Rewarding Recycling

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

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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, policymakers, 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. DRSs are typically established through legislation passed by state or national governments. The policy is known for its effectiveness, with leading systems routinely recovering in excess of 90% of deposit containers sold.[3]

* 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.

Figure 1:

Principles and elements of high-performing deposit return systems

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

PERFORMANCE

1. Broad scope of beverages and containers
2. Minimum deposit value
3. Return-rate target

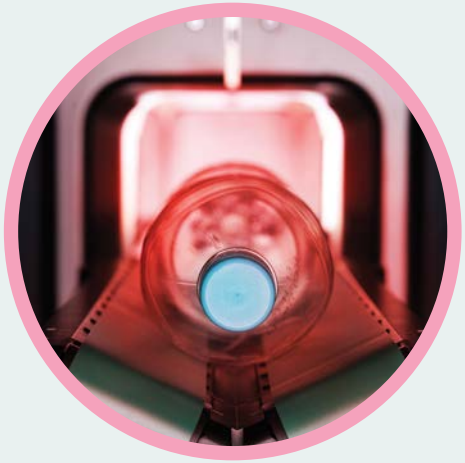
CONVENIENCE

4. Convenient redemption system for consumers
5. Separately charged and fully refundable deposits
6. Container deposit markings for consumers and manual returns, barcodes for accurate accounting

PRODUCER RESPONSIBILITY

7. Extended producer responsibility financing
8. Reinvestment of unredeemed deposits and material revenue within the system
9. Recycled content requirements

SYSTEM INTEGRITY



10. Centralized, non-profit administration and operations
11. Government reporting and consumer communication
12. Government enforcement

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.

In the past three years alone, 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 45 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:

- **Performance:** A collection target for all beverages plus a meaningful deposit delivers strong results.
- **Convenience:** A redemption system that is easy, accessible and fair for all users.
- **Producer Responsibility:** Producers finance and invest in the system using the unredeemed deposits, commodity revenues, and an eco-modulated EPR fee.
- **System Integrity:** Trust is built into the system's processes through transparent management, a data-driven clearinghouse, and reliable redemption technology.

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:

PERFORMANCE

1. Broad scope of beverages and containers: The legislation clearly defines which beverages, material types and sizes will be included in the program. Leaving out one beverage category could mean millions of recyclable cans or bottles are wasted and potentially littered. 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.

2. Minimum 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 achieve a return rate around 90%.[9] By contrast, Connecticut's 5-cent deposit has not changed since 1978, when it was an engaging value. The return rate has dropped from 88% in 2002 to 50% in 2018, making it tied for the lowest return rate in the world.[10] High-performing systems establish a minimum deposit value at a meaningful level and allow producers to raise it as needed to reach 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). Regulators then measure performance and enforce provisions. (See Key Element #12: Government enforcement). Setting expectations through targets also grants a license for businesses to design the program with flexibility and responsiveness in mind. For example, Oregon's stakeholders agreed to incorporate a performance target in a 2011 legislative update. By 2016, the return rate had fallen below the target of 80% for two consecutive years, and triggered an automatic increase in the deposit value from 5 to 10 cents.* The return rate rose from 64% in 2016 to 86% in 2019.[11]

CONVENIENCE

4. Convenient redemption system for consumers: 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

* April 2017

employ return-to-retail collection, achieving an average return rate of 91%.[12] Germany, which has the highest-performing deposit system in the world with a return rate of 98%, leverages retailers in this way.

5. Separately charged and fully refundable deposits: Effective deposit systems label the deposit value separately on receipts and store shelves, and ensure deposits are fully refundable. A true "deposit", in any context, is designed to be returned in full when the payor completes a given action. This maintains the strong financial incentive and delivers higher return rates than those with partial refunds (known as "half-back" models). The top-five performing deposit systems in the world (Germany, Netherlands, Finland, Denmark and Lithuania) all offer fully refundable deposits. Together they average a 92% return rate.[13] Listing the deposit value separately from the sales price on both the store shelf and receipt helps educate the consumer and avoids unnecessary confusion.

6. Container deposit markings for consumers and manual returns, barcodes for accurate accounting: 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.

PRODUCER RESPONSIBILITY

7. Extended producer responsibility financing: 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. See also how they can utilize several cost-saving measures (Elements #8 and #10).

8. Reinvestment of unredeemed deposits and material revenue within the system: 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.[14]

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 (€0.007 / US$0.008).[15]

9. Recycled content requirements: 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 food-grade recycled PET in the US was 7% cheaper than virgin PET, but by mid-2020 it was around 35% more expensive.[16] 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.[17] Mandates for beverage producers to use recovered materials, such as the EU's requirement that PET bottles utilize 30% recycled content by 2030, will stabilize recycled commodity values, thereby incentivizing high-quality recycling.[18]

* Refers to the permission from governmental authorities and more generally from the public at large to conduct business in a specific jurisdiction.

SYSTEM INTEGRITY

10. Centralized, non-profit administration and operations:

Deposit systems provide a platform for producers and retailers to responsibly manage the take-back and recycling of product packaging. Given there are typically hundreds of producers, importers, distributors and retailers operating in each market, if every regulated organization provides their own compliance service, overall system costs increase. High-performing systems address this by encouraging the beverage industry to centralize some common DRS responsibilities under a non-profit entity. This "Central System Administrator" (CSA) facilitates cross-industry problem solving and realization of cost efficiencies. Common responsibilities that a CSA manages include (among others) product registration, managing the deposit and fee "clearinghouse", and establishing fraud-mitigation protocols*. But making sure redemption is easy for consumers (including the design of the redemption infrastructure and its management) is not left solely to the CSA, because of the potential for conflicts of interest. System design is designated in legislation in most programs as "return-to-retail" redemption or delegated to an independent "network operator", who is responsible for delivering certain pre-requisites such as a certain number of collection points per capita.

11. Government reporting and consumer communication:

Reporting keeps regulators and the public informed about the performance of the program, to measure progress towards goals. Education raises awareness among the public about how to participate in the deposit program, which improves the public's confidence and the system's integrity and performance.

12. Government enforcement:

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.

* See "Clearinghouse" definition, pg. 65.

THE UN CALLS FOR CONTAINER DEPOSIT SYSTEMS

As leaders grapple with the extent of the challenges ahead to address waste and transition to a circular economy, it's evident the ambition of public policies will need to grow to meet the moment. 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]

As the world enters the sixth decade of deposit systems for one-way (non-refillable) containers, there are areas for improvement. No public policy can be established and expected to meet its objectives indefinitely. Changes in consumer products, packaging, inflation and innovation are encouraging system designers to consider "modernizing" traditional deposit return models. By moving ahead with a thoughtful approach – one based on the principles of Performance, Convenience, Producer Responsibility and System Integrity – more high-performing deposit return systems can become a reality.

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 45 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 in two businesses and an innovation accelerator.

TOMRA COLLECTION

TOMRA Collection provides reverse vending solutions for Clean Loop Recycling - collecting beverage containers that can be continually reused and recycled back into new bottles and cans. With approximately 80,000 installations across more than 60 refillable and one-way deposit markets, TOMRA's reverse vending machines capture over 40 billion used beverage containers every year for reuse or closed-loop recycling. The TOMRA system of machines, digital solutions and service make recycling easy for deposit system owners, retailers and consumers, all contributing to a more sustainable planet.

TOMRA SORTING

TOMRA Sorting applies advanced, sensor-based sorting technology to the Recycling, Food and Mining industries to maximize resource productivity. TOMRA Recycling's technology is favored by state-of-the-art material recycling facilities and the waste management industry. Over 6,000 TOMRA Recycling systems have been installed in more than 100 countries worldwide. TOMRA Food reduces waste in the processing of a wide range of foods, maximizing both yields and profits. Solutions from TOMRA Mining help to increase the energy efficiency and extend the life of mining operations, increasing the overall value of mineral and ore deposits.

TOMRA CIRCULAR ECONOMY

TOMRA Circular Economy (TCE) was established to leverage TOMRA's expertise to accelerate the transition to a circular economy. With its leading position in collection and sorting product technology and recognized process knowledge, TCE will work to position TOMRA as an essential strategic partner by collaborating with key business players across the entire plastics recycling value chain. Our target is to develop new methods, processes, technologies and business models, aiming to develop sustainable and holistic solutions. TCE's long-term focus will lead to new business opportunities beyond today's business through exploration of disruptive technologies and digitalization of the value chain.

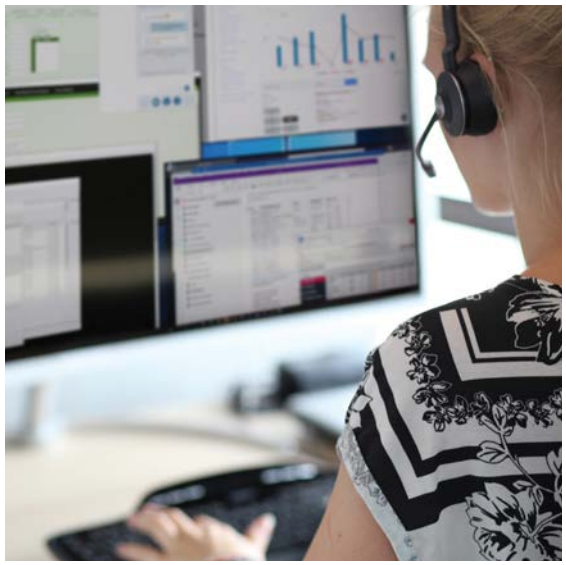
TOMRA's founders, Tore and Petter Planke

Our experience in container deposit return systems

In 1972 our founders, Tore and Petter Planke, invented the first fully-automated reverse vending machine after a local grocery store asked for help with redemption of beverage containers. Now retailers could offer their customers a self-service option for returning their empty refillable bottles for the deposit. Since then, TOMRA has expanded to most container deposit markets in world, providing invaluable experience in system design, investment and execution.

TOMRA's deposit system competencies

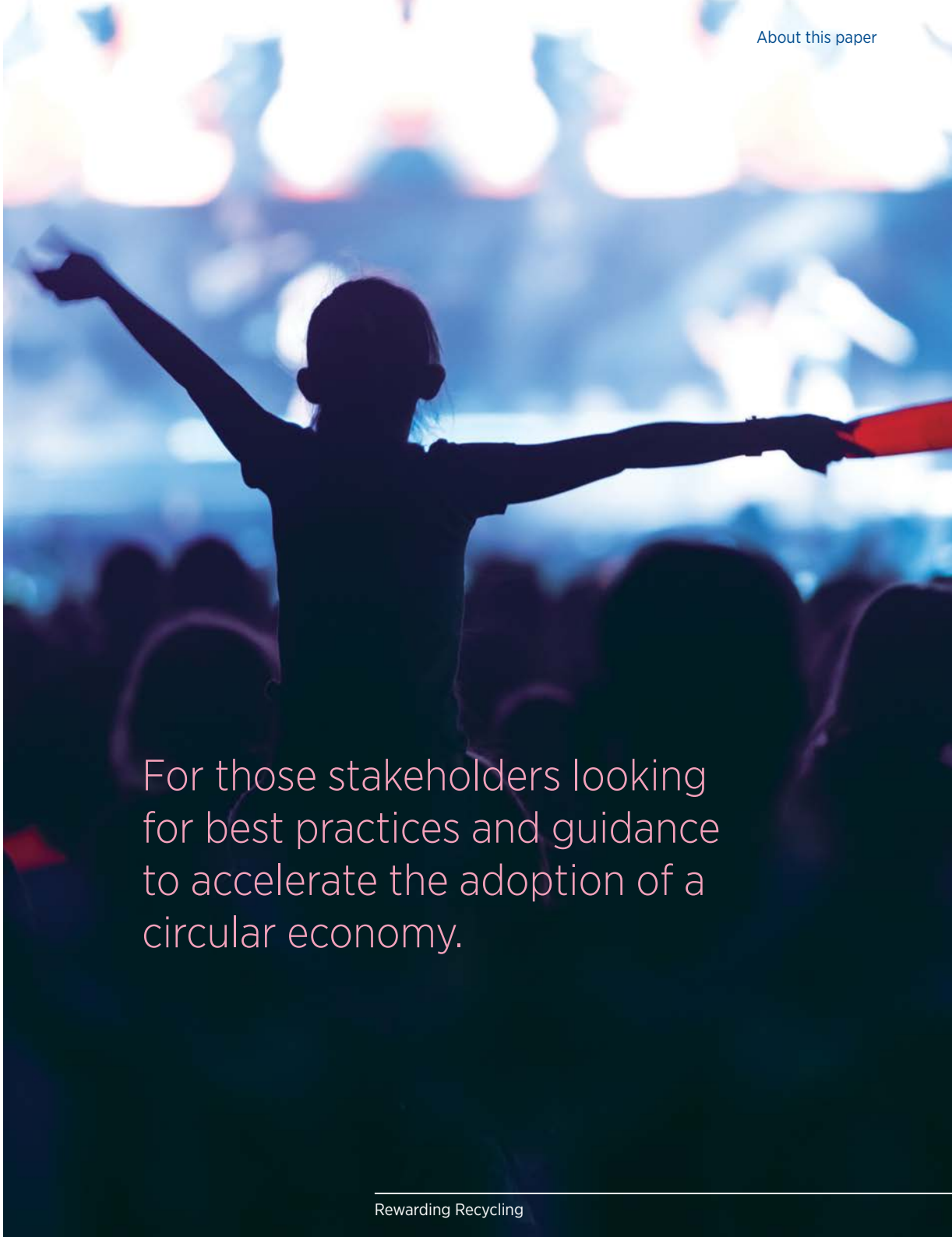
TOMRA's experience extends beyond developing and managing technology. In some markets, TOMRA partners with beverage producers in managing data and material recovery (US and NSW, Australia).

REDEMPTION	DATA MANAGEMENT	COLLECTION	RECYCLING
			
RVM technology	Clearing deposits/fees and managing data integrity	Material pick-up, processing and brokerage	PET processing

3. About this paper

This white paper was published for those stakeholders looking for best practices and guidance to accelerate the adoption of a circular economy, to meet performance targets, and to address the chronic problem of beverage container litter. This resource is also designed for legislative and regulatory drafters seeking to understand how to organize a DRS in a legal document. It is applicable in the design of new deposit programs and modernizing existing ones. However, it is recognized that local culture, socio-economic groups, infrastructure, and politics will add nuances.

This paper does not seek to describe a comprehensive economic analysis of recycling systems. It provides information on the highest-performing DRSs and their best practices. However, where data is available, we have presented it to illustrate the cost efficiency of such a system.



4. The challenge

Today, a number of trends are shaping a debate about how society approaches waste:

• **Ocean plastic leakage:** As of July 2018, policymakers have passed 325 laws to regulate the use of plastic packaging.[22] Scientists have determined that plastic waste is leaking into the oceans at a rate of one garbage truck per minute, and they forecast there will be more plastic in the ocean than fish by 2050 (by weight).[23] This has led researchers to review how much plastic has actually been recycled given the current recycling system in place. Scientists have determined that of all the plastic ever produced, only 9% has been recycled.[24] In the absence of a global policy framework to address this global challenge, producers have set ambitious commitments like Coca-Cola's goal to take back one can or bottle for every one they sell by 2030.[25]

• **Rising recycling costs as the world focuses on material quality:** After years of pollution concerns, the China National Sword policy effectively prohibited the import of "personal/household waste plastic" and "unsorted waste paper", removing a major buyer from the global market. This nearly eliminated demand for low-quality recyclables and forced communities to invest in raising material quality. For example, the collective exports from the US to China

and Hong Kong dropped by 94% for plastic scrap and 60% for paper scrap.[26] The Basel Convention Plastic Waste Amendments in 2019 only amplified this effect by placing regulations on the global trade of plastic waste. Where some communities used to make a small profit from recycling, many are now covering steep costs.[27] Some have shut down recycling services altogether due to budget concerns. Others have called for producers to take on a larger role in financing waste management.[28]

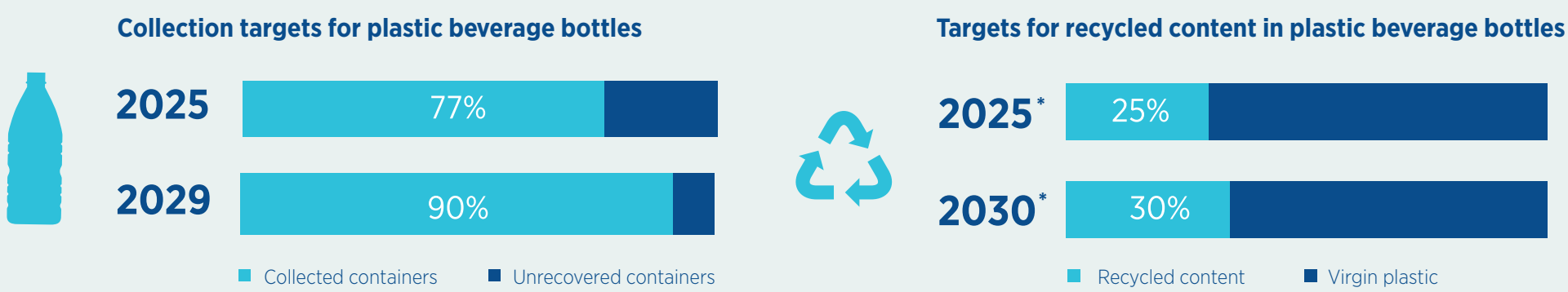
- **Circular economy aspirations:** A staggering amount of perfectly recyclable material is sent to landfills, incinerators or leaked into nature each year (86% of plastic packaging globally).[29] This material is actually sought after by industries seeking to use it for manufacturing new products, which means society is unnecessarily disposing of valuable resources.

