Beyond Waste

A circular economy blueprint for airports

May 2025

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Executive summary

The aviation sector stands at a critical intersection of growth and sustainability, with airports playing a pivotal role in reshaping how resources are managed. Beyond Waste — A circular economy blueprint for airports presents a comprehensive circular economy blueprint tailored to the unique operational, infrastructural, and stakeholder complexities of airports.

Produced by Excess Materials Exchange [EME], this white paper explores how airports can move beyond traditional asset and waste management to proactive, value-retaining circular strategies that prevent waste at its source. Building on EME's work as the Circular Airports Work Package lead for the EU-funded TULIPS project, this white paper provides actionable guidance to help airports transition from linear to circular material flows.

The blueprint is underpinned by real-world initiatives, case examples and practical tools, including digital platforms for material tracking and operational materials' management templates developed through collaboration with the TULIPS project. These tools empower airport stakeholders—from airlines to retailers—to embrace circular solutions through transparency and data-driven decision-making.

With illustrative examples and strategic recommendations, the paper provides a path forward for airports aiming to align operational excellence with sustainability goals. It ultimately makes the case that the real opportunity lies not just in managing waste more effectively, but in preventing it altogether.

Introduction

Why airports must lead on circularity

Airports are pivotal infrastructure assets undergoing rapid expansion to meet escalating global air travel demands. The global airport construction market was valued at $1.3 trillion in 2023 and is projected to reach $1.8 trillion by 2030, growing at a CAGR of 4.4%[1]. This surge is driven by increasing global air traffic, advancements in construction technologies, and a heightened focus on sustainability and passenger experience.

Airports function as interconnected ecosystems involving airlines, retailers, contractors, and service providers. Collaborative efforts towards sustainability goals, such as net-zero emissions and zero waste, can enhance environmental outcomes, operational resilience, and economic viability.

In this context, adopting Circular Economy [CE] principles becomes essential—not merely for waste management but for proactive resource stewardship. By prioritising efficient design and procurement practices, airports can minimise material use, extend product life cycles, and facilitate future reuse or high-quality recycling.

While waste management remains important, viewing waste as a potential resource is crucial. Implementing digital platforms and material tracking systems can enable the traceability and reuse of building components, furnishings, and equipment. For instance, reusing construction materials not only reduces landfill dependency but also delivers substantial carbon savings.

By embedding circular principles into infrastructure planning, material procurement, and stakeholder partnerships, airports can position themselves as leaders in sustainability, balancing regulatory compliance, climate goals, and infrastructure demands in an era of intensifying resource constraints.

4.4%

Growth rate [CAGR] of global airport construction market

$1.3tn

Size of global airport construction market in 2023

$1.8tn

Projected value of global airport construction market in 2030

Airport sustainability commitments and global regulatory landscape

Taking action

In response to the growing urgency of climate change, resource scarcity, and regulatory pressures, **airports around the world** are embracing **sustainability** as a ***core strategic priority***.

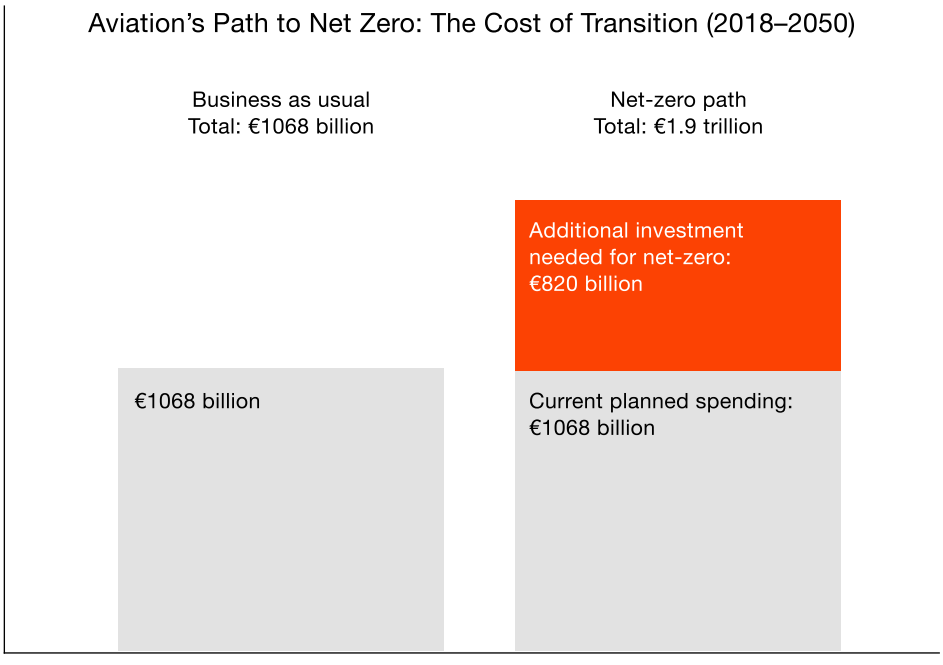
A significant number of airports—ranging from major international hubs to regional terminals—have committed to ambitious environmental goals. These commitments extend beyond carbon reduction to encompass broad circular economy principles and zero-waste targets, fundamentally reshaping how airports operate, procure, and interact with stakeholders.

