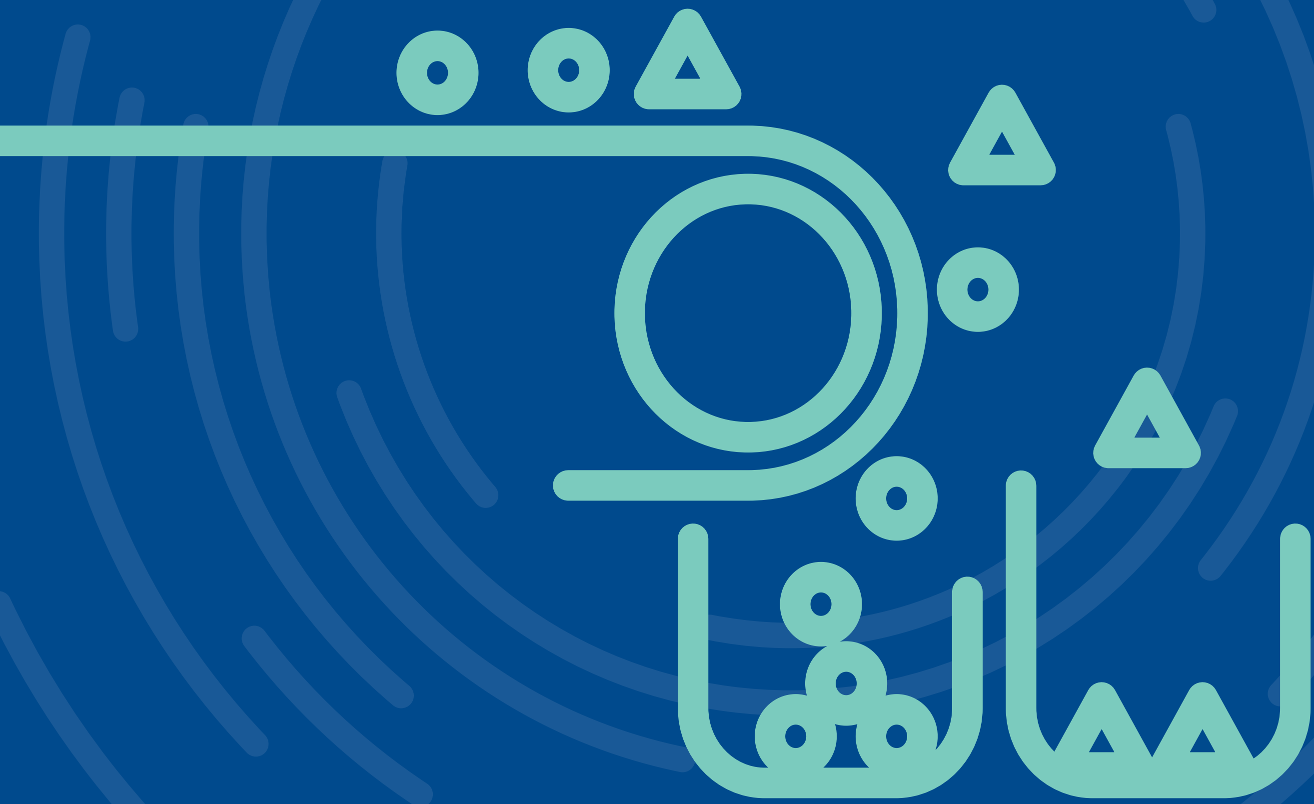
The Ultimate Guide to

Mixed Waste Sorting

Holistic Resource Systems approach of presorting municipal solid waste before incineration and landfill to significantly reduce greenhouse gas emissions.



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INTRODUCTION

Every day worldwide, thousands of tonnes of greenhouse gas (GHG) emissions could be avoided with technology that exists today. All we need is for policymakers and stakeholders placed more value on recovering recyclable plastics from municipal solid waste before it is sent to incineration or landfill.

For decades, society has become disillusioned with plastics due to the lack of Holistic Resource Systems that ensure materials are collected, recycled, and reused. Deposit return systems and separate collections have boosted recycling rates and even helped reduce litter in the environment. Still, a backstop is urgently needed to prevent plastics mixed into everyday household and municipal waste from being buried or burned.

There has never been a greater demand for recycled content in the marketplace, and the trend is expected to continue. Yet common misconceptions about 'dirty' and contaminated plastic waste prevent momentous change that can significantly reduce global GHG emissions. Mixed waste sorting combined with advanced mechanical recycling unlocks the key to recovering and producing high-quality, odor-free recycled feedstocks. **Finally, it is possible to create virgin-like recycled plastic from one of the world's most abundant resources – municipal solid waste.**

LOCAL FOCUS.
GLOBAL IMPACT.

As global economic growth continues to rise, it is often up to local communities to tackle the increase in waste. It is not uncommon for excess residual waste to be transported across borders, by road, rail and boat leading to higher carbon footprints and more risks to human health.

Localized processing of municipal waste, where plastics are diverted from incineration and landfill presents a huge opportunity to reduce GHG and offset primary production. Emissions related to transporting waste can vary greatly, depending on the weight of materials, distances covered, and even the type of vehicle – to name a just few factors. Holistic Resource Systems focus on local solutions with global impact – eliminating the need for transporting waste cross-borders or even cross-country.

Municipal waste contains valuable secondary raw materials, which, if processed with advanced mechanical recycling, take circularity and GHG benefits to new heights. Extended Producer Responsibility (EPR) policies, such as the Packaging Waste Fund in the Netherlands, incentivize the collection, sorting and recycling of plastics – even from municipal solid waste. As a result, waste management companies opt to recycle plastics over the previously lower-cost option of incineration.