- **Mandated performance targets:** As policymakers transform public sentiment to "fix" plastic waste issues into legislation, beverage producers have new, legally-mandated packaging collection targets to achieve. The European Union's Single-Use Plastics Directive, for example, mandates the collection of 90% of single-use plastic bottles with caps and lids by 2029, with an interim target of 77% by 2025.[30]

- **Access alone has not increased recovery:** As the number of people who had access to curbside recycling quadrupled from 1990 to 2010 in the US, the recycling rate of beverage containers actually decreased.[31] This suggests public motivation for recycling plays an important role in the success of waste management.

- **Glass recycling remains a challenge:** Glass, in particular, is challenging for curbside recyclers to handle (especially in single-stream operations) as it often breaks, contaminating other materials and reducing its own value. A survey of 45 material recovery facilities (MRFs) throughout the US Northeast found that facilities accepting curbside material sent almost 40% of glass straight to the landfill to be buried or used as landfill cover.[32] Separate glass collection systems in Europe perform better, with an average collection rate for recycling of 76% (2017).[33]

EU Single-Use Plastics Directive targets for plastic beverage bottles



* 2025 target for PET beverage bottles only. 2030 target for all plastic beverage bottles.

• **Committing to recycled content:** In part due to the challenges outlined above and the associated public pressure, major beverage brands have announced goals to increase the amount of recycled content used in their containers. This presents a dilemma, because there is simply not enough post-consumer PET plastic collected and recycled at a high quality to meet these commitments. For example, the National Association of PET Container Resources in North America estimates that in order for US beverage producers to meet a 50% recycled PET content threshold, the national recycling rate for PET bottles would need to rise to over 70%, up from 29% in 2019.[34]

Public motivation for recycling plays an important role in the success of waste management.

These challenges have led policymakers to evaluate container DRSs for their ability to collect high quantities of beverage containers and maintain the materials' high quality in a way that enables closed-loop applications like "bottle-to-bottle recycling".

However, not all container deposit systems deliver high performance. This is due to the fact that no two deposit systems are alike. For example, both Norway and Connecticut (USA) have deposit return systems but they are vastly different in structure and performance. Norway's model allows producers to manage the system's operations and administration through a central non-profit entity and retailers provide a convenient redemption system. (For the purposes of this paper, "producers" means beverage producers, importers and/or distributors). The deposit value itself is relatively high at €0.18-0.27 (US$0.21-0.32) and it achieves a container return rate of 89%. In comparison, Connecticut's statute assigns responsibilities to brand owners but does so without a redemption target. Further, it does not encourage centralizing management of operations and compliance measures. Two third-party systems serve a significant portion of the market and carry out these functions well, but there are opportunities to improve efficiency and apply controls. Connecticut's deposit value has stayed at the same level since it was passed in 1978, US$0.05 (€0.04), and as a result the state has the lowest return rate in the world at 50%.[35]

In addition, the operators that manage deposit systems strongly influence its success. While fundamentals like a meaningful deposit value drive return rates, leaders need to maneuver wisely to evolve the program over time.

Think of the DRS like a car: if you use the wrong component or the driver has had no training, the car will struggle to drive and ultimately break down. By using the right parts with a seasoned driver and consistent maintenance, the car will drive reliably for years.

The challenge for policymakers and stakeholders alike is to negotiate legislation that will enable sustainably high performance. In the following chapter we outline what deposit return systems are capable of delivering, and in Chapter 6 what makes these programs "work" in practice.

5. High-performing deposit return systems: what can they deliver?

To better understand deposit return systems, it helps to review the results of high-performing models, such as the following:

Reduction of litter and ocean plastic leakage

Beverage container litter as a proportion of all litter is 66% less in regions with a DRS than without.[36] Regions with a meaningful deposit value experience less beverage container litter as a proportion of all litter compared to deposit systems with a low deposit value or no deposit system.[37]

More material captured for recycling and "saved" from disposal

The European average collection rate for PET plastic beverage containers recycling in a curbside system is 47%, versus 94% for deposit return systems.[38] In the US on average, 27% of aluminum, glass and plastic non-deposit containers are collected for recycling vs 72% of deposit containers.[39]

Guaranteed recycling

While collecting material is half the challenge, the other half is maintaining the material's value throughout the recycling process. The deposit stream is particularly successful at this component. For example, 100% of the glass that TOMRA processes from New York's deposit return system goes to the glass bottle manufacturing process.

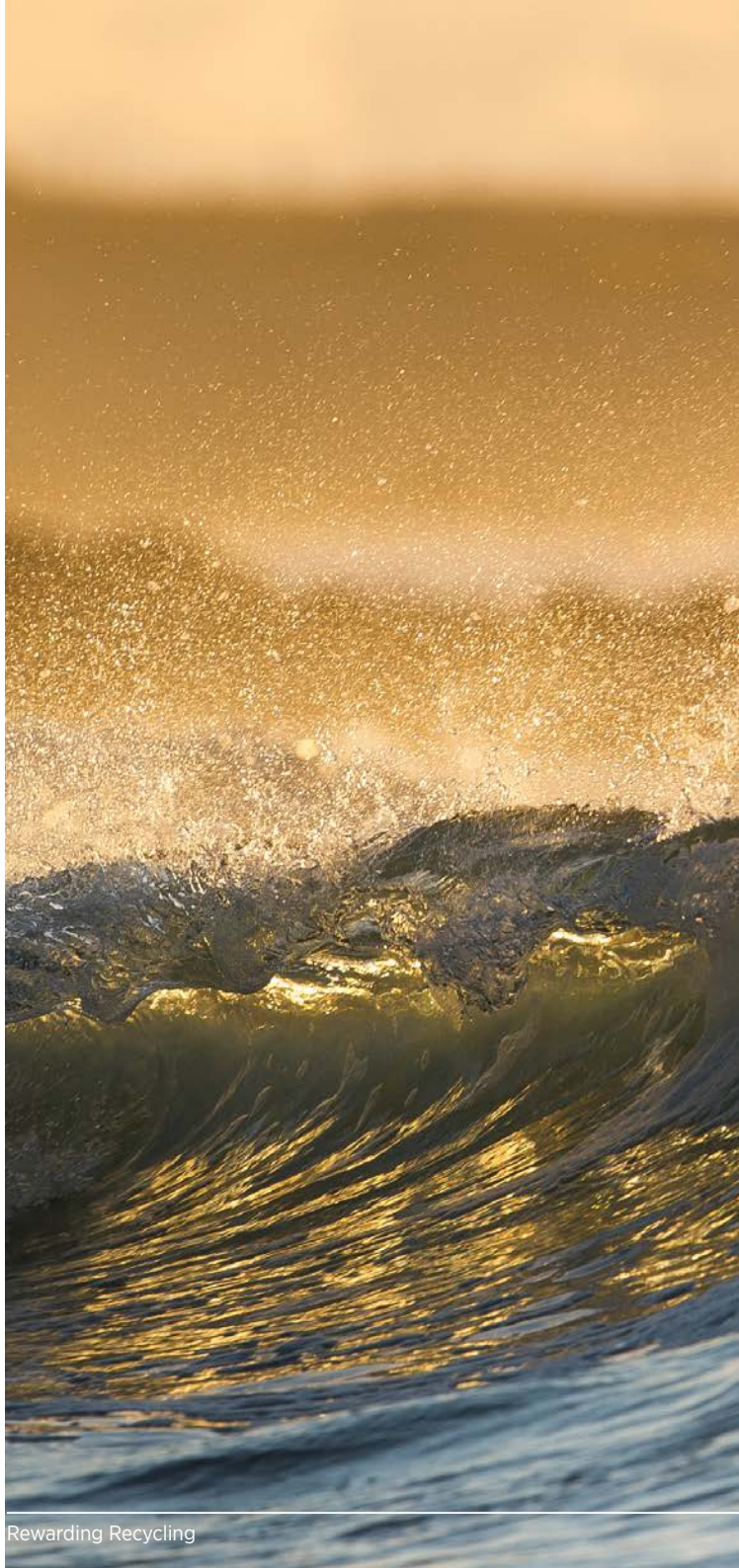
Climate benefits

Recycling materials enables manufacturers to *replace* the use of virgin material in the production of new goods. This avoids the upstream environmental impacts associated with virgin material extraction, transportation and processing. According to a 2019 Ellen MacArthur Foundation study, recycling 1 ton of plastics could reduce emissions by 1.1-3.0 tons of CO_2e* compared to producing the same ton of plastics from virgin fossil feedstock.[40]

More material recycled in a closed loop rather than "down-cycled"

Separate collection and processing of con-

* Carbon dioxide equivalent



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tainers in a DRS maintains the material's quality. This results in more demand from manufacturers, and a significantly higher market value than containers handled by the "single-stream" recycling process (due to contamination).[41]

Waste disposal cost savings

Disposing of recyclable beverage containers in landfills or incinerators incurs a cost either through taxes or private waste services. Placing a meaningful deposit on containers has been shown to divert the majority of deposit-bearing beverage containers from disposal, which saves money and frees capacity for processing more recyclables.[42]

Litter clean-up cost savings

There is a cost on municipalities, regional governments and private property owners for dealing with littered material, and a further, uncalculated environmental cost when it escapes into the marine environment and food chain.[43]

Jobs

DRSs are a job creator in the sense that they create market demand for collection, sorting, counting, processing and recycling services.[44] In 2017, the calculated number of

direct, indirect and induced jobs resulting from New York's DRS was over 5,700.[45]

Enjoyment of local environment

Sociology studies have shown that people are willing to pay to live in areas without litter. A Belgian study, for example, calculated the willingness to pay for the removal of beverage litter at the equivalent of US$33.28 per household per year, which if applied across the EU and US would equate to US$11.6 billion (€9.8 billion).[46] [47]

Facilitate the transition to refillables

DRSs are a mechanism that can facilitate the adoption of a system for refillable (reusable) beverage containers, which is known to have superior environmental benefits.[48] DRSs help shift consumer behavior to return containers and build out the infrastructure needed to make reuse possible. Germany, for example, operates one of the most successful programs for refillable beverage containers in the world with a 41% refill quota, collecting 98% of refillable containers annually (25.4 billion containers) in addition to collecting 98% of one-way containers (20.5 billion containers). Oregon's refillable beer program started recently in part because the infrastructure and cost-sharing between producers was already in place through the non-refillable DRS.

Creation of a local circular economy

Regions that have DRSs are also likely to spur the creation of local material processors. A good example is New York, which is home to multiple processing facilities, two PET plastic reclamation facilities, and two glass bottle manufacturers, all of which depend on the deposit system's reliable supply of clean, high-quality material.

Access to recycling

High-performing deposit systems allow all households – regardless of demographic or income – equal access to recycling services. Increasing convenient access is a key component in increasing recycling. This benefit has become even more apparent during COVID-19-related shutdowns of material recycling facilities that accept material from curbside and drop-off collection streams.

SNAPSHOT: HOW DEPOSIT RETURN SYSTEMS HAVE ADAPTED IN THE COVID-19 ERA

COVID-19 has affected deposit systems in two different ways. Some systems continued on without real interruption by implementing best practices in COVID-19 prevention, while others experienced enforcement suspensions or, in two rare cases, total shutdown.

For the deposit systems that faced redemption service suspensions or shutdowns, regulatory authorities began to resume normal redemption activity after the first wave of coronavirus cases subsided and public health authorities clarified that person-to-person transmission was more of a concern than surfaces (including cans and bottles).[49]

While public health guidance varies from region to region, some of the common best practices for beverage container redemption to emerge in terms of COVID-19 prevention include:

- **Requiring or recommending the wearing of masks during returns**
- **Promoting social distance at all times through signage and floor markings (6 feet / 1.5 meters)**
- **Limiting occupancy in redemption areas as necessary to maintain social distance**
- **In redemption locations with multiple reverse vending machines, turning off every other RVM as necessary to maintain social distance, or installing plexiglass barriers**
- **Cleaning and disinfecting frequent touchpoints**
- **Prioritizing touchless, automated redemption rather than manual in order to minimize person-to-person interaction**
- **Automatic printing of deposit receipts without the need to touch buttons**

This shows that with proper planning, deposit systems can provide reliable access to recycling even in the face of a global pandemic.

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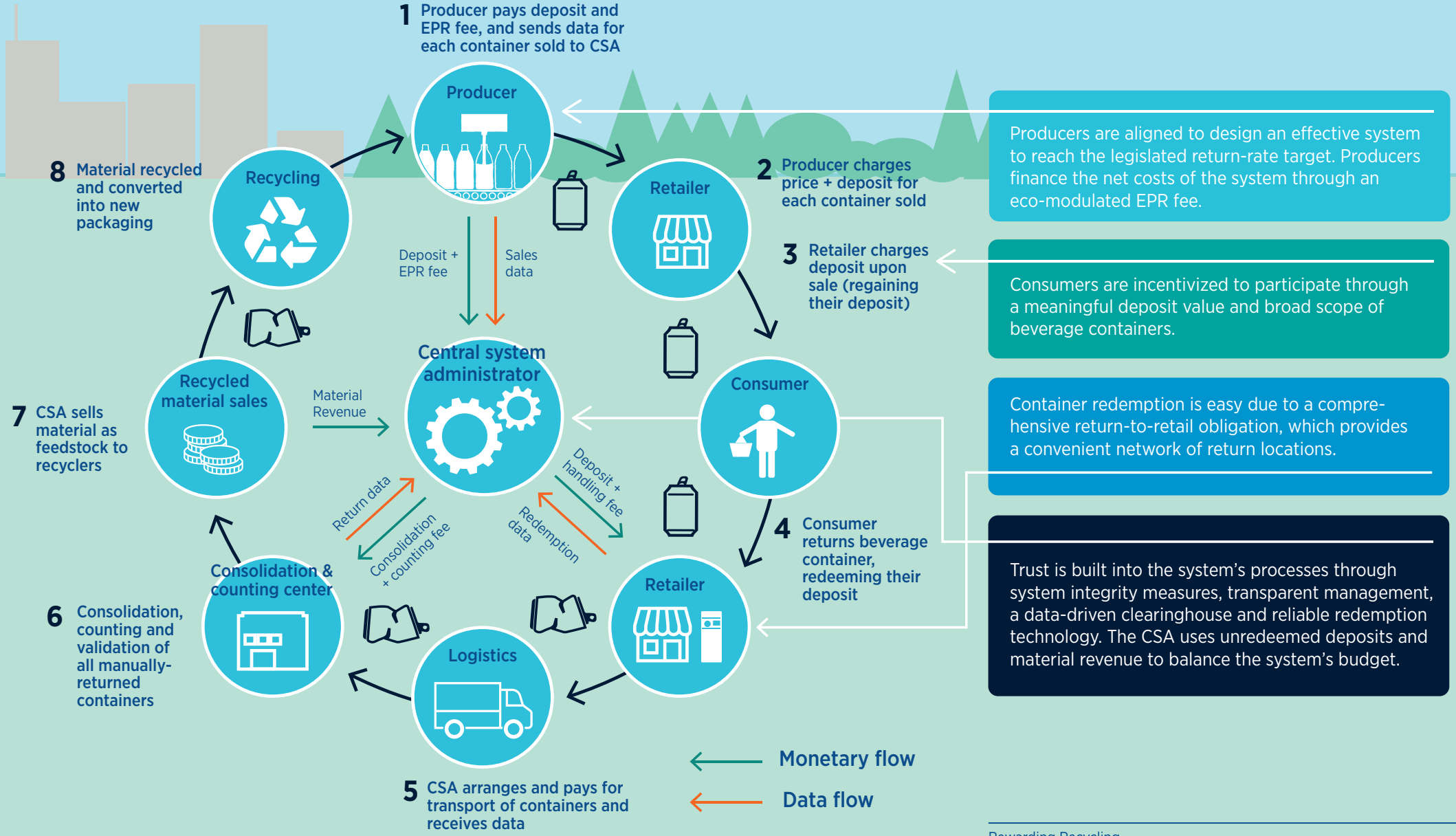
Figure 2:

How a high-performing deposit return system works in practice



Producers are aligned to design an effective system to reach the legislated return-rate target. Producers finance the net costs of the system through an eco-modulated EPR fee.

Consumers are incentivized to participate through a meaningful deposit value and broad scope of beverage containers.

Container redemption is easy due to a comprehensive return-to-retail obligation, which provides a convenient network of return locations.

Trust is built into the system's processes through system integrity measures, transparent management, a data-driven clearinghouse and reliable redemption technology. The CSA uses unredeemed deposits and material revenue to balance the system's budget.

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

In reviewing the results of deposit return systems from around the world and reflecting on over 45 years of TOMRA's experience in the field, TOMRA found that effective deposit systems are built around four principles: Performance, Convenience, Producer Responsibility and System Integrity.

This section explores these Principles, the Key Elements that deliver them in practice, and case studies that illustrate their importance.

All of the elements – when applied together – will address global waste challenges and advance a circular economy. Considering some but not all could disrupt the system's performance and cost effectiveness. For example, legislation that centralizes responsibilities under the beverage industry but does not explicitly require a convenient redemption system (e.g. retailer obligation to offer redemption) will underperform. Any system without a return-rate target backed by enforcement has the risk that the system will not reach the target without the producer and retail-funded central system administrator voluntarily taking action.

Note that policymakers should consider a region's current recycling context (e.g. infrastructure, historical learnings, etc) when it comes to adopting significant system design measures.

Figure 3: Principles of high-performing deposit return systems

PERFORMANCE

A collection target for all beverages plus a meaningful deposit **delivers strong results.**

PRODUCER RESPONSIBILITY

Producers finance and invest in the system using the unredeemed deposits, commodity revenues, and an eco-modulated EPR fee.

CONVENIENCE

The redemption system is **easy, accessible and fair** for all users.

SYSTEM INTEGRITY

Trust is built into the system's processes through transparent management, a data-driven clearinghouse, and reliable redemption technology.

Principle

#1

PERFORMANCE

A collection target for all beverages plus a meaningful deposit delivers strong results.

