ARUP

Circular Lighting

Circular Lighting: Our Ethos.

Circular Lighting

The construction industry has long been identified as a major consumer of resources. Although recent decades have seen many improvements in reducing consumption, too much of the built environment continues to be designed around the linear 'take-make-dispose' model, in which materials are sourced, used and then disposed of as waste. This linear model can be seen across all building services, including extensively within the lighting industry.

The circular economy as it relates to lighting is focused on managing materials and how they are used, assembled and dismantled within the product design process; as well as the lighting design decisions that are made to define how lighting products are used within the built environment.

Lighting designers have an influence in both these areas as the specifiers and designers of lighting projects and installations. The adoption of circular economy principles will allow lighting designers to change the way lighting systems are designed, manufactured, procured, operated, and returned. It needs a truly holistic approach to design that considers the lighting aesthetic and quality, material impact of lighting systems, energy efficiency, financing, optimal maintenance, and the reuse or recycle mechanism.

Lighting is ubiquitous within the built environment: creating safer cities after dark, illuminating workplaces, and lighting our homes. Wherever people are, lighting exists. A tremendous opportunity therefore exists for lighting designers to respond to the United Nations Sustainable Development Goals by adopting circular economy principles to transform how lighting is manufactured and used within the built environment.

We have identified five key principles to allow a shift towards circular lighting.

1. Daylight:

Buildings and interiors should be designed for daylight first. This ensures that spaces can provide the daylight requirements of your project's functional, experience and wellbeing objectives, while minimising the use of electric lighting systems.

2. High quality design:

A successful circular lighting design must go beyond box checking of energy efficiency and longevity. The quality of the lighting design will have a significant impact on the longevity of its use, affecting its circularity.

3. An adaptable system:

Lighting systems must be able to adapt to new layouts, functions and programmes over a building's lifetime, while being able to integrate with technologies that may not exist at the time of design.

4. Higher flexibility, higher resilience:

Lighting outputs, layers, and distributions of light within a space must be flexible to accommodate variable functions and uses throughout the day.

5. Circle of lighting materials:

Lighting products should be capable of being dismantled to base components to be up or down cycled, or, as a last resort, re-cycled and returned to the materials reservoir.

