

# Circular Economy at Amsterdam Airport Schiphol

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## INTRODUCTION

Royal Schiphol Group (RSG) is a Dutch airport company with an important socioeconomic function. Airports in the Group create value for society and for the economy. Its mission is to connect the Netherlands to the rest of the world as effectively as possible. By doing so, RSG contributes to prosperity and well-being in the Netherlands and elsewhere. It facilitates leading-edge multi-modal connectivity for the benefit of national and regional development, trade, and well-being.

The RSG vision is to safely and seamlessly operate the world's most sustainable hub and regional airports.

Sustainability and safety are fundamental principles governing the actions and activities of all aviation and non-aviation activities across the Group. They are also key indicators against which the Group's success and performance are measured.

## OPERATOR OF THE MOST SUSTAINABLE AIRPORTS IN THE WORLD

Royal Schiphol Group aims to lead by example when it comes to sustainability in the aviation sector. The ambition of the Group is to operate the most sustainable airports in the world. It focuses on four key priorities:

1. Supporting communities
2. Sustainable aviation
3. Energy-positive
4. Circular economy

RSG cares for the well-being of people: its employees, neighbors, passengers, business partners, and future

generations. New and existing employees find it important that Royal Schiphol Group is socially responsible. By caring about its employees and surrounding communities, it attracts talented people who add value to the company and to society as a whole and value RSG as a responsible employer. The Group wants to contribute to healthy living and working environments, including to restoring nature. The goal is to go beyond 'zero' and create value, which can be given back to the environment and communities in the Netherlands.

## CIRCULAR ECONOMY

Our current world is based on the linear economy: natural resources are mined, produce goods, transport and use them and finally throw them away. By doing so, lots of valuable materials and natural resources are thrown away. At the same time, the rise in world population and the increase of prosperity levels will lead to a higher demand in natural resources. However, the natural resources that the earth can supply are limited.

Therefore humankind needs to shift from a linear economy to a circular economy. Once circular economy would have been achieved, it will be possible to preserve and increase natural resources and their derivative materials for future generations.

RSG is striving to be operating completely circular airports by 2050. The first milestone in reaching this ambition is to operate zero-waste airports by 2030. Zero waste means that all raw materials, components, and products used by Royal Schiphol Group will be reused or recycled to the highest degree possible according the waste hierarchy. This will be achieved preferably at RSG's own locations or as close to those airports as possible. The consequence of this vision is that what has been traditionally treated as

waste will now be regarded as “residuals” of the operation of value, rather than as useless waste.

A target of 2030 may seem like the distant future, but RSG assets have long life cycles, and that is why the Group has already spent a number of years working toward achieving its ambition for 2030. In fact, the first zero-waste plan was launched in 2015.

RSG has embraced the circular economy concept both in thinking and acting because it offers significant advantages including: it reduces negative environmental impacts, it creates opportunities for new business models, and it decouples the need for natural resources and materials from economic growth, which in turn leads to more stable commodity prices. As detailed in the next paragraph, the application of RSG’s zero waste guiding principles to improving its fixed assets results in various benefits such as: increased speed and flexibility during the construction phase, improved cost control during the facility life cycle, and improved indoor quality of life.

## DESIGN

Royal Schiphol Group has developed zero-waste principles, and is gaining experience in applying them to the design and construction of new buildings and the renovation of existing assets. The lifetime of an asset determines the amount of maintenance and renovation needed. RSG wants to achieve the maximum output from its resources by allowing them to “circulate” for as long as possible. Durability is also an important aspect regarding embodied carbon is the carbon footprint of a material. It considers how many greenhouse gasses are released throughout the supply chain (mine – produce – transport – use – waste). The design and construction of assets are key elements in achieving the zero-waste goal.

The Group has learned from experience that it is important to think through the design of an asset from the very beginning in a different way than previously. From the outset, project goals and major requirements should already include circular economy principles. Designing an asset first and then trying to add on circular economy principles later does not work. One has to think several steps ahead about such issues as: what will be the

estimated lifespan of the asset, and will it be disassembled after use; and what could be the eventual new purpose for the materials. This last reflection on future use will stimulate the designer to use standard sizes and to rethink the way components are assembled, for instance by using screws instead of glue, so the chance that components will be reused again will increase. The design must also take into account processes and procedures such as future maintenance impacts.

