TULIPS

Demonstrating lower polluting solutions for sustainable airports across Europe

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WP6 CIRCULAR AIRPORTS

Circularity Performance Management System

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Abstract

This report summarises the work of the TULIPS Work Package 6 Circular Airports project from October 2022 to June 2023. It aims to provide a robust circularity performance measurement system that tracks key performance indicators (KPIs) related to the quantity, quality, and composition of operational waste streams. This system is designed to monitor reduction targets in and around airports. The conceptual model and KPIs presented in this report were validated by three airports: Schiphol Amsterdam Airport, Avinor Oslo Airport, and Hermes Larnaca Cyprus Airport. These airports will demonstrate the system in practice, which is part of the second deliverable scheduled for release on December 31, 2023.

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1 Executive Summary

The TULIPS WP6 Circular Airports project aims to reduce operational resource streams by 20% in 2025 and maximise the use of secondary materials for constructional resource streams. The project also seeks to scale solutions and develop a circular economy roadmap for airports, guiding them in implementing circular economy practices and achieving sustainability goals. The overall objective is to contribute to a more sustainable aviation industry.

In summary, this report aims to promote knowledge exchange, scale best practices, and accelerate the transition towards a circular economy in the aviation industry. The report focuses on the setup of a circularity performance measurement system, highlighting three horizons to guide airports towards circularity: 1. Reducing priority streams by 2025, 2. Achieving zero waste by 2030, and 3. Transitioning to a circular economy by 2050. The prioritised operational resource streams addressed within the first horizon are residuals, plastics, paper, and food. For more details on the prioritisation rationale, please refer to deliverable 6.1 Circularity Baseline Assessment (published April 2023).

The circular performance measurement system combines the R-Strategies and the Value Hill model into a single conceptual model to monitor circular performance. The overarching Key Performance Indicator (KPI) in the framework is to reduce residuals produced per passenger by 20%, based on weight and the 2019 level, excluding CAT1 waste handled by contracted waste partners at airports. The strategies employed to achieve this KPI include smarter product use and manufacturing, extending the lifespan of products and their parts, and the practical application of materials. Please note that participating airports may employ customised strategies based on their specific circumstances. While this report includes the conceptual model, KPis, and strategies validated by TULIPS airports, the demonstration of these strategies at the airport will be part of a subsequent report to be published in December 2023.

2 Introduction

Airports play a vital role in transitioning towards a circular economy, which aims to maximise resource efficiency and minimise waste. Measuring and monitoring progress towards a circular economy is crucial for airports as it allows them to enhance operational efficiency, reduce environmental impacts, and contribute to the sustainability goals of the aviation industry. By tracking their progress, airports can identify areas for improvement, promote sustainable business practices, and demonstrate their commitment to sustainability, fostering innovation and inspiring others to follow suit. This chapter provides an introduction to the TULIPS consortium, its collaborating partners, and the process-steps taken to set up a monitoring framework to further accelerate a circular economy.

2.1 TULIPS Circular Airports

TULIPS is a consortium that develops innovations that facilitate the transition to low-carbon mobility and enhance sustainability at airports. The TULIPS project is supported by the EU with €25 million in funding and started in January 2022 up to December 2025. TULIPS is short for DemonsTrating lower pollUting soLutions for sustaInable airPorts acrosS Europe. Each Work Package (WP) within TULIPS focuses on a different sustainability aspect and one of these aspects is circularity, which is addressed in WP6. WP6 aims to implement the circular economy principles within both operational and constructional resource streams as visualised in Figure 1.

Figure 1 - Overview of activities, demo's and deliverables of TULIPS WP6

The main objectives of WP6 Circular Airports are piloting initiatives, which reduce operational resource streams by 20% in 2025 (comparing baseline year 2019 with year 2024) and maximise secondary materials for constructional resource streams. Additionally, the project aims to scale solutions and develop a circular economy roadmap for airports, guiding them in implementing circular economy practices and achieving their sustainability goals. By doing so, the TULIPS consortium hopes to contribute to the development of a more sustainable aviation industry. The WP6 objectives are divided into various deliverables (asvisualised in Figure 1), and this document,

the circularity performance measurement system, represents the second deliverable. The set-up of this monitoring framework for airports to transition towards circularity is a collaborative effort between TU Delft (hereafter: TUD), Excess Material Exchange (hereafter: EME) and the three participating TULIPS airports (Schiphol Amsterdam Airport, Avinor Oslo Airport, and Hermes Larnaca Airport). Please refer to Appendix B for more information on these TULIPS partners.

2.2 Circular Economy – A definition

For the purpose of the TULIPS project, circular economy was collaboratively defined as follows:

"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."

It is acknowledged that by applying circular economy principles, airports can become more sustainable, resilient, and competitive while reducing their environmental footprint (International Civil Aviation Organization, 2019). This can make airports more attractive to passengers, airlines, and other stakeholders, and help to ensure their long-term viability.

2.3 Monitoring progress towards a Circular Economy

By adopting a circular economy model, airports can enhance their operational efficiency, reduce environmental impacts, and contribute to the larger sustainability goals of the aviation industry. Measuring and monitoring progress towards a circular economy is of paramount importance for airports. Monitoring initiatives provide airports with essential data to evaluate the effectiveness of their strategies, identify areas for improvement, and track their overall progress.

The developed circularity performance measurement system at hand is designed for operational resource streams but can also be used for other streams as well. The overall goal of the report is to promote knowledge exchange, scale best practices, and accelerate the transition towards a circular economy in the aviation industry.

