



Demonstrating lower polluting solutions for sustainable airports across Europe

WP6 Circular Airports

Airport Circularity Baseline Study

Within the TULIPS consortium, five partners collaborate under WP6.



The purpose of this report is to provide an in-depth understanding and baseline of the operational resource streams of airports and its management, to promote knowledge exchange, scale best practices and all together accelerate the transition towards a circular economy in the aviation sector.

Check this icon throughout the document and click on it to learn more about 'How to get started'.



Get started

Definitions can be found in the Glossary at the end of this document.
Look for the words formatted like **this**.



Written by: Excess Materials Exchange (EME)
Date: April 30, 2023

INTRODUCTION

As reducing carbon emissions and other environmental impacts becomes a requirement by governments, society, and the aviation industry itself, airports around the world are recognizing the need to accelerate their **transition towards a circular economy**, which have become part of **their license to operate and grow**.

How can airports reinvent themselves to thrive in a circular economy while reducing environmental impacts?

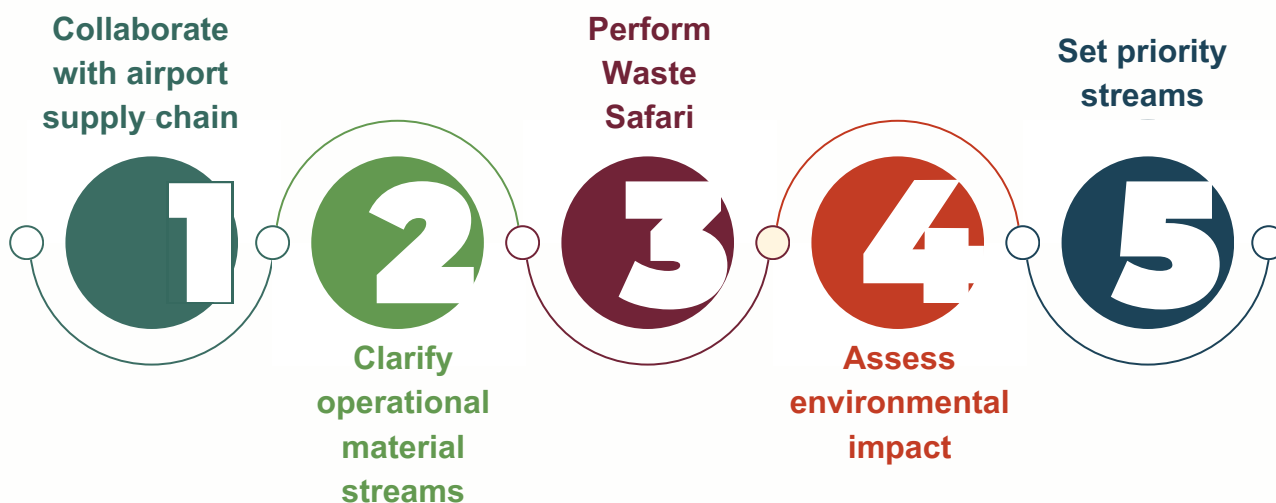
By applying **circular economy** principles, airports can become more sustainable, resilient, and competitive while reducing their environmental footprint. This can make them more attractive to passengers, airlines, and other stakeholders, and help to ensure their long-term viability.

Changing the perspective on waste from a problem to a resource is key to accelerating the transition towards a circular economy.

Airports adopting **circular economy** principles typically define and implement waste reduction targets and develop partnerships across the value chain to meet those goals. As a result, they are now seeking new ways to collaborate with partners and emphasize greater transparency and accountability in waste management beyond the airport premises.

Circular Economy roadmap for airports

This report by Excess Materials Exchange (EME) presents insights from a **baseline assessment** conducted at three airports. It outlines five key steps organized into five sections, to help other airports implement similar initiatives. The report also includes useful tools and additional information, accessible through hyperlinks.



1. Collaborate with airport supply chain

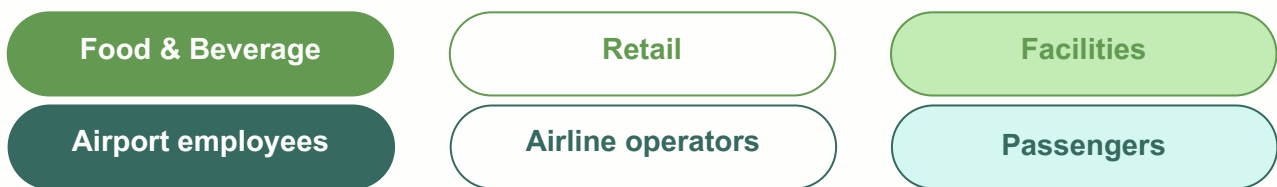


Waste is generated not only by passengers but also by shops, restaurants, lounges, and other areas within and around the airport. Therefore airports recognise the importance of collaboration and involving **stakeholders** in order to prevent or reduce such streams.