A growing coalition of airports, under frameworks such as the Airports Council International [ACI] Net Zero 2050 pledge, are aligning with science-based climate targets to reduce emissions across Scope 1, 2, and, increasingly, Scope 3 activities[2]. The actions for making this target a reality need to happen now.

Key initiatives

- Electrification of ground support equipment and shuttle fleets.
- Deployment of renewable energy systems, such as solar photovoltaic arrays and geothermal heating.
- Energy-efficient building retrofits and LEED-certified terminal design.
- Sustainable aviation fuel [SAF] partnerships and infrastructure investments.

Close to 100 airports are setting a target of reaching net zero by 2030 or even earlier[6].



The business as usual expenditures between 2018 and 2050 are estimated to be €1068 billion. Accordingly, the aviation sector's total expenditures towards net zero will be just under €1.9 trillion – €1068 billion of BAU expenditures + €820 billion of premium expenditures.

Large airports such Heathrow airport and Schiphol airport are taking significant steps towards sustainability and circularity through various initiatives.

Examples of leadership

Heathrow Airport
Targeting net-zero carbon by 2050, with initiatives spanning low-carbon construction and SAF integration.

Amsterdam Schiphol Airport
Aiming for zero-emission airport operations by 2030.

San Diego International Airport
Recognised for its LEED Platinum-certified terminal and energy-efficient infrastructure.

Gatwick Airport
Adopting a Circular Economy approach, focusing on reducing, reusing, and recycling materials to minimise waste.

Regulatory landscape pushing net-zero airports

Regulation or framework	Scope and jurisdiction	Objectives related to airports	Implications for airports
Paris agreement	Global – UNFCCC signatories	Global push for decarbonisation: nationally determined contributions (NDCs) include transport	Indirect pressure on airports through national strategies targeting emissions reductions
European green deal	EU	Climate neutrality by 2050: deep integration of sustainability in planning	Drives investments in sustainable infrastructure, mobility electrification, public transit, and carbon management
EU sustainable and smart mobility strategy	EU – part of green deal	90% reduction transport emissions by 2050: "zero-emission airports" by mid-century	Airports must modernise infrastructure, improve energy efficiency, and promote low-emission transport connections
EU "Fit for 55" package	EU	55% reduction in GHG emissions by 2030 across all sectors	Proposals targeting aviation sector emissions influence how airports operate and support airlines
ReFuelEU aviation regulation	EU	Mandates increasing use of sustainable aviation fuels (SAFs): 2% by 2025, 6% by 2030, up to 70% by 2050	Airports must upgrade fuel infrastructure to accommodate SAFs and collaborate with airlines to meet targets
EU circular economy action plan & waste directives	EU	Waste reduction, resource efficiency, circular systems	Airports must improve waste management (segregation, recycling), adapt supply chains, and meet landfill diversion targets
EU waste framework directive	EU	55% recycling by 2025, 60% by 2030, 65% by 2035 – landfill minimisation	Requires advanced waste processing and tracking systems in airport operations
[CRSD] corporate sustainability reporting directive	EU	Standardised ESG disclosures for large companies, including transport infrastructure	Airports must report sustainability performance, embedding environmental metrics in corporate governance
[ESPR] ecodesign for sustainable products regulation	EU	Sustainability and circularity requirements for products sold in the EU	Affects procurement and vendor management practices at airports (e.g., furniture, electronics, uniforms)
Voluntary net-zero commitments (e.g., SFO 2030 Goal)	Global – self-imposed	Support for Paris agreement targets	Airports commit to net-zero by 2030/2050, often as part of sectoral alliances or local policy alignment

