Pioneering Circularity in Airport Operations: Schiphol's Path to Zero-Waste

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Introduction

At Royal Schiphol Group (Schiphol)[1] waste is no longer viewed as an inevitable by-product of air travel. Instead, it is treated as a valuable resource, meticulously monitored and managed. Schiphol has set ambitious goals to operate zero-waste airports by 2030 and achieve full circularity by 2050. These objectives are part of the Quality of Life pillar, under the circular economy chapter (Figure 1).

This is not a vision born of marketing, but one rooted in practice. Schiphol's practical approach acknowledges the substantial material resources and CO_2 emissions involved in managing high passenger volumes, and since 2016, has actively implemented circularity principles like avoidance, reuse, upcycling, and closed-loop systems across its operations. These actions signal a shift from the traditional linear approach to materials and towards a more regenerative model.

One such initiative is the 2024 food and beverage covenant, a collaborative effort with Amsterdam Airport Schiphol's concessionaires aimed at reducing environmental impact both at the front-end and back-end of operations. By promoting plant-based offerings, cutting back on single-use plastics, and reducing packaging and waste, the airport is making strides to influence consumption patterns in a practical and measurable way. While the effects are visible at Schiphol, the hope is that similar practices may inspire broader changes across the sector.

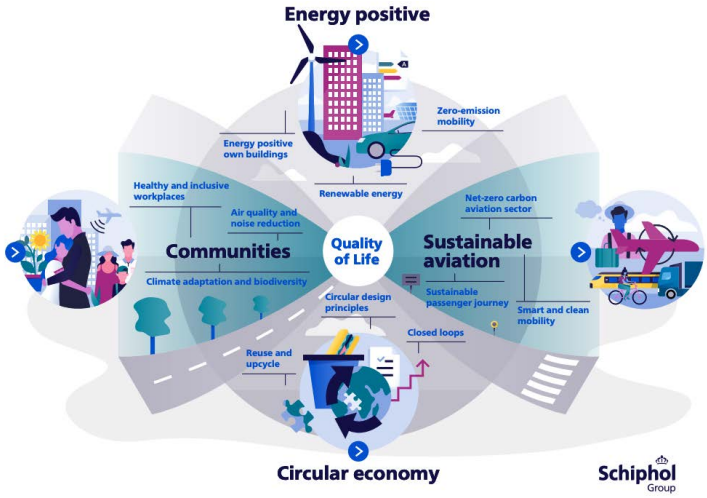

FIGURE 1: Circular Economy is one of topics in the Quality of Life pillar of Schiphol.

Schiphol's circular strategy is driven not only by environmental responsibility but also by necessity. Resource scarcity, rising material costs, and shifting public expectations are reshaping how infrastructure organisations operate. Airports, with their complex supply chains and large ecological footprints, have a unique opportunity—and responsibility—to lead by example.

Transforming Waste Management Methods

Through the EU-funded TULIPS programme, Schiphol is working to rethink how waste is generated and processed at large airports. The Circular Airports Work Package within this programme focuses on turning waste into

1 Royal Schiphol Group is the owner and operator of Amsterdam Airport Schiphol, Rotterdam The Hague Airport and Lelystad Airport, and holds a majority stake in Eindhoven Airport. For the sake of clarity, Royal Schiphol Group will hereafter be referred to as 'Schiphol'.

value, and Schiphol has joined forces with Excess Materials Exchange and Delft University of Technology to develop tools and methodologies that support this goal. The Baseline Circular Airports Method (BCAM) is one such tool[2]. By mapping material flows within airport operations, BCAM helps identify the sources, treatment pathways, and environmental impacts of waste streams. It revealed that five key streams—residual waste, plastics, swill, paper/cardboard, and cabin waste (Category 1) —dominate the Amsterdam Airport's operational profile.