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A CLEAR SOLUTION FOR ‘DIRTY’ WASTE

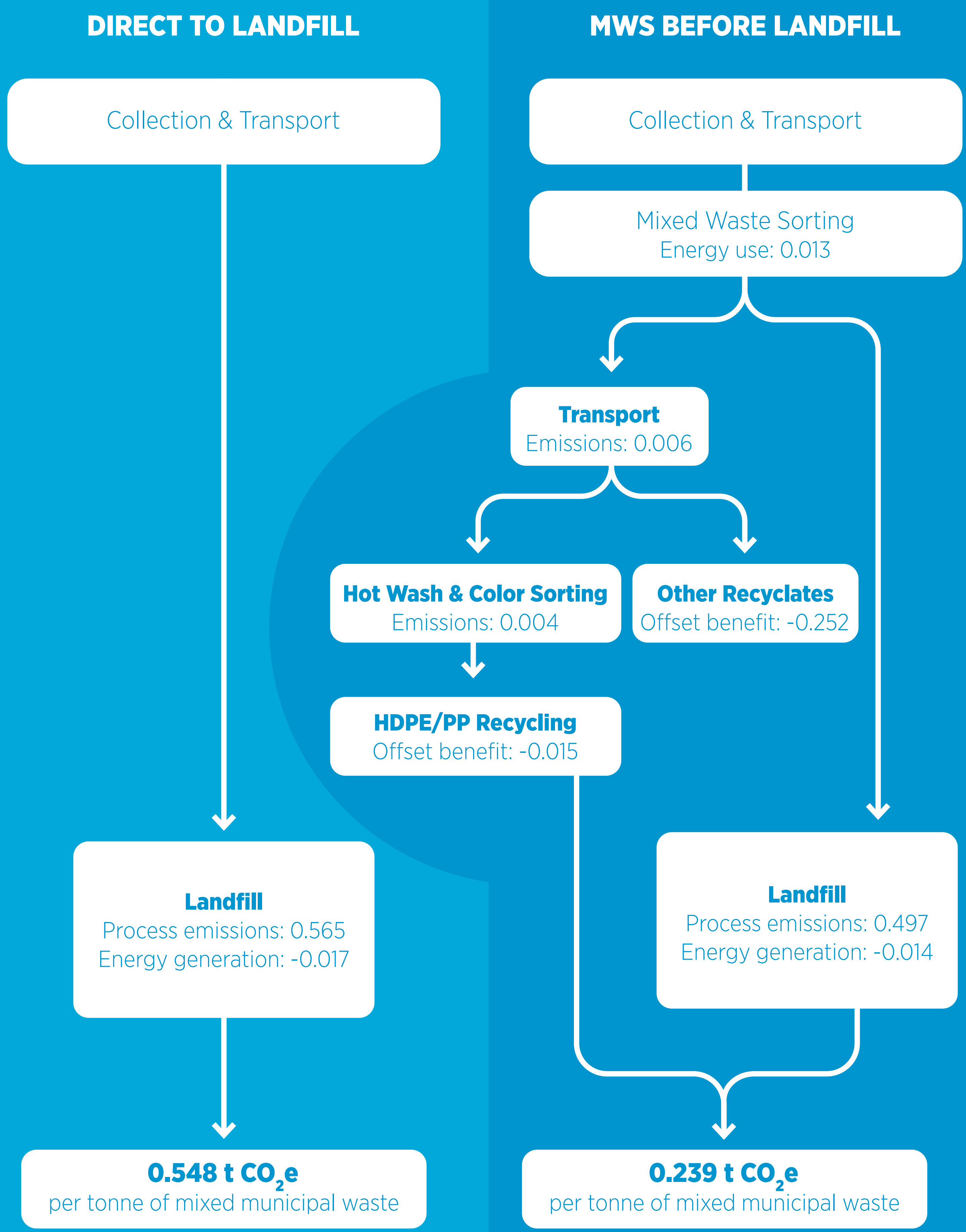
Mixed Waste Sorting (MWS) is a final stage solution for recovering recyclable materials such as plastics, metals and paper before residual waste is incinerated or sent to landfill. It serves as a recovery backstop for recyclable materials not captured in deposit return systems and separate collections effectively and is essential for meeting climate mitigation demands.

Until recently, plastics recovered from mixed waste were considered contaminated and of poorer quality. Today, automated sorting systems combined with advanced mechanical recycling transform these plastics into virgin-like recycled content through sophisticated purification and deodorizing technologies. The high-quality recycled plastics are ideal for non-food grade packaging, further accelerating the transition to a circular economy.

As a fundamental pillar of Holistic Resource Systems, MWS is necessary for closed-loop recycling and plastic sustainability. In Norway, waste management systems that introduced presorting mixed waste captured more than double the amount of plastic packaging for recycling than other separate collection methods.* By adding mixed waste sorting before incineration and landfills, the regions gained recycled content to meet market demands and simultaneously reduced GHG emissions.

Depending on local circumstances and where the resulting benefits outweigh the costs, MWS can also include target materials not captured by separate collections, such as paper, glass packaging and organic waste. In most cases, the overall system cost is reduced due to savings on residual treatment and substantial environmental benefits.

Source: “Sirkulær plastemballasje i Norge – kartlegging av verdikjeden for plastemballasje” [Circular plastic packaging in Norway – mapping of the value chain for plastic packaging], Report for Forum for Circular Plastic Packaging, Deloitte AS, April 2019.