Circularity as an opportunity – why airports should act now

Embracing CE principles offers airports a wide range of benefits that go beyond environmental impact, creating value across operations, finance, and stakeholder engagement.

Cost savings through resource efficiency

One of the most immediate and tangible benefits of CE for airports lies in optimising resource use. By designing out waste and reusing old construction materials airports can significantly reduce procurement costs.
In addition, by enabling reuse, airports generate less waste, resulting in decreased waste handling and landfill costs.

CO2 savings from construction materials reuse

Reusing existing materials significantly reduces CO_2 emissions by avoiding the extraction, manufacturing, and transportation of new products. This is especially impactful in airports, where large volumes of construction and operational materials are regularly consumed due to frequent refittings. By keeping materials in circulation, airports can lower their embodied carbon footprint and contribute meaningfully to their net-zero goals.

Get ahead in compliance

Airports that get ahead of tightening EU and international waste directives, landfill reduction targets and Net Zero [Scope 3] aims by integrating circularity early can turn compliance into a competitive edge and avoid costly penalties.

Cutting delivery times

By reusing materials already available on-site, airports can avoid long delivery times and disruptions linked to global supply chains. This not only accelerates project timelines but also supports circular procurement practices by keeping materials in use longer. Sourcing from existing assets reduces dependency on new materials, cuts emissions from transportation, and offers greater control over availability and quality.

Access to finance, incentives and certifications

Adopting circular strategies can help airports secure green financing and qualify for sustainability-linked incentives. Achieving certifications like LEED boosts credibility by showcasing efficient resource use, waste reduction, and low-impact design—core aspects of circular economy.

Potential for collaboration

Circularity in aviation also opens doors to collaboration with broader industrial ecosystems. Airports can act as catalysts for local circular initiatives—for example, by facilitating the production and distribution of SAFs from airport waste sources.

From waste to resource: airport waste management

Airports generate two broad categories of waste:

operational waste from routine activities, and construction and demolition waste from infrastructure projects. While both contribute to an airport's environmental footprint, they differ in their sources, composition, and management approaches.

Operational waste

Operational waste is the refuse produced by ***day-to-day* airport functions** – essentially, the trash generated by passengers, airlines, tenants, and employees during normal operations. This includes materials collected in terminals, offices, aircraft cabins, and other facilities.

Major sub-streams of operational waste include catering waste [food waste and disposables from airport restaurants and in-flight services], paper products [newspapers, office paper, boarding passes], plastics [bottles, packaging, bags], metal and glass containers, and "residual waste" [mixed garbage that isn't sorted for recycling][3].

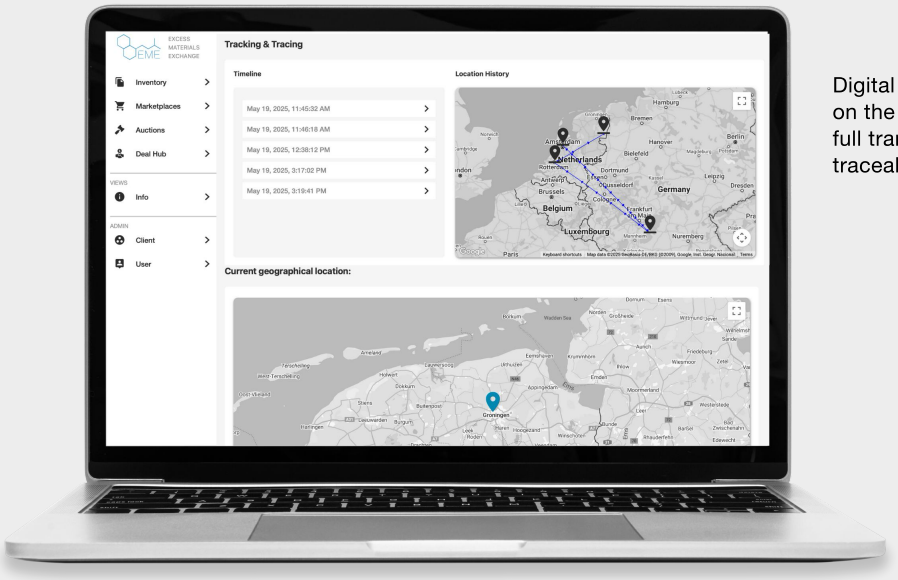
A special subset is International Catering Waste (ICW) which is often classified as Category 1 regulated waste in regions like the EU and must be incinerated or sterilised by law for biosecurity reasons. Such regulations make international food waste a high-impact stream to manage, as it can't be easily recycled or composted.

