed via
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