2.4 Reading guide

This report summarises the work carried out by TULIPS WP6 from October 2022 to June 2023. The process of setting up a circularity performance measurement system is summarised in Figure 2 and further elaborated on in following chapters.

Figure 2 - Overview of process steps

**Note that part 2 of this deliverable, piloting the KPIs and demonstrating the circularity performance measurement system, will be published on December 31 2023.*

Please be aware that certain airport-specific information is considered confidential and has not been included in this report. The visuals in this report draw on existing frameworks but have been specifically created for this project by TUD (Elisabeth Tschavgova), with input provided by participating partners. Any other images used are either developed by TULIPS or properly credited to the source.

3 Perform baseline assessment

Before embarking on any journey towards progress, it is essential to understand where one currently stands. This principle holds true when it comes to monitoring progress towards a circular economy. Performing a baseline assessment provides a crucial foundation for measuring and evaluating the advancements made in transitioning to a circular economy. By establishing a clear starting point, airports can effectively track their progress, identify areas of improvement, and make informed decisions that will drive the desired outcomes. In this chapter a summary is provided of the Airport Circularity Baseline Study, performed within TULIPS and published in April 2023 (Cordis, 2023).

3.1 Purpose and benefits of baseline assessments

A baseline assessment is crucial for understanding an airport's adherence to circular economy principles. It serves as a diagnostic tool to evaluate current practices and set benchmarks for future progress. Without this assessment, measuring improvements and assessing the effectiveness of strategies becomes challenging. The assessment also promotes transparency and accountability to stakeholders. Additionally, it helps to identify barriers and challenges, allowing airports to develop targeted interventions and strategies.

3.2 Summary of WP6 TULIPS Airport Circularity baseline study

Based on an extensive environmental impact assessment, performed Waste Safari and close stakeholder mapping and involvement, the following operational streams are prioritised in the baseline assessment of TULIPS participating airports (Schiphol Amsterdam Airport, Avinor Oslo Airport, and Hermes Larnaca Airport)*:

1. Residuals - Residuals are prioritised mainly due to their large volume at airports. Due to the contamination of most of the bin bags as observed during the Waste Safari (note: performed in Amsterdam and Oslo), an assumption is made that relatively large proportions of waste separated at the source still end up in the residual stream. Residuals significantly contribute to climate change (CO^2 and other greenhouse gas emissions) and resource scarcity.
2. Food - Food waste is a global problem that contributes to hunger and food insecurity. By reducing food waste, airports can demonstrate social responsibility and contribute to global efforts to address food waste and hunger. While tenants can separate food waste at the airports, passengers cannot and this ends up in the other bin bags on site (which usually are plastic, paper, or residuals). As food waste comes in large volumes, reducing this stream is vital to limit the impact on ecotoxicity and resource scarcity.
3. Plastic (and PMD or PET/cans) – Similar to residuals, food, and paper, plastics are found in most of the airport bins and contaminate the bags drastically, as observed during the Waste Safari (note: performed in Amsterdam and Oslo). Plastic waste is a major contributor to ocean pollution, harms wildlife and has a significant impact on climate change as it takes hundreds of years to decompose, releasing harmful chemicals into the environment over time.
4. Paper/cardboard - Similar to residuals, food, and plastics, paper is found in most of the airport bins as observed during the Waste Safari (note: performed in Amsterdam and Oslo). It seems difficult for passengers to separate for instance their coffee cups, assuming it's paper and potentially not knowing that it's also plastic. Paper and cardboard waste contribute to deforestation and greenhouse gas emissions.

Other important streams for the airports, not included in the environmental impact assessment are:

- International Catering Waste (ICW) – This stream is regulated by EU law (Regulation 1069/2009) and hence needs to be incinerated within 24 hours. From an airport's perspective, its influence on International Catering Waste (ICW) may be limited as it depends on a variety of factors such as airline practices and their respective agreements with waste handlers. ICW significantly contributes to impact criteria such as acidification, eutrophication, and ecotoxicity.
- Aircraft cleaning waste – Similar to the ICW, the airport's influence on aircraft cleaning waste may be limited. However, IATA highlights that in the absence of smarter regulation, cabin waste volumes could double in the next 10 years (IATA, 2019). To address this issue, a collaboration between airlines, catering companies, airports is required.
- Waste water and sewage sludge – Water is an essential resource for life, but unfortunately, almost all water on Earth is not readily available for human consumption (National Geographic Society. n.d.). Additionally, the distribution of usable water is not equal globally, and water scarcity in some areas can lead to social unrest and conflict. Given the limited availability of water, it is critical for airports to reduce water usage and ensure proper treatment of wastewater in order to meet the current and future needs of humans, ecosystems, and the planet.

Note that all details are to be found in Airport Circularity Baseline Study, performed within TULIPS and published in April 2023 (Cordis, 2023).

4 Develop conceptual model

This chapter introduces a conceptual model specifically designed for airports, integrating elements from the R Strategies model and the Value Hill model. The purpose of the conceptual model is to guide airports in their journey towards transitioning to a circular economy. The chapter explores the key components of the conceptual model used and applied in setting up the circularity performance measurement system.

4.1 R-ladder or R-strategies

The measurement of progress in the transition towards a circular economy (CE transition) is a crucial aspect to consider. PBL and Utrecht University collaborated to develop a framework that explores the role of innovation in CE transitions within product chains (PBL, 2016). Figure 3 presents a model that offers a framework for analysing and designing circular economy strategies for businesses, organizations, and governments. The model comprises ten steps, each representing a key aspect of the circular economy.