Construction and demolition waste

Airports periodically generate **large quantities** of **construction** and **demolition waste** whenever facilities are built, expanded, renovated, or demolished. This waste tends to occur in big pulses tied to project timelines rather than steadily year-round.

Construction and demolition waste arises from projects like building new terminals, extending runways, or upgrading infrastructure, and it includes materials such as excavated soils, concrete rubble, asphalt from runways, metals (steel beams, rebar), wood, drywall, glass, bricks, roofing material, piping, and insulation4.

Unlike the mixed nature of operational waste, construction and demolition waste is often bulkier and more homogeneous by material type.



Digital Product Passports on the EME platform ensure full transparency and traceability of all materials.

From waste to resource thinking

Traditionally, airport operational and construction material streams have been managed through a waste-centric lens, focused on collection, disposal, and regulatory compliance. However, leading airports are now shifting toward a ***resource-oriented mindset***, recognising **waste streams** as **reservoirs of untapped value**.

This transition from linear waste management to circular resource stewardship is foundational to implementing circular economy principles. It reframes waste not as an inevitable byproduct, but as a potential input for new processes, products, or services.

Whether through reuse, refurbishment, recycling, or bio-based valorisation, airports are increasingly designing systems to **capture**, **trace**, and ***reintegrate*** **materials** across their **value chains**.

Examples in practice include the repurposing of terminal furnishings during renovations, the reuse of construction materials guided by digital material passports, and the implementation of closed-loop systems for food waste and packaging within terminal concessions.

Material reuse in airport infrastructure presents a powerful opportunity to reduce embedded carbon emissions at scale.

If just 5% of the materials use at an airport terminal of 100,000 m², the climate benefits and financial savings would be substantial.

Airport terminal
of 100,000 m²

5% reuse
= 5,000 m2 worth of materials reused

Assuming renovation cost of €1000/m2

Assuming 500kg embedded CO_2 per m² and 75% carbon savings through reuse

€5 million
savings

2,375 tonnes
CO_2e saved

Going beyond recycling

In the journey toward circularity, recycling alone is no longer sufficient. While it remains a valuable component in waste management strategies, recycling often signifies the last stop before materials lose much of their original value, utility, and quality.

In complex environments such as airports—where diverse materials, products, and waste streams converge—circular ambitions must aim higher. This means prioritising value retention strategies that intervene earlier in the lifecycle of products and materials.