Recognised benefits of collaborating between value chain actors includes improving service and reliability to attract customers, sharing data and insights across the value chain, removing inefficiencies, working together on decarbonization, meeting ever-changing demands and customer requirements, and enhancing resilience and robustness.

Collaboration with key **stakeholders** is considered a priority in achieving the objectives of TULIPS WP6, which focuses on high-impact circular solutions.

Airport's key stakeholders influencing the operational resource streams are the following:



Do you know how to identify your **stakeholders**?



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How can airports build stronger relationships with their **stakeholders**?



2. Clarify operational resource streams

Operational resource streams at airports refer to the various types of waste generated during daily airport operations and activities. **A detailed mapping and understanding of these streams can help embed circular principles in airport operations.** Since various **stakeholders** in and around the airport create **operational streams**, gaining an overview and identifying significant contributors can assist in reducing or eliminating waste and improving behaviour.

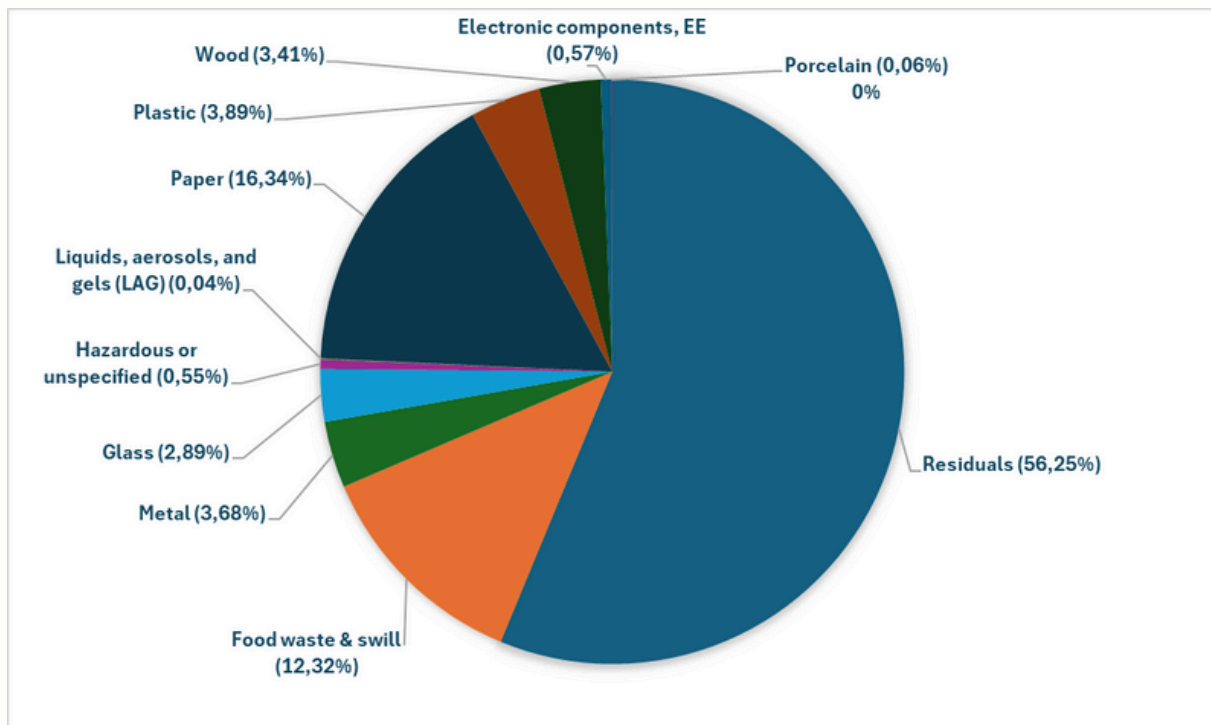
The calculated waste per passenger is an important KPI for monitoring waste reduction

AIRPORT	PASSENGERS
Schiphol Amsterdam	71.7 million (Schiphol, 2019)
Avinor Oslo	28.5 million (Avinor, 2019)
Hermes Larnaca Cyprus	8.2 million (Hermes, 2019)

In 2019, the average waste per passenger at participating airports was 218 grams.