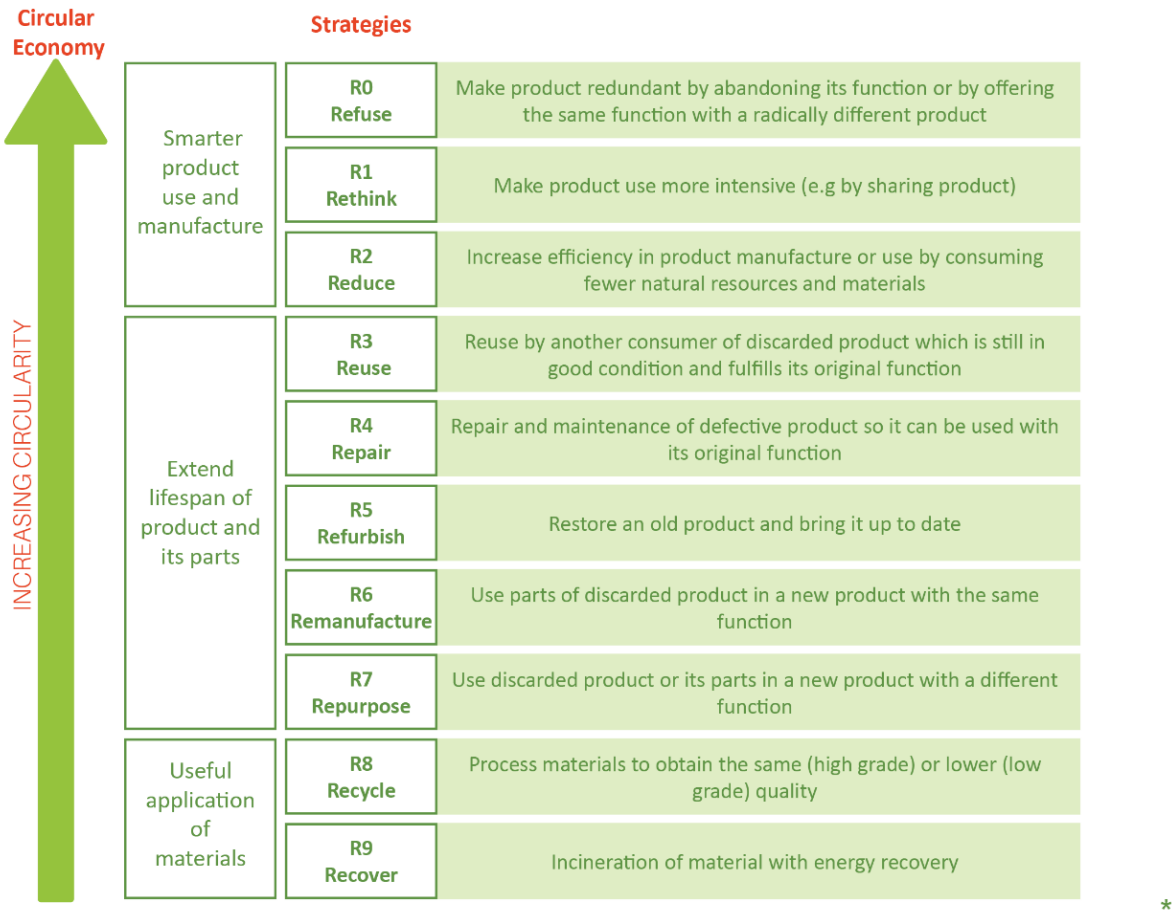

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Figure 3 - R-Ladder or R-strategies

4.2 Value Hill

The Value Hill model - developed by Sustainable Finance Lab, Circle Economy, Nuovalente, TUDelft, and Het Groene Brein (2016) - aims to illustrate the potential value that can be created through the effective management of resources and waste within a circular economy framework.

As presented in Figure 4 and adapted to the airport context, the Value Hill model highlights the importance of moving away from the traditional linear economy, where products are discarded after use, towards a circular economy where resources are kept in use for as long as possible. By capturing and maximising the value of materials throughout their lifecycle, the model encourages the reduction of waste, the conservation of resources, and the creation of economic opportunities.