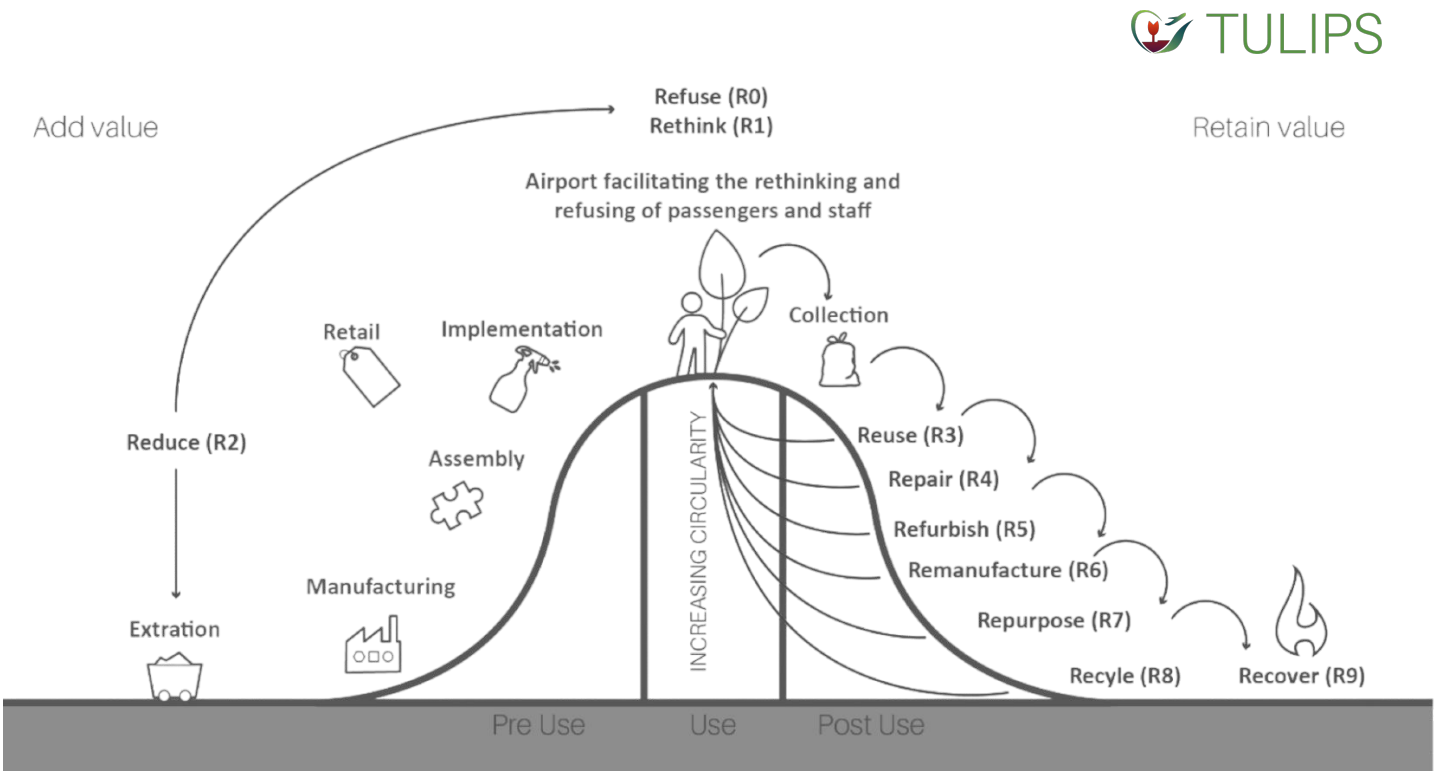
The R-Ladder framework offers a structured approach to this shift, ranking circular actions from the most to least impactful: from Refuse (R0) and Rethink (R1) at the top, to Recycle (R8) and Recover (R9) at the bottom. Strategies like Reduce (R2), Reuse (R3), Repair (R4), Refurbish (R5), and Remanufacture (R6) help extend the life of products and preserve embedded value, reducing the need for virgin material extraction and energy-intensive processing.

These strategies become even more powerful when mapped onto the Value Hill model, which illustrates how value is created, maintained, and lost throughout a product's lifecycle.

On the uphill climb, value is added through processes like manufacturing, assembly, and distribution. At the peak, during the use phase, products deliver their intended function. Without intervention, products slide down the right side of the hill into value loss.

However, by implementing circular strategies—especially those higher on the R-Ladder—airports can flatten the descent, looping materials back into the system before they become waste.

The real opportunity lies in preventing waste, not just managing it.



Implementing circular airports: step-by-step approach

1) Understand the baseline

Start by conducting a comprehensive analysis of the airport's current waste and material streams. This includes quantifying waste volumes, mapping the types of waste generated, and assessing existing handling, treatment, and disposal practices. For instance, Schiphol Airport developed the **Baseline Circular Airports Method [BCAM]**, which involves a detailed ***"Waste Safari"*** to gather data on waste composition, stakeholder responsibilities, and environmental impacts of various treatment pathways.