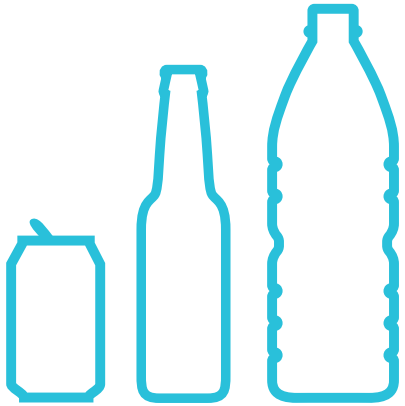
1. BROAD SCOPE OF BEVERAGES AND BEVERAGE CONTAINERS

To maximize capture rates, prevent consumer confusion and create a fair playing field among producers, effective systems accommodate what's sold on the market today, and consider this in three ways:

a. Beverage type: Specified by using industry-identified categories (i.e. bottled water, carbonated soft drinks, sport drinks, energy drinks, juice and juice drinks, beer, hard cider, wine, spirits, plant-based beverages, and non-dairy drinks). Legislation can empower the regulatory or managing body to ensure that new beverages placed on the market are added to the program.

b. Material: Defines the packaging material to be included such as plastics, metals, glass, and liquid paperboard. Policymakers typically prioritize packaging commonly used by producers and recyclability.

c. Size: Using volume as the metric, ranges are often set at 100 ml up to 3 liters (or 4 ounces up to 101 ounces.) This range will capture 99% of the containers on the market – while allowing all deposit containers to be automated through reverse vending machines. However, local container shapes may require special consideration, so engagement with the system operator and beverage industry is recommended prior to codifying accepted sizes.



Local market beverage consumption patterns should be considered when defining scope, to ensure the DRS achieves maximum recycling performance and avoids market distortions.

SYSTEM SPOTLIGHT

The regions below all include broad yet well-defined specifications:

	Oregon, USA	Estonia	Lithuania	New South Wales, Australia
Beverage type	**118 ml up to and including in 1.5 L (4-50 oz)** Coffee/tea, energy and sports drinks, fruit and vegetable juice (does not have to be 100%), juice smoothies, coconut water, non-alcoholic wine, hard cider if 8.5% ABV or less, marijuana beverages, protein shakes (unless marketed as meal replacements), kombucha, cocktail mixers. **Up to and including 3 L (101 oz):** Soda (carbonated/ sparking beverages), beer and malt beverages, water, hard seltzer, kombucha.	Soft drinks, water, juice, juice concentrates, nectars, beer, cider, perry, low-alcohol beverages (up to 6% alcohol content).	Beer and beer cocktails, cider and other fermented beverages, mixed alcoholic and non-alcoholic beverages, all types of water, juice and nectars. Fruit wines and wine-product cocktails are included when sold in plastic and metal packaging.	All beverages sized 150 ml up to 3 L (5-101 oz). Excluded: • Plain milk (or milk substitutes) • 1 L (33 oz) or more of: flavored milk, pure fruit/ vegetable juice, wine and water casks • Wine and spirits in glass containers • Wine sachets of 250 ml (8.4 oz) or more • Cordials and concentrated fruit/vegetable juices • Registered health tonics
Material type	Plastic, metal (aluminum/ tinplate), glass.	Plastics, metal, glass.	Plastic, metal, glass.	Metal (aluminum/steel), glass, plastic (HDPE, PET), liquid paperboard.
Size	118 ml to 3 L in some cases (4-101 oz).	100 ml up to 3 L (3-101 oz).	100 ml up to 3 L (3-101 oz).	150 ml up to 3 L (5-101 oz).

• **Michigan, USA:** While the system achieves the highest return rate in North America (around 90%), it does not include modern beverage categories like bottled water.[50] By contrast, when New York expanded its DRS to include water alone in 2009, it doubled the amount of PET plastic containers captured by the system. Water containers now make up about 25% of all the containers that New Yorkers redeem for recycling.

• **Netherlands:** Until recently, the Netherlands' DRS only included PET plastic bottles over 1 liter. This left out plastic containers under 1 liter and all aluminum and glass containers. Of the approximately 900 million small plastic bottles sold every year in the Netherlands, around 100 million are estimated to end up in the environment. As a result, in 2020, the Dutch government announced that a deposit on plastic containers smaller than 1 liter would carry a €0.15 (US$0.17) deposit by July 2021, which is expected to collect 90% of large and small plastic deposit bottles.[51] In addition, the DRS will most likely add cans to the program in 2022.

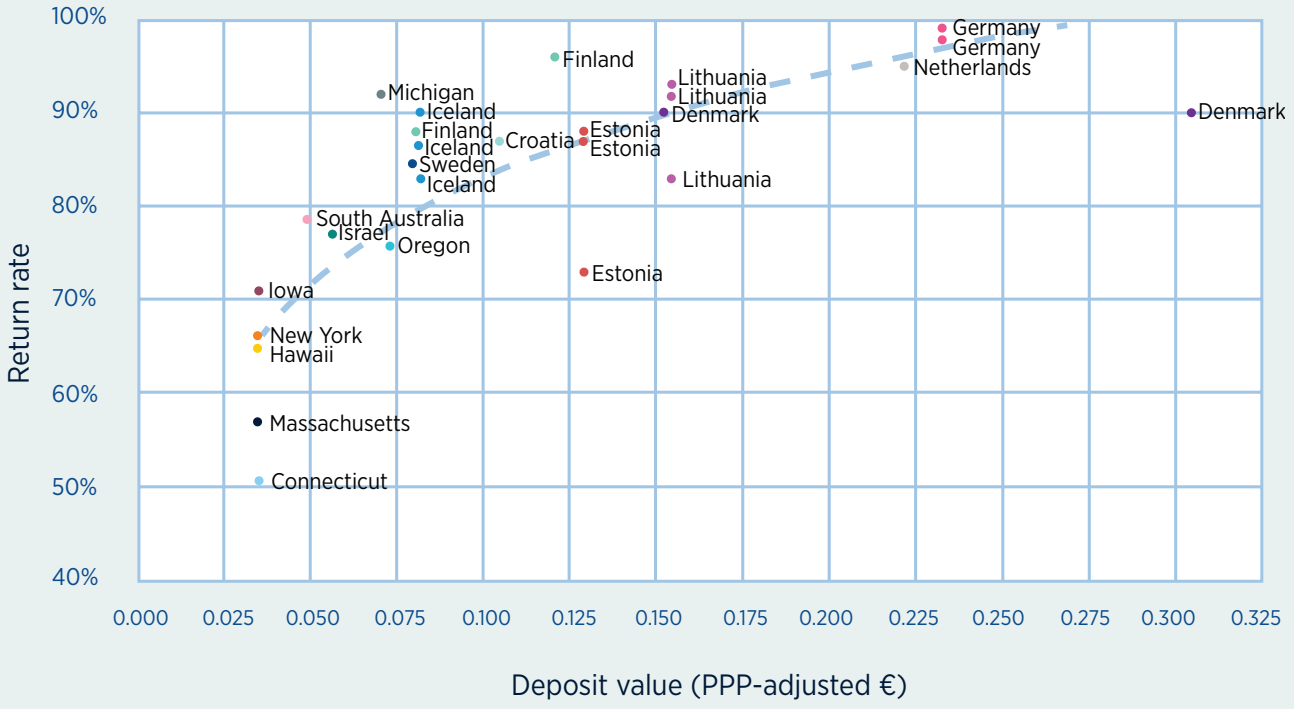
2. MINIMUM DEPOSIT VALUE

Providing a financial incentive to prevent littering and promote recycling is what separates deposit return systems from other collection programs. The deposit motivates consumers to treat packaging as a resource, rather than trash. Decades of redemption data shows that meaningful deposit levels effectively drive more containers out of the waste stream and into the recycling stream.

The higher the deposit amount placed on a beverage container, the higher the collection rate.

As Figure 4 illustrates, it is difficult to reach an 80% return rate or above with a deposit value at or below €0.05 (adjusted for Purchasing Power Parity).

Figure 4: Return rates compared to Purchasing Power Parity-adjusted deposit values - € (2018)[52]*



* Figure 4: Multiple country titles refer to instances where a DRS utilizes multiple deposit values depending on beverage type, material or size.

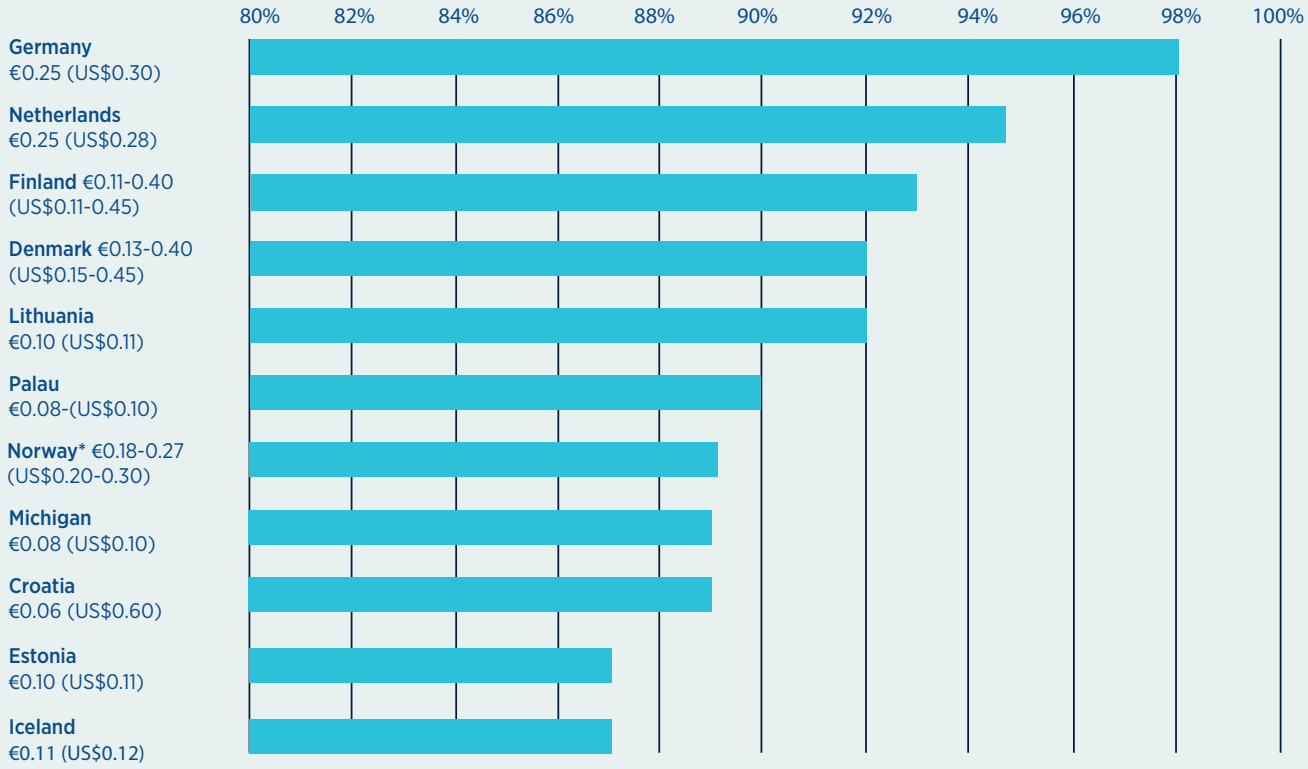
High-performing systems set values by considering the purchasing power of the respective market, which takes into account the relative strength of economies and differences in wealth. Based on a review of global return rates, a good principle appears to be setting the deposit value high enough to motivate consumers to return empty containers at a rate of 90%+, while low enough to discourage fraud. While the definitive deposit amount will depend on the system's collection infrastructure and the government's collection target, performance metrics suggest that policymakers consider a deposit of a minimum €0.10 (PPP-adjusted) or $US0.10 to be effective at this time.

When coupled with a performance target, policymakers will set a minimum deposit value(s) while empowering producers to raise it if they choose. As discussed later under Element #10, effective systems allow producers to manage the day-to-day operations of the DRS including the deposit value. Producers may choose to voluntarily set a higher deposit value if they seek to achieve a performance target, or if there are penalties associated with underperformance.

Stakeholders may debate the use of a single or "flat" deposit value vs a variable deposit value for all beverage types, materials and sizes. A flat deposit value is easiest for consumers and other parties to understand. In that case, a harmonized or flat deposit value provides clarity in the system. However, policymakers may choose to set higher deposit values on containers that are larger and more expensive in order to ensure the incentive to redeem remains meaningful. Ultimately, the goal is to capture and recycle the highest number of containers.

While a meaningful deposit value is critical, high return rates also depend on a convenient network of redemption points to ensure the deposit does not act as a tax.

Figure 5: Return rates and deposit values for the world's highest-performing deposit return systems (2019)*[53]



* In 2019, Norway recovered 88.9% of containers by units, 89.4% by weight. The total recovery rate including volumes collected by central sorting and recovered through waste to energy is above 95%. Latest data available shown for Germany, Netherlands and Palau (2018).

SYSTEM SPOTLIGHT

• **Germany:** Germany has deposit systems for both refillable and one-way containers. German law initially required beverage producers and retailers to sell an overall 72% of beverages in refillable containers (known as a "reuse quota"). As the quota was not met, a one-way DRS was implemented. To ensure one-way containers do not overtake refillables, policymakers set a high deposit value, but allowed producers to set a higher value if desired.[54] With the world's highest return rate, at 98%, producers have not seen a need to increase the deposit value. Empowering the producers this way allows for flexibility to manage the program to achieve objectives.

• **Connecticut, USA:** On the opposite end of the spectrum is Connecticut with its 50% return rate, making it among the poorest performers. Containers carry a US$0.05 (€0.04) deposit value, which has not been updated since the law was passed in 1978.[55] In a survey, 27% of Connecticut residents reported that the deposit is too low to justify redeeming; this compares to just 3% in Michigan, where the deposit is US$0.10.[56] If Connecticut's deposit value had kept pace with inflation, the deposit would be US$0.19 (€0.17) today.[57] The deposit value was set by the legislature in statute, and requires the legislature to amend it. As such, there is no mechanism to future-proof this key element as performance declines.

3. RETURN-RATE TARGET

Programs with return rates matching or exceeding 85% of the containers sold are considered "high performers" (see Figure 5 for examples). This is achievable primarily through setting a meaningful deposit value and ensuring redemption is easy for the consumer. Inflation pressures may weaken this, as will a consolidation or decline in the number of redemption points. In addition, "unredeemed deposits" may provide a perverse incentive to prioritize income over performance.

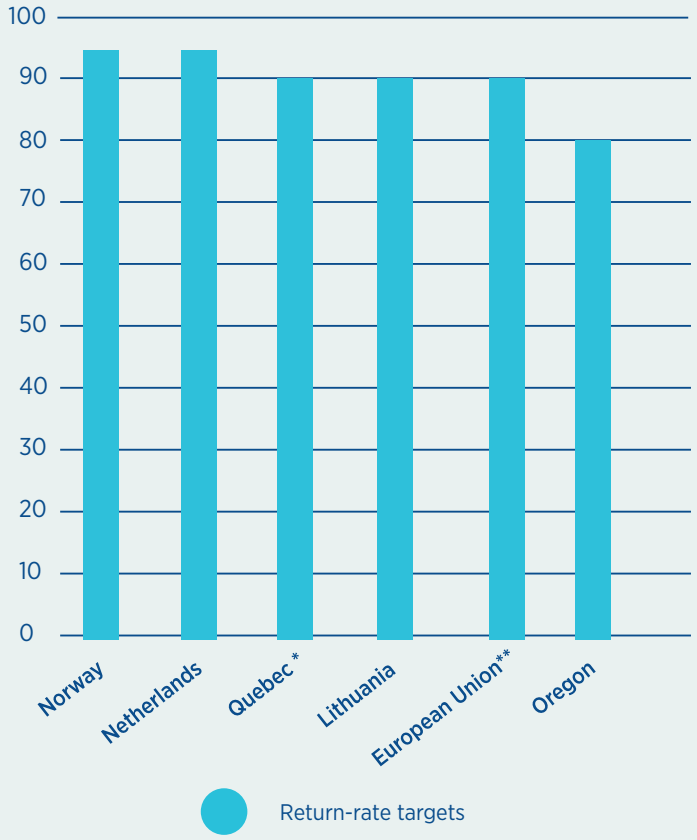
Setting a target for the return rate defines a common goal for producers, retailers and regulators. It aligns design, investment, data management and encourages cooperation. It is also a way for producers to maintain their "license to operate" to manage the program, with some flexibilities in setting fees and maintaining the unredeemed deposits to help finance the program. Taxes, delisting products or implementing a "trigger" to automatically raise the deposit value are some of the ways used to ensure a fair playing field for all brand owners and to raise the return rate. Penalties are set at a level to properly incentivize compliance. (For more see Key Element #12: Government enforcement).

$$\text{Return rate} = \frac{\text{deposit containers redeemed}}{\text{deposit containers sold}}$$

SYSTEM SPOTLIGHT

• **Massachusetts, USA:** Massachusetts is an example of what happens when a performance target is not in place. With a 2019 return rate of 50%, Massachusetts matches Connecticut for the lowest return rate in the world. With a deposit value of US$0.05 (€0.04), the incentive to participate has diminished since the law was implemented in 1983.[58] Without a return-rate target and penalties associated with underperformance, producers lack incentives to improve the system at scale. In addition, unredeemed deposits are diverted to the government, which may incentivize the regulatory body to keep the return rate low.

Figure 6: Beverage container return-rate targets (%)



* In 2022, Quebec will instate a staggered target of 75% collection by 2025, 90% by 2030.

** The European Union set staggered goals of 77% collection of plastic bottles by 2025, 90% by 2029.

Principle

#2

CONVENIENCE

The redemption system is easy, accessible and fair for all users.

4. CONVENIENT REDEMPTION SYSTEM FOR CONSUMERS

"Deposit return" is the moniker for a system made up of two distinct but inseparable parts. While the deposit value engages the consumer, the return rates also rely on a return system which is equally engaging. High-performing programs make redemption easy for the original consumer by making it as accessible as it was to purchase the product in the first place.

