TOMRA

Mixed waste sorting

in short

Table of contents

Introduction

To develop a circular economy, fight plastic pollution, and protect our rapidly depleting resources, we must apply an “all-hands-on-deck” approach. As it stands, waste management solutions such as deposit return systems (DRS) for beverage containers, which achieve the highest collection rates, as well as the separate collection of select material streams – organic, e-waste, textiles, paper and, sometimes, glass - have proven to be the most efficient at reducing litter.

That being said, these methods alone, while immensely effective, cannot tackle all waste. There is still an abundance of valuable material being lost every day. To maximize the recovery and recycling of these lost resources, we need to take advantage of a largely untapped opportunity: to recover recyclable materials from mixed waste streams.

Undeniably, a large portion of recyclable materials end up in mixed waste. Even when collection services are available, some recyclable materials are left unsorted. This is, in large part, because even if everyone knows how to recycle, and makes it a priority to properly separate their waste, a significant number of items will invariably end up in the wrong bin. Without any further attempts to recover those valuable materials, they are burned, or buried in landfills, rather than recycled into new products.

For decades, recovering valuable material from mixed waste streams was unthinkable, let alone technically feasible – until now. In fact, mixed waste sorting, or MWS (also known as mixed waste processing) is now proven to be a fundamental way to advance circularity and scale sustainable change. A 2019 study by Deloitte AS addressed plastic recycling in Norway, revealing that MWS recovers 2 - 5 times more plastic packaging per inhabitant than relying solely on the separate collection of plastic packaging. This process also makes the system less reliant on the sorting performance of consumers and, in countries where the separate collection of plastics has not been introduced, it makes recycling more convenient for consumers.

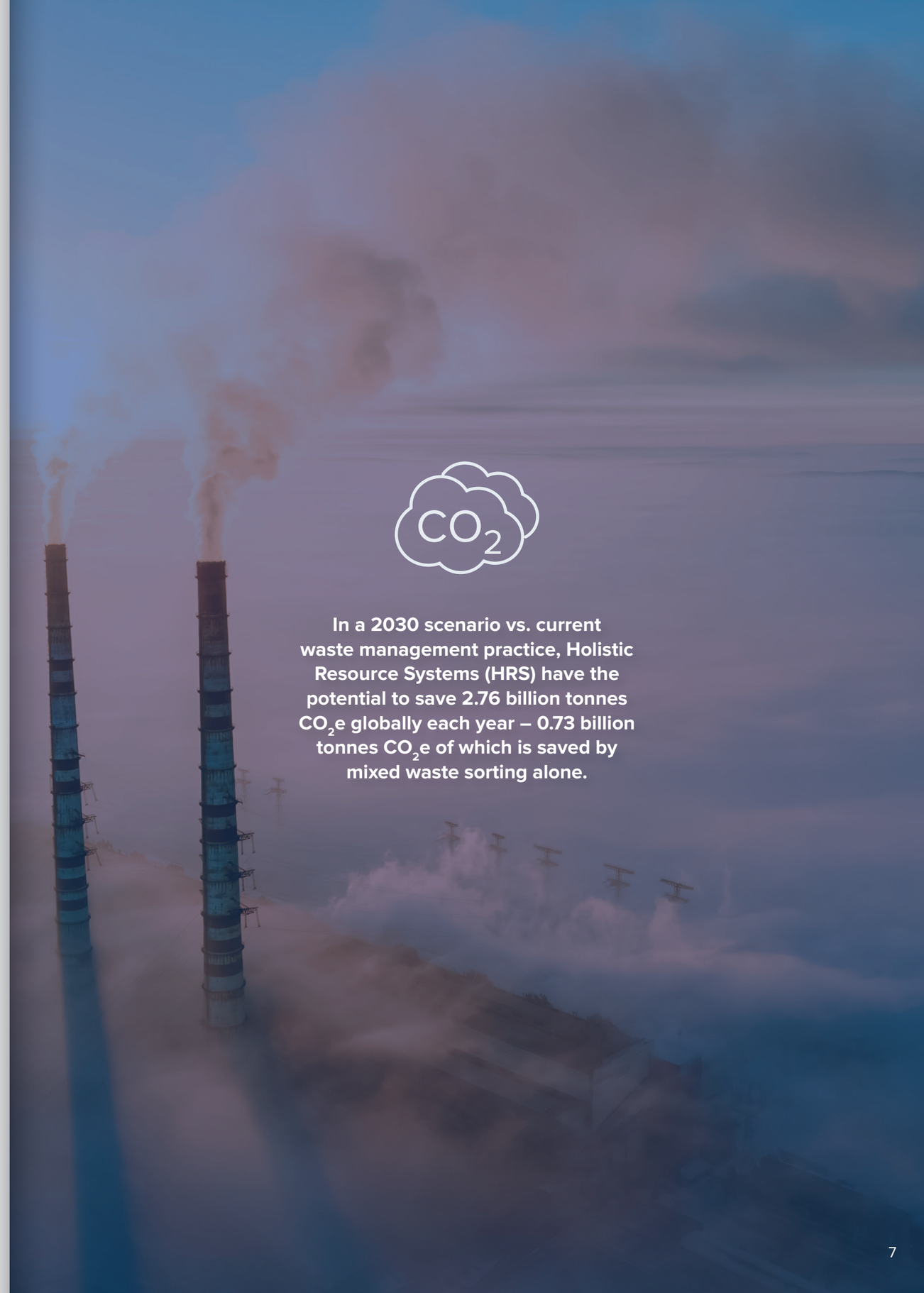
Effectively, MWS acts as a stop gap and final chance to recover any materials that are en route to disposal. This process has the power to maximize the reutilization of resources, thereby reducing virgin resource extraction and greenhouse gas (GHG) emissions – vital components in the development of a circular economy, the fight against pollution, and the protection of our valuable resources.