## REUSE AND RECYCLING

Apart from construction and renovation of fixed assets such as buildings, insight into incoming and outgoing residual flows is key to closing material loops as well as to reusing and recycling residuals to the fullest extent possible. To “reuse” means that the component will be used again without changing its basic specifications: that is, a chair will remain a chair. The component will keep its value. On the other hand, to “recycle” means that materials will be broken down and blended, and will decrease in value. For instance, a platform made of concrete can be recycled as foundation materials for a new road. Besides operational and infrastructure-related residuals, RSG focuses on preventing food wastage and the responsible use of electronics residual flows.

The Group uses the “waste hierarchy” (Figure 1), or “10Rs approach” to determine the best option with regard to the use of residual waste. The waste hierarchy helps one to visualize the next best application of the material to reduce its environmental impact and ultimately create value.

## STRATEGIC RESOURCE MANAGEMENT

The circular economy provides many opportunities for regional and national stakeholders. RSG strongly believes that an organization cannot become circular on its own. Regional partners are important because they can help in reusing material locally, especially when the value of the residual material is low and the costs of transportation would become prohibitive. For instance, concrete has a low value so it is not beneficial to transport it on long

distance. One need to recycle it in the local environment. Insights into resource characteristics help with the exchange of materials with the communities around the Group's airports as well as third parties. Material passports capture information about which materials are used in buildings, including the construction method. Ultimately, the idea is to set up a marketplace that will step up efforts towards creating a circular economy together with the stakeholders.

## CHALLENGES

There are challenges regarding time, mindset, production processes and technological aspects, since the circular economy principles are gaining attention but are not mainstream yet. One example involves airport terminal buildings for which there are very high standards for fire safety. As a result, materials are impregnated with fire retardant. These are toxic and the materials can't be reused anymore. Industry has to find a way to overcome these kinds of challenges. Another area that has to be explored and developed is the development and presentation of circular economy business cases. It is important to take into account the full net value during the entire life cycle of a facility. In most cases, the capital expenditure for a circular economy facility will be slightly higher than usual. However, maintenance costs will be lower because the smart design and the value at the end of the asset life will be much higher. Financial controllers are not used to thinking about business cases in that way. Together with knowledge centers, RSG needs to develop this new capability. Another challenging topic is the esthetical look of biological materials when incorporated into circular buildings. Most of them are not that fancy and neat, and people have to get used to a new style. This movement has already begun, and industry is currently working hard to develop biological components that also look like what people are used to now.

## CIRCULAR ECONOMY PRINCIPLES IN PRACTICE

RSG works according to its zero-waste principles, which it applies to: the design and construction of new buildings, the renovation of existing assets, and the procurement of

products and services. Each new project brings circular economy principles into practice. Even when the final results of a project are not entirely circular, every action provides additional insights, and the goal gets closer.

The following five paragraphs describe circular economy programs and projects in which RSG is currently involved.

**FIGURE 2:** Light as a service; terminal building lighting system



### Light as a Service

Philips, Engie, and Schiphol joined forces on this exciting program, inspired by a shared vision and objective. The "light as a service" concept is an arrangement in which Schiphol pays for the light produced, while Philips and Engie remain the owners of the lamps and fittings. Philips and Engie adapted fittings in consultation with Schiphol that made it possible to replace separate components with ease, thus extending the service life of the lighting fixtures. When lamps have reached the end of their service life, Philips will collect and reuse and recycle them.

The above is a good example of how the circular model disrupts the traditional business models which are based on the linear approach of take-make-waste. To create a circular future, the models had to be adapted according to the principles of the circular economy. As a result, the contracts and partnerships with suppliers had to be changed. It was a challenge that took time and perseverance to get everyone on the same page but the payoff was a significant contribution to a more sustainable future, as follows:

- 50% reduction in energy consumption thanks to energy-efficient LED lighting.

- 75% longer service life of the fittings.
- Decline in maintenance costs – components of fittings can be replaced separately.
- Maximum reduction of raw material consumption – complete fittings can be reused.

**FIGURE 3:** Demountable BREEAM-certified mortuary building



### Mortuary

At the morgue, the airport facilitates the process for deceased persons and their friends and relatives, who enter or depart from the Netherlands via the airport. The morgue is located on the limit between airside and landside, which allows the deceased to be transported directly to and from the aircraft. The new morgue was designed to accommodate a range of different cultures and mourning rituals. It is also a place for friends and relatives to say farewell. In addition, the morgue has a viewing room with bathing facilities for cleansing the deceased, a preparation area and an autopsy room for the police.