Source: Waste in the Net Zero Century: Greenhouse Gas Impacts of Mixed Waste Sorting. Eunomia. July 2021.

GHG EMISSIONS COMPARISON:

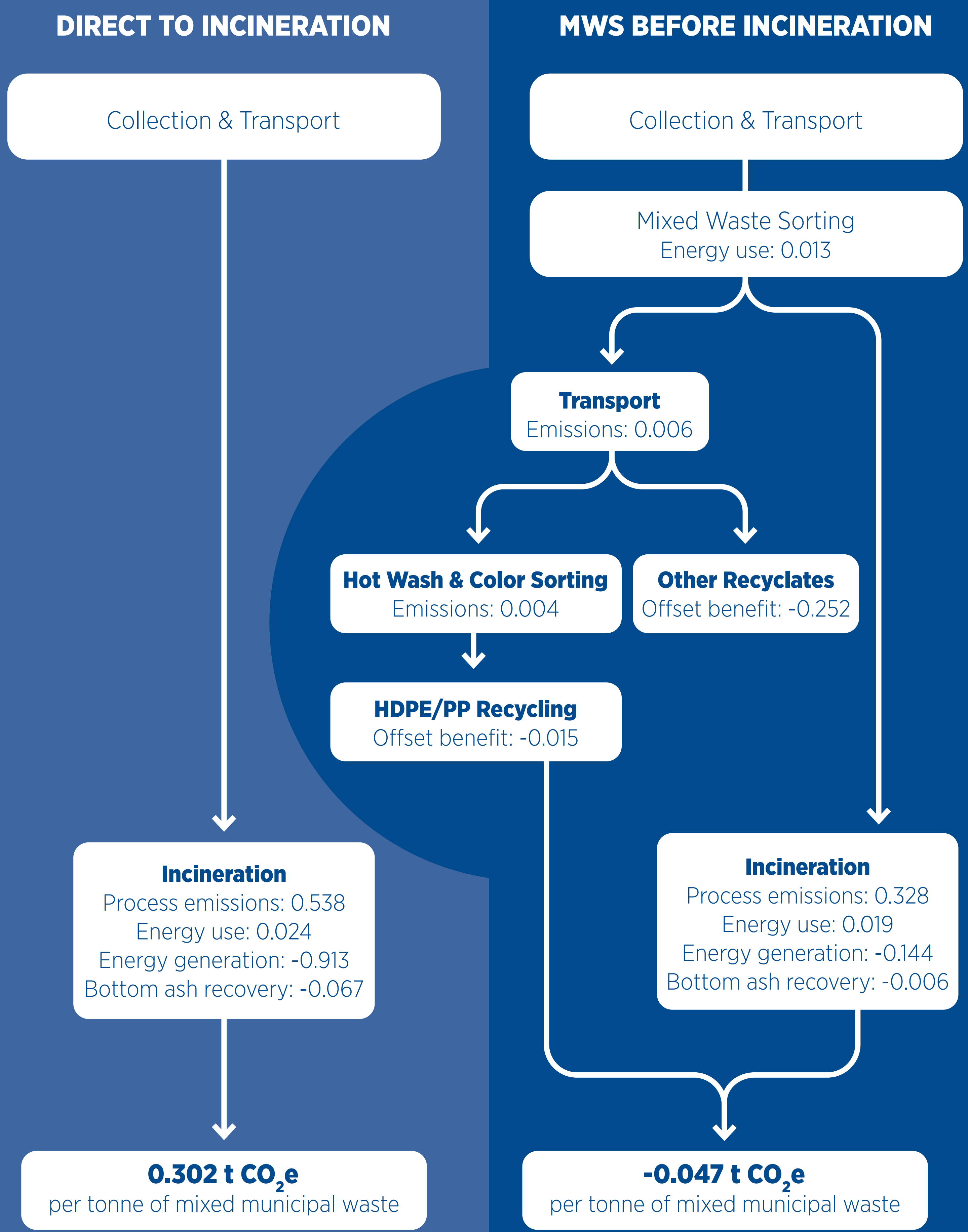
DIRECT TO LANDFILL VS MWS BEFORE LANDFILL

Net difference of

0.309 t CO_2e*

for every tonne of mixed municipal waste

* To determine the GHG benefit of sorting materials from mixed waste, a study was conducted by Eunomia. It examined the emissions saved by sorting and recycling from one tonne of mixed waste prior to sending the remaining material to landfill compared to sending that one tonne of mixed waste directly to landfill.



Source: Waste in the Net Zero Century: Greenhouse Gas Impacts of Mixed Waste Sorting. Eunomia. July 2021.

GHG EMISSIONS COMPARISON:

DIRECT TO INCINERATION VS MWS BEFORE INCINERATION

Net difference of **0.349 t CO_2e***
for every tonne of mixed municipal waste

* To determine the GHG benefit of sorting materials from mixed waste, a study was conducted by Eunomia. It examined the emissions saved by sorting and recycling from one tonne of mixed waste prior to sending the remaining material to incineration compared to sending that one tonne of mixed waste directly to incineration.

FINANCIAL INCENTIVES TO CUT EMISSIONS

The international carbon market establishes a framework and market mechanism to help cost-effectively reduce GHG emissions. These ‘cap and trade’ systems support the trading of emission allowances, which offer financial incentives for the biggest emitters to cut back or face significant fines. The allowances are limited, ensuring their value, and reduce in number over time.