Holistic waste management drives circularity for plastics

Prioritizing closed-loop recycling as the preferred treatment method for plastic waste is instrumental in reducing fossil fuel reliance, decarbonizing plastics, and transitioning to a circular economy. For this to happen, the world needs infrastructure and system-level changes that keep plastics at their highest and best use.

TOMRA, in partnership with the sustainability consultancy Eunomia, examined which combination of existing waste management systems around the world deliver the highest recycling rates and reduction in CO_2 emissions. We found that the best performing systems are 1) deposit return systems (DRS) for beverage containers; 2) separate collections for certain waste fractions; and 3) mixed waste sorting (MWS) to recover recyclables prior to disposal. Taken together, these three elements form what we call the Holistic Resource System (HRS).

This holistic approach to waste management – built on mandatory extended producer responsibility (EPR), a strategic policy principle that calls for producers to manage and pay for the recovery of the products they put on the market for the full lifecycle of the products – is crucial in stopping the endless flow of plastic waste worldwide, and closing the quantity and quality gaps that undermine the plastics value chain.



Mixed waste: From taboo to treasure

Mixed waste streams contain a significant portion of overall plastic waste, even in countries with well-established curbside and drop-off collection systems for plastic packaging. Until recently however, plastics recovered from mixed waste were considered unrecyclable due to impurities. Now, with advancements in sorting and recycling technology, it is possible to detect the molecular structure of materials and offer recyclers high-volume, quality feedstock.

As an intrinsic part of the Holistic Resource System (HRS), mixed waste sorting (MWS) can recover plastics from one-bin systems as well as plastics that were not separated correctly by consumers, and therefore not collected for recycling. Depending on the local context, including infrastructure, policy, and the economics of recycling, MWS can also be utilized to recover paper, glass, metals, and organic waste. In most cases, the overall system costs are reduced due to revenues from material sales and tipping floor fees, savings on residual treatment, as well as other financial implications (landfill bans, plastic tax, etc.). In countries with carbon pricing, there would also be savings on CO2 tax. When the sorted materials are processed with the same advanced mechanical recycling (AMR) techniques – explained in the next section – as source-separated collections, it can produce equal yield and quality.

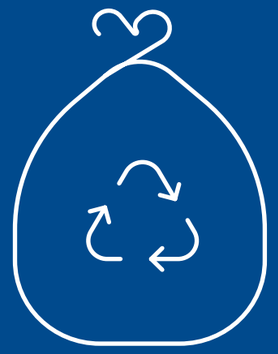
MWS is a waste management solution that we can implement now, and it is the basis of our white paper, The Ultimate Guide to Mixed Waste Sorting, available for free download.

What is mixed waste sorting (MWS)?

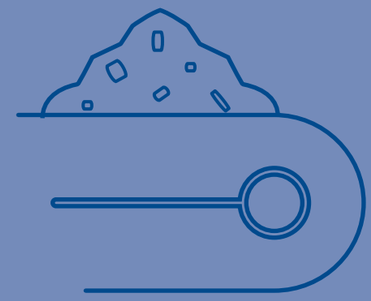
Mixed waste sorting is the process where carbon-intensive materials, like plastics and metals, are recovered from household waste (also known as municipal solid waste) prior to disposal.