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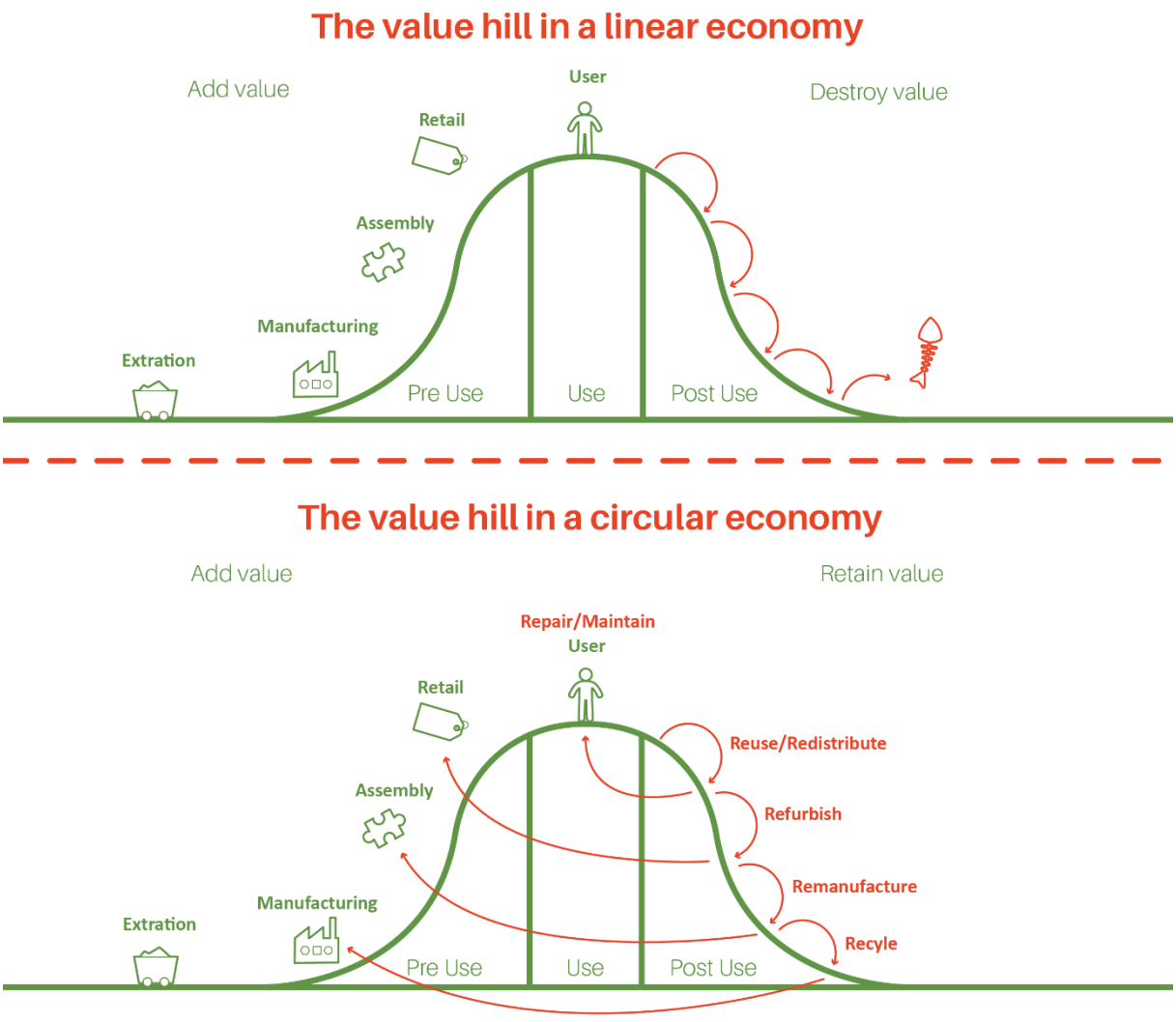

Figure 4 - Value Hill

4.3 Conceptual model

The R-Strategies and Value Hill were combined into one model to develop a strategy towards a circular economy in airports. Please refer to Figure 5 to observe the conceptual model used for creating the circularity performance measurement system.

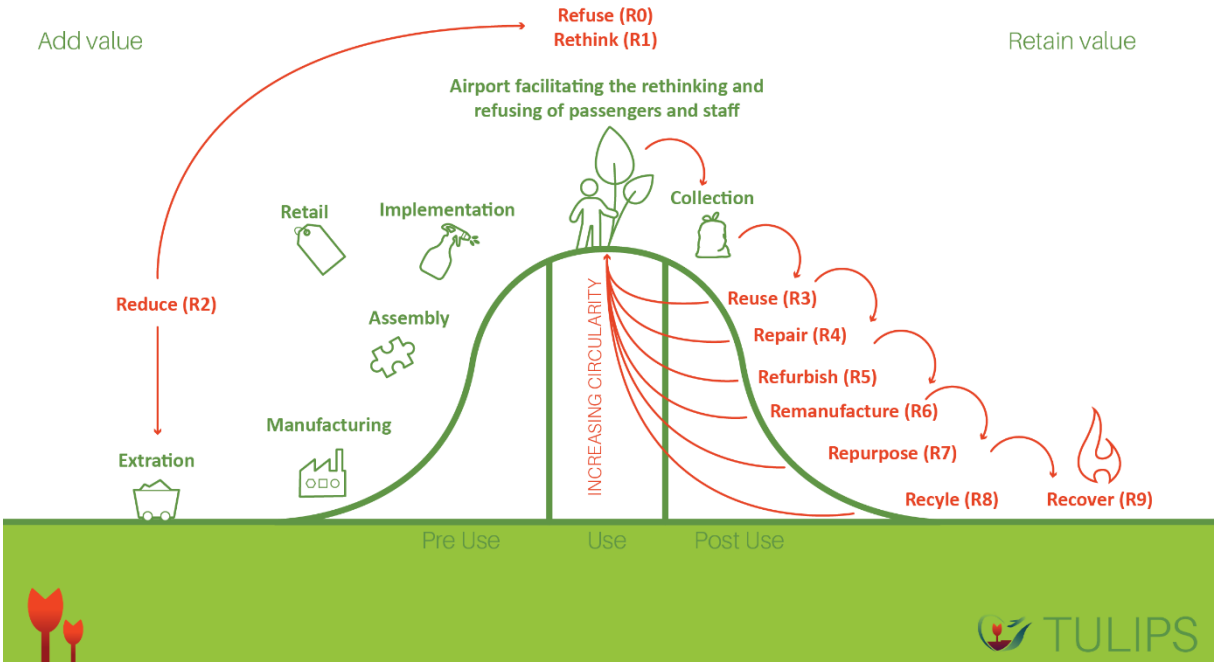

Figure 5 - Conceptual model performance measurement system

The rationale behind combining both models was to develop a coherent and practical framework to underpin the key performance indicators for the work package, as well as align with industry best practices and international standards. This alignment enhances consistency, comparability, and collaboration among airports and stakeholders, fostering a collective effort towards a circular economy in the aviation sector. Moreover, combining these models will ensure to bring the best of each together: The Value Hill model provides a holistic view of the entire lifecycle of materials and products, highlighting the different stages where value can be created. By integrating it with the R-Strategies model (prevention, smarter product use, extending product lifespan, and upcycling), airports can adopt a comprehensive approach that encompasses both the prevention of waste generation and the maximisation of value from existing waste streams. This combination allows for a more complete and effective circular economy strategy.