Fortunately for the waste and energy recovery sectors, there are already field-proven techniques to attain future climate and pollution targets. Existing technologies such as mixed waste sorting can give companies a clear economic advantage, and in some cases, resulting in extra emissions allowances - saleable in international carbon markets. What’s more, the recovery and resale of secondary raw materials through advanced mechanical recycling prior to incineration or landfill also offers economic benefits as well. Against the backdrop of taxes levied on virgin materials, secondary material usage will likely increase driving the market to favor recycled content.

While the **GHG emissions** from landfills (and therefore the waste sector overall) are seemingly reducing, the actual emissions from waste activities are **shifting to the energy sector** as more waste is being incinerated in waste to energy plants across Europe.

Zero Waste Europe

Shifting plastic emissions to the energy sector hinders climate action.

BURNING VALUE

In 2020, the Breaking the Plastic Wave report indicated that incineration emits 5.4 tons of CO_2e per metric ton of plastic. According to the report, incineration results in the highest level of GHG emissions among all waste management solutions analyzed while also generating significant health risks. Even countries considered leaders in recycling heavily rely on incineration to deal with plastic waste problem, despite being a high-carbon solution.

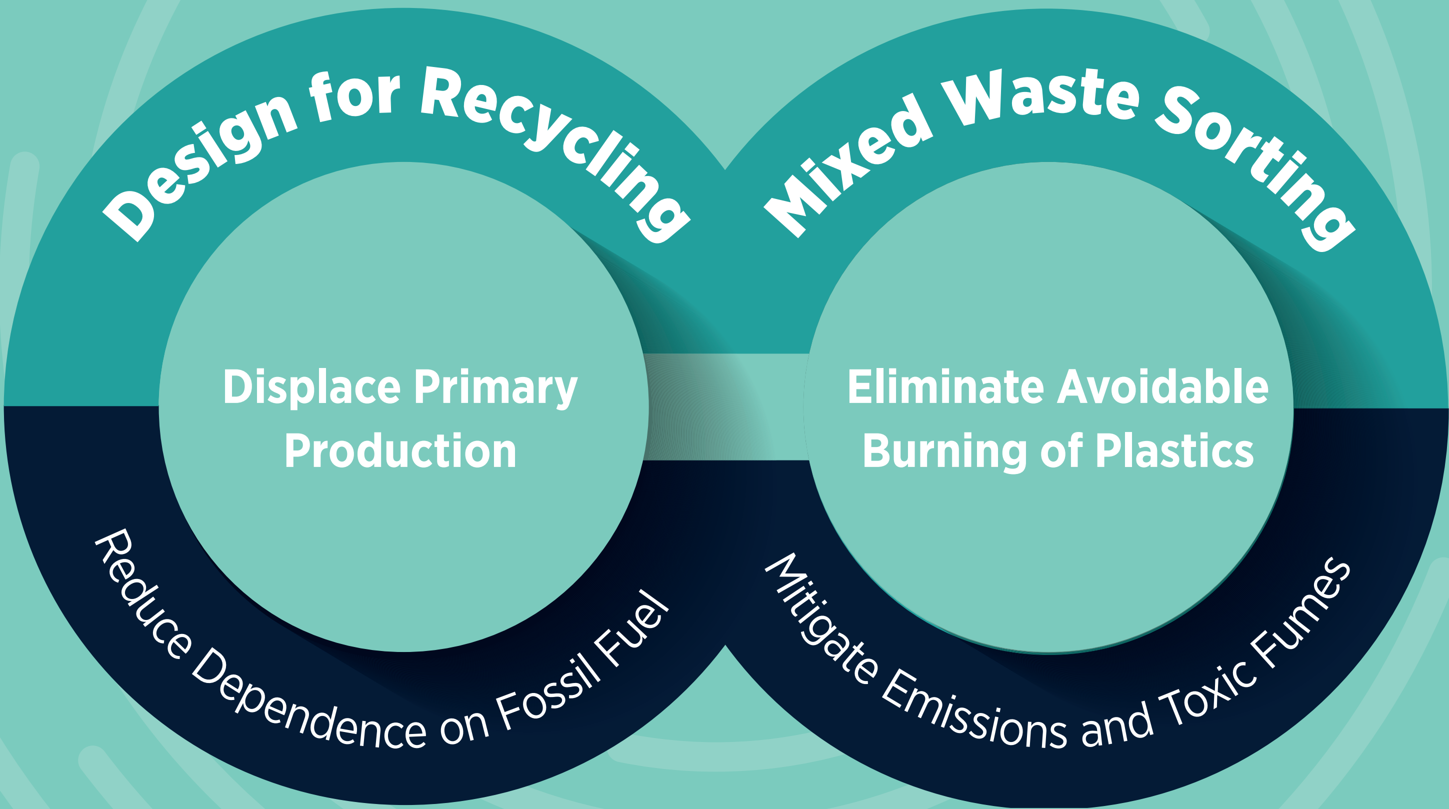
Waste to Energy (WtE) facilities have played a key role in mitigating the climate impacts of landfills, yet both disposal methods are extremely sensitive to the composition of waste input. While landfill emissions in Europe appear to be decreasing, emissions from WtE plants pumped out an estimated 95 million metric tons of CO_2 in 2018 – almost the same as from landfills. Shifting emissions from the waste to the energy sector effectively changes nothing when it comes to climate action. **Resources will always remain limited if we burn more than recycle**. The world requires solutions that exponentially increase the use and reuse of carbon-intensive materials. Reducing GHG emissions from incineration and landfills is mission-critical on the path towards decarbonization.

DECARBONIZING PLASTICS WITH MIXED WASTE SORTING

Sorting and recycling plastics from mixed waste streams – and not relying solely on material-dedicated collection systems – results in a twofold reduction of CO_2 equivalent (CO_2e) emissions. Firstly, by avoiding primary production and secondly, by mitigating unnecessary and toxic burning of plastics.