"Return to retail" refers to the aspect of the system where retailers who sell beverages must take them back. Nine out of 10 of the world's highest-performing deposit return systems employ return-to-retail collection, achieving an average return rate of 92%.[59] In 2019 the average return rate for return-to-retail deposit systems was 88% vs 77% in systems that do not involve retailers.[60] Retailers have been involved in container returns since at least the early 1900s when the original refillable systems were common. As one report on the history of packaging put it, "if an apothecary or merchant provided goods in a bottle, there was typically an understanding that the bottle belonged to its purveyor and was to be returned after use."[61] Today retailers continue to share responsibility with producers for the end-of-life collection of deposit containers.

As a deposit is charged, a promise is made to consumers that they will be able to recoup their money. Producers, retailers and the government have an obligation to make it so, otherwise they run the risk of purporting an unauthorized tax or eco-fee. Effective systems consider cost-effectiveness in the design of a DRS – but also the consumer's experience and rights. Return-to retail-systems deliver both.

Setting the redemption system up for success

High-performing systems do not allow design of collection point infrastructure and operations to be left to a central beverage industry-run administrator, due to conflicts of interest. Either redemption system design is left to legislation – e.g. "return to retail"– or to an independent network operator tasked with delivering certain prerequisites, like a number of collection points per capita, effectively splitting the responsibility for system administration into two levels (see the New South Wales case study on pg. 55 for more).

Measuring convenience

Although a metric for "convenience" does not exist yet in statute, high-performing programs are effectively providing consumers points to return their containers in parallel with retailer density. Or, as data suggests below, a ratio of 1 point of return for every 355 – 1,100 people. Due to higher populations in urban areas, effective systems approach those localities differently. For example, the number of collection points per square kilometer across Norway is 0.3, but in the capital Oslo it is 11.

Other metrics used to evaluate convenience include the return rate and the percentage of consumers that participate in the system.

Figure 7: Redemption points per person

System	Norway	Lithuania	Germany	Michigan	California
Return rate (2019)	89%	92%	98%*	89%	60%**[62]
Redemption locations	15,000	2,500	130,000	13,500	1,219[63]
Population (2019)	5.33m	2.79m	83.02m	9.99m	39.51m
Redemption point to consumer ratio	1 : 355	1 : 1,117	1 : 638	1 : 739	1 : 32,411

* Displays 2018 return rate as 2019 data is not available as of publication.

** 2020

Design for efficient transportation logistics

Container compaction provides an important value within deposit systems. By compacting (or crushing) containers, PET bottles are reduced in size to a ratio of 2.5 : 1 and aluminum cans 6 : 1. This saves space and therefore transportation costs during material pick-up and mitigates against unauthorized redemption since containers cannot be redeemed twice (known as a "devaluation of containers"). The closer container compaction occurs to the point of redemption, the more fuel, carbon and resources are saved. For this reason, among others, systems like Norway and Sweden incentivize the use of RVMs that can compact containers and promote return to retail, as discussed under Element #10.

Retailer participation

- Typically, retailers are paid for their redemption services in the form of a "handling fee". In high-performing systems this is paid by the beverage industry funded Central System Administrator to the retailer on a per-container basis (see Element #10 for more detail on Central System Administrators). It is typically set by a central system organization. Eight out of the top-10 performing deposit systems pay a handling fee to retailers.[64]

- With benefits for both the consumer and retailer, consumers may return deposit containers to any retailer in the network*, and retailers take back containers similar to the types they sell.

- Retailers below a certain size might not be obligated to participate but can offer redemption services if they wish.

Rewarding Recycling

* Known as "universal redemption".

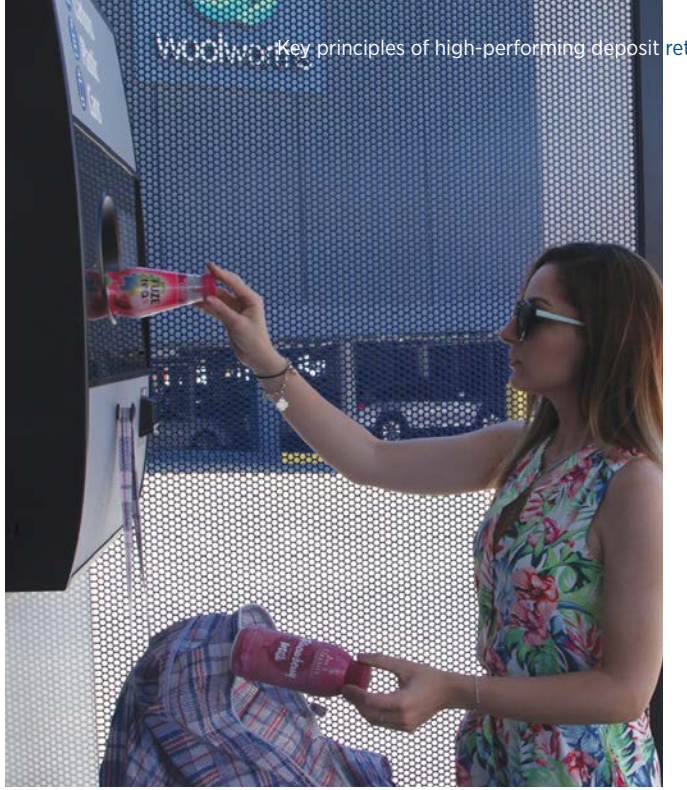
Redemption centers, depots, and/or kiosks can also play a role in redeeming containers by:

- Serving high-volume redeemers and consolidating volumes for operational efficiencies.
- Maintaining a minimum number of redemption points per population (e.g. one redemption point per 355 - 1,100 people).
- Providing redemption locations close to high-consumption points, like outdoor eateries and marketplaces.
- Providing unmanned redemption kiosks at retail locations including parking lots, to provide cost efficiency and convenience.

WHY A RETURN-TO-RETAIL APPROACH LEADS TO HIGH PERFORMANCE

CONSUMER'S PERSPECTIVE

• **Convenient redemption options:** As Victoria, Australia, considers its DRS model, a recent poll by Ipsos commissioned by the Boomerang Alliance found that 71% of those asked preferred container retail refund points in supermarkets or shopping centers.[65]



• **No extra trips required, and additional travel time is eliminated:** By positioning container return facilities in locations that people already visit regularly, this removes the barrier of "going out of your way" to recycle. In the US, consumers already visit grocery stores 2.7 times a week for food shopping.[66]

• **Ability to redeem containers while "on the go":** Beverage containers are often consumed on the go so a high number of redemption points makes redemption more convenient. One US study estimates the percentage of on-the-go consumption between 30-50% of all US beverage container consumption.[67]

• **Frequent recycling without waiting is possible:** With many supermarkets and grocery stores available, consumers can access multiple return points locally. This reduces waiting or queuing times at the return location, so consumers can take a "little and often" approach to redemption. In user surveys from Norway, over 80% of respondents said having access to a return point without waiting was extremely important in returning their empties.[68]

GOVERNMENT'S PERSPECTIVE

• **Address plastics pollution:** Beverage container litter as a proportion of all litter is 66% less in regions with a DRS than without.[69] And given that the average return rate for return-to-retail deposit systems is 88% vs 77% in systems that do not involve retailers, it is reasonable to infer retailers play a significant role in reducing plastic pollution.[70]

• **Achieving targets:** As regions (especially EU member states) seek to achieve ambitious recycling, collection and recycled content targets, deposit return has been recognized as a reliable way to achieve high performance. For example, in a study com-

missioned by the Government of Ireland to evaluate pathways to achieve the EU's 90% collection target for plastic bottles, the authors state, "no evidence has been presented to suggest that the current (waste management) system could be enhanced to reliably achieve a 90% separate collection rate... On the basis of this study, a DRS is a feasible option for Ireland, and indeed the only way in which it can confidently be asserted that a 90% collection rate for plastic beverage bottles can be achieved." The study goes on to recommend return to retail because those models "generally have higher return rates."[71]

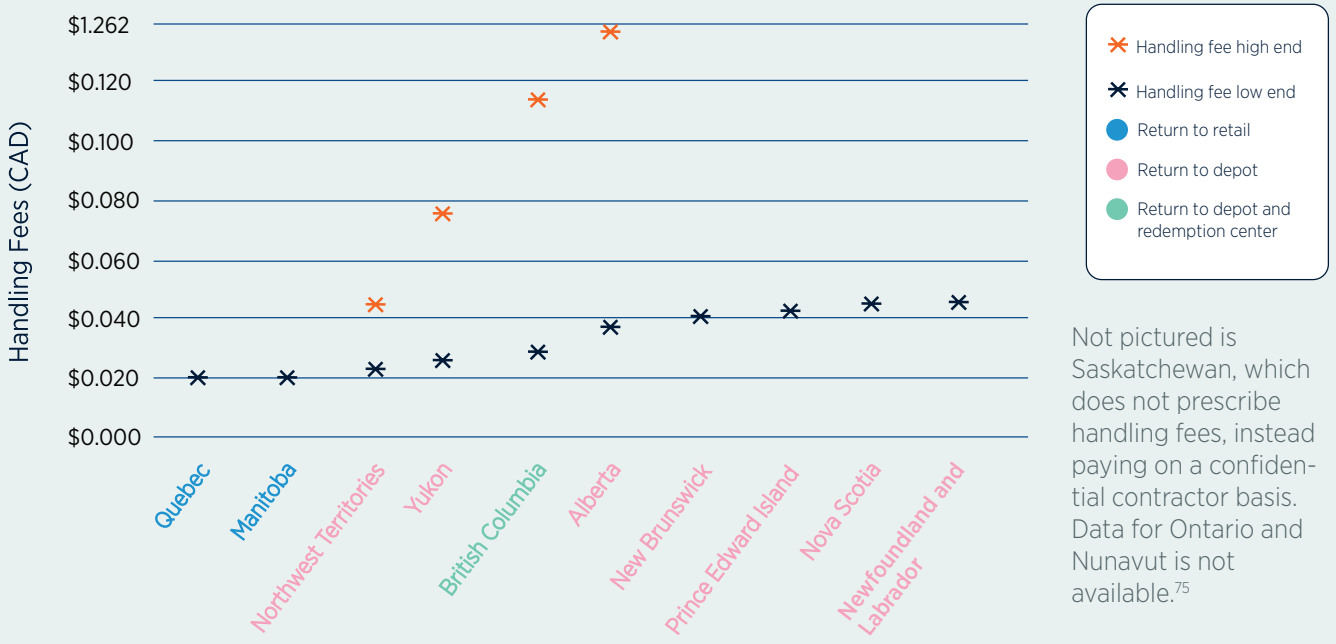
- **Ensure convenience:** Governments requiring deposits to be charged on container purchases also seek to maximize convenient opportunities for citizens to recoup their money. Convenience is built into return-to-retail models, because retailers have already designed a system to make purchasing products convenient. For example, Norway's return to retail model offers one redemption point for every 355 people[72] and achieved an 89% return rate in 2019.[73]

- **Immediate results:** Governments are currently under pressure to quickly address plastic pollution and rising recycling costs related to the impacts of National Sword. Leveraging existing retail infrastructure in a DRS helps accelerate progress. For example, after Lithuania implemented its return-to-retail-based DRS, beverage container return rates rose from 34% to 92% in less than two years.[74]

PRODUCER'S PERSPECTIVE

- **Hitting targets in a cost-effective way:** Off-retail redemption centers tend to incur higher and increasing costs such as labor, site maintenance, etc. This is due to the fact that the cost of redemption at off-retail redemption locations reflects 100% of the fixed costs for the location, like insurance, labor, utilities, taxes, etc. In a retail environment, the cost of redemption offers a marginal increase because other businesses are sharing those costs and labor. Handling fees can be viewed as a proxy for the cost of redemption. Across Canada, the two provinces with return to retail also exhibit the lowest handling fees, contributing to a more cost-effective system. (See Figure 8)

Figure 8:
Handling fees for one-way deposit containers in Canada



Not pictured is Saskatchewan, which does not prescribe handling fees, instead paying on a confidential contractor basis. Data for Ontario and Nunavut is not available.[75]

• **Leverage an existing network:** Building on existing logistics networks and infrastructure can form an efficient reverse logistics system. With supermarkets located close to residential areas, the infrastructure for convenient redemption is already in place. A return-to-retail approach reduces the need to permit, build and outfit new recycling locations. As such, the DRS can launch faster, and more cost effectively. Supermarket chains typically have networks across whole regions, including remote communities, ensuring shopping points are available for everyone. Supermarkets already accommodate truck for delivery of goods; these could also be used for reversing the logistics or consolidating pick-up and transportation services.

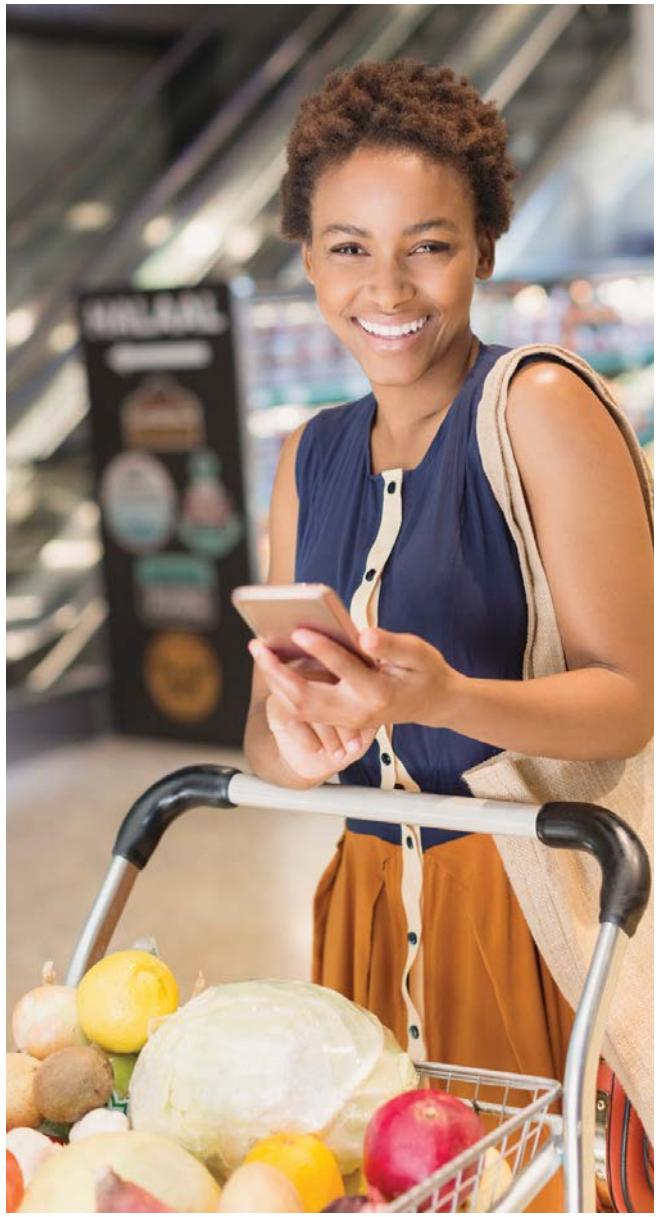
RETAILER'S PERSPECTIVE

• **Consumers spend deposit money at retailers:** Providing the opportunity to redeem cans and bottles adds another reason for consumers to visit retail locations, and consumers tend to spend their deposit money in stores. In a survey of Michigan consumers, 73% say they spend deposit money at the store where they returned their containers while assumptions in other markets are as high as 95%.[77] In another study across four European countries, shoppers returning containers spent up to 50% more money in that store visit than those who did not return empties.

• **Retailers sell beverages and want to ensure a cost-effective program too:** Costs to producers are ultimately borne by consumers, so retailers have an interest in reducing costs for their own customers.

• **Many retailers today are also brand owners selling their own private label:** In this case they share the "Producer's perspective" above.

• **Positive environmental impact and brand image:** Offering convenient access to recycling in store enables retailers to track data on how many containers they help to collect and recycle every year and tell a brand story about products made from recycled containers, supporting Corporate Social Responsibility commitments. The service also provides a regular reminder to consumers that retailers practice environmental stewardship. For example, in Germany in 2020, the retailer Lidl launched a large advertising campaign promoting how containers returned by customers to more than 6,200 RVMs at Lidl locations are recycled into new bottles, enabling the

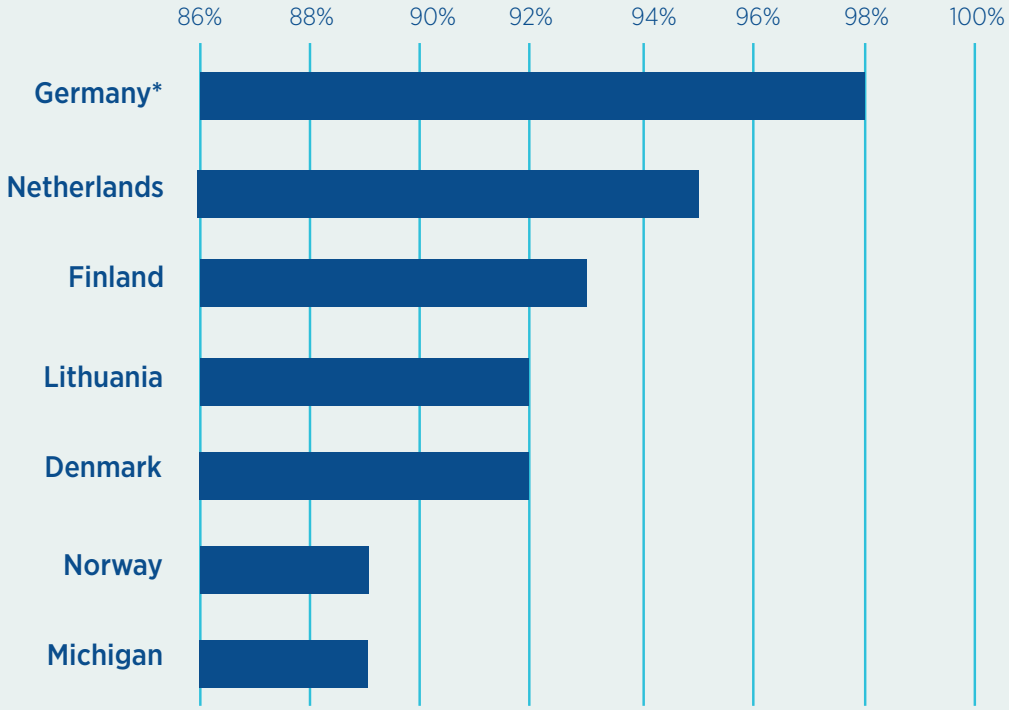


store's private label water brand to manufacture new bottles out of 50% recycled content on average at a minimum.[78]

SYSTEM SPOTLIGHT

All the systems below operate on the return-to-retail model, with an average redemption rate of 93%.