5 Setting horizons

To set ambitious yet achievable goals to significantly reduce the waste streams identified in the baseline measurement, it is crucial to implement performance measurement systems with different horizons. Horizons provide a structured way to categorise and track progress towards objectives set for different timeframes. The use of horizons as a strategic planning tool has been developed and employed by various organisations in the field of performance measurement and sustainability. This chapter elaborates on the horizons used in the circularity performance measurement system.

5.1 Horizon 1: Reducing waste in 2025

Reducing waste refers to the efforts and strategies aimed at minimising the amount of waste generated within a given timeframe. In the context of TULIPS objectives, a reduction of 20% (waste per passenger) is set for operational waste streams comparing year 2019 with 2024. Reducing waste within WP6 will be done according to three different strategies, in line with R-strategies (refer to Chapter 4.1):

- Prevention through smarter product use: This involves rethinking solutions, such as Light as a Service, using technologies to predict food consumption patterns and stop certain waste streams to even exist by moving away from paper tissues and installing hand dryers in toilets.
- Extending the lifespan of products/materials: The focus here is on reusing, repairing, and refurbishing products and materials already present in the airport environment. By ensuring their continued use, the need for new resources and waste generation is reduced.
- Upcycling: This strategy emphasises improved waste separation to increase recycling rates and move towards a scenario where only upcycling (rather than downcycling or incineration for energy) takes place. This shift promotes the reuse of materials in higher-value applications.

5.2 Horizon 2: Zero waste in 2030

Zero waste is an ambitious goal that envisions the elimination of waste sent to landfills or incineration (refer to R9 elaborated in chapter 5.1 R-strategies). It involves designing systems, processes, and products in a way that prevents waste generation or ensures that waste is recycled, composted, or recovered as valuable resources. The concept of zero waste encourages a holistic approach to resource management, focusing on waste prevention, reduction, and efficient material flows. Schiphol Airport sets similar targets of achieving zero waste in their Sustainability Roadmap 2030 (Schiphol Group, 2022) as well as Avinor in their annual report (Avinor, 2022). Note that the definition of what is considered ‘zero waste’ might change in different contexts.

5.3 Horizon 3: Circular Economy in 2050

The EU Circular Economy Action Plan, referring to as CEAP (European Commission, 2020) outlines a comprehensive strategy to accelerate the transition to a circular economy by 2050. CEAP’s aim is to create a system where resources are used efficiently, waste is minimised, and economic growth is decoupled from resource consumption and environmental degradation.

Refer to Figure 6 for a summary of the three horizons set. The urgency to move from reducing waste to achieving zero waste and, ultimately, establishing a circular economy is crucial. It requires collaborative efforts, policy support, innovation, and collective action across the supply chain to address environmental challenges, preserve resources, unlock economic opportunities, and create a more sustainable and resilient future for airports and all.

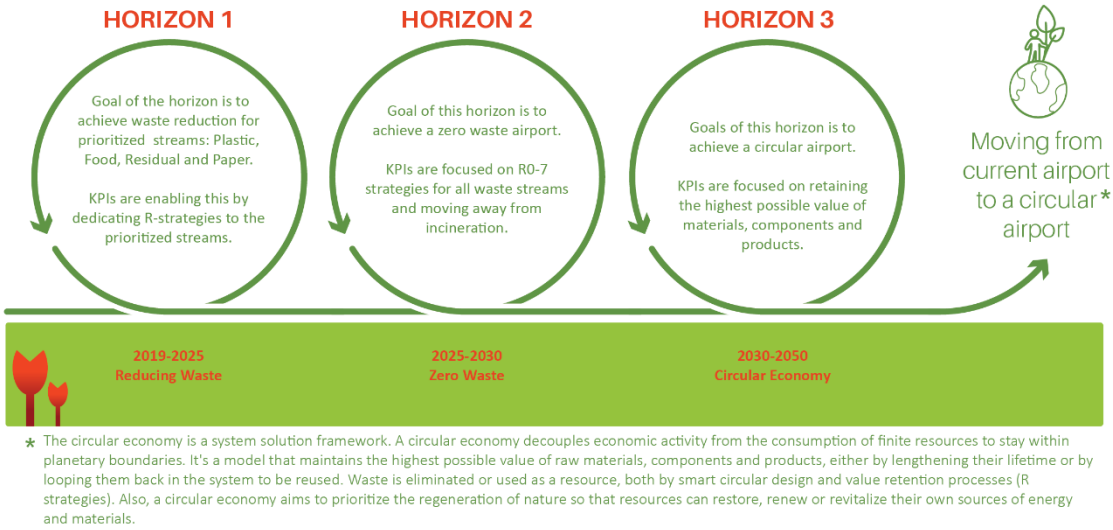

Figure 6 - Three horizons towards a circular economy for airports

5.4 Linking horizons and conceptual model

The three horizons of reducing waste, achieving zero waste, and transitioning to a circular economy (refer to Figure 6) are interconnected with the conceptual model based on the Value Hill and R-Strategies (refer to Figure 5).