A recently published study from sustainability consultancy Eunomia shows that even when not all plastics are fully recyclable, mixed waste sorting before incineration and landfill still significantly reduces CO_2e emissions. The task is clear and two-fold: ensure plastic packaging is recyclable and recover these carbon-intensive materials before sending them to incineration or landfills.

ONE SOLUTION. TWO-FOLD CO_2e REDUCTION.



HDPE/PP PROCESS

VIRGIN MATERIAL

Crude Oil Extraction
↓
Oil Refining
↓
Cracking
↓
Polymerization
↓
Coloring
↓
1.719 t CO_2e
per tonne of virgin material

SECONDARY MATERIAL

Collection & Transport
↓
Mixed Waste Sorting
↓
Transport
↓
Hot Wash & Color Sorting
↓
HDPE/PP Recycling
↓
0.689 t CO_2e
per tonne of secondary material

Source: Waste in the Net Zero Century: Greenhouse Gas Impacts of Mixed Waste Sorting. Eunomia. July 2021.

GHG EMISSIONS COMPARISON:

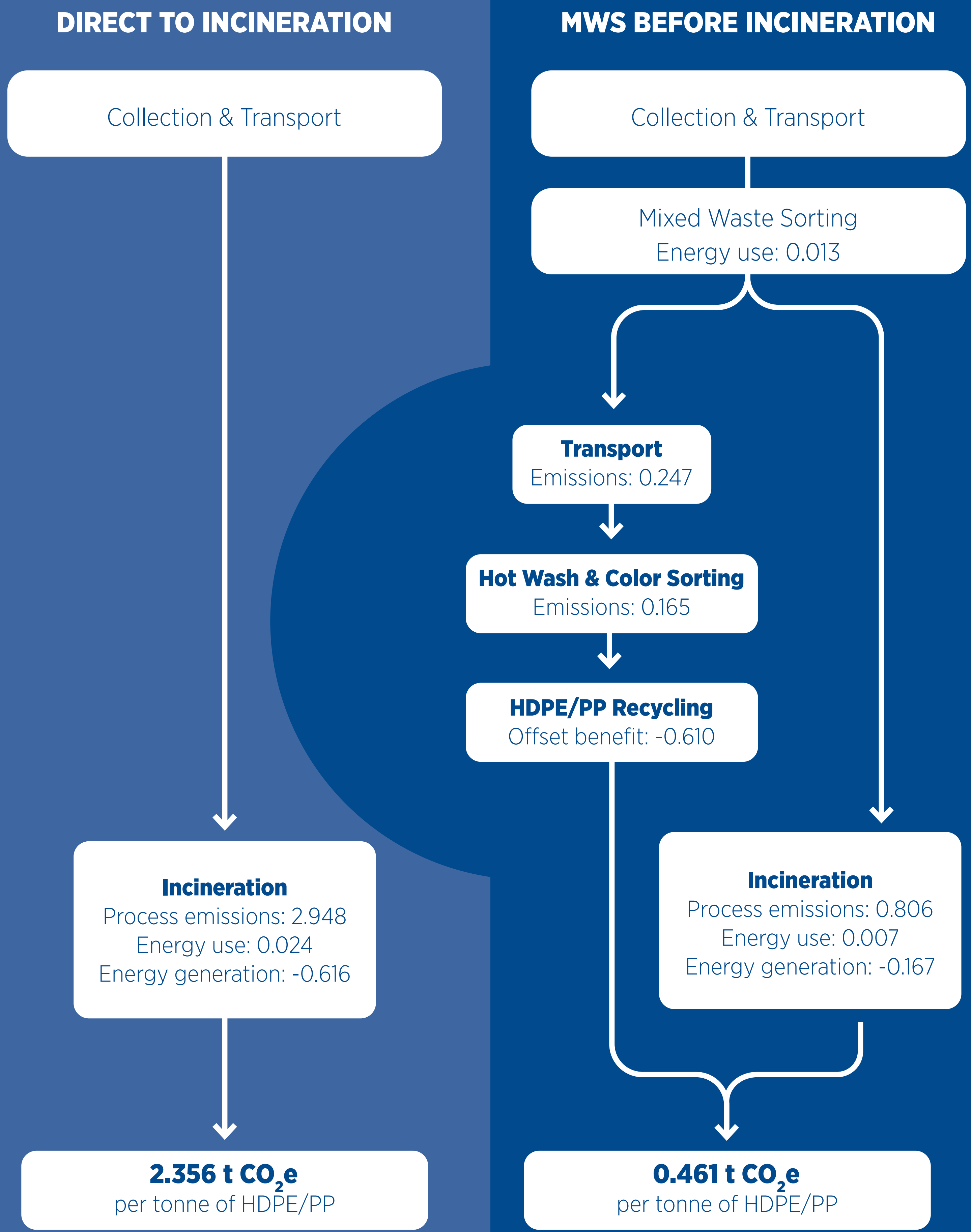
VIRGIN VS SECONDARY MATERIALS

GHG Benefit

1.03 t CO_2e

per tonne of recycled content*

* To determine the GHG benefit of sorting plastic from mixed waste, a study was conducted by Eunomia. It examined the emissions saved by sorting and recycling HDPE and PP plastics to create one tonne of plastics with structural quality equivalent to virgin materials.



Source: Waste in the Net Zero Century: Greenhouse Gas Impacts of Mixed Waste Sorting. Eunomia. July 2021.