Such a baseline provides a starting point for strategic planning and allows airports to track progress toward circularity over time.

2) Prioritise high-impact streams

With baseline data in hand, the next step is to **identify** the **material categories** that **contribute most** significantly to **environmental impact** and **waste volume**. At Schiphol Airport — and similarly at Larnaca and Oslo airports through the EU TULIPS project — the BCAM analysis highlighted a consistent set of high-priority waste streams: residual municipal waste, Category 1 international catering waste, paper, food waste ("swill"), and plastics.

Additionally, construction materials represent a major concern due to their high levels of embodied carbon. When these materials are left unused or sent to landfill instead of being reused or repurposed, they lead to elevated Scope 3 carbon emissions. By focusing on these high-impact streams, airports can prioritise interventions where they will deliver the most significant reductions in waste and carbon output.

By zeroing in on such high-impact streams, airports can target interventions where they will yield the greatest benefits in waste reduction and carbon savings.

3) Implement circular solutions

Building on the baseline analysis and prioritisation of high-impact waste streams, airports should implement tangible actions across operations and infrastructure to move up the circular economy "R" hierarchy (Refuse, Reduce, Reuse, Recycle, Recover).

Digital product passports, **internal marketplaces** and **track & trace tools** enable the precise identification and monitoring of material streams—such as construction components, equipment, and furnishings—making it easier to reuse, repurpose, and reintegrate materials into projects. By implementing these solutions through pilot projects, airports can demonstrate circular value in practice.

4) Monitor progress and iterate

Establish **data-driven tracking** and **feedback loops** to ensure the circular initiatives are on course. Measurement and transparency are key.

Airports like Schiphol use live "waste dashboards" as a single source of truth for waste performance[5]. By continuously monitoring waste segregation rates, reuse quantities, and recycling outcomes, the airport can measure improvements and quickly spot issues (e.g. a spike in residual waste).

Regular reporting and **audits** should be implemented to verify compliance with circular practices. This ties in with emerging EU requirements such as the CSRD, which demand rigorous disclosure of environmental performance and resource usage. Aligning monitoring with such policies ensures that data on circular economy efforts (like waste reduction and reuse rates) is collected and reported transparently.

These feedback loops enable airports to refine their approach over time – scaling up successful initiatives, modifying those that underperform, and continuously engaging stakeholders with evidence of progress.

Case study 1:
Heijmans & Schiphol pilot project on material reuse using the EME platform

As part of the TULIPS Green Airports EU-funded project Work Package 6 [WP6], Schiphol Airport, in collaboration with its subcontractor Heijmans, piloted the Excess Materials Exchange [EME] platform to facilitate the reuse of construction materials on-site.

Each material deemed suitable for reuse was assigned a **Digital Product Passport [DPP]** on the EME platform, containing key details such as material specifications, condition, location, and reuse potential. In practice, a QR code was affixed to each item, allowing users to scan and access its digital profile, with editable fields for **real-time updates** and **location tracking**.

Uploading DPPs to the centralised marketplace on the EME platform showcased available materials in a clear and accessible way. This helped bridge the gap between demolition and design, enabling project teams to identify and consider reclaimed resources early in the planning process, fostering strong cross-disciplinary collaboration.

The platform's **track-and-trace functionality** (enabled through QR codes and geolocation updates) allowed for efficient material management reducing the risk of valuable components being lost, forgotten, or underutilised. This visibility empowered project teams to make data-driven decisions about reuse opportunities.

The improved traceability made Material Flow Analysis more accurate and efficient, strengthened Quality Assurance and Quality Control through better visibility, and enabled more precise environmental impact calculations by clarifying the provenance and movement of materials.

The pilot successfully enabled material reuse at Schiphol Airport, significantly advancing circularity at an airport setting and demonstrating the practical value of digital tools in supporting circular resource management.