Importantly, the method distinguishes between mass and impact. For instance, while residuals and plastics represent a large share by weight, cabin waste (Category 1) and plastics are far more significant in terms of CO_2 emissions. Additionally, the eco-cost, which quantifies the monetary value of the environmental impact, offers a comprehensive overview of the streams (Figure 2).

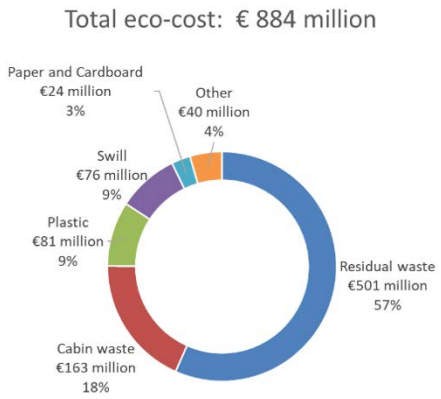

FIGURE 2: Eco-cost (LCA C3 & C4) of the operational waste at Amsterdam Airport area, 2019.

Insights like these have helped Schiphol prioritise its efforts more effectively. For instance, they have triggered actions such as redesigning waste bins to improve separation, piloting alternative treatment pathways for high-impact materials, and exploring waste-to-resource innovations.

These initiatives are part of Schiphol's shift from reactive to proactive waste management, shaped by the availability of better data. BCAM has also proved to be a valuable tool for stakeholder engagement. By translating waste flows into tangible data, Schiphol can involve partners more effectively in decision-making. This transparency has strengthened relationships with tenants, vendors, and regulators, and helped build shared ownership of sustainability goals.

Material Flow Management: Terminals, Airlines and Offices

As part of its broader transition, Schiphol launched the Material Flow Management programme in 2023 to execute its zero-waste strategy. The goal is to view waste as valuable materials, reduce consumption, and maintain or enhance their value in subsequent applications, all while minimizing environmental impact. This approach effectively puts circularity principles into practice. To support this initiative, a data-driven approach is being followed, with targets set and a monitoring system in place to guide actions.

The terminal —where around 70% of all operational waste is generated—is a priority area. (Figure 3). Schiphol has set clear performance targets for 2030, including keeping waste below 170 grams per passenger, and achieving an on-site separation rate of 65%.

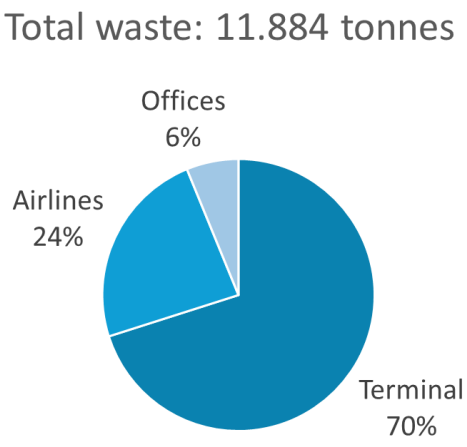

FIGURE 3: Distribution by workstream of the operational waste at Amsterdam Airport area, 2024.

2 For more information see *van der Tuin-Rademaker, A., Tschavgova, E., van Maaren, C., Solis, S., Campisano, S., & van Dam, S. (2024). Transforming waste management methods: a Dutch Airport's journey toward a circular economy through baseline measurements and strategic priority setting. Frontiers in Sustainability, 5, 1356041.*

Meeting these targets is not only about infrastructure, but also about behaviour. Enhanced bin signage, staff and vendor engagement, and pilot programmes for reusable products systems are all contributing to improvements. It's a process of learning and iteration, with results emerging gradually. These changes are already bearing fruit. In 2024, Amsterdam Airport recorded a 7.5% reduction in total waste compared to the previous year. At the same time, passenger numbers increased—demonstrating that growth and sustainability can be balanced when materials and waste systems are carefully managed.