CASE STUDY COMPARISON:

GHG BENEFIT OF REMOVING PLASTICS BEFORE INCINERATION

GHG Benefit

1.895 t CO_2e*

for every tonne of HDPE/PP in mixed municipal waste

* Case study of mixed waste with plastic composition assumed to contain 34% HDPE and 66% PP. The case study examined emissions saved from collecting one tonne HDPE and PP each to determine the GHG benefit of MWS before incineration.

HELPING BRIDGE THE GAP

With the widespread coverage of ocean plastics pollution and extreme climate-related events, countries have set more ambitious targets to reduce greenhouse gas (GHG) emissions. The waste sector can do its part by ensuring plastic waste is being collected for recycling through deposit return schemes, separate collections and mixed waste sorting.

Today, only 2% of plastic packaging is collected for recycling in a closed-loop system. The **only solution** for a green recovery that tackles the plastic waste problem is a closed-loop, holistic resource system.

New legislation is being introduced worldwide, influencing packaging standards and creating a demand for versatile feedstocks that compete with virgin plastics. Concerted policies such as the EU Single-Use Plastics Directive and EU Plastic Packaging Levy aim to reduce marine litter and plastic pollution by prioritizing recyclability and closing the loop on packaging materials. Other approaches include the UK's new Plastic Packaging Tax that focuses on non-recycled plastic content in packaging. The Australian Packaging Covenant targets that 100% of packaging is reusable, recyclable or compostable by 2025.

Only

2%

of the planet's annual plastic production is reused for the same or similar products.

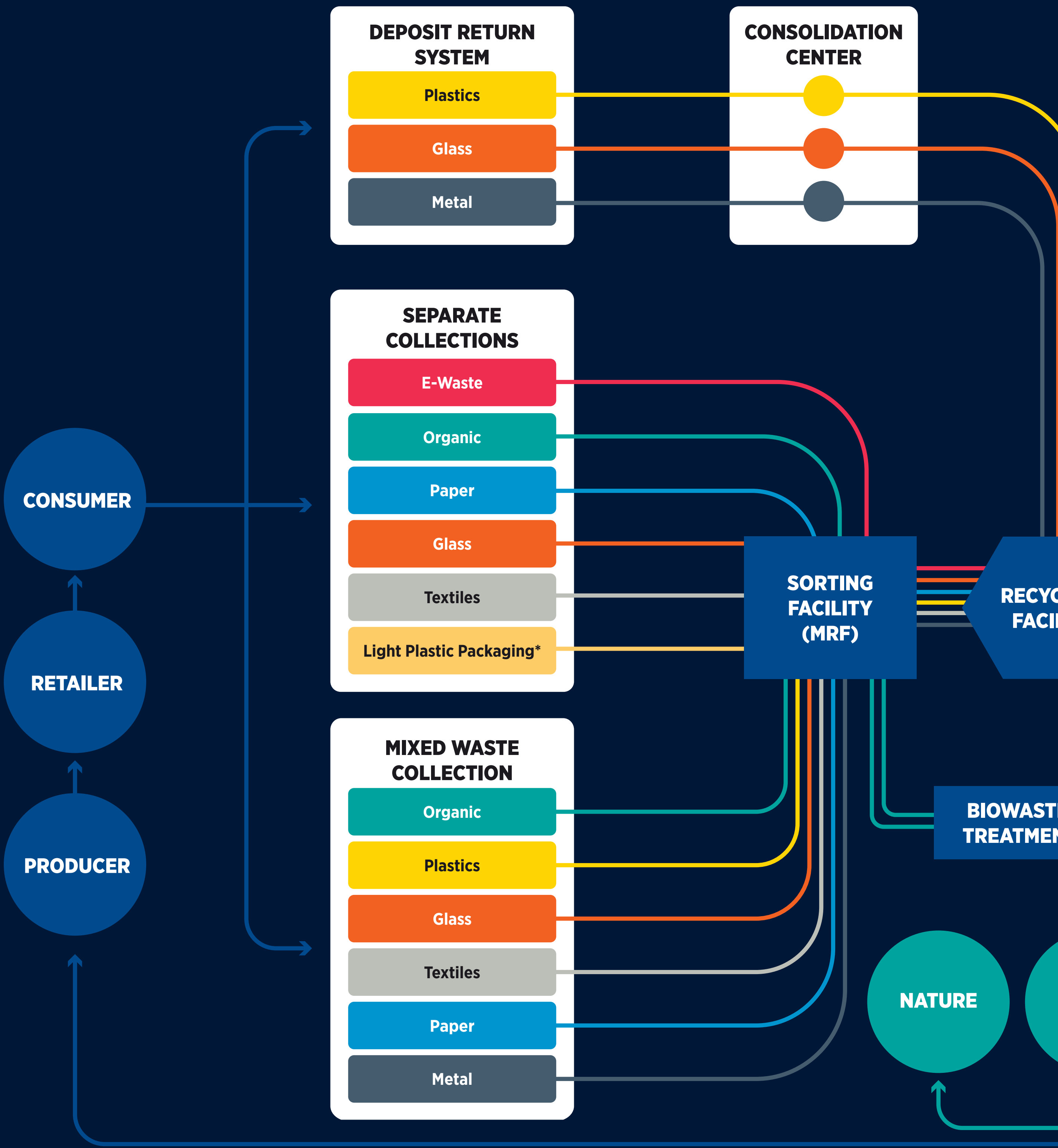
SUSTAINABLE PACKAGING DEPENDS ON RESOURCE RECOVERY SYSTEMS AS MUCH AS ‘DESIGN FOR RECYCLING’

When policy dictates circularity, it is fair to assume that **most plastic packaging will be recyclable by 2030**. Therefore, the composition and inherent value of municipal solid waste will dramatically change. This indicates an urgent need for infrastructure to **capture recyclable materials before being sent to landfill or incineration**, thus replenishing feedstocks. Brand owners and converters looking to increase the share of recycled content in packaging are already facing challenges of having enough high-quality renewable feedstock. Closed-loop recycling that includes material recovery across all waste streams builds feedstock capacity and enables zero waste packaging.