Do you know which resource streams are taken into account when calculating the waste generated per passenger over the course of a year?

For the purpose of ensuring comparability between participating airports (Schiphol Amsterdam, Avinor Oslo, Hermes Larnaca), this report only includes an analysis of **common operational resource streams (and it's average weight in %)**:

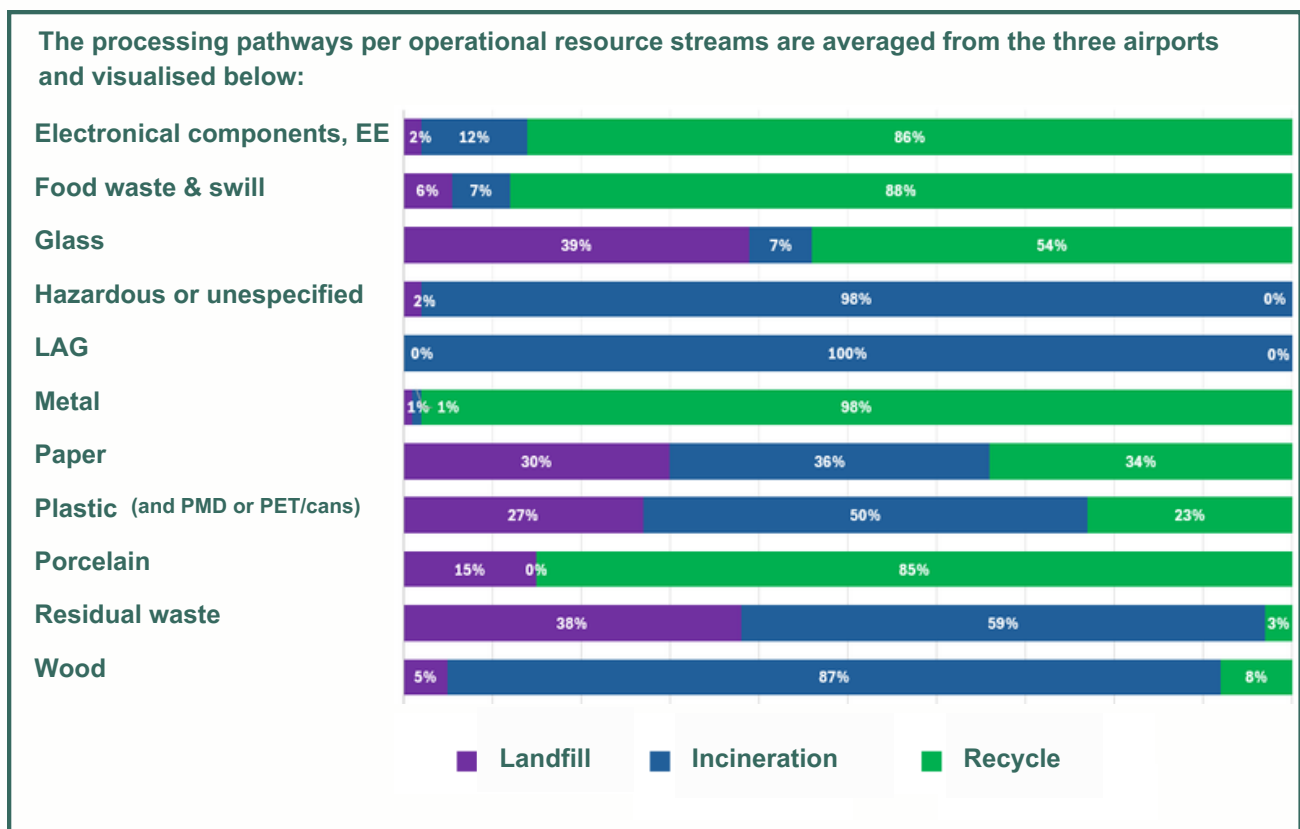


The streams that are considered important but could not be used for comparable purposes at these three airports are: *Waste water and sewage sludge, International catering waste, Aircraft cleaning waste.*

What is the difference between waste processing pathways?

Understanding the difference between waste processing pathways is important for identifying opportunities to improve waste management practices and moving towards a more sustainable approach.

The airport's waste handlers are generally responsible to provide the processing pathways for each waste stream, reflecting their intended or aspirational methods for treating the materials. In case they are not able to provide evidence of actually performed treatments per stream, external databases such as Eurostat (2022) can be consulted to track what happens to the waste after it leaves the airport. Sometimes a difference in pathways between handlers and databases can arise, of which deep dive meetings can support to understand the actual treatment. If no evidence could be provided by the handlers, the most negative treatment from the databases can be applied in the assessment.