Figure 9: Container return rates for best-practice return-to-retail models (2019)



* 2018. 2019 return data not available.

Michigan, USA: Over the course of its 40+ year history, Michigan's DRS has collected 96% of the 150 billion deposit containers sold.[79] To help retailers manage the redemption volume and accelerate the redemption process for consumers, Michigan offers retailer provisions such as limiting the number of containers that any one consumer can redeem per day (250) and only requires retailers to take back brands that they sell (though the latter can cause consumer confusion). A 2019 poll showed that 94% of Michiganders supported the deposit law.[80]

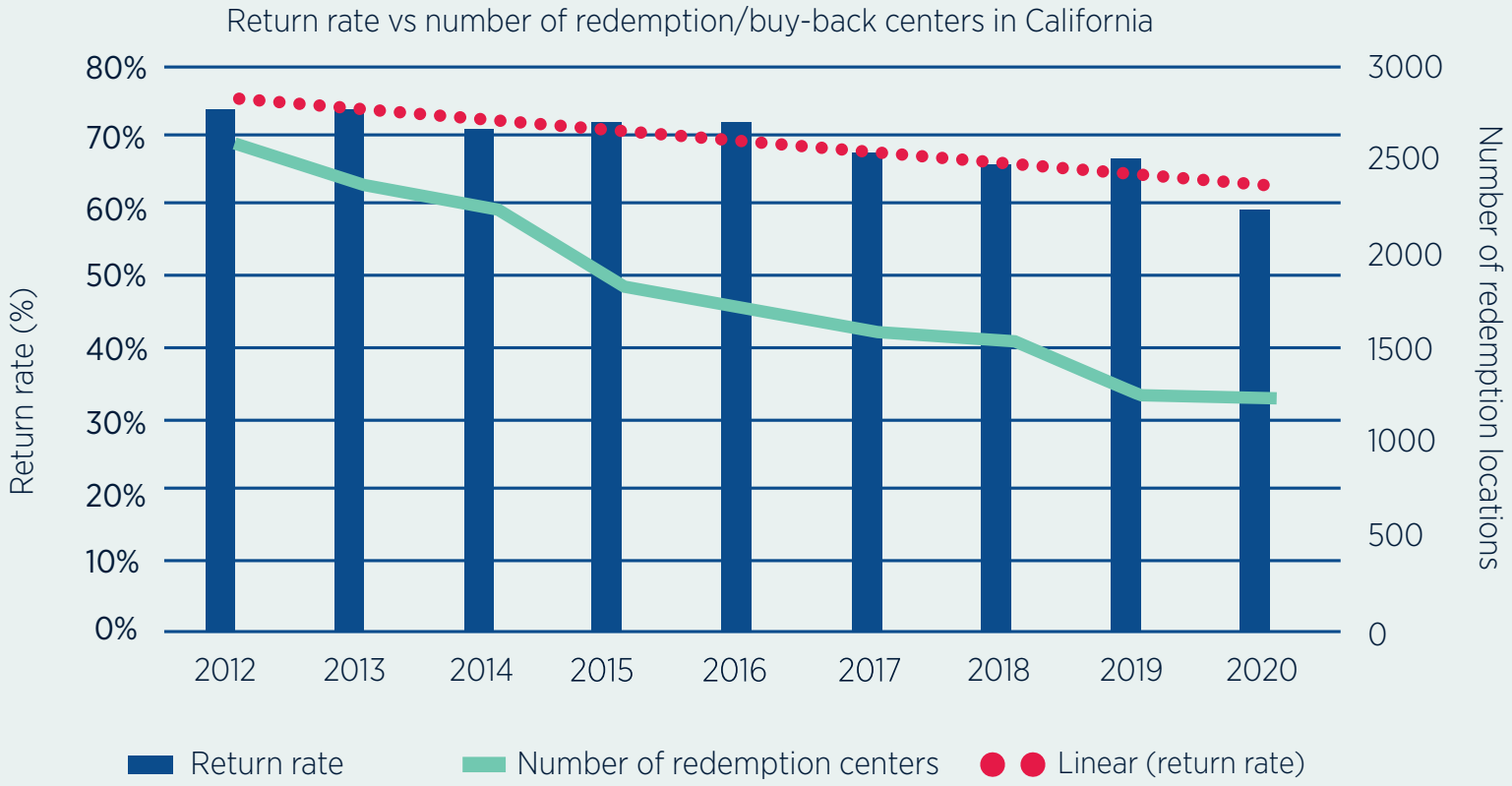
Norway: Norway offers 15,000 redemption locations, which equates to a ratio of one redemption point per 355 people.[81] Only 23% of redemption locations utilize RVMs but those locations collect 93% of returned containers. This allows the Central System Administrator (see Element #10 for more), Infinitum, to make the transportation network as efficient as possible due to container compaction and redemption data that predicts pick-up routes. In 2019, Norway achieved an 89% return rate.[82]

California, USA: California is a perfect example of the impact of inconvenience on recycling performance. California's deposit system was built on the backbone of a network of redemption centers, with no redemption obligations for retailers. Retailers are only obligated to redeem containers if they are not located near redemption centers (or redemption centers close, as is now the case). Retailers are also allowed to opt out of redemption by paying a fee of US$100 (€88) fee per day, but this is largely unenforced.

Redemption centers have been hobbled by a rigid and outdated state funding formula that leaves the centers starved for cash while commodity prices plunge and operating costs such as the minimum wage rise.

As a result, recycling centers have closed en masse since 2013. Closures have left California with 1,219 recycling centers, less than half the 2,578 centers that were in operation in 2012.[83] San Francisco has only one center to serve nearly 900,000 residents.[84] This has created a situation where California consumers have lost convenient access to a deposit redemption point, making deposits difficult to redeem and essentially turning the deposit into a tax. The recycling rate for the deposit program has declined from 74% in 2013 to 60% in 2020 (and that includes cans and bottles placed in curbside recycling bins).[85]

Figure 10:
Comparing California's redemption performance vs number of redemption locations[86]



SNAPSHOT: HOW INNOVATION HAS BROUGHT DEPOSIT SYSTEMS INTO THE 21st CENTURY

When public deposit return systems first launched in the 1970s, consumers had to rely on manual redemption: meaning literally handing a crate or bag of cans and bottles over to be counted, while redemption providers kept track of the accounting by hand. Today, technology has enabled the automation of these processes and added a number of new features that increase the system's accountability, cost efficiency and convenience.

REVERSE VENDING MACHINES (RVMS)

RVMs provide a range of services:

- **Automated redemption and accounting:** RVMs enable redemption operators to accept containers and manage accounting automatically, which reduces labor time and associated costs and allows retailers to focus store staff on other tasks like stocking shelves, etc.

- **Sorting and processing:** RVMs start the process of recycling by separating materials at the collection point. This keeps materials free from contamination, protecting their material value, and enabling recycling into high-value applications like new containers.

- **Accountability:**
  - **Container verification:** The latest RVMs take 1,000 pictures per second of the returned containers and perform other inspections to analyze the shape, weight, material, barcode, and (if applicable) any security markings on each container. Analyzing these features allows retailers and the system operator to keep track of exactly which containers are accepted for redemption. Such measures also ensure non-deposit containers cannot be accidentally accepted for redemption.

    Modern DRSs require RVMs to be placed online, because this allows the system administrator, operators and regulators to monitor the entire redemption system remotely and through real-time data. Irregular redemption can serve as an "early warning system" to alert operators to potentially fraudulent activities.

  - **Compaction eliminates repeat redemption:** RVMs come equipped with compaction capabilities, which prevents consumers or redemption employees from redeeming the same container more than once.

- **Data administration:** RVMs scan container barcodes and check against a database of tens of thousands of products to verify the container is registered in the system, in order to reconcile return data with sales data for the beverage producer associated with that product. Operators can instantly update the products eligible for redemption across entire networks of participating RVMs by providing new databases online.

- **Consumer marketing:** The redemption process is another marketing "touchpoint" for redemption operators, especially retailers who can offer advertising and coupons via RVM touch screens and paper vouchers. Reverse vending digital tools enable retailers to track consumer insights, gamify the recycling experience, and link to operators' own loyalty programs.

- **Consumer choice in payment options:** RVMs offer consumers greater options for payments including paper and paperless vouchers redeemable for cash, digital transfers directly into consumer accounts and donation options.

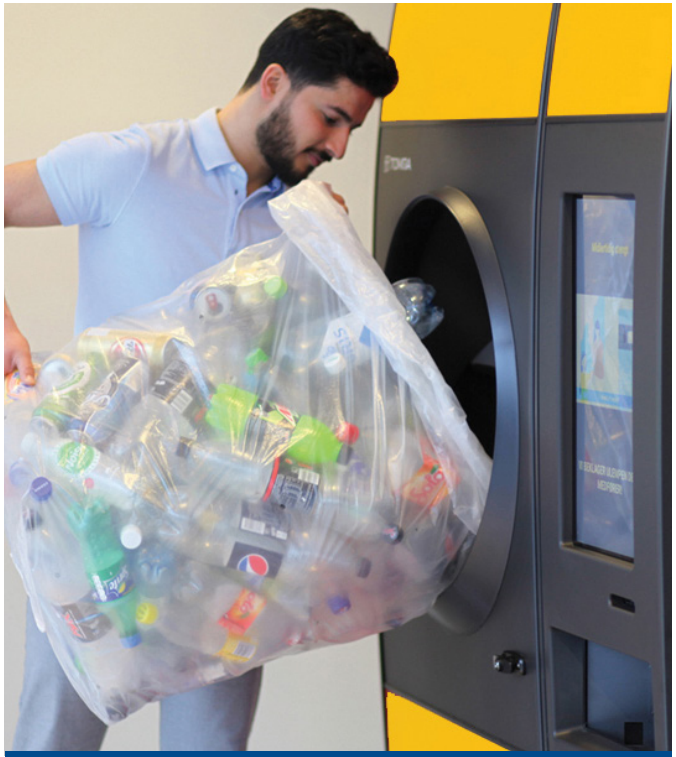
• **Cost and space reduction through compaction:** As mentioned earlier, compaction reduces the size of PET bottles by a ratio of 2.5 : 1 and aluminum cans 6 : 1, which makes storage and transportation more efficient. In Norway, despite return rates increasing, the Central System Administrator, Infinitum, reports that they have reduced their transport costs by 35% between about 2014 and 2018. Much of this is attributable to compacting RVMs, which Infinitum relies on to reduce the number of collections that are required. Infinitum also utilizes the redemption data sent directly to them from RVMs to improve pick-up logistics.[87]

• **Convenience:** RVMs have steadily increased how many containers can be accepted per minute. The latest models offer 60 containers per minute, or 100 per minute with "multi-feed" models that allow consumers to empty an entire bag into the machine at once. This design has been paired with digital payment solutions and QR codes to enable consumers to simply empty their bag of containers at once and walk away. The machine automatically counts containers and pays the consumer through an app.

BULK COUNTING EQUIPMENT:
Bulk counters are industrial-sized reverse vending solutions that automatically count and verify the barcode and/or security marking of each container.

Bulk counting equipment

• **Accountability:** While manual redemption is still in place in some form in all deposit systems, it can be susceptible to inefficiencies and fraud if not supported by automated counting at some stage in the process. Effective DRSs address this by requiring containers redeemed manually to be verified through a second count, through automated equipment during or after initial collection. Alberta, for example, directs all manually-redeemed containers to centralized counting centers where bulk counting equipment counts containers at high volumes.



Multi-feed reverse vending machine (TOMRA R1)

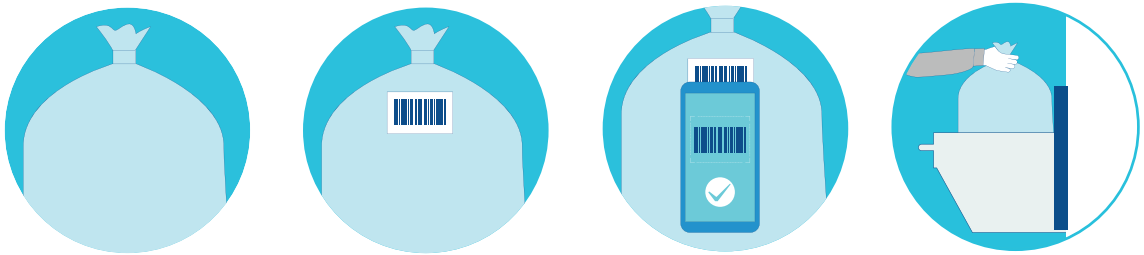
BAG DROP

• **Convenience:** For consumers who accept a delay in their deposit return, bag-drop services can provide an alternative means to redeem. Consumers sign up for an account with their local redemption operator and download a mobile app with payment functionality like PayPal. The operator provides them with stickers with a personalized barcode that consumers place on bags that they purchase. Funds are deposited in user accounts within 3-5 days. Although bag-drop services provide a convenient way to engage some specific consumer demographics, they do carry more cost for the operator due to bulk counting requirements, risk of fraud and consumer complaints related to counting results and repayments. Bag drop may come with consumer fees for processing or bags as in the Oregon model.[88]

DOOR-TO-DOOR

• **Convenience:** Retailers, technology players and system operators are collaborating to offer more pick-up services right from the consumer's doorstep. For example, Norway's Central System Administrator, Infinitum, partnered with local retailer Kolonial to offer a service where Kolonial's grocery delivery team picks up consumer empties and takes them back to a Kolonial warehouse. It delivers the empties to Infinitum where the system operator utilizes bulk counting equipment to count containers and reconcile consumer transactions. Consumers buy special bags from the retailer that are barcoded and embedded with a code to track their containers and ensure they receive an accurate refund. The system operates on a small scale. Approximately 1% of returns are processed through home delivery.[89] As with bag drop, door-to-door redemption may come with additional consumer fees for processing or bags.

How bag drop works



5. SEPERATELY CHARGED AND FULLY REFUNDABLE DEPOSITS

A true "deposit", in any context, is designed to be returned in full. Systems issuing partial refunds in order to hold back funds for paying system costs (also known as "half-backs") collect significantly less containers, because they reduce the incentive to participate. The top-five performing deposit systems in the world (Germany, Netherlands, Finland, Denmark and Lithuania) all offer fully refundable deposits. Together they average a 94% return rate.[90]

Effective DRSs engage the consumer at the point of sale by making them fully aware that they are being charged a refundable deposit on top of the sales price. Separately listing the deposit value from the sales price on both the store shelf and receipt avoids unnecessary consumer confusion.

Exempting the deposit from value-added or sales taxes help reinforce the perception among the public that a container deposit is not a tax.

SYSTEM SPOTLIGHT

Separately charged deposits

- **All European deposit systems (Germany, Norway, Sweden, Finland, Estonia, Netherlands, etc):** All of these systems require the container deposit amount to be clearly listed on both the store shelf and sales receipt.

- **All Australian states:** While deposit containers in Australia indicate the container has a "refund" value, sales receipts and product labels on shelves do not, which misses a key public education opportunity.

Fully refundable deposits

- **Newfoundland & Labrador, Canada:** In Newfoundland & Labrador, consumers pay a deposit and receive about 70% of the value back upon redemption. For example, consumers pay CA$0.08 and get $0.05 back (US$0.06/$0.04) for beer cans and imported bottles. In 2019, the region's overall container deposit return rate was 65%.[91]

- **California, USA:** The California Refund Value (CRV) is the amount paid to consumers when they recycle beverage containers at certified recycling centers. The minimum refund value established for each type of eligible beverage container is 5 cents for each container under 24 ounces and 10 cents for each container 24 ounces or greater. The typical means for redeeming containers at state-certified recycling centers is by first weighing them and then using a state-supplied conversion formula. For every deposit consumers pay at checkout, they are most often paid less than when redeeming through this "weight-based" system. While container-based redemption is straightforward (one deposit for one container), weight-based redemption requires regular updates of the average weight calculation. Weight estimates are skewed by the wide and evolving bottle sizes and weights – an example most obvious when redeeming plastic bottles, because some categories like water have undergone extensive efforts to reduce container weights.

6. CONTAINER DEPOSIT MARKINGS FOR CONSUMERS AND MANUAL RETURNS, BARCODES FOR ACCURATE ACCOUNTING

In order for consumers and manual return points to easily identify containers eligible for a deposit, it is standard practice for DRSs to require standard text or a logo to be printed on each container.

Barcodes serve a similar purpose as they enable automated redemption technology to recognize and count each deposit container – in the same way that grocery cashiers scan items at checkout. This provides the same accurate payments, a baseline level of security and fair financial accounting by keeping track of each brand. Virtually all deposit systems around the world, except for California and many Canadian provinces, have barcode-based recording systems that can identify whether containers qualify for redemption.[92]

To further enhance accountability, modern deposit systems require or incentivize unique deposit markings and market-specific barcodes to prevent fraudulent redemption of non-deposit containers,

reducing costs. Producers utilize these controls for their cost-saving benefits. In the United States this is utilized voluntarily by some brand owners where the benefit is clear.

If direct printing of labels is not viable (e.g. small quantities of imported beverages), a sticker or stamp can be purchased from the CSA and affixed to the label.