The new building is ready for disassembly, which means that when a structure's lifespan has ended, the same materials used in building it initially can be easily reused in a new project. The architect designed the building according to the Fibonacci Sequence, which uses mathematical principles to create a sense of harmony. Following this approach, whether one is alone in the mortuary or with a large group, the building always feels respectful and comfortable. This was the main objective when the building was designed.

The mortuary has been awarded via a sustainability building rating system. The rating system used is called BREEAM (Building Research Establishment Environmental Assessment Method) and the certificate obtained is the second highest "Excellent". This level was achieved through insulating and energy-generating applications, such as the climate resilient circular water system that drains away waste water more slowly and filters it, and rain water is captured to flush toilets. Electricity is supplied by solar panels and the building is lit by low energy LED lighting. The building uses a heat pump so no natural gas is needed. The morgue has a green roof and special locations for bees. Housing and protecting bees is an essential part of the RSG ecosystem, and it supports them because bee populations are dwindling worldwide.

**FIGURE 4:** Demountable car park at Schiphol Airport



### Car Parks

The P1 car park at Schiphol Centre was extended in 2017. Schiphol requested a demountable system in the invitation to tender because it anticipates expansion will be required for a 15-year period. The construction is not yet circular; however, because the car park can be dismantled in components, it will be possible to reuse the materials in the future. The P2 car park has been demolished, and 99 per cent of the concrete has been recycled as the foundation for a new platform airside. Charging facilities and payment machines have been relocated to other parking facilities. P2 was located between two important roads at Amsterdam Airport Schiphol, and at the foot of the air traffic control tower – so tearing down P2 with a wrecking ball was not an option. Instead, workers carefully

drilled 1,500 concrete slabs loose before cranes lifted the slabs onto trailers, before transporting them to a storage facility. In addition to the concrete, the electrical charging points, ticket dispensers, and barriers, were also carefully removed for later use. Essentially, the building process was carried out in reverse. The P3 long-stay parking garage is fully demountable. The parking garage is constructed out of 90 per cent recyclable concrete and metal.

**FIGURE 5:** New pier – Schiphol Airport



### New Pier

The new pier at Schiphol is over 55,000m<sup>2</sup> in size, equivalent to 11 football fields. The era of sitting in one of those black chairs and simply waiting in one place until boarding time is almost over. The new pier will have comfortable lounge chairs for relaxation, high-top tables for working, as well as last-minute shopping outlets. The pier's open layout means that travelers can see the boarding process begin – even when they aren't waiting at the gate. There are trees, flowers and plants all around, and the new pier is green in more ways than one. RSG has carefully considered various ways of reusing energy and using reusable or sustainable materials in the design of the new pier. The ceiling is made of reusable plastic marble rubblework tiles, and 5,000 m<sup>2</sup> of solar panels. Toilets are flushed using rainwater, and much of the floor is made of bamboo. The goal is to achieve the LEED Version 4 Gold certificate for the pier.

**FIGURE 6:** Refurbished airport lounge furniture



### Furniture

The furniture requirements are very stringent at Schiphol Airport. Of course the furniture has to look good and has to fit into the overall Schiphol look and feel design. The furniture also has to last a long time under intensive usage conditions. Schiphol Airport is well known for its black functional design Tecno chairs, and in some pier upgrade projects the Tecno chairs are reused – without any changes. For the project Bus gate at Pier E, the Tecno chairs were upgraded to incorporate electronic charging components into the frames. This is an example of meeting the current wishes and expectations of passengers by upgrading the existing chairs. Thus, by treasuring furniture that was still functional and already available at Schiphol it was possible to restyle the furniture and keep its value.

### Next steps

Airports have a direct influence on the circular economy. Therefore, RSG wants to play its role fully and gain more experience in the field of circular economy. The focus will be on design and increase insights in reuse and recycle residual streams. One of the improvements needed relates to the better registration of the residual streams. RSG investigates the opportunities to open a place where materials can be stored and/or exchanged with (regional) partners and RSG has to team up with partners that can close the loops.

**Figure 1:** The Waste Hierarchy