250+

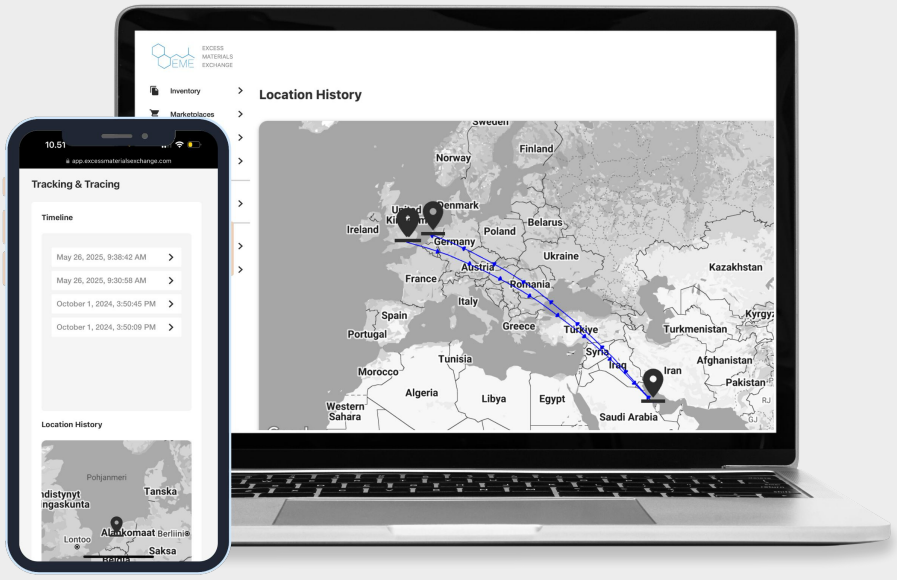
Materials reused

85%

CO_2 saved from item reuse

30%

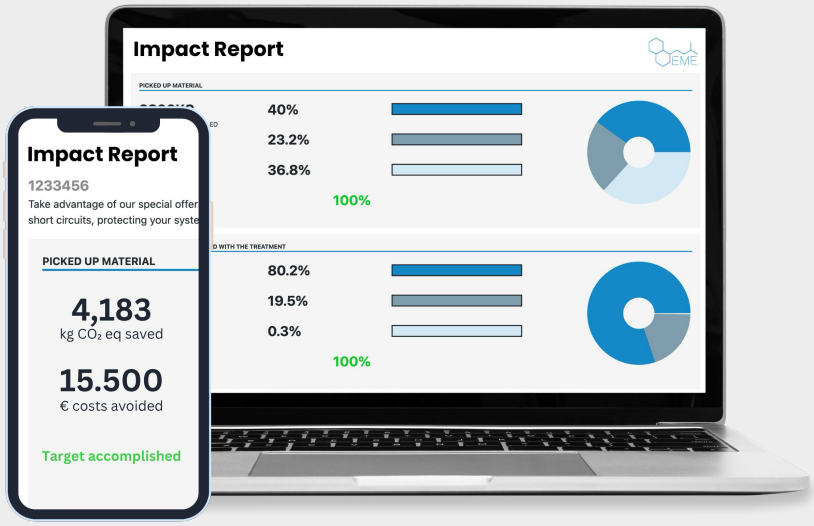
Lower inventory costs



Using the EME track & trace function, when a product, component, or material is tagged (e.g., with an RFID tag), each scan updates its recorded location. Scanning it again at a different point in the process provides a new location, effectively building a traceable movement history over time.

This simple mechanism can be applied not only to entire products, but also to individual components and even to raw materials (e.g., through tags on packaging). As a result, it becomes possible to reconstruct the path that materials have taken through the value chain.

Case study 2: Cyprus Larnaka airport & EME platform pilot for monitoring



As part of the EU-funded TULIPS Green Airports project WP 6, Cyprus Airport piloted the Excess Materials Exchange [EME] platform to support the reuse of construction materials and implement a system for monitoring sustainability performance.

Similar to the Schiphol Airport and Heijmans pilot, the initiative at Cyprus Larnaka Airport explored material reuse but also placed strong emphasis on monitoring the environmental and operational impact of circular practices.

At the pilot, old office construction materials sourced internally from airport demolition were reused in the construction of new office spaces at the airport.

By leveraging the EME platform's data-driven capabilities, Larnaka airport was able to **track key indicators** such as **material reuse rates**, **embodied carbon savings**, and **diversion from landfill**.