SYSTEM SPOTLIGHT

• **Norway:** Beverage producers pay a fee to register their products with the Central System Administrator (CSA), Infinitum. Containers must be marked with the deposit logo, deposit value, and a barcode. Prior to product launch, these containers are sent to Infinitum for testing and approval to ensure that that they can be read by reverse vending machines.

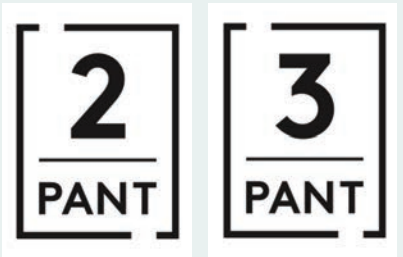
As part of the registration process, manufacturers can choose whether to use a universal barcode (which allows the beverage to be sold in any country), or a barcode unique to Norway. Norway-specific barcodes carry lower fees for producers since they prevent consumers from potentially collecting deposits for containers bought outside of Norway. Infinitum retains all unredeemed deposits, so preventing unauthorized redemption reduces cost to the system. By contrast, universal barcodes carry slightly higher fees for producers due to potentially higher unauthorized redemption, since the product is sold across multiple markets.

All bags used for transporting the containers after collection are tagged with a unique radio frequency identification (RFID) chip so they can be traced electronically. The bags, provided by Infinitum, are filled in the storage areas of RVMs and sealed with integrated closing tape so the contents cannot be tampered with.[93]

Figure 11: Examples of visual container deposit markings for consumers

Germany

Sweden



Norway

• **Croatia:** For the first nine years Croatia's DRS was in place, deposit containers only included small text and no visual deposit marking. This made the process confusing for consumers, especially foreigners. Croatia overhauled its system in 2015 at which point logo container markings were required.

• **California, USA:** The program utilizes visual markings, but not barcodes. This creates unnecessary vulnerabilities to fraud. Barcodes enable automated redemption equipment to verify each container as eligible for a deposit. As Eunomia stated in a comprehensive analysis of California's system, the "payment by weight option increases the potential for out-of-state containers and also out of scope containers to be redeemed."[94] The lack of barcodes also leaves the system unnecessarily vulnerable to fraud. CalRecycle spends somewhere between US$40 million and $200 million annually due to loss of unredeemed deposit revenue by way of weak accounting standards and cross-border fraud.[95]

• **New South Wales, Australia:** Before the deposit system was launched in New South Wales, beverages sold together in what is known as "multi-packs" did not have individual barcodes. If nothing had changed, this would have created a situation where one container sold individually would be accepted by an RVM whereas those sold in "multi-packs" would be rejected in many cases. Due to concerns about consumer confusion and fairness, the government updated labeling requirements to add individualized barcodes before the system was implemented.

Principle

#3

PRODUCER RESPONSIBILITY

Producers finance and invest in the system using unredeemed deposits, commodity revenues, and an eco-modulated EPR fee.

7. EXTENDED PRODUCER RESPONSIBILITY FINANCING

Extended Producer Responsibility (EPR) is defined as an "environmental protection strategy to reach an environmental objective of a decreased total environmental impact from a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal of the product."[96] DRSs engage beverage producers to manage the take-back of packaging and cover the costs of the system. In principle and practice, in high-performing models, producers reinvest the unredeemed deposits and the sale of returned material (or "commodity revenue") within the system. Should costs exceed these revenues, the net costs are paid for by the producers. When producers manage the deposit system through a centralized organization, they can agree to pay this net cost in the form of an "EPR fee" (see Figures 13 and 14 on pg. 45)*. EPR fees are charged to the producer for the remaining net costs and can be set based on the full cost of handling and recycling the material type that the producer chooses to place on the market (known as "eco-modulated" fees).
This ensures no one producer is cross-subsidizing for another. It has the added incentive for producers to utilize packaging that is designed for recyclability (see Figure 12).

* Not to be confused with a "handling fee", which is a payment from the Central System Administrator to redemption providers such as retailers or redemption centers for container redemption and storage services.

SYSTEM SPOTLIGHT

• **Norway:** Norway's Central System Administrator, Infinitum, establishes EPR fees for each producer based on the recycling cost and material value of each container material, even differentiating between clear vs colored PET. For example, aluminum cans carry no additional EPR cost for producers in Norway because their inherent commodity value plus the unredeemed deposits outweigh their cost to recover and process (see -0.08 NOK in Figure 12).

• **Saskatchewan, Canada:** Alternatives to producer responsibility financing include models that force consumers to pay for part of the system. Consumers pay this fee when purchasing a product, yet only recoup a portion of their deposit upon redemption. Half-back models only exist in regions with relatively small populations (1.5 million and less). For half-back models with significant populations*, the highest return rate is Saskatchewan at 84%. This contrasts with Germany, a full redemption market, with a 98% return rate.[97]

* Over one million citizens

Figure 12: Eco-modulated EPR fee structure for Norway's Central System Administrator, Infinitum[98]

	Aluminum can	Steel can	PET bottle	HDPE bottle
Basic fee	-0.08 NOK	0.21 NOK	0.10 NOK	0.10 NOK
Surcharge for standard barcode (also sold outside Norway)	0.06 NOK	0.06 NOK	0.06 NOK	0.06 NOK
Surcharge for light blue container			0.08 NOK	0.08 NOK
Surcharge for colored container or a sleeve that covers 75% or more of the packaging			0.15 NOK	0.15 NOK
Surcharge for label or sleeve that covers 75% or more of the packaging	0.03 NOK	0.03 NOK		

1 NOK = €0.096 / US$0.12

8. REINVESTMENT OF UNREDEEMED DEPOSITS AND MATERIAL REVENUE WITHIN THE SYSTEM

There are two main revenue streams in a DRS:

1) **Unredeemed deposits:** Revenue from deposits that consumers chose not to redeem.
2) **Packaging commodity (or "material revenue"):** Revenues from the sales of collected glass, aluminum, PET and liquid paperboard containers.

High-performing deposit models allow producers to reinvest these two revenue streams into the system, reducing the need for any additional charges or fees. Having a return-rate target (as discussed in Elements #3 and #12), a meaningful deposit value (Element #2), and convenient redemption system (Element #4), will drive high return rates, counteracting any perverse incentive for producers or governments to discourage redemption.

SYSTEM SPOTLIGHT

Norway: Unredeemed deposits and material revenue are enough to cover almost all of Norway's DRS costs: 49% of system costs are offset by unredeemed deposits, 35% from material sales, and 8% from other revenues (mainly interest). In the case of aluminum beverage cans, those income streams are even high enough to avoid any additional EPR fee from producers.[99] With these three revenue streams, producers reinvest in the deposit system's infrastructure. Infinitum incentivizes the use of compacting RVMs, due to their cost-saving benefit with respect to fraud mitigation and transportation efficiencies. Retail sites with compacting RVMs are paid a higher handling fee than those redeeming manually or without compaction.[100]

Figure 13: Profit and loss overview of Norway's Central System Administrator (2019)[101]

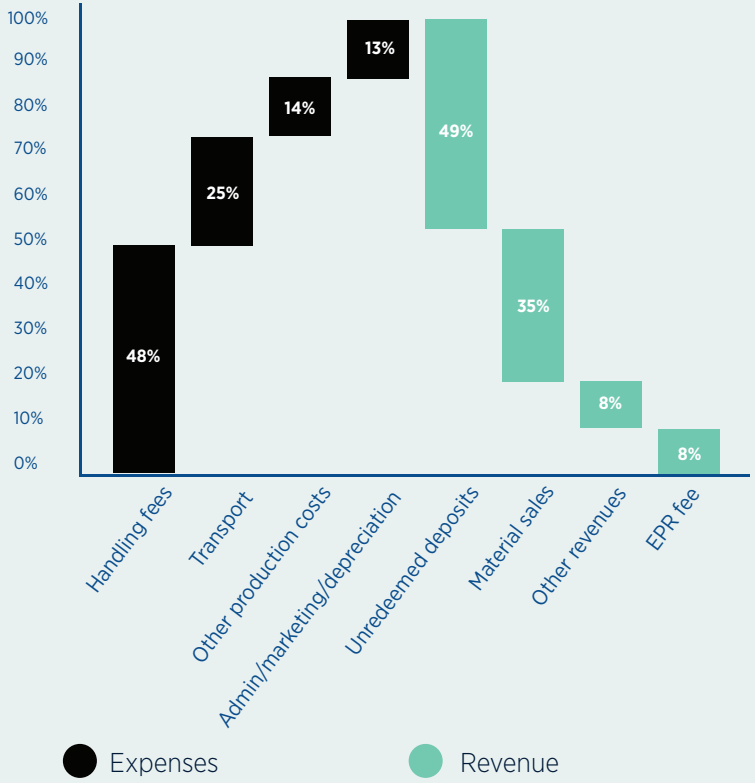


Figure 14: Detailed profit and loss statement of Norway's Central System Administrator (2019)[102]

Expenses		
Handling fees	249,241,000 NOK	48%
Transport	126,091,000 NOK	25%
Other production costs	74,569,000 NOK	14%
Admin, marketing and depreciation	64,704,000 NOK	13%
TOTAL expenses	**514,605,000 NOK**	**100%**
Income		
Unredeemed deposits	252,035,000 NOK	49%
Material sales	180,164,000 NOK	35%
Other revenues	45,695,000 NOK	8%
EPR fee	40,759,000 NOK	8%
TOTAL income	**518,653,000 NOK**	**100%**
Operating profit in 2019	**4,048,000 NOK**	

Figure 15: Handling fees as set by Norway's Central System Administrator (2019)[103]

	HANDLING FEE		
	Aluminum can	PET bottles	HDPE bottles
• RVM with compaction	0.20 NOK	0.25 NOK	0.25 NOK
• RVM without compaction • Manual receiving	0.05 NOK	0.10 NOK	0.10 NOK

Sweden: Sweden's CSA, Returpack Svenska AB, keeps the revenue from both material sales and unredeemed deposits within the system. This funding model has allowed Returpack to reinvest in technology to drive cost- and eco-efficiencies. In the 1990s, 80% of Sweden's deposit cans were serviced by automated equipment. The remaining 20% was handled manually and, due to its relatively high cost, Returpack looked to automate. Returpack already offered a higher handling fee to retailers that utilize RVMs with compaction, but to accelerate the transition to a low-cost automated redemption network, the CSA granted a one-time sum of 20,000 SEK (€1,925/US$2,188) to each manual collection point willing to invest in an RVM.[104]

New York, USA: In 2009, after the global financial crisis, governments faced steep budget shortfalls that threatened public programs. It was in this climate that New York policymakers adjusted the distribution of unredeemed deposits. Previously 100% diverted to producers. There was a perception that producers had not utilized the revenue to reinvest in the performance of the deposit recycling system, and policymakers diverted 80% of the unredeemed deposits to the government, with a portion going towards the Environmental Conservation Fund and 20% remaining with producers to offset costs.

9. RECYCLED CONTENT REQUIREMENTS

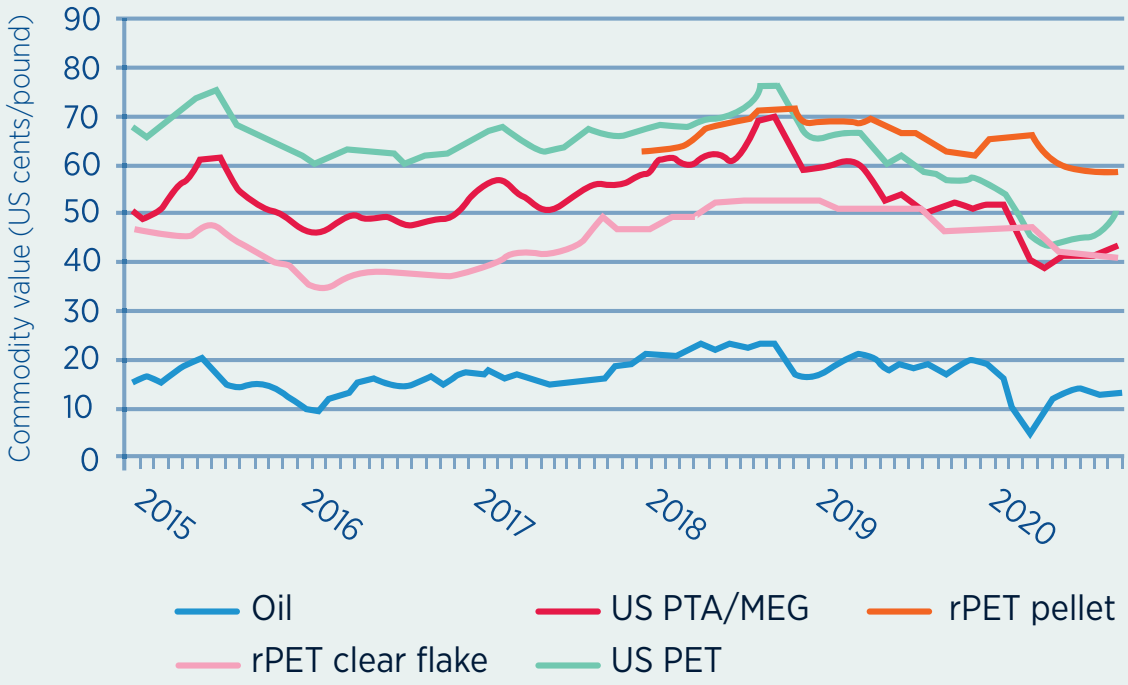
As TOMRA stated in *The Resource Recovery Playbook*, decoupling economic growth from resource extraction is one of the most critical challenges for regulators today.[105] The Ellen MacArthur Foundation points out if "all plastic packaging were to be recycled into lower-quality applications, the 'high-quality industries' such as packaging would remain dependent on continuous virgin material input (e.g. oil)".[106]

Beverage producers have responded to the growing public pressure to reduce the environmental footprint of packaging by setting ambitious targets to utilize a greater amount of recycled PET (rPET). However, brands have found it challenging to deliver on that promise. As of 2020, Coca-Cola states that it utilized 9.7% post-consumer recycled content as a percentage of its total global plastic packaging volume, by weight. PepsiCo utilized 4% and Nestle utilized 2%.[107]

Part of the challenge is due to the fact that market volatility occasionally results in food-grade rPET selling at a premium compared to virgin PET, positioning the sustainable option at a cost disadvantage. For example, in January 2018 the price of food-grade recycled PET was 7% cheaper than virgin PET, but by mid-2020 it was around 35% more expensive (see Figure 16).

Another barrier is simply a lack of supply of high-quality recycled material for manufacturing. "One of the key challenges the industry currently faces is that there isn't enough food-grade recycled plastic locally available in the UK to switch to 100% rPET across our entire range," explained Jon Woods, General Manager, Coca-Cola Great Britain.

Figure 16:
US commodity values for oil, PET raw materials, virgin PET, recycled PET flake, and food-grade recycled PET pellet



This illustrates the volatile market price for virgin PET ("US PET") and food-grade recycled PET pellet ("FG rPET pellet"). PTA and MEG refer to PET crude-oil derived raw materials purified terephthalic acid and monoethylene glycol.[108]

"There needs to be more high-quality recycled plastic produced, so it's vital to make sure we collect more bottles in an efficient way, and stop it ending up as waste."[109] In order for US beverage producers to meet a 50% recycled PET content threshold, for example, the National Association of PET Container Resources (US) estimates that the national recycling rate for PET bottles would need to rise to over 70%, up from 29% in 2019.[110]

The price premium for food-grade rPET relative to virgin PET has apparently not been strong enough to meaningfully stimulate further collection of plastic.

"Plastics recycling needs a high-priced virgin polymer environment to be economically viable on a standalone basis", states the research firm S&P Global.[111]

In that environment, producers will be pressured to opt for the cheaper virgin PET option. Some larger brands that have made public commitments may continue to purchase rPET (up to a point) but smaller brands that do not have as much public exposure may switch to virgin. Indeed, returning to virgin resin has been documented on numerous occasions, despite public commitments to manufacture bottles with more recycled content.[112]

This unreliable market value creates risks for those considering investments in increasing recycling. To enable the fundamental shift towards the circular economy, well-designed policy frameworks and regulatory instruments are necessary. Pew Charitable Trusts, which published a landmark study in 2020 on interventions needed to meaningfully reduce ocean plastic pollution, acknowledged the low value of recyclable material and recommended "mandating the use of recycled content to increase demand for secondary materials."[113]

That would help ensure brand owners continue to value high-quality collection which will "monetize the entire waste management system" as Steve Alexander, CEO of the Association of Plastic Recyclers, (APR) puts it.[114]

All decarbonization pathways have high-lighted the need to switch to low-carbon energy sources and to reduce the demand for energy.[115] By increasing the use of recycled content, society would reduce the demand for energy associated with consumption. This is why it is so important to collect, sort and process materials for recycling in such a way that their quality enables their re-integration into productive

use within the framework of a circular economy.

Deposit systems are uniquely suited to deliver a large supply of clean, high-quality material to fulfill such recycled-content requirements, due to minimal contamination of the collected material.* For example, PET post-consumer bales collected and processed through a DRS have a value approximately 40% greater than PET collected through a curbside program.[116]

In the context of a deposit system, establishing recycled-content minimums, such as requiring PET beverage bottles to be manufactured with 30% recycled content by 2030, provides a complementary benefit: cost reduction. If recycled content requirements were to be put in place, this would send a signal to the markets that the demand for recycled material is consistent, which should stabilize its value. S&P analysts think voluntary pledges have already helped to stabilize the market value of food-grade rPET, though continued investments on this scale are not guaranteed.[117] Since most deposit systems allow producer-funded Central System Administrators to retain revenue from collected material sales, this stabilized price would support the overall cost efficiency of the deposit system while encouraging producers to decouple economic growth from resource extraction.

Rewarding Recycling

* Contamination' refers to unwanted material polluting the material stream reducing its quality or causing it to be disposed of altogether.