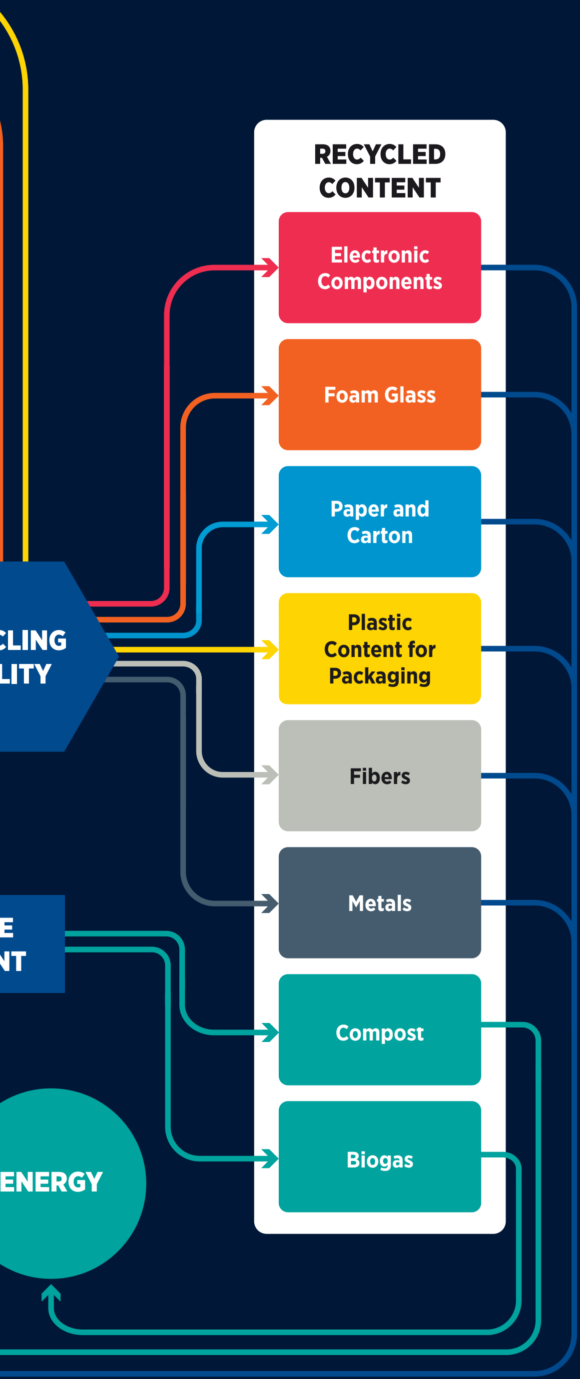
Sending residual mixed waste directly to incineration or landfill without sorting plastics, metals, and other recyclable materials is no longer reasonable. There is huge potential to make a positive and sustainable impact.

László Székely, VP,

Head of Business Development, TOMRA



* Depending on circumstances for a given location. Container parks can also serve e-waste, bulky items and garden waste.



HOLISTIC RESOURCE SYSTEMS

As an intrinsic part of TOMRA's Holistic Resource Systems, mixed waste sorting powerfully enables the recovery of recyclable materials from mixed waste. By recovering carbon-intensive materials such as plastics and metals before waste goes to incineration or landfill, recycling rates are maximized and GHG emissions are significantly reduced across both waste and energy sectors.

Adopting mixed waste sorting as a standard practice before residual waste goes to incineration and landfill could avoid up to 730 million tonnes of CO2e globally by 2030.

Want to find out more? Download our free white paper here.

1 Producer
2 Retailer
3 Consumer
4 Mixed Waste Collections
5 Plastic Recovery
6 Polymer & Color Sorting
7 Shredding
8 Hot Washing
9 Flake Sorting
10 Deodorization
11 Extrusion

A CONCEPT MADE INTO REALITY.

Until recently, plastics recovered from mixed waste were downcycled and generally unattractive to the marketplace. Working in close partnership with key players across the plastics value chain, TOMRA developed advanced mechanical recycling – a process that enables operators to produce high quality and odor-neutral recycled plastic pellets in a variety of grades and colors.

When building or retrofitting waste management and energy recovery facilities to include mixed waste sorting, it is advisable to consider advanced mechanical recycling technologies. Polyolefin reprocessing facilities featuring hot-washing, deodorization, color and flake sorting systems deliver recycled plastic content with qualities similar to virgin feedstock.

The case for mixed waste sorting and advanced mechanical recycling has never been more compelling. Sorting plastic from mixed waste is also fiscally advantageous with higher gate fees, additional revenue from selling recovered material, and lower plastic taxes. TOMRA will publish further information on advanced mechanical recycling in the near future.


ADVANCED MECHANICAL RECYCLING FOR MIXED WASTE
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CASE STUDY: 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 the residential 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 lifestyles 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. Mixed waste sorting before incineration commenced in December 2018 and added a second identical sorting line in 2019.