Case Study

Amorepacific Headquarters, Seoul, South Korea

12
Different light distributions

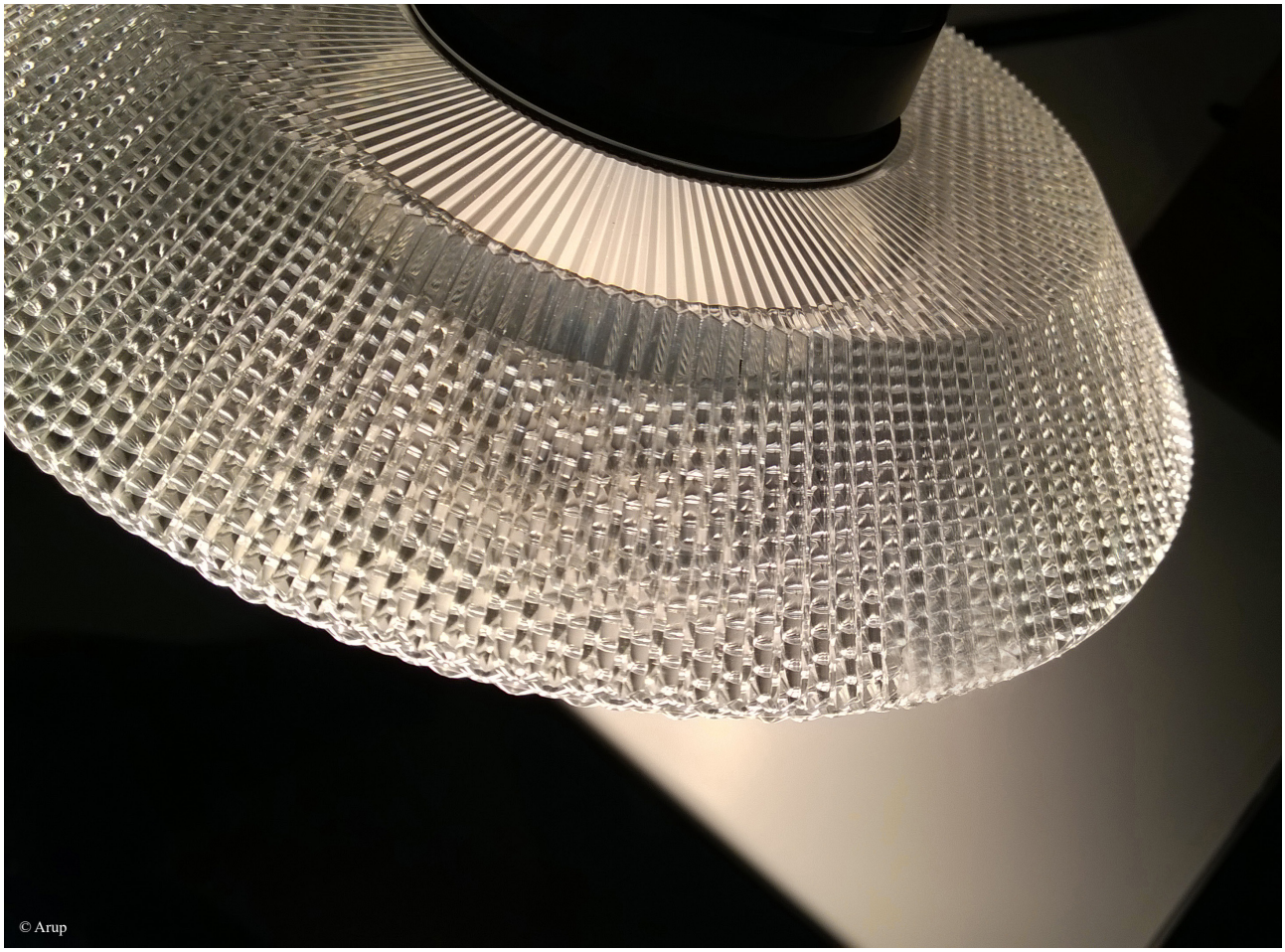
100%
Replaceable components

With 28 different brands and 7,000 occupants under one roof, Amorepacific required a high level of flexibility for the current and future use of its space. The need for various light atmospheres in the building mirrored its multi-use nature.

Arup developed a variety of lighting solutions for the building using a single luminaire type, removing the need to bring together several luminaires and manufacturers. The bespoke luminaire developed for Amorepacific offers a range of interchangeable lenses. This allows for all occasions and full replacement of parts, making easy transitions for the changing needs of the building

There are more than 30 different combinations of lighting that can be specified to achieve the light atmospheres desired in the building. Their globally unique interchangeable optical lenses combine total internal reflection with refraction at their underside for a quality lighting experience.

Key principles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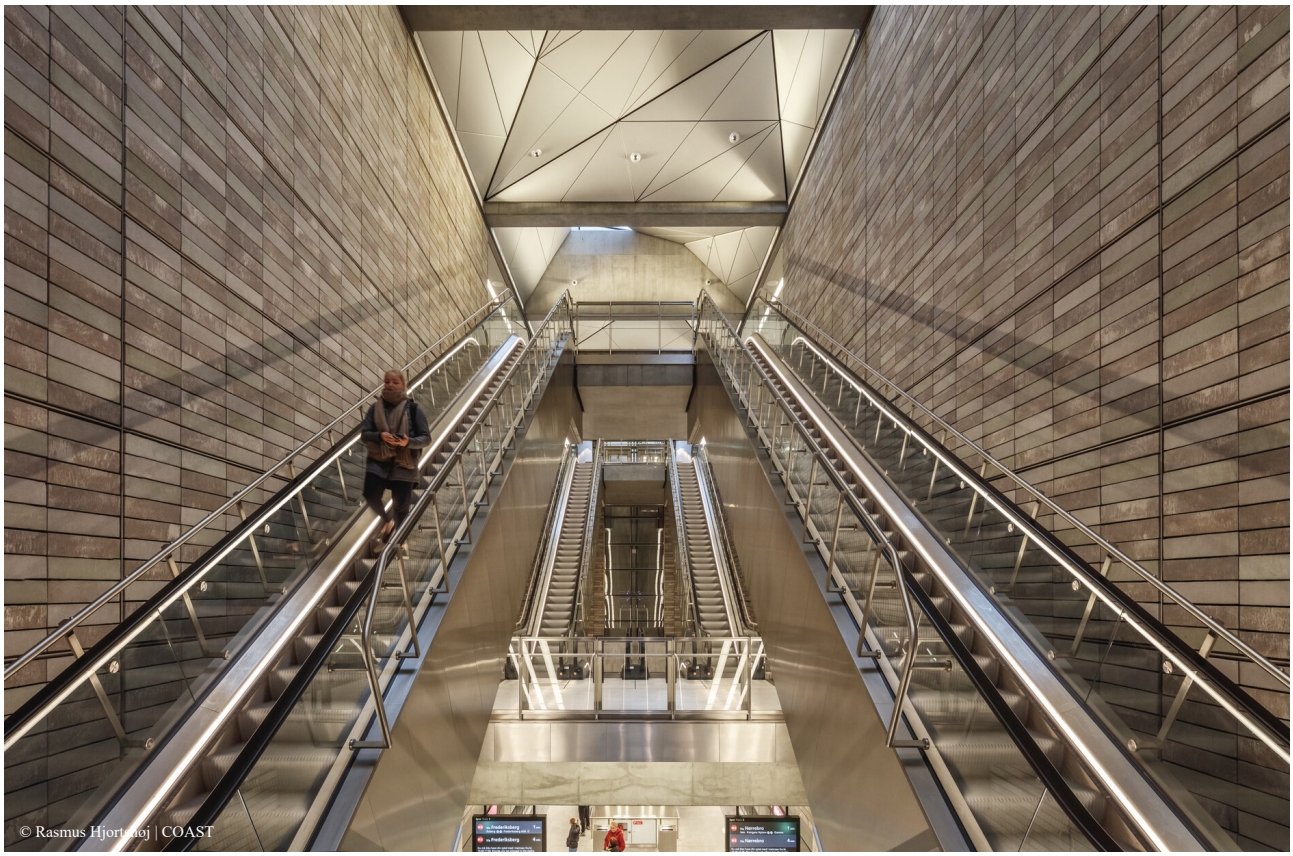
Case Study