Please refer to Figure 7 wherein is highlighted:

- In Horizon 1, the primary focus lies in moving up the R-ladder for prioritised operational waste streams (plastic, paper, food, and residuals). The goal is to pilot waste reduction strategies, including prevention, smarter product use, and extending the lifespan of materials within these operational streams.
- The focus of Horizon 2 expands beyond the prioritised operational waste streams mentioned in Horizon 1. Here, the emphasis shifts towards avoiding incineration, reducing downcycling, and moving up the R-ladder for all operational waste streams.
- The final Horizon 3 emphasises prevention as the primary focus, aiming to eliminate waste generation at its source. The goal is to design products, processes, and systems that are inherently circular and do not generate waste. If recycling becomes necessary, it is limited to upcycling, wherein waste materials are transformed into higher-value products or materials.

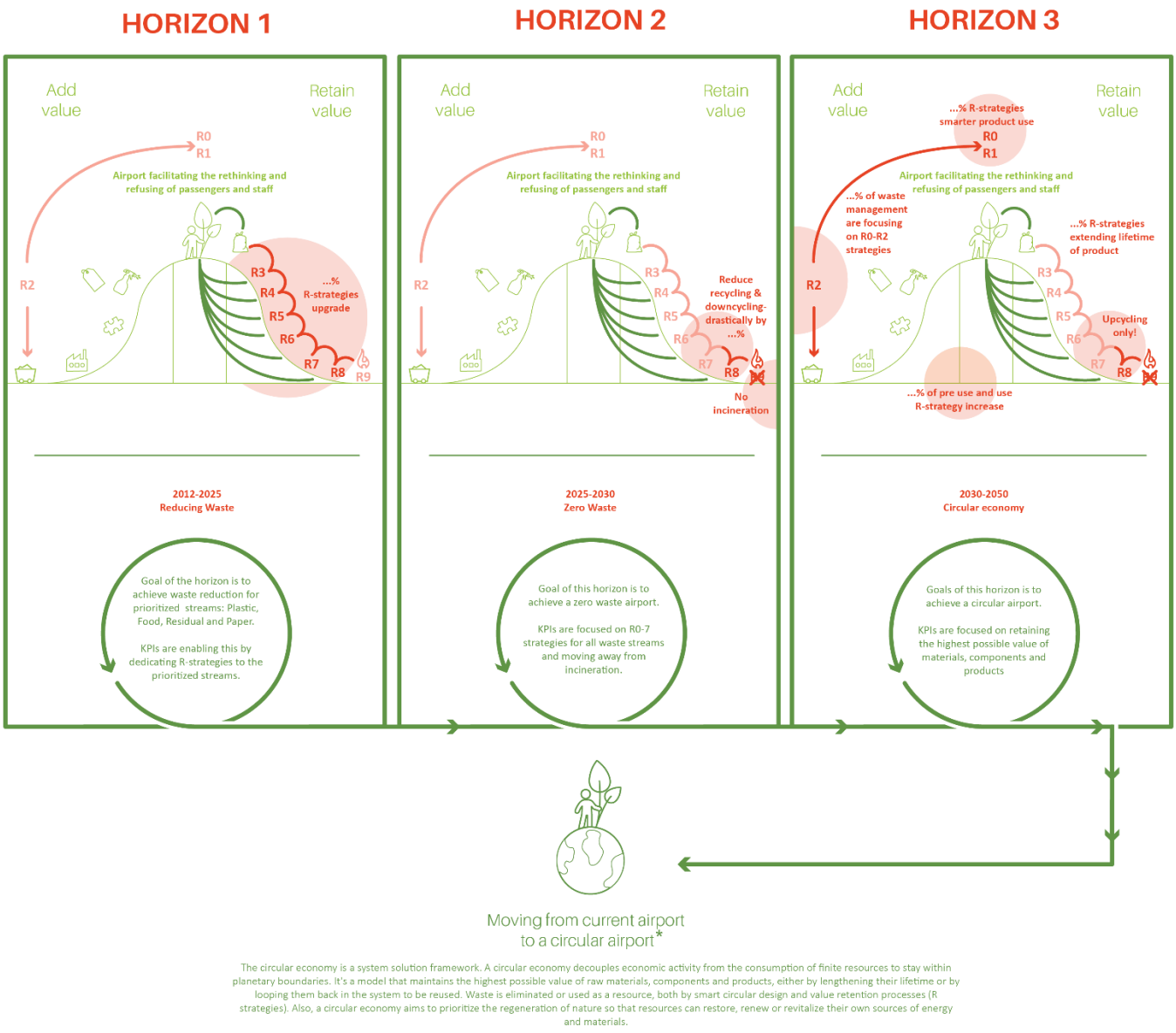

Figure 7 - Integration of horizons and conceptual framework

The integration of horizons (refer to Figure 6) and the conceptual model (refer to Figure 5) enables airports to progress systematically towards a circular economy by incorporating waste reduction strategies, value creation from waste, and long-term sustainability goals. It ensures a cohesive approach, guiding airports in their journey towards a more sustainable and circular future.

6 Select KPIs

This chapter delves into the key performance indicators (KPIs) established for Horizon 1 within the context of the conceptual model developed for the TULIPS project.