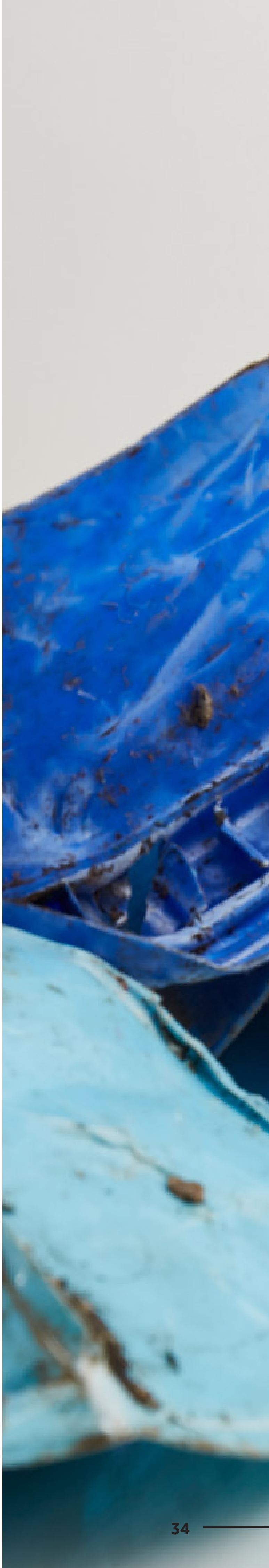
Currently, AVR targets rigid plastics (PET, PE, PP), films (DKR 310) and beverage cartons (Tetra Pak, DKR 510) for sorting and removal before sending residual waste to incineration. For every 1 kilogram of plastic packaging recovered, an additional 3 kilograms of marketable capacity is made available 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 GHG benefit.

SUMMARY

Our environment is in urgent need of solutions that mitigate greenhouse gases and the global waste problem. Installing automated sorting technology in front of incineration plants and landfills reduces emissions and our dependency on primary production. Moreover, sorting plastics and other recyclable content from municipal waste creates excess capacity at incineration facilities, simultaneously decreasing capital expenditures and meeting future demands.

There is enormous potential to significantly reduce greenhouse gas emissions and supply secondary raw materials for today's more sustainability-driven marketplace. Mixed waste sorting combined with advanced mechanical recycling offers a field-proven method for rescuing finite resources from municipal waste and giving these materials new life in products and packaging.

To meet climate targets, we must take swift action moving towards a circular economy, in which plastics and other viable materials are collected for recycling from all waste streams. Let's aspire to give our resources more value and create holistic systems to ensure their longevity.



ABOUT US

TOMRA

TOMRA is a global impact leader in the resource revolution, creating and providing sensor-based solutions for optimal resource productivity. Founded in 1972 on an innovation that began with the design, manufacture and sale of reverse vending machines (RVMs) for automated collection of used beverage containers. Today, TOMRA provides technology-led solutions that enable the growth of the circular economy with advanced collection and sorting systems that optimize resource recovery and minimize waste in the food, recycling and mining industries.

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GLOSSARY OF KEY TERMS

ADVANCED MECHANICAL RECYCLING
A complementary solution for mixed waste processing, in which recyclable plastics are sorted, washed, deodorized, and extruded for producing high quality secondary raw material feedstocks.

CAP AND TRADE SYSTEMS
A system designed to reduce emissions, such as those from power plants, by ensuring progressively stricter limits over time and creating market-based incentives.

CIRCULAR ECONOMY
A restorative and regenerative economy by design. Looking beyond the take-make-waste extractive industrial model, it is based on three principles: design out waste and pollution, keep products and materials in use, and regenerate natural systems.

CLOSED-LOOP RECYCLING
Recycling of materials into the same or similar quality applications, such as bottle-to-bottle recycling.

DEPOSIT RETURN SYSTEM (DRS)
A collection 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).

DESIGN FOR RECYCLING
A principle of designing products and packaging to facilitate the recovery of materials and keep them in use, thereby eliminating waste and pollution. Also known as circular design.

DOWNCYCLING
Recycling of post-consumer waste in a way that results in lesser material quality, and even result in end of product lifecycle.

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.

GHG BENEFIT
The reduction of greenhouse gas emissions because of mitigation efforts. Also known as emissions savings.

HDPE
High-density polyethylene is a thermoplastic polymer and one of the most versatile plastic materials used in everyday applications, including packaging.

HOLISTIC RESOURCE SYSTEMS
A framework approach for improving the management of waste using well-established techniques including deposit return schemes (DRS), the separate collection of specific material types and mixed waste sorting (MWS) to maximize recycling rates and reduce greenhouse gas emissions.

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.

MIXED WASTE SORTING (MWS)
A final stage solution for recovering recyclable materials such as plastics, metals and paper before residual waste is incinerated or sent to landfill. It serves as a recovery backstop for recyclable materials not captured in deposit return systems and separate collections effectively and is essential for meeting climate targets.

PET
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.

POLYOLEFINS
A family of polyethylene and polypropylene thermoplastics primarily produced from oil and natural gas. Their versatility has made them one of the most popular plastics in use today.

PP
Polypropylene is a thermoplastic polymer used in a wide variety of applications, including flexible and rigid packaging.

RECYCLED CONTENT
Materials recycled as a result of resource systems that sort and process post-industrial and post-consumer waste.

SORTING SYSTEMS
An automated sorting unit that combines advanced sensor and software technology to identify and separate target materials from an input stream.

SEPARATE COLLECTIONS
A curbside or drop-off collection program that accepts designated post-consumer materials to keep them as uncontaminated and dry as possible. Also known as
single-stream recycling.

WASTE TO ENERGY
The process of generating energy in the form of electricity and/or heat from the treatment of residual waste.

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