Note: The databases used primarily provide data on traditional linear waste management methods, such as landfill, incineration, and recycling. They do not cover more circular treatments, such as reuse, remanufacturing, or other processes higher up on the R-ladder.

Bridging differences in waste processing pathways is key to accurately showcasing airport's waste management. Airports are now seeking new partnerships with waste handlers to improve transparency and accountability in waste management beyond airport premises.

Do you know what resource streams airport's stakeholders are contributing to? Do you know what happens with the streams after collection?



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3. Waste Safari



Why should airports perform a Waste Safari?

- **Gain insights** into resource streams to understand where and how it's generated and managed.
- **Assess passenger and tenant waste separation** practices for areas of improvement.
- **Identify opportunities for waste reduction or diversion** to lower costs.
- **Promote sustainability** by raising awareness among employees, stakeholders, and passengers.

Steps to perform a Waste Safari



Example results from airports based on performing a Waste Safari



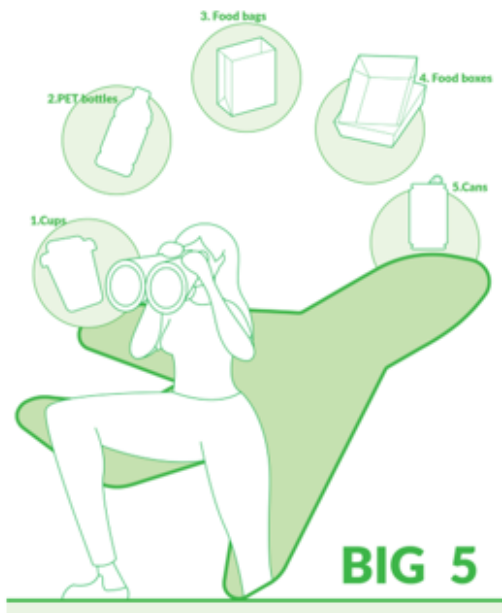
Avinor Oslo Airport

Commercially generated waste stands for **82% of all residual waste**, while passenger waste stands for 18%.



Schiphol Amsterdam Airport

The **BIG FIVE** waste items generated were all related to **food and beverage** consumption.



Main take aways from the performed Waste Safari's:

- The bin bags are most of the time not full once emptied which results in more plastic waste.
- The paper bins always contain paper waste contaminated with other materials like glass, PET, coffee cups and cans.

Are you interested in performing a Waste Safari and spot the Big Five of your airport?



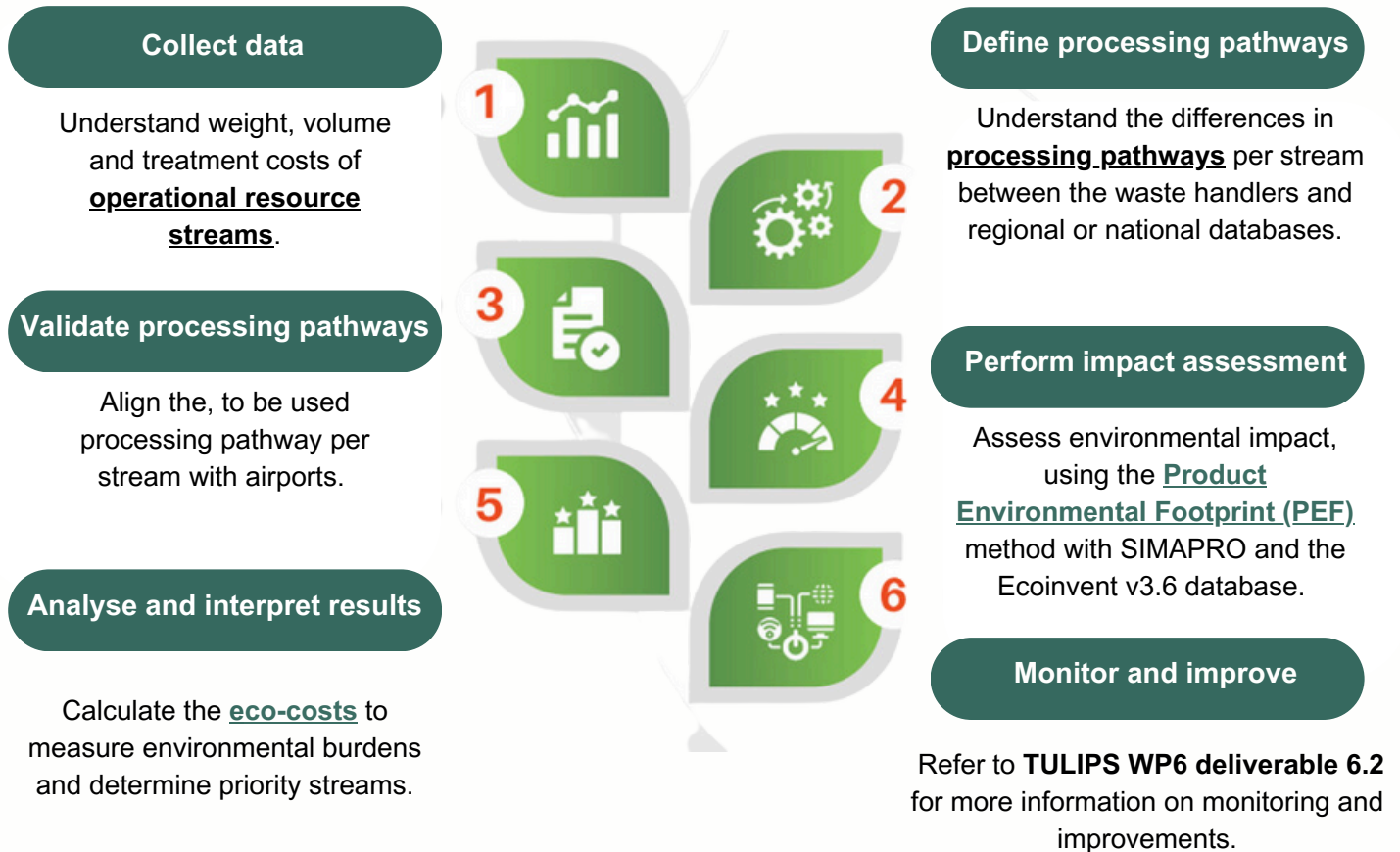
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4. Environmental impact assessment