Cityringen Metro, Copenhagen, Denmark



20%

Output of LED lighting in the concourse during daylight hours

9km

Of modular LED lighting

More than ten years in the making, the Cityringen Metro line in Copenhagen opened in 2019. While LED technology is the norm today, the lighting systems were initially specified at a time when LEDs were still in their infancy with regard to practical use as an architectural light source.

The design team was ambitious and careful with outlining the requirements of the luminaires so that they could be achieved by technology yet to be available on the market. This was done by use of trends and prediction curves mimicking Moore's law.

On top of the luminaires used, the design maximises natural daylight, not often associated with an underground metro system. Beyond their functional use as air vents, asymmetric, sculptural skylights allow natural light to flood the stations, helping to reduce carbon usage during daylight hours and connect passengers to the natural world.

Key principles

Case Study

Arup, Leeds, United Kingdom

4.8
Metric tons of carbon saved

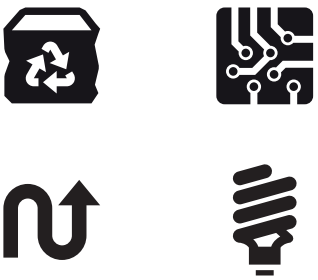
55%
Energy savings

We reviewed the lighting design of our Leeds office to support our target of reaching net zero emissions across our operations by 2030. Originally installed in 1997, we identified that the office's lighting set-up needed to be revised to keep pace with our zero-carbon objectives.

Based on Arup's circular lighting strategy, we developed a carbon-neutral luminaire by retrofitting the office's existing features. Rather than choosing new components, our team re-used the original installation's aluminium fittings to save over 4.8 metric tons of carbon. The retrofit LED system is highly adaptable and flexible by design, which allows it to be re-deployed in the event of future alterations.

We also installed daylight dimming technology to reduce energy waste throughout the luminaire's lifecycle. This enables the system to deliver energy savings of 55% when compared with the original lighting design.

Key principles



Case Study

Columbia University Manhattanville, New York, USA

$8.4M
Lighting Energy Savings in 2019

85%+
Luminaires in recycling and re-use program

Circular Lighting principles were at the center of the Lighting Masterplan for the new 56 500m², USD 6.3 billion campus expansion scheme.

Leading with daylighting first as a key driver of the building design, floor plates and program alignment were optimised based on daylight access allowing massing and right-to-light principles to be adhered to.

The architectural lighting was specified with durability in mind with high quality adjustable fixtures throughout front of house areas. LED modules can be replaced without having to replace the entire fixture.

Lighting controls allow for daylight dimming of fixtures in response to daylight availability, and provide notifications on maintenance issues.

Key principles

Case Study

Neue Nationalgalerie, Berlin, Germany

2,400
Restored and upgraded existing luminaires

80%+
Energy saving

One main goal in refurbishing the lighting of the Neue Nationalgalerie was an invisible and sustainable technical upgrade.

Following the circular economy principle “reduce, reuse, recycle”, all existing luminaire housings and components were carefully restored, and the ceiling, which had become cluttered over the years, was tidied.

The luminaires originally designed for various types of incandescent lamps from the 1960s were upgraded using state of the art lighting technology in such a way that the original light distributions could be retained. In addition to drastic energy savings of more than 80 percent compared to the original lighting system, the refurbished luminaires are designed in such a way that individual components can be replaced as easily as possible for repair and maintenance purposes.

Key principles

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