6.1 KPI Horizon 1

In the context of TULIPS objectives, a reduction of 20% (waste per passenger) is set for operational waste streams in 2025 (comparing year 2019 with 2024). Hence the following overarching KPI is set:

> *Reduce residuals produced per passenger by 20% - based on weight and on 2019 level, excl. CAT1, handled by contracted waste partner at airport.*

To ensure this KPI is translated into SMART targets, there are three strategies determined to target the prioritised four waste streams. (plastic, paper, food, and residuals). Overall, the proposed strategies align with the strategies applied in the R-model (Chapter 5.1):

- **Smarter product use and manufacture**: Of 20% waste reduction, 20% of prioritised streams* go through pre-use R0-2 strategy before ending up in R8.
- **Extend lifespan of product and its parts**: Of 20% waste reduction, 20% of prioritised streams* go through post-use R3-7 strategy at least once before ending in R8.
- **Useful application of materials:** Of 20% waste reduction, 60% of prioritised streams* go straight to R8-strategy.

Prioritised streams: Residual, plastic, food waste and paper. These streams flow out of the Circularity Baseline Assessment performed and published in April 2023 under the TULIPS flag (Cordis, 2023).*

Please note that these strategies guide the implementation of targeted strategies, encourage continuous improvement, and foster a culture of sustainability and circularity within the airport environment. Note that the participating airports have used the proposed framework but customised the proposed strategies and hence might use different strategies towards achieving the reduction of 20% (waste per passenger) comparing year 2019 with 2024.

6.2 KPI Horizon 2 and 3

While the other horizons are not the immediate focus for TULIPS, Horizon 1 holds significant importance as a crucial step towards achieving a circular economy in airports. There are no KPIs or strategies defined for Horizon 2 and 3 at this point in time as TULIPS primary focus lies in piloting new initiatives and scaling them up if proven successful. Consequently, initiatives that do not meet the desired outcomes or fail to demonstrate their viability during the pilot phase are excluded from Horizon 2 and 3. By maintaining a flexible approach, TULIPS WP6 can explore innovative ideas and ventures without being confined to rigid KPIs and strategies from the outset. This allows the airports to adapt swiftly to changing market dynamics, technological advancements, and emerging opportunities. The emphasis on piloting initiatives before integration into later horizons ensures a thorough assessment of each project's potential, mitigating the risks associated with allocating significant resources to unproven concepts.

7 Pilot KPIs and framework validation

This chapter focuses on the steps to take to pilot the KPI and proposed strategies and hence validate the performance measurement system. One significant aspect is the data collection and monitoring process required to pilot the strategies aimed at reducing waste within the TULIPS project.

7.1 Collaboration with stakeholders

As elaborated in D6.1 Airport Circularity Baseline Study (published April 2023), there are various activities to undertake with various key stakeholders in reducing waste. Some of these activities can be performing in the piloting phase of the KPI and strategies (starting in July 2023), such as:

- Providing incentives: This includes brainstorming on how to encourage stakeholders to reduce operational resource streams, such as discounts or rewards for returning used products or materials.
- Teaming up in pilots to improve: This includes the involvement of stakeholders in the design and implementation of circular initiatives to ensure that their needs and perspectives are taken into account. Pilots can be executed to test new circular initiatives and identify areas for improvement.
- Sharing data and experiences: This includes sharing data and experiences to learn from each other and monitor progress towards circularity.
- Facilitating communication: This includes the creation of platforms and channels for stakeholders to communicate with each other and with the airport organisation, to facilitate dialogue and collaboration.

7.2 Next steps in reducing operational resource streams

As elaborated in chapter 6, the strategies to reduce the prioritised operational waste streams are focused on prevention, extending lifetime and increasing recycling (and decreasing burning for energy).

So far, airports have identified several potential opportunities for reducing priority streams, for example (no exhaustive list):

- Circular decisions around choices of bins, material selection for the bags, and sensors for route optimisation.
- Closer collaboration toward achieving similar targets with key business partners.
- Reusing products such as furniture, electronics, and textiles.
- Increasing transparency of treatment waste streams with (new) waste management handlers.
- Exploring similar complex systems with partners in other complex systems environments, such as the NS Dutch railroad and municipalities in the surrounding areas, to increase understanding of successful nudging strategies. These conversations are made possible by the TULIPS External Advisory Board.

For the four priority streams, interventions and nudging strategies will be set-up that contribute to achieving the SMART strategies. Currently this list is co-created with the TULIPS airports and will be part of the second deliverable (published December 2023). Consequently selected interventions and nudging strategies will be piloted at participating airports to determine their effectiveness. For lighthouse Schiphol specifically, collaboration with the material flow management party takes place to pilot the interventions and nudging strategies. Key stakeholders, such as F&B partners and

waste management companies, will collaborate to execute pilots and share data to gain insights into waste management practices. Deliverable D6.3 Demo report for pilot in terminal, will include the design and testing of these nudging strategies in 2023 and 2024, with a summary report of the pilots delivered in 2025.

8 Conclusion

The TULIPS WP6 Circular Airports project aims to pilot initiatives that reduce operational resource streams by 20% in 2025 and maximise the use of secondary materials for constructional resource streams. The project also seeks to scale solutions and develop a circular economy roadmap for airports, guiding them in implementing circular economy practices and achieving sustainability goals. The overall objective is to contribute to a more sustainable aviation industry.

This report focused on the set-up of a circularity performance measurement system, which is the second deliverable of the TULIPS project. It specifically addresses operational resource streams prioritised by the airports (refer to deliverable 6.1 Circularity Baseline Assessment) which are residuals, plastic, paper, and food. The set-up of this monitoring framework for airports to transition towards circularity is a collaborative effort between TU Delft, Excess Material Exchange and is validated by three participating TULIPS airports (Schiphol Amsterdam Airport, Avinor Oslo Airport, and Hermes Larnaca Airport.