In order to determine priority streams per airport, an **environmental assessment** can be performed to understand the impact next to the weight or volumes of the streams. This process can be done supported by the below described six steps.



Scope:

- This methodology aligns with Life Cycle Assessment standards (ISO-14040 and ISO-14044) and focuses solely on end-of-life treatment.
- Transport is excluded due to geographical differences between the three airports and waste handlers.
- The assessment relies on existing databases detailing **waste processing pathways** — **landfill, incineration, and recycling**— and hence excludes **R-strategies** (e.g., repair, reuse).
- Taking into consideration that **waste management** practices vary by country (Netherlands, Norway, Cyprus) with nation-specific procedures.



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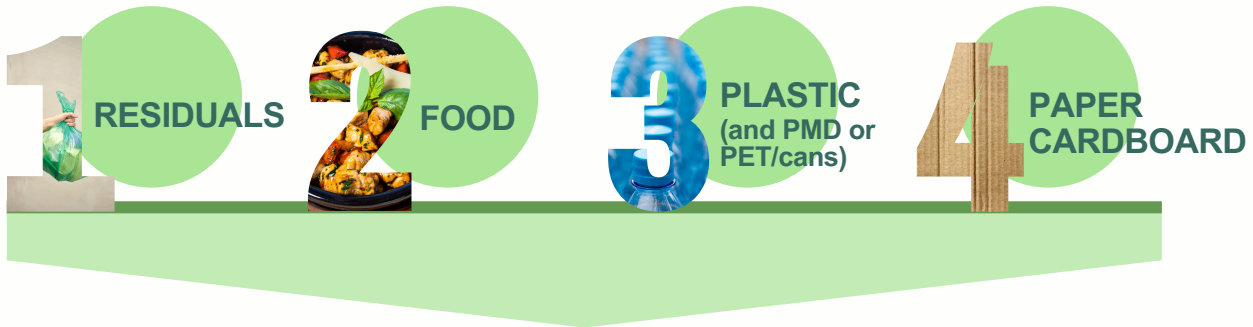
Do you know that our method of determining the priority streams is now also published?