At mixed waste sorting facilities (sometimes known as ‘dirty MRFs’, usually in regions that don’t have separate collection of organics) these valuable materials are extracted for recycling before they end up in landfills or incinerators.

A mixed waste stream contains an abundance of valuable resources that can and should be recovered for recycling, rather than being lost to landfills or incinerators.



A residual waste stream has undergone sortation for recoverable material and is void of recyclable material, thereby ready for disposal.



Advanced mechanical recycling delivers high-quality feedstock

Designed to overcome the significant supply and demand challenges in the market, advanced mechanical recycling (AMR) processes use existing technologies and upgraded and additional steps to increase the availability of high-quality recyclates in the marketplace. With standard mechanical recycling, plastic waste is shredded into flakes, some impurities are removed, and the flakes are then washed in a cold-water treatment and thus, mostly downcycles mixed plastics for low-value applications. With AMR however, high-quality, odorless recyclates can be produced thanks to polymer and color sorting as well as quality-assured decontamination processes.

AMR produces high-quality recyclates derived from mixed waste with all the standard mechanical recycling steps, as well as additional and upgraded steps which include dedicated pre-sorting, hot washing, enhanced flake sorting, deodorization, enhanced extrusion, and super-clean technology (which is a final purification step – if needed - before pellets go into production).

Together with complementary solutions, such as emerging chemical recycling technologies, these extra steps help to ensure that the highest quality recyclate is available to industries that depend on it to reduce their $C0_2$ emissions and reach recycling and recycled content targets.

The complementary role of chemical recycling technologies

TOMRA's Resource Hierarchy prioritizes waste prevention and minimization, and reuse, followed by closed-loop mechanical recycling. As it stands, mechanical recycling is the most effective way to recycle plastics and, when technically possible, should always be the preferred method. However, chemical recycling could be an option if there is no viable route to produce a high-quality end-product with mechanical recycling. It is also an option for those streams which are unable to be further sorted, such as sorting residues, multi-material composites, and highly filled plastics (plastics that are filled with particles with the purpose of cutting production costs and improving specific properties of products).

A report by the U.S. Department of Energy's National Renewable Energy Laboratory revealed that, after analyzing the performances of current and emerging plastic recycling technologies to determine the most sustainable options, mechanical recycling outperformed all other technologies, as well as virgin plastic production across economic and environmental considerations. It also revealed that glycolysis (a chemical recycling technique that allows for the molecular degradation of PET polymers by glycols) outperforms its chemical recycling competitors in terms of economic and environmental performance.

To ensure that AMR is feasible and adaptable across markets, a sufficient and consistent supply of post-consumer plastic waste is needed. This requirement can be fulfilled by tapping into mixed waste streams. The material is out there, but we need to collect it and we need to recover it for recycling.

Mixed waste sorting around the world

The plastics recovered through mixed waste sorting (MWS) in many plants around the world (including the state-of-the-art plant that TOMRA, Borealis, and Zimmermann Recycling opened in 2021) are recycled back into high-quality raw materials, like the quality seen in separate collected plastics in modern, high-end recycling plants. Globally, several hundred plants now sort plastics from mixed waste for recycling.

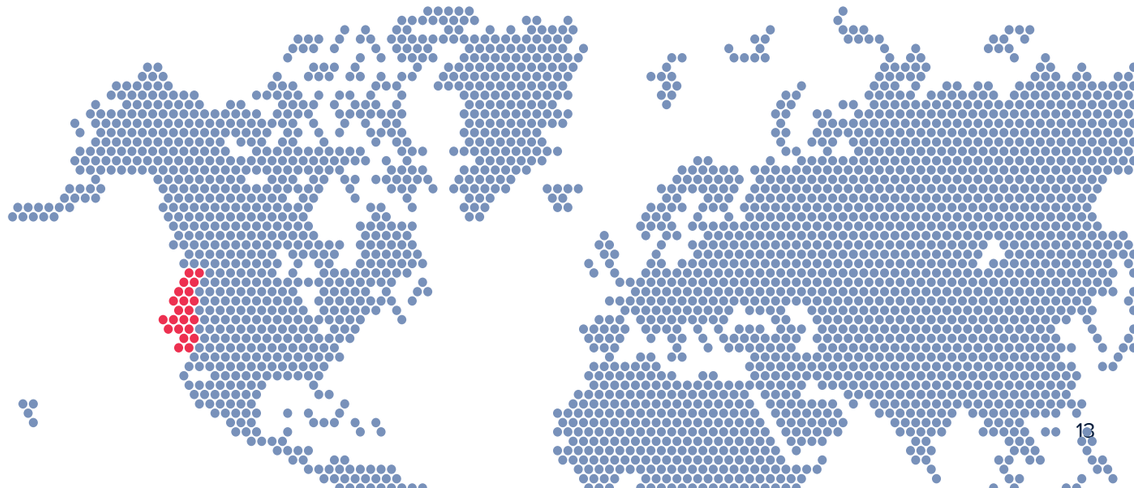
The implementation of MWS varies around the world, even within nations. It tends to be slower in places with a lack of legislation (for example, targets for recycling) and low landfill tipping fees. However, as the need to divert materials grows - due to new legislation, disposal capacity limits, and siting constraints - MWS is the obvious path forward.