The integration of sustainability metrics into construction workflows marked an important step toward embedding circular economy principles into airport infrastructure planning and evaluation. However, monitoring through the EME platform also allowed for exploring the financial benefits of reuse.

In addition, the EME platform helped **streamline** the **safety and regulatory material inspections** by centralising material histories, certifications, and inspection records, reducing administrative work and speeding up compliance checks.

Retrofitting salvaged glazed sections into new office designs required flexibility and close collaboration between teams. The EME platform provided real-time access to material inventories and specifications, enabling faster design decisions and improving coordination between designers and project teams.

€15,700

Costs saved on sourcing

4.1t

CO_2e (tonnes) avoided through reuse

30+

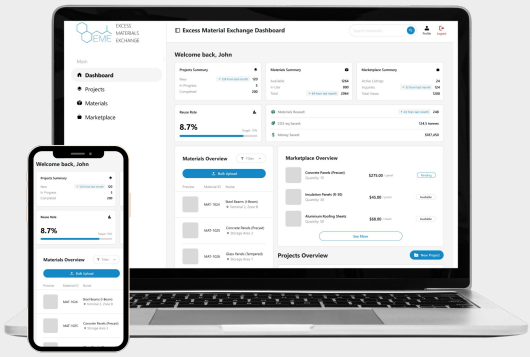
Materials reused

1.5t

CO_2 (tonnes) saved from item reuse

Recommendations

Click here to access TULIPS WP6 resources



Click here to access EME airports platform

Make use of scalable frameworks and toolkits

The methodologies proven in one airport can often be translated to the context of other airports. Open toolkits [such as the TULIPS templates] can help airports implement circular economy measures in a consistent, benchmarked way.

Stakeholder collaboration and shared incentives

Making circular economy a shared mission among all airport stakeholders is essential. This can be achieved by establishing joint working groups or committees that include airlines, concessionaires, ground handlers, waste contractors, and local authorities to co-design circular solutions.

Regular workshops and transparency about data can build trust. When stakeholders see their efforts [like better waste sorting or use of reusable materials] translated into measurable benefits, they are more likely to stay engaged.

Use digital tools for material management and reuse tracking

Airports can adopt digital platforms like the Excess Materials Exchange [EME] platform to support circular waste management strategies. EME enables digital product passports, internal and external marketplaces, and the track & trace of materials, bridging the gap between material flows from demolition and the procurement for new construction.

This approach enhances transparency, coordination, and resource efficiency, allowing procurement and planning teams to make informed, circular decisions. Data insights on material recovery and environmental impact [such as embodied carbon savings] also supports better sustainability monitoring and reporting.

Leverage funding and policy support

Airports should tap into different funding programs and initiatives to offset initial costs and de-risk innovation. In fact, many circular airport pilots [e.g. the TULIPS Green Airports project led by Schiphol] are co-funded by the EU, which has provided millions of euros to spur low-carbon and zero-waste technologies[5].

Aligning projects with broader EU Green Deal goals also ensures regulatory support and visibility.

Conclusion

By committing to goals such as zero waste by 2030 or full circularity by 2050, airports position themselves as leaders in climate action and resource stewardship – paving the way for a cleaner, more efficient, and future-ready aviation industry.

Become a circular leader

Adopting a circular economy approach in airport waste management offers a transformative and sustainable pathway that delivers environmental, economic, and social benefits. By shifting the perspective from waste disposal to resource recovery, airports can significantly reduce their environmental footprint, lower costs, and enhance resilience across both operational and construction activities.

The integration of circular strategies — from preventing and reusing waste to incorporating recycled materials and leveraging digital tools like the Excess Materials Exchange (EME) — empowers airports to design out waste, extend material life cycles, and embed sustainability into their core infrastructure and procurement processes.

Moreover, integrating initiatives such as Digital Product Passports (DPPs), material tracking platforms, and stakeholder collaboration demonstrate how innovation and cross-sector coordination can drive measurable impact. As demonstrated by pilots at Schiphol, Oslo, and Larnaca airports, circular economy principles are not only feasible but scalable across the aviation sector.

"I was intrigued to hear about the innovative approach being developed in the Netherlands by a company called the Excess Materials Exchange."

– HM King Charles

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