5. Set priority streams



The following four streams are found to be most impactful at airports:

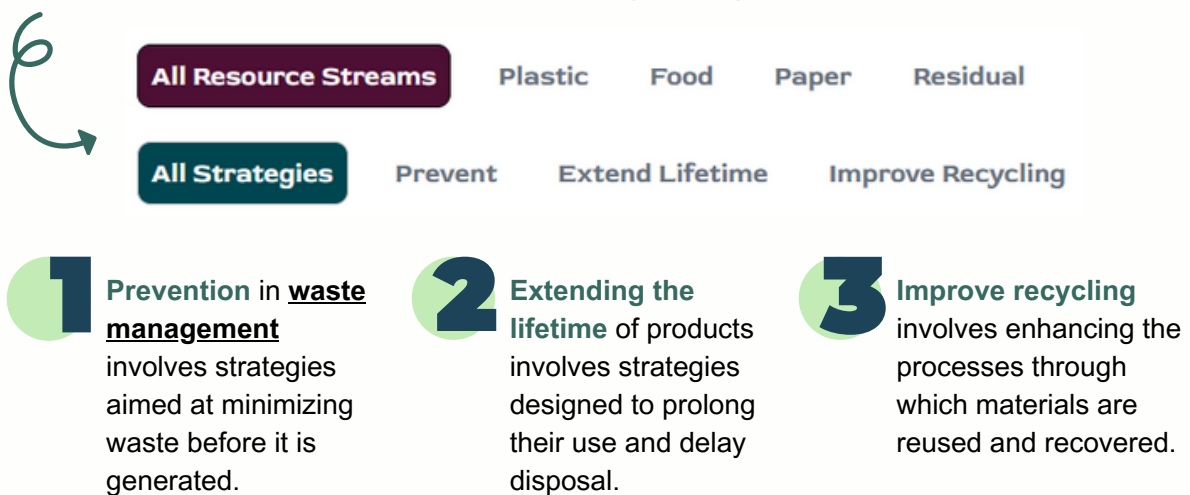


Top priority streams exemplified for Schiphol Airport (incl. CAT1).

	<i>Residuals</i>	<i>Food & Swill</i>	<i>Plastic</i>	<i>Paper & Cardboard</i>	<i>CAT1 & Other</i>
Weight in %	44,4%	10,4%	2%	9,9%	33.3 %
Eco-cost in EUR	500.854.081 €	76.169.462 €	80.782.640 €	23.611.44 €	202.785.247 €

While the **eco-costs** may differ at each airport, the prioritized streams are similar across the three airports assessed. Now the resource streams are prioritized per airport, the next steps in reducing the streams involves **selecting sub-streams to focus on**, such as PET in plastic bins or coffee grounds in food streams.

All initiatives in the launched database are classified by resource stream and reduction strategy based on the R-ladder, a model that provides a framework to analyse and design circular economy strategies.



6. Conclusion and next steps

The TULIPS project has generated a great momentum towards achieving a circular economy in the airport industry. Airports can turn waste into opportunities, reducing the need for virgin materials and enhancing sustainability.

This report introduces a circular economy approach and provides a 2019 baseline assessment for Schiphol Amsterdam, Avinor Oslo, and Hermes Larnaca airports. Top findings highlight residuals, food waste, plastics and paper as priority areas based on the performed assessments.

“It is great to see that our work is showing that a shift towards circular economy principles at airports has the potential to significantly reduce Scope 3 CO2 emissions by optimising resource use, minimising waste and enabling a more sustainable and efficient operation.”

Christian Van Maaren - Excess Materials Exchange

This report serves as a foundational guide for performing similar assessments, scaling circular solutions and advancing airport's circularity. We invite other airports to leverage these methods and insights as a starting point. By building on the shared experiences and learnings from the TULIPS consortium, airports can feel supported and confident in their journey toward a circular economy. Together, we can accelerate progress and foster a more sustainable aviation industry.

Follow our journey with detailed progress in future TULIPS WP6 deliverables, including co-creating interventions, developing monitoring systems, developing a track and trace module for construction materials and publishing a circular design principles handbook.



Glossary

Baseline assessment method

TULIPS WP6 developed the Baseline Circular Airports Method (BCAM) to assess and enhance waste management practices. BCAM systematically analyzes resource streams, such as Residual, Plastic, Swill, Paper, and International Catering Waste (CAT1), considering their composition, stakeholders, treatment processes, and environmental impact. It helps airports prioritize high-impact streams, like plastic waste, for targeted interventions and enables them to assess waste management efficiencies. By optimizing resource use and treatment processes, BCAM supports airports in minimizing waste and improving sustainability efforts.

Circular Economy

The circular economy is a system solution framework. A circular economy decouples economic activity from the consumption of finite resources to stay within planetary boundaries. It's a model that maintains the highest possible value of raw materials, components and products, either by lengthening their lifetime or by looping them back in the system to be reused. Waste is eliminated or used as a resource, both by smart circular design and value retention processes (R strategies). Also, a circular economy aims to prioritise the regeneration of nature so that resources can restore, renew or revitalise their own sources of energy and materials.