SYSTEM SPOTLIGHT

• **European Union:** The EU's Single-Use Plastics Directive was designed to target the most commonly littered items on European beaches, in an effort to stem ocean plastic pollution. To incentivize the collection and recycling of valuable plastic resources, the Directive incorporated recycled-content mandates for plastic beverage containers alongside a 90% collection target. The Directive establishes a 25% target for recycled content in PET bottles by 2025 and 30% for all plastic bottles by 2030.[118]

• **California, USA:** Upon signing the world's most ambitious recycled content law for beverage containers to date, Governor Newsom said "California has long led the way on bold solutions in the climate space, and the steps we take today bring us closer to our ambitious goals."[119] The law requires plastic beverage containers subject to a deposit ("California Refund Value") to include 15% recycled content by 2022, 25% by 2025, and 50% by 2030. Previously, the state had established minimum recycled-content requirements for glass containers, rigid plastic packaging containers, news-print, trash bags, and other products.[120]

• **New South Wales, Australia:** Due to the lack of security over infeed material volumes and the volatile market price of rPET as described earlier, investing in PET sorting and recycling facilities carries significant risk. To de-risk such an invest-ment in New South Wales, brand owner Asahi and packaging manufacturer Pact committed to purchase a certain amount of food-grade PET pellets and hot-washed PET flake, should a facility be developed. With this guaranteed assurance of a customer, Asahi, Pact and waste management company Cleanaway formed a joint venture, Circular Plastics Australia, to co-invest in a plastic pelletizing plant that would provide high-quality recycled content. The New South Wales government provided a supporting grant as well. Another key factor was the deposit system Network Operator, TOMRA Cleanaway (see Element #10, pg. 55), providing a long-term supply agree-ment. In this way, the Network Operator has a guaranteed customer for plastic bottles collected through the deposit system, Circular Plastics Australia has certainty of feedstock for its plant and certainty of offtake of the finished product, and Asahi and Pact have certainty over access to a scarce resource that helps the companies reach sustainability commitments. The facility is expected to increase the amount of locally-sourced recycled PET from 30,000 tons to 50,000 tons a year, be partly powered by solar energy, and create 300 direct and indirect jobs in its construction.[121]

Rewarding Recycling

Principle

#4

SYSTEM INTEGRITY

While performance, convenience and producer responsibility are the cornerstones of a high-performing deposit return system, the program is incomplete without appropriate checks and balances that come with best practices in transparency, efficiency, and oversight.

10. CENTRALIZED, NON-PROFIT ADMINISTRATION AND OPERATIONS

Deposit systems provide a platform for producers and retailers to responsibly manage the take-back and recycling of used beverage containers. There are numerous responsibilities and tasks to facilitate the take-back of containers and ensure fair financial reconciliation among participants. Synergies abound if beverage producers and retailers collaborate. Fraud mitigation can be difficult to address without this. Many of the high-performing systems highlighted here address this by enabling the beverage industry to centralize common responsibilities. A central organization facilitates cross-industry problem solving and realizes cost efficiencies. No two deposit systems are identical so the responsibilities that are centralized in one market may not be the same in another. Local market needs or politics often make allowances in responsibility and execution.

All effective deposit systems take on the following responsibilities:

Common DRS responsibilities			
System operation	**Data management, deposit clearing, and reporting**	**Sale of collected material**	**Public communications**
• Fulfilling collection performance targets • Managing the system's finances including setting any EPR (administration) and handling fees • Designing and funding the redemption infrastructure, including return to retail and where applicable branded redemption centers, to enhance the number of convenient redemption points • Registering sellers and new containers into the system • Assessing fraud risk and developing countermeasures (e.g. container markings) • Developing and signing contracts with all stake-holders and service providers (e.g. pick-up and processing) • Auditing producers and service operators • Approving and conducting quality assurance of manual and automated collection procedures and technology	• Maintaining a central database for all participating products' barcodes (provided by producers) and provision to parties in need • Aggregating data from automated and manual collection points • Clearing of deposits across the different trade levels • Administering handling fees/compensations • Reporting program performance to government	• Negotiating conditions/ prices and sale of materials • Conducting quality assurance and product development	• Establishing branding and communication guidelines • Conducting public awareness campaigns regarding (at a minimum) deposit value, covered containers and how to participate • Providing standardized marketing packages to every collection point

In a DRS where some responsibilities are centralized, an organization known as a "Central System Administrator" (CSA) coordinates these efforts. Typically, a CSA is owned by beverage producers or their respective importers plus retailers and distributors, with a Board of Directors composed of representative companies. It can also be owned and operated by a business with those stakeholders as customers. A CSA can be organized as a mission-driven, not-for-profit corporation to ensure the organization reinvests revenue generated by the system back into the collection program.

Central organizations have successfully formed to ensure system integrity and compliance. CSAs can capture, assess and evaluate data to better understand risks and threats to the system, in addition to developing mitigation protocols. For example, product registration will reduce the number of "free riders" (companies that sell in a market, but are not paying) and prevent cross-border redemption when unique product labeling is utilized (see Norway case study in Element #6 on pg. 40).

It is difficult for programs defined completely in statute to "continuously improve". Policies with clear targets, roles and responsibilities have allowed the private sector and regulatory bodies to execute innovatively. When needing to amend the deposit value, handling fees and add new beverage categories, that flexibility has proven more successful. Tackling this challenge is made easier when the stakeholders are aligned within a system operator or administrator organization.

EVERY CONTAINER PROCESSED THROUGH TECHNOLOGY

All high-performing systems require every deposit container redeemed to be counted electronically in order to accurately verify deposit markings, record the redemption transaction, and reconcile return data with the sales information received from producers. In order to gain deposit repayment for containers redeemed through reverse vending machines, retailers must devaluate redeemed containers to ensure they cannot be redeemed a second time. This is typically conducted by RVMs, which have compaction capabilities.[122] For containers redeemed manually, they must be sent to a central counting center for proper counting and identification.

Ensuring governance and establishing checks and balances

Policymakers establish governance principles to ensure the execution of the program by producers and retailers remains true to the purpose of recovering used beverage containers. Effective policies balance the private sector's interest in cost reduction, to ensure the system is easy for consumers to redeem their containers and attains both social and environmental targets, namely:

- **Return-rate target:** A performance target ensures the industry is constantly striving to deliver high rates of container collection and recycling (pg. 26).

- **Convenient redemption system for consumers:** A network of convenient redemption points, including retailers, provides a way for consumers to fairly recoup their deposit money (pg. 28). Redemption system design is either left to legislation – e.g. "return to retail" – or to an independent network operator tasked with delivering certain prerequisites like number of collection points per capita, effectively splitting the responsibility for system administration (see New South Wales case study, pg. 55).

- **Government enforcement** (pg. 58): Governments play the role of "referee", arbitrating violations and enforcing performance targets.

When these elements are in place, producers have proven they can deliver high return rates at the lowest possible cost.

SYSTEM SPOTLIGHT

• **Norway:** Norway's deposit system is unique in that it was established voluntarily by the beverage and retail industries. Norway issued an eco-tax on used beverage containers that are not collected (the lower the collection rate, the higher the eco-tax). After an analysis showed a deposit system was the most efficient way to collect the most packaging placed on the market, the beverage and retail industries formed Infinitum, a non-profit corporation that is designed to collect and recycle beverage containers by managing the deposit system. Infinitum is wholly owned by beverage associations (50%) and retailer associations (50%). Its Board includes Coca-Cola Enterprises, the retailer Coop Norge SA, two of Norway's major breweries, the largest grocery wholesaler and a leading grocery chain. To ensure a convenient redemption system for consumers, retailers selling deposit containers are obligated to take them back for recycling. Infinitum manages virtually all the responsibilities listed earlier in the "Common DRS responsibilities" chart. As of 2019, Infinitum achieved an 89% return rate.[123]

• **Finland:** Finland's DRS model is nearly identical to Norway. Producers can avoid paying a packaging tax on beverage containers if they are registered in a deposit system. If retailers sell deposit containers, they are obliged to accept them for recycling. To manage the deposit system, retailers and the beverage industry formed a Central System Administrator, Palpa, of which they each own a 50% share. Palpa's strategy is to operate the DRS on a free-market basis, outsourcing all but a few key responsibilities in order to reduce costs. For example, the system is serviced by two container pick-up providers and two processing providers. Palpa covers all system costs, management, service providers' and retailers' costs with the help of unredeemed deposits and materials' revenues plus the EPR fees from the industry. In 2019, Palpa achieved a 93% return rate.[124]

• **New South Wales, Australia:** New South Wales operates what is referred to as a "split-responsibility" model. While a return-to-retail-based system is recognized as the gold standard of convenience due to its numerous and cost-effective return points, a split-responsibility model is considered the next best option. Where retailers are not included in legislation, strong governance is required to ensure industry system administrators balance convenience with cost effectiveness. In New South Wales the government issued calls for tender for two distinct organizations that are responsible for certain roles:

- The "Scheme Coordinator" provides financial management, auditing, fraud identification, community education and marketing services. A key part of the scheme coordinator's role is to manage producers and ensure producer funds are paid into the system. Five Australian beverage companies (Asahi, Carlton United Breweries, Coca-Cola Amatil, Coopers and Lion) formed a joint venture, Exchange for Change, to operate as the Scheme Coordinator.
- The "Network Operator" provides set up and management of a state-wide network of redemption points, as well as manages the logistics and sale of commodities to ensure all collected containers are recycled. Cleanaway, a waste management company, and TOMRA formed a joint venture, TOMRA Cleanaway, to act as the Network Operator.
- The government is responsible for the design and development of the system, managing product registration and

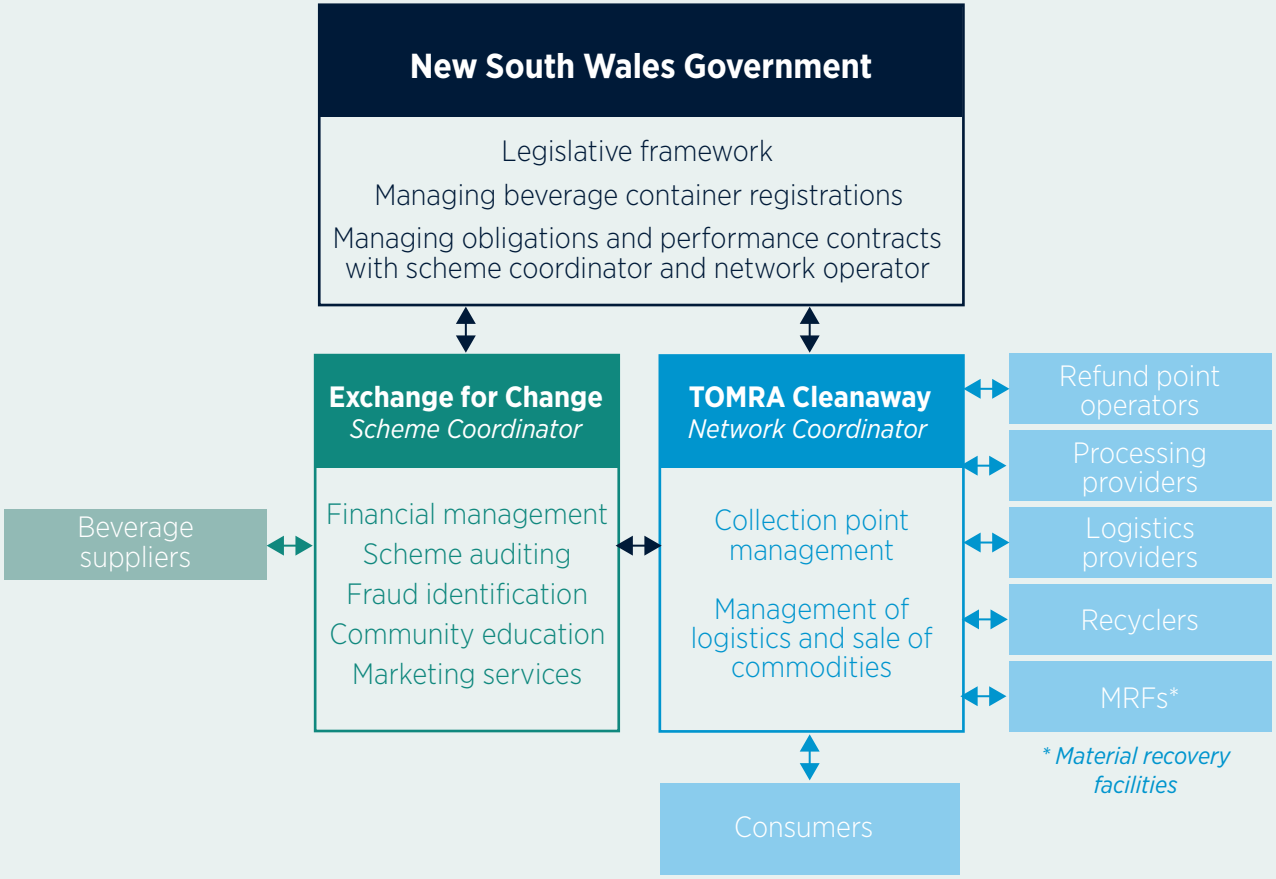
enforcing contracts for the Scheme Coordinator and Network Operator.

Exact roles, responsibilities and financial arrangements are specified between each entity and the NSW government. As the Victorian Government recently put it, "The split responsibility creates a self-correcting tension between cost minimization of the scheme and achieving high return rates." The Scheme Coordinator is incentivized to minimize overall system costs. The Network Operator is driven to collect as many containers as possible because it is their revenue source. Also, the Scheme Coordinator is driven to validate the redemption claims of the Network Operator, which incentivizes enhanced transparency.[125]

The New South Wales system involves a variety of redemption point operators including the private sector and charities. However, retailers are not obligated to take back containers, which has raised the overall cost of the system.

The New South Wales DRS launched in December 2017 and in three years collected more than 4.6 billion containers via its network of redemption points.[126]

Figure 17:
Roles and responsibilities in the New South Wales, Australia deposit return system[127]



11. GOVERNMENT REPORTING AND CONSUMER COMMUNICATION

Key to any program's success is communicating with its constituents. System managers do this through performance reports and marketing to:

1. Keep regulators and the public informed about their progress towards goals
2. Engage both of these constituents to retain long-term support for industry's management of the system (the "license to operate")

Performance reporting

Typically, CSAs audit and report performance data annually to the regulator. Such reports include the aggregate sales and collection data per material type for the previous period. Regular and accurate performance reporting is easily made possible by registering all returned containers through technology.

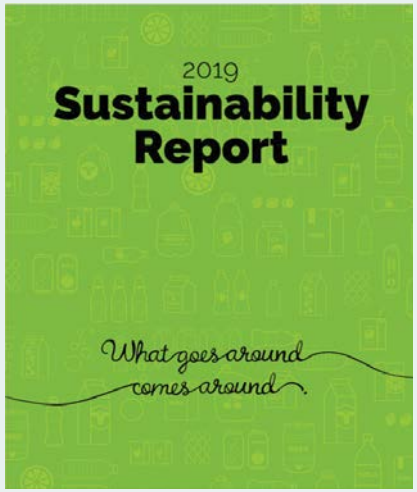
Marketing to stakeholders, including consumers

CSAs raise public awareness about the redemption process, the location of redemption points and beverage types that are eligible for a deposit. CSAs also utilize marketing to increase participation in the system, improve public perception of the industry stewards, and ultimately raise return rates.

Figure 18: Annual reports from Central System Administrators

Oregon Beverage Recycling Cooperative, Oregon, USA

Infinitum, Norway



Alberta Beverage Container Recycling Corporation, Alberta, Canada

Reports are published to communicate program performance, innovations, and often to tell the "story" of the program including the final product that utilizes recycled material.

SYSTEM SPOTLIGHT

Alberta, Canada: In its annual report, the Alberta Beverage Container Recycling Corporation publishes information pertaining to the amount of material collected for recycling, as well as proof it was recycled, by sharing data related to material type, the material buyer, the percentage finally recycled, and ultimately what the material was used to produce.[128]

Norway: Norway's CSA, Infinitum, evaluated opportunities to increase the return rate to reach a mandated performance target. The analysis found that the millennial age group was among the least likely to participate in the deposit system. To attract more participants from this demographic, Infinitum launched a marketing effort complete with millennial-focused branding (Infinitum Movement), a lifestyle blog and comedic television advertisements.[129]

Maine, USA: In 2018, when Maine's Office of Program Evaluation and Government Accountability analyzed its state's deposit system for effectiveness, it realized a key metric was missing: the return rate. Under the law, producers had no legal obligation to report redemption performance. The government oversight body recommended a requirement for initiators of deposit to report beverage sales and redemption data.[130]

Lithuania: Lithuania's deposit legislation specifies that 1% of the CSA's annual turnover must go towards public education and communications.