Santa Barbara County's Resource Center (California, USA)

Santa Barbara County's Resource Center is a dual-purpose processing facility in California (USA), located at the Tajiguas Landfill site, that sorts two different streams: single stream recycling and mixed waste. In operation since 2020, this facility serves approximately 220 000 people, with waste generation averaging 9 lb, or 4kg/person/day.

One of the resource recovery center's main objectives is to achieve an 80% diversion rate (a rate which measures the portion of waste not sent to landfill or incineration) to help meet California's organics recycling diversion target of 75% by 2025. Removing organics from landfilled materials is imperative in the fight against climate change. The decomposition of organic material emits methane gas, a pollutant that is 25 - 100 times more potent as a greenhouse gas (GHG) than CO_2.

The recovery center's automated sorting circuit is designed to handle up to 1 000 tons per day of municipal solid waste and single stream recycling. It has been operating at roughly 80% capacity, corresponding to a reduction of 117 000 metric tons of CO_2 annually. This facility is also a thriving community resource, where students and citizens can visit and learn more about waste and recycling to better inform and change their behaviors going forward.

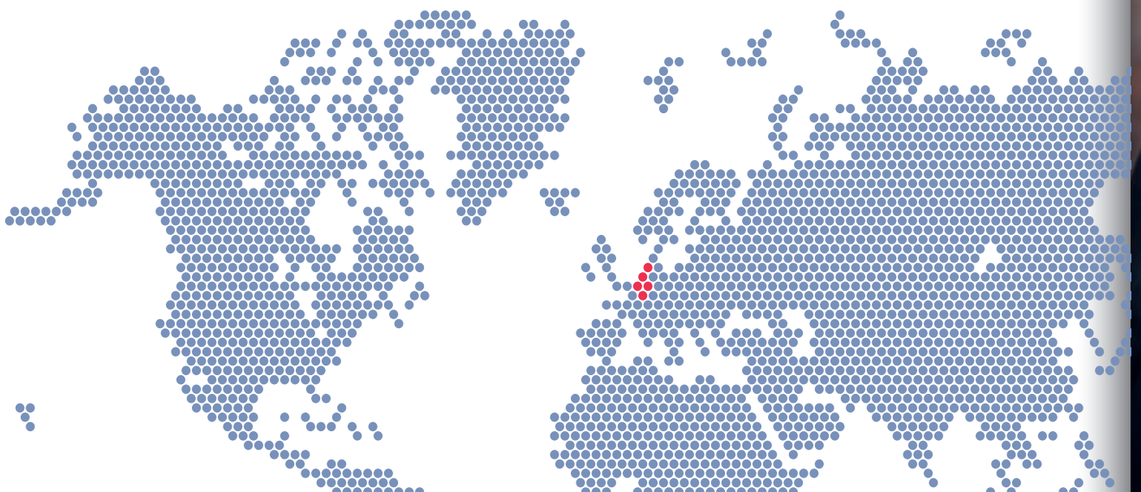


AVR (the Netherlands)

AVR specializes in the processing of various types of residual waste and has two waste-to-energy plants. Serving the cities of Rotterdam, The Hague, and Utrecht, AVR collects and converts household waste into energy and secondary raw materials. In 2020, AVR processed 2.3 Mton of municipal waste that supplied 8.3 PJ total energy consisting of steam, district heating, and electricity to households and industrial customers.

Densely populated urban areas face the challenge of collecting and sorting plastics effectively, especially with on-the-go life-styles and international tourists not accustomed to local recycling habits. As a forward-looking company, AVR implemented a post-separation plant to improve recycling rates for its municipal customers.