The report highlights the use of three horizons to guide the airports toward circularity: Reducing priority streams by 2025, achieving zero waste by 2030, and transitioning to a circular economy by 2050. These horizons align with TULIPS' focus on waste reduction, prevention, and designing circular products, processes, and systems. The circular performance measurement system was constructed by combining the R-Strategies and Value Hill models into a coherent framework. This integration aims to develop key performance indicators aligned with industry best practices and international standards.

The overarching KPI in the framework set is: Reduce residuals produced per passenger by 20% - based on weight and on 2019 level, excl. CAT1, handled by contracted waste partner at airport. The strategies employed to achieve this reduction encompass smarter product use and manufacture, extending the lifespan of products and their parts, and the useful application of materials. Note that customised strategies may be employed by participating airports based on their specific circumstances. While this report includes the model, key performance indicators, and strategies validated by TULIPS airports, the demonstration of these strategies will be part of a subsequent report to be published in December 2023. Overall, this report aims to promote knowledge exchange, scale best practices, and accelerate the transition towards a circular economy in the aviation industry.

Appendix A: LIST OF REFERENCES

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Appendix B: WP6 INVOLVED AIRPORTS AND PARTNERS

About Avinor

Avinor is a 100% state owned limited company under the Norwegian Ministry of Transport and Communications and is responsible for 43 airports. Avinor has taken a leading role in reducing greenhouse gas emissions from the aviation industry, including the development of electric aircraft and supplying sustainable aviation fuel (SAF). Avinor provides safe and efficient travels for around 50 million passengers annually, half of which travel to and from Oslo Airport. Avinor is financed via airport charges and commercial sales. The air navigation services are organised as subsidiary completely owned by Avinor. Avinor's headquarter is in Oslo.

About Excess Materials Exchange (EME)

Excess Materials Exchange is a software as a service (SaaS) platform that functions as a “dating site" for secondary materials and waste. With that, the platform unlocks the maximum potential of the world’s excess materials and products by matching them to their highest value uses. EMEs approach is to provide an identity to materials and (waste) products, add intelligence to them by using Collective Intelligence and use an integral approach by identifying high-value reuse opportunities across sectors.

The vision of EME is to create a world without waste by reinstating waste or the valuable resource that it is. Their mission is to fundamentally change the waste game - by introducing innovative ways of doing business that become the industry standard on how to deal with excess materials. That way, they will speed-up the world’s transition to a circular economy and create a clean planet for everyone.

EME is contributing to the Project by demonstrating the use of their platform in the airport environment, mapping waste streams and excess building materials/components through their resources passports approach, quantifying the environmental impact of materials flowing through the airports part of this consortium and demonstrating how tracking and trace technologies can be applied in an airport environment.

About Hermes Airports Ltd

Hermes Airports, a Cyprus registered company comprises an international consortium of 9 shareholders, representing a mix of Cypriot and international partners. Hermes Airports operates the two international airports of Cyprus in Larnaka and Pafos, since 12th May 2006 under a BOT agreement with the Government of Cyprus. The fellow airport Larnaka is located on the south east coast of the island and it is built on a total area of 603 hectares. Since January 2010, the airport has served more than 69 million passengers reaching a record high of 8m total passengers in 2019 and has an annual contribution of around 3% on the island’s GDP. Hermes airports is serving the needs of a primarily leisure destination and as such is committed to improve the island’s connectivity to maintain high levels of passenger experience and to support the creation of touristic demand for Cyprus.

About Royal Schiphol Group

Connecting your world embodies the 'Why' of Royal Schiphol Group. Amsterdam Airport Schiphol is one of the world’s best-connected airports, offering direct links to 296 international destinations. This reach is expanded by our regional airports. In a world where demand for connectivity continues to grow, we want to ensure air travel develops responsibly by balancing the needs of air passengers and cargo with those of society at large. Our ambition is to operate the world's most #sustainable, high-quality airports. We want our airports to be zero-emission and zero-waste by 2030 on route to becoming energy-positive and circular in the long run. We're taking steps, being already CO2-

neutral when it comes to our own activities since 2012. All the while, we will continue to play a leadership role in making the aviation sector more sustainable to achieve net-zero emission aviation by 2050. To achieve this, collaboration is key. That's why we're proud to lead the TULIPS consortium.

About TUD

Delft University of Technology, founded in 1842, is one of the world's top Universities of Technology with excellent international rankings. The University has 25.000 students, 5.000 staff members and 8 Faculties: Mechanical, Maritime and Materials Engineering; Architecture and the Built Environment; Civil Engineering and Geosciences; Electrical Engineering, Mathematics and Computer Science; Industrial Design Engineering; Aerospace Engineering; Technology, Policy and Management; Applied Sciences. TU Delft offers 16 Bachelor's programs and 35 English taught Master's programs in science, engineering and design, but you can also work on your doctorate there. Delft University of Technology is the oldest and largest Dutch public technical university. TU Delft works together with many other educational and research institutions at home and abroad. The main tasks include providing scientific education, conducting scientific research, transferring knowledge to society and promoting social responsibility. The university has been designated as a 'public benefit institution'. Besides, TU Delft offers one of the largest university campuses in the world, stretching over 161 hectares, with a library, an aula and a cultural and sports centre. Additionally, three museums are associated with the university and they operate a botanical garden.