12. GOVERNMENT ENFORCEMENT

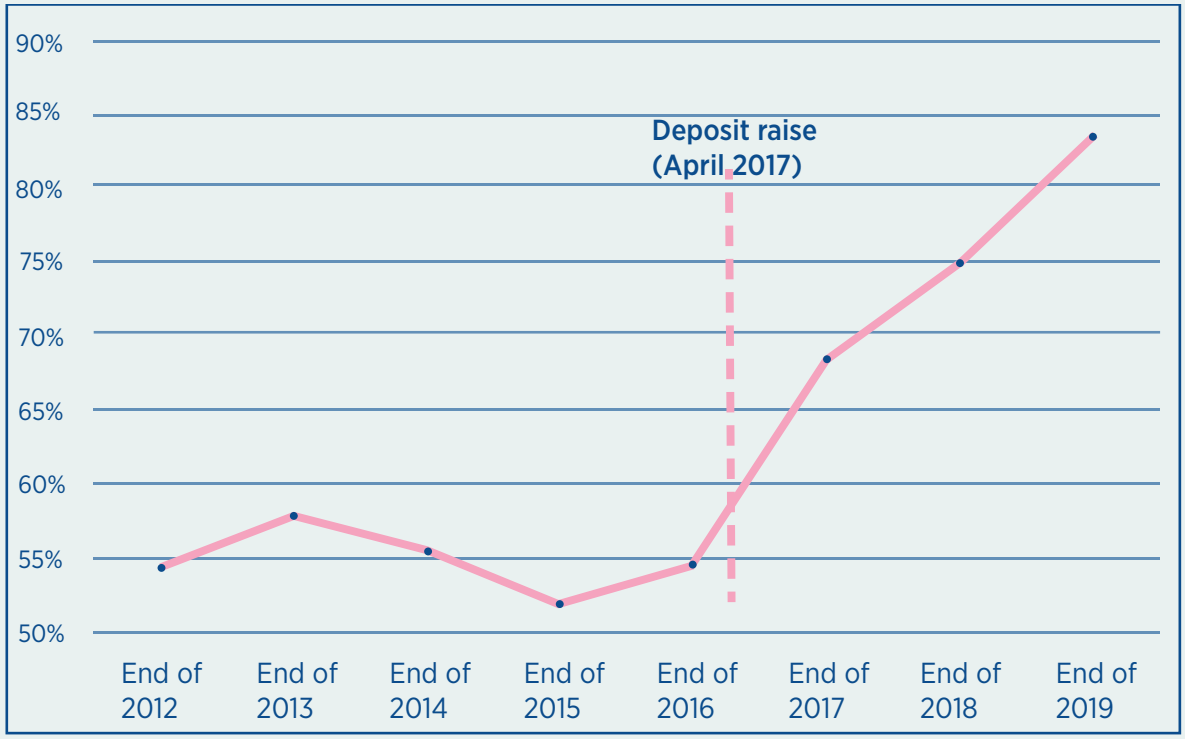
At a minimum in high-performing systems, enforcement procedures are clearly stated in statute and regulations, including penalties and the government agency with the authority to enforce them. While enforcement priorities and procedures are established, the program requires an active government agency to maintain regulatory compliance. The agency itself is an empowered owner of the program's success. It ensures performance standards are met by producers and retailers, maintains a competitive "level playing field", and communicates program performance.

• **Oregon, USA:** Today the return rate exceeds 85%, but Oregon's program was in decline pre-2008. Advocates sought a number of changes including raising the deposit value, adding new beverage categories, and even reverting to the state the unredeemed deposits that were not being invested into the redemption infrastructure. A compromise created the industry-owned CSA, Oregon Beverage Recycling Cooperative, and allowed it to modernize the system, while also setting a "trigger" mechanism to raise the deposit if the return rate fell. In this case, the CSA and regulatory body, the Oregon Liquor Control Commission (OLCC), worked together.

In 2016, when data showed the return rate had fallen below 80% for the previous two consecutive years, the deposit was increased from five to 10 cents in 2017. The result: a steady increase from 64% in 2016 to 86% in 2019.[131]

Oregon legislators set goals in statute, and enabled the OLCC to establish rules to ensure they were met over time. For example, the program excludes "milk", but as products came onto the market that included milk as one of several ingredients, OLCC conducted a rule-making process to define what beverages would be included or excluded. In partnership with OBRC, the agency decided to exclude all beverages where milk is the first ingredient (mostly a milk product).[132]

Figure 19: Return rate of plastic bottles (Oregon)



7. CONCLUSION

When it comes to beverage container recovery, Rewarding Recycling is about identifying what works and what doesn't. As leaders grapple with the extent of challenges ahead – from plastic pollution and rising recycling costs to climate change – it's evident the ambition of public policies will need to grow to meet the moment. Based on decades of data illustrating high recovery rates, deposit return systems are the proven solution to many of these challenges.

Yet, as this paper shows, the performance of these systems varies depending on their design. Since at least 34 state or national governments are defining deposit regulation at this very moment, with the fate of billions of beverage containers at stake, it is imperative policymakers grasp the principles that separate successful models from ones that are failing. Based on over four decades of operating experience in most deposit markets in the world, TOMRA identified the success factors for effective systems:

- **Performance:** A collection target for all beverages plus a meaningful deposit delivers strong results.
- **Convenience:** A redemption system that is easy, accessible and fair for all users.
- **Producer Responsibility:** Producers finance and invest in the system using the unredeemed deposits, commodity revenues, and an eco-modulated EPR fee.
- **System Integrity:** Trust is built into the system's processes through transparent management, a data-driven clearinghouse, and reliable redemption technology.

Crucially, TOMRA encourages stakeholders to consider the 12 elements discussed in this paper as part of an ecosystem rather than a menu of options. Prioritizing one but not the other could disrupt the system's performance and cost effectiveness. While there is no one-size-fits-all approach, the concepts outlined here seek to educate the system design discussion based on evidence.

While plastic pollution and climate change are enormous challenges, stakeholders can take comfort in knowing there is a recognized blueprint for action when it comes to beverage container waste. By embracing a thoughtful approach to deposit system design, leaders can turn the tide on plastic pollution, curb climate change, and deliver on the promise of circular economy.

8. Appendix

A. FREQUENTLY ASKED QUESTIONS

1. How does a container deposit return system work?

A deposit return system motivates people to recycle by placing a small deposit on the sale of beverage containers, which is repaid when consumers return them for recycling.

1. A beverage producer pays a deposit and an eco-modulated EPR fee and sends sales data for every beverage container sold in the deposit market to the Central System Administrator (CSA).* "Producer" means the company first selling the deposit container in the market (e.g. producer, importer or distributor).
2. The producer charges a deposit on the beverage container they sell to the retailer.
3. The retailer charges the consumer the deposit upon sale (therefore regaining their deposit).
4. When consumers return beverage containers to a retailer, they are refunded their deposit.
5. CSA then reimburses the retailer the deposit amount for each container, plus handling fee (if applicable).
6. CSA arranges for these containers to be picked up, processed and marketed to manufacturers for recycling.

* Typically co-owned by producers and retailers. See "Centralized non-profit administration and operations" for more, pg. 51.

2. Are retailers compensated for redeeming beverage containers?

Mostly yes, and compensation varies among states – but in some cases, like Oregon, Germany and the Netherlands: no. It may be specified in statute (e.g. New York), or as a percentage of the unredeemed deposits (25% in Michigan). In Europe, compensation in the form of a handling fee is typically set by the CSA in ways that progressively encourage cost-efficient investments by the retailer. For example, Norway and other markets awards a higher handling fee to retailers who utilize compacting RVMs rather than manual redemption (see Figure 15 on pg. 46).

3. What happens to the unclaimed deposits?

In the high-performing programs, unclaimed deposits are retained by the producer-operated, non-profit Central System Administrator. Most importantly, this allows for sustainable reinvestment in the program's redemption infrastructure, material processing and marketing to consumers.

4. How effective is using a deposit for reducing litter and driving both collection and recycling rates?

Beverage container litter as a proportion of all litter is 66% less in regions with a deposit system than without.[133] In Europe, deposit systems achieve an average PET bottle collection rate for recycling of 94%, compared to other curbside recycling which averages a 47% collection rate.[134] Across the US, deposit containers are captured for recycling at a rate of 72%, vs 27% for non-deposit containers,[135] with Michigan and Oregon achieving return rates above 85%.[136]

5. Why do we need both curbside and deposit collection systems?

Because the social demand to capture beverage containers is high. Both systems complement each other in the fight against waste and litter. Here's how:

• Ensuring quality from the start guarantees recycling.

To achieve "circularity", manufacturers need recovery systems that retain the material quality of resources. Due to food safety concerns, a bottle manufacturer will have more rigorous quality specifications than one producing fiber for carpet or fiberglass. Materials collected through a DRS are valued by producers seeking food-grade recycled material that can help them achieve recycled-content commitments for new beverage containers.[137] For example, PET post-consumer bales collected and processed through DRSs in the US can have a value approximately 40% greater than PET collected through a curbside program.[138]

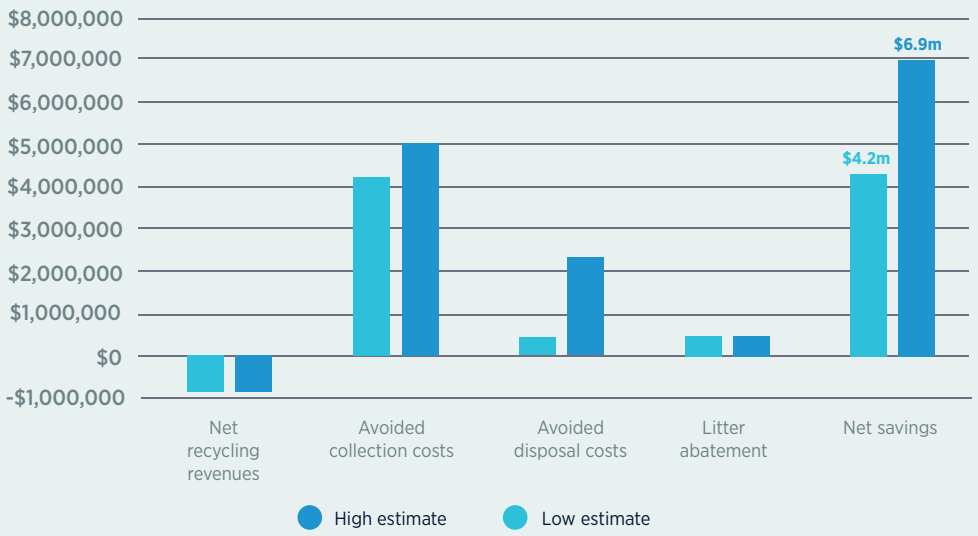
There are many examples where DRSs and curbside collection work together to achieve high collection rates, but no instances where curbside collection is the sole collection system.[139] British Columbia, for example, achieves an 82% deposit container collection rate[140] and a 70% packaging and paper product collection rate.[141]

6. How do local communities benefit from a DRS?

A common finding is that deposit systems result in net savings for local communities. In 2009, Massachusetts considered expanding its existing deposit system to include additional beverage categories like bottled water. To better understand the impacts this update would have on local communities, the state's regulatory agency, the Department of Environmental Protection, commissioned a study. The study found that while communities would lose US$899,000 in material revenue, the update would still result in a net savings of $4.2-6.9 million. The shift of material from curbside recycling and garbage collection to a DRS would save $4.2-5 million on collection costs, $482,000 to $2.3 million saved in disposal costs, and $500,000 on litter clean-up costs.

This is a common finding from deposit system impact analyses. For further reading see "Fact Sheet: Economic Savings for Municipalities" from Reloop: https://www.reloopplatform.org/resources/factsheets/

Figure 20:
Municipal benefits of an expanded bottle bill, Massachusetts Department of Environmental Protection[142]



In addition to the economic savings, deposit systems provide communities with reductions in litter as described earlier, divert more material from the waste stream, and create jobs. In 2019, a Eunomia study found that New York's current deposit system supports 5,726 jobs through direct, indirect and induced effects. If the program were to be modernized with an expanded set of beverage categories and a higher (10-cent) deposit, the shift would create about 2,000 more jobs, bringing the total to 7,803 jobs.[143]

7. How do the best programs manage the risk of unauthorized or "fraudulent" redemption?

Policymakers or Central System Administrators design their systems with this in mind, by putting in place protocols, governance and technology to enhance the integrity of the system. High-performing systems utilize a redemption network connected to the internet to collect and monitor data. With data, regulators and the CSA can conduct auditing and enforcement to prioritize response and ensure compliance throughout the system. Some incentivize the use of unique barcodes and/or security markings on containers that automated redemption equipment can recognize (see Key Element #6 on pg. 39). Reverse vending solutions are highly sophisticated machines that can identify fraud attempts and will reject containers that do not belong to the system.

8. Do all retailers need to participate in a deposit return system?

Yes. Retailers provide a critical role by charging the deposit to consumers at the start of the process. Since redemption systems are designed to make redeeming one's deposit money as easy as it was to charge the deposit in the first place, beverage retailers are almost always required to take back containers and refund deposits. See "Why a return-to-retail approach leads to high performance," on pg. 31 for more information. Policymakers have made allowances for small-format stores (i.e. less than 100 m^2) by limiting the number of containers that a consumer can redeem per day, or allowing such stores the choice to opt in to the system. In some markets, redemption centers complement the return-to-retail redemption network by offering a more suitable option for high-volume redeemers.

B. GLOSSARY OF KEY TERMS

BEVERAGE DISTRIBUTOR: A business entity that provides transportation, storage and delivery of deposit drink containers from drink producers to drink retailers.

BEVERAGE PRODUCER: A manufacturer of drinks whose containers are eligible for a deposit. Throughout this paper, a "producer" is the company first selling the deposit container in the market, which technically could be a manufacturer, an importer or a distributor.

BEVERAGE RETAILER: In the context of deposit return systems, a beverage retailer is the business entity that sells deposit containers to consumers. In almost all cases these same stores take back containers for recycling and repay deposits.

CARBON DIOXIDE EQUIVALENT (CO_2e): The number of metric tons of CO_2 emissions with the same global-warming potential as one metric ton of another greenhouse gas (e.g. methane).

CENTRAL SYSTEM ADMINISTRATOR (CSA): A cooperative entity established by beverage producers and retailers to manage the day-to-day deposit system administration roles (e.g. product registration, anti-fraud processes, clearing deposits, etc). It may undertake operational roles such as system design, awarding of vendor contracts, approval of collection equipment, etc.

CIRCULAR ECONOMY: A circular economy is one that is restorative and regenerative by design. It looks beyond the take-make-waste extractive industrial model, and aims to redefine growth, focusing on positive society-wide benefits. It is based on three principles: design out waste and pollution, keep products and materials in use, and regenerate natural systems.

CLEARINGHOUSE: An institution that facilitates the exchange of data, settling of deposits and fees, and government reporting. Key responsibilities of a deposit system clearinghouse include:
- Aggregation of data from automated and manual collection sites
- Settling of deposits across the different trade levels in the system
- Administration of handling/delivery/logistics/consolidation/counting fees
- Facilitating collection rate reporting to government

CLOSED-LOOP RECYCLING: Recycling of materials into the same or similar quality applications (e.g. "bottle-to-bottle recycling").

CLEAN LOOP RECYCLING: A type of closed-loop recycling. Consumers are incentivized to utilize a dedicated collection infrastructure (e.g. RVMs) which minimizes littering, maximizes material cleanliness and if applicable guarantees prior food-grade use. Recycling efficiency and process yield is maximized due to dedicated collection and logistics solutions.

DEPOSIT RETURN SYSTEM (DRS): A system in which a small deposit is placed on the price of drinks sold in beverage containers, which is repaid when the consumer returns the container for recycling. Also known as deposit return schemes, container deposit schemes (Australia), or bottle bills (US).

DOWN-CYCLING: A recycling process where a recyclable item is recycled into a new object, which at the end of its life will not (or cannot) be recycled.

EXTENDED PRODUCER RESPONSIBILITY (EPR): Policies that obligate producers to contribute to the end-of-life costs of products they place on the market, such as packaging collection, recycling and disposal.

EXTENDED PRODUCER RESPONSIBILITY FEE (EPR FEE): The fee that brand owners or manufacturers pay when putting products on to the market in a centrally-operated DRS. The fee is dependent on the cost of collecting and recycling the material of each product and its market value. Decentralized systems do not have a published fee; rather, producers execute program services themselves or through third-party agents, and own the collected material commodities themselves. EPR fees are set based on the Central System Administrator's operating expenses, which are substantially reduced when the producer-run non-profit retains revenue from unredeemed deposits and commodity sales.

HANDLING FEE: Where required or negotiated, a fee that the CSA pays to retailers and redemption center operators who accept used beverage containers for redemption. In Norway, the DRS CSA's board sets this fee amount. In some markets the handling fee is set in statute as a whole number (e.g. 3.5 cents in New York), as a percentage of the unredeemed deposits (25% in Michigan), or not set at all (Oregon, Germany, and the Netherlands). Typically, this fee is based on an analysis of container collection, storage and transportation costs, and as such normally differentiates between manual and automated redemption.

MATERIAL RECOVERY FACILITY (MRF): A specialized plant that receives commingled materials from residential and commercial collection programs for the purpose of separating, quality control, and compacting like materials to ship to recyclers.

MATERIAL REVENUE: The money made from selling the materials collected in a deposit system, such as PET, aluminum, glass, and liquid paperboard. Material revenue is commonly used to offset DRS costs. Depending on the system's design, revenue from material sales may be owned by the Central System Administrator, the beverage producer, the retailer or redemption center operator. High-performing systems allow the CSA to retain material revenue.

PET PLASTIC: Refers to a specific plastic polymer type, Polyethylene Terephthalate, commonly converted to plastic beverage containers. The material is known for properties such as flexibility, durability, light weight, and an inability to biodegrade.

REDEMPTION CENTERS/DEPOTS: A location with return facilities where consumers can return their empty beverage containers and receive their deposits back. Redemption centers can be owned by private business owners or the Central System Administrator.

REDEMPTION NETWORK: The infrastructure that enables consumers to return beverage containers to receive their deposits back. Collectively refers to all retailers and redemption center redemption options in a market.

RETURN RATE/REDEMPTION RATE: The percentage of beverage containers sold with a deposit that are returned for recycling in exchange for the deposit refund.

RETURN TO RETAIL: A reference to the redemption model that relies on beverage retailers to take back deposit containers.

REVERSE VENDING MACHINES OR REVERSE VENDING SYSTEMS: The technology used to automate the redemption and collection of used beverage containers for recycling. A reverse vending machine will confirm, identify, compact and sort eligible empty containers. It refunds the user's deposit in the form of a paper or digital voucher. Redemption data is collected and then shared with a central administrator for the purposes of reimbursing the redemption provider the deposit and handling fee (if applicable) and informing container return logistics.

SENSOR-BASED SORTING: A process using machine sensors to identify and sort different material types from each other, e.g. separating plastic by polymer type.

SINGLE-STREAM RECYCLING: A curbside collection program that accepts authorized materials from homeowners in one mixed or commingled format. Materials are sorted at the MRF.

Endnotes

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