Eco-costs

The eco-cost represents the cost of the environmental burden of a product or process, for the scope of the LCA defined. This is expressed in monetary terms and is intended to reflect the cost necessary to reduce environmental pollution and resource depletion to a sustainable long-term level. By converting environmental impacts into monetary value, eco-cost makes these impacts tangible and comparable, allowing for more informed decision-making in terms of sustainability.

Operational resource stream

Operational resource streams at airports refer to the various types of waste generated during daily airport operations and activities.

Product Environmental Footprint (PEF)

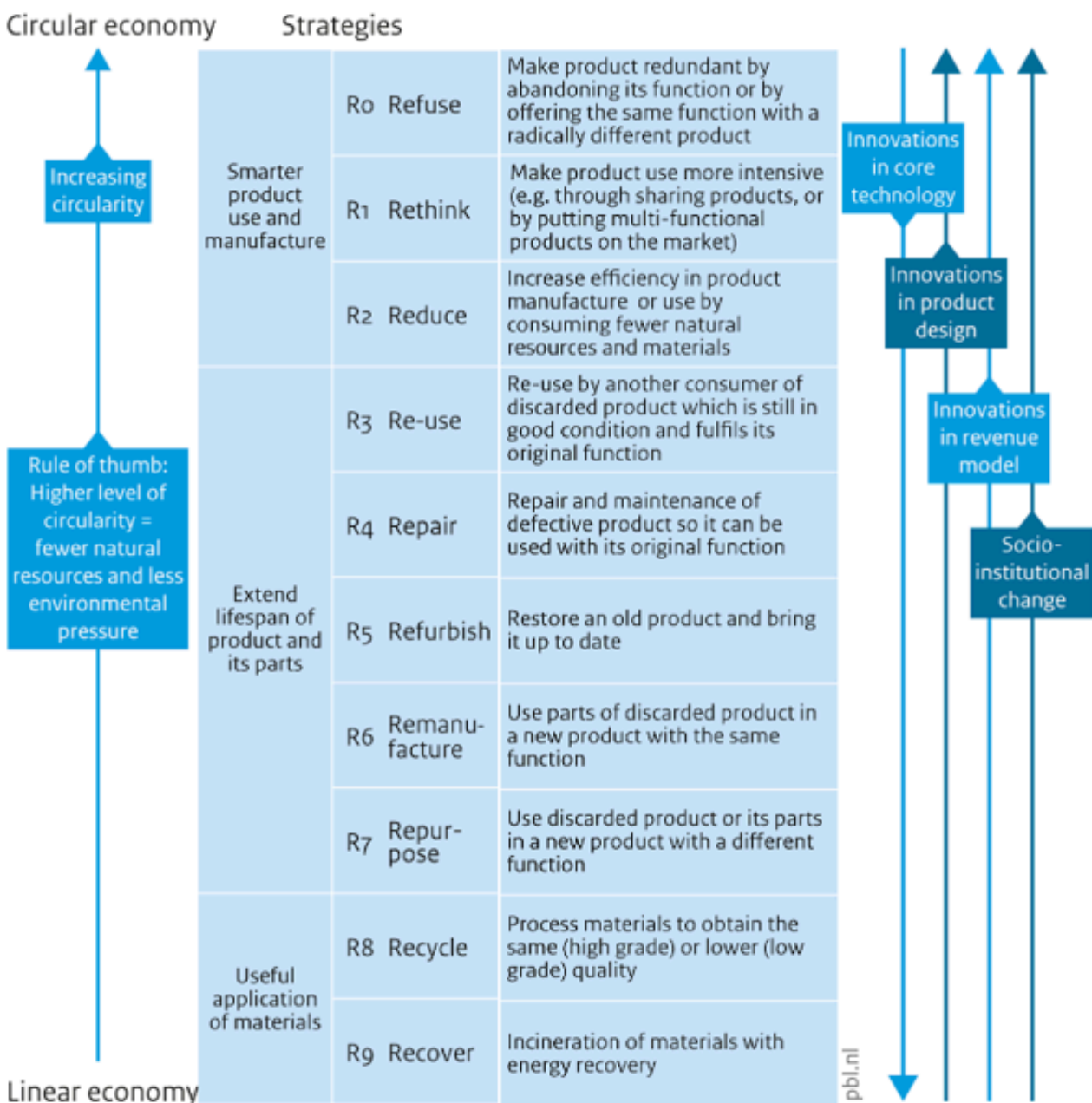
The European Commission proposed the Product Environmental Footprint (PEF) method as a common way of measuring environmental performance ([EU Commission Recommendation 2021/2279](#)). PEF is the EU recommended Life Cycle Assessment (LCA) based methods to quantify the environmental impacts of products (goods or services).