Airline operations are also being re-examined. This workstream is responsible for 24% of the waste, as shown in Figure 3. Managing cabin waste that is classified as Category 1 remains a significant challenge due to the EU regulation 1069/2009. In response, Amsterdam Airport Schiphol is post-separating the recyclable cabin waste of several airlines. In addition, we are testing a per-flight waste tracking system to differentiate EU from non-EU flights and explore the potential for more nuanced sorting. Data from these initiatives may also inform future policy discussions. By demonstrating where and how residuals can be safely diverted from incineration or landfill, Schiphol hopes to contribute evidence-based insights that support gradual regulatory adaptation.

In addition to the terminal and the airlines, office environments are being brought into the strategy. We have begun benchmarking waste performance across Schiphol's administrative and tenant spaces. This work is supported by revised cleaning contracts, employee training, and new signage systems that reinforce circular practices.

Digital Tools for Circular Progress

A key enabler of progress has been the Amsterdam Airport Schiphol Operational Residual Stream Dashboard for zero-waste —a platform that provides transparency across the waste streams. From collection to end-of-life treatment, data is tracked and analysed to inform decisions and interventions. Each collection point in the Amsterdam Airport Schiphol area is equipped with tracking tools, enabling reporting on waste weight, type, and sources. This data is systematically collected and verified, and it is presented in a useful visualization to guide progress towards zero-waste goals. Figure 4 highlights the sections of this dashboard.

FIGURE 4: Sections of the Zero-Waste Operational Residual Stream Dashboard.

The insights extracted from this information allow operational and sustainability teams to respond to underperformance—whether it is a significant increase in a waste stream, a low separation rate, or higher CO_2-equivalent levels for end-of-life transport and treatment.

This visibility has turned insights into actions. When data revealed high quantities of a specific waste stream, Schiphol conducted targeted waste audits. We found that 45% to 55% of residual waste from passenger areas could have been recycled. Additionally, we identified recurring items in the residual waste (Figure 5).

FIGURE 5: Recurring items in the residual waste.

These insights are shared with business partners to adjust procurement practices and reduce certain streams or products. Additionally, intervention strategies, such as testing different signs or smart garbage bins in the terminal, are implemented to increase the separation rate. By providing transparent performance data, the dashboard fosters engagement and accountability.

This collaborative approach aligns everyone towards zero-waste goals, driving continuous improvement and innovation in circularity practices.

Lessons and Reflections

Schiphol's ongoing efforts offer practical reflections for other airports exploring similar goals. First, collaboration is essential. Meaningful progress requires cooperation across different stakeholder groups—from retailers to cleaning services to airline partners.

Second, data must underpin decision-making. The shift to digital monitoring has helped Schiphol evolve from intuition-based planning to performance-based management. While this system is still evolving, it's already proving valuable.

Third, policy remains a critical factor. Challenges around international catering waste (Category 1) cannot be resolved at an airport level alone. Schiphol is engaging with aviation stakeholders and EU policymakers, using data from its pilots to advocate for regulatory flexibility that supports circularity.

Fourth, innovation is best approached incrementally. Pilots in smart waste sorting, reusable systems, and per-flight data capture have allowed Schiphol to test ideas, refine processes, and scale what works.

Finally, circularity is about system thinking. It's not simply about cutting waste, but about rethinking how materials are used, recovered, and valued. The benefits are multiple—reduced emissions, lower costs, and greater resilience in the face of resource constraints.

Looking ahead, Schiphol remains committed to improving and expanding its approach. We continue to engage with peer airport operators and sustainability experts to exchange knowledge and improve practices. While much progress has been made, the path to full circularity is one of continuous refinement.

Schiphol is proud to lead the way in the circular economy by sharing its findings and learning from others. As a pioneer and innovator in sustainable practices, Schiphol is committed to driving a broader shift in how the aviation industry manages its environmental responsibilities. Embracing circularity as a shared journey, Schiphol is dedicated to making a significant and positive impact.