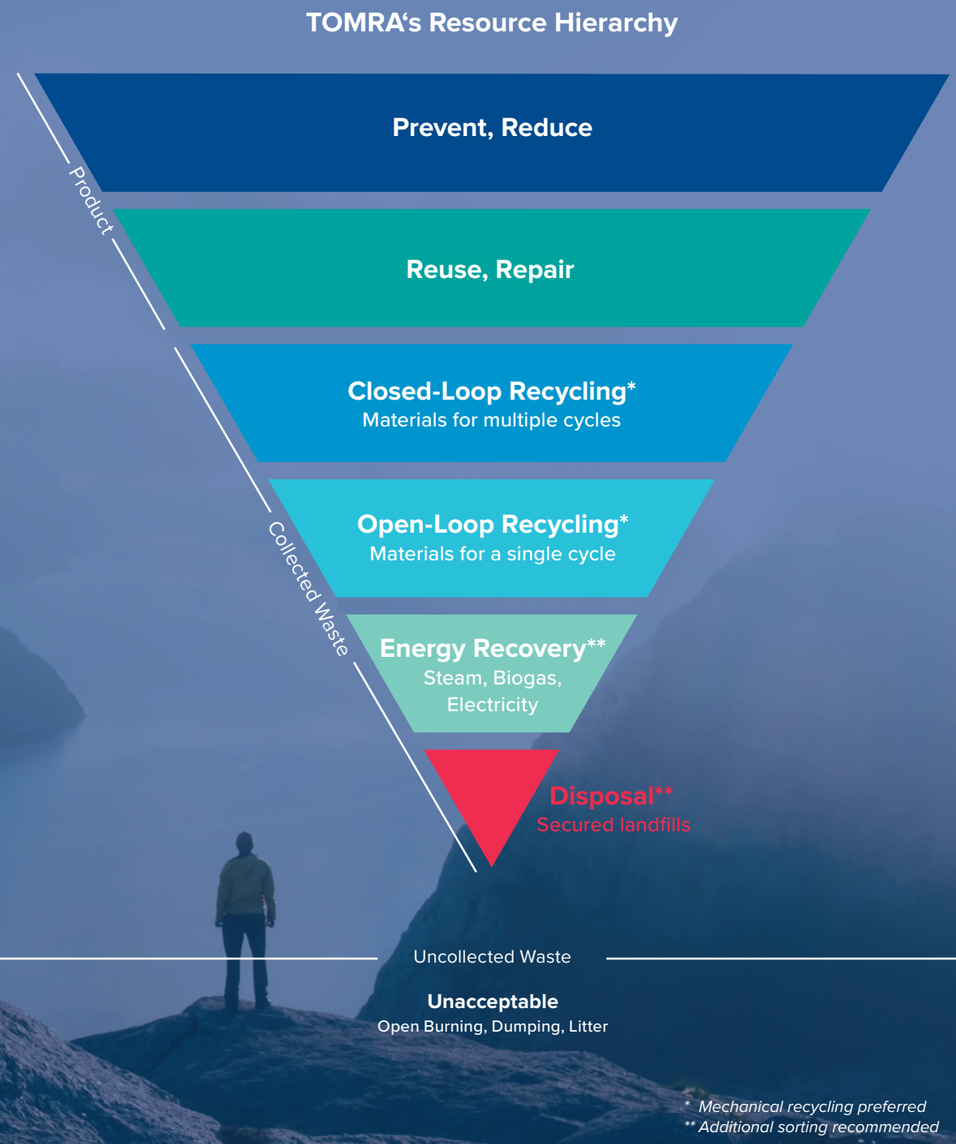
Currently, AVR targets rigid plastics (PET, PE, PP), films (DKR 310) and beverage cartons (Tetra Pak, DKR 510) for sorting and removal before sending residual waste to incineration. For every 1 kilogram of plastic packaging recovered, an additional 3 kilograms of marketable capacity is made available at the incineration facilities. The extra capacity creates new business opportunities in a market with dynamically increasing gate fees. More impressive still, AVR now recovers 12 times the amount of plastic for recycling with mixed waste sorting – an enormous boost in recycling rates and greenhouse gas (GHG) benefit.



Conclusion

As the demand for convenient products and packaging continues to grow, we must prioritize the solutions highlighted in TOMRA's Resource Hierarchy – prevention, minimization, reuse, and closed-loop advanced mechanical recycling – rather than maintain a dangerous dependence on virgin raw materials.

Accelerating global participation and the mandatory implementation of proven waste management methods – such as mixed waste sorting as a final recovery effort prior to landfill and disposal, complemented by advanced mechanical recycling – will go a long way towards improving our carbon benefit, bridging the gap for high-quality recycled plastic content, and ultimately, accelerating the transition towards a circular economy.



TOMRA

Click here to visit our website

Click here to download TOMRA's white papers

Click here to listen to our podcast

For further information, please contact:
PublicAffairs@tomra.com