Definitions

R-ladder / R-strategies

An important question is how to measure the progress of the transition towards a circular economy (CE transition). Together PBL and Utrecht University (PBL, 2016) a framework is developed that dives into the role of innovation in CE-transitions in product chains. The model provides a framework to analyse and design circular economy strategies for businesses, organisations, and governments.

Circularity strategies within the production chain, in order of priority



Source: RLI 2015; edited by PBL

www.pbl.nl

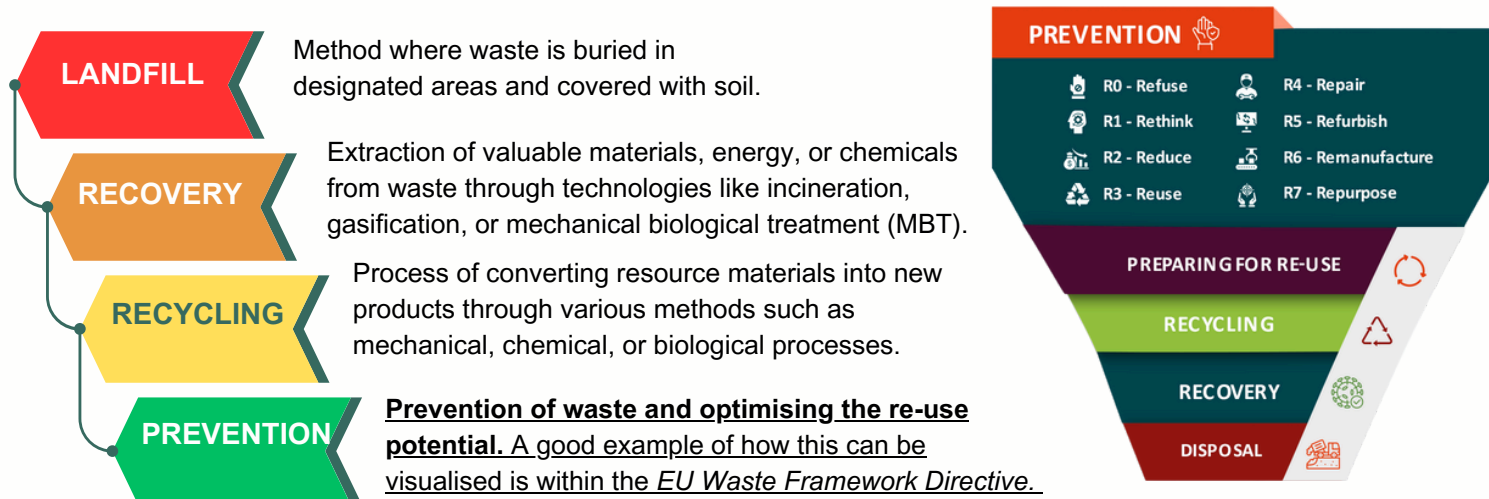
Definitions

Stakeholders

Individuals, groups, or organisations that are impacted by, or have an impact on, the activities of the airport. They can be classified as internal, such as employees and management, or external, including suppliers, customers, government entities, and non-governmental organisations (You, L., Du, J., Zhang, L., & Yan, X. 2022).

Treatment of resource streams

There are three treatments of waste commonly known and reported on, namely landfill, recovery and recycling (European Parliament, & Council of the European Union. 2008). Even though these three treatments are most commonly known and used, there are other strategies, like actual prevention of waste and optimising the re-use potential, that can be executed to avoid applying treatments in general. The focus on prevention aligns with the core principles of transitioning to a circular economy.



Waste management / Waste processing pathway

In a circular economy, waste is no longer seen as something to dispose of, but rather as a resource that can be repurposed and reused to create new products. Keeping resources in use for as long as possible, at the highest possible quality, is one of the core principles of a circular economy (Ellen MacArthur Foundation, n.d.). A traditional linear approach to waste management is reactive, focusing on activities like collection, sorting, and disposal after waste is generated. In contrast, the circular economy approach is proactive, aiming to prevent waste by designing systems that minimize waste generation and maximize resource use from the start.

Waste Safari

A Waste Safari, also known as a waste audit, is a process of evaluating and analysing the waste generated within the airport. It involves collecting, sorting, and measuring the different types of waste produced, as well as identifying the sources and causes of waste.