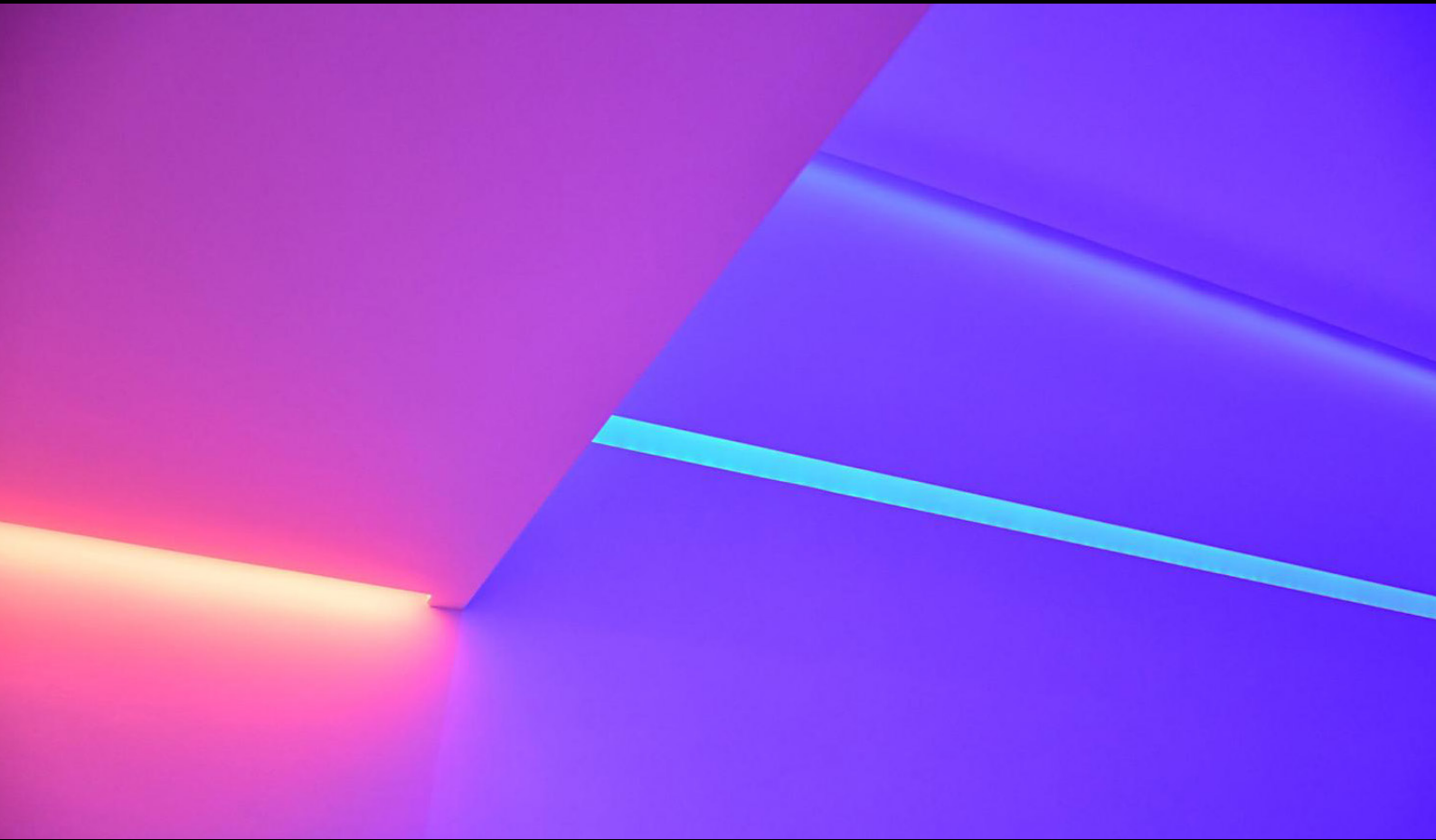


# Casambi Whitepaper

## Wireless lighting control for: **Sustainability and Well-being**



# Introduction

We're living in particularly turbulent times as global energy prices soar while efforts to reverse climate change with stringent sustainability measures are further piling on the pressure. We urgently need to rethink the built environment, the way we use it, and the materials we use to construct it.

Europe is implementing new measures against the energy crisis. EU members are limiting heating temperatures, reducing taxes, and providing monetary help for energy bills. Public buildings and landmarks - even the Eiffel Tower - are turning off their lights a few hours earlier than usual - if not switching off completely. This crisis highlights the need for greener policies to ensure that energy is generated and consumed in a sustainable manner.

In 2015, world leaders gathered at the United Nations General Assembly to agree on a plan of action that became known as the 2030 Agenda for Sustainable Development. Seventeen high-level goals were set with 169 associated targets, which are all interlinked to achieve peace and prosperity for people and the planet. The plan includes actions to end poverty, provide good health and well-being for everyone on the planet, enable resiliency and slow down the effects of climate change. All industries, including the lighting industry, can contribute to achieving these goals.

With the adoption of smart controls and sustainable technology, the lighting industry can make an impact under three key objectives: well-being, sustainability, and ecological responsibility. And there is slow but steady progress around these objectives. Transitioning to a circular economy is higher on the agenda of specifiers and manufacturers. The CIBSE (the Chartered Institute of Building Services Engineers) has introduced a framework to measure how lighting equipment fits into the circular ecosystem to minimize waste. In February 2022, the European Commission published its decision to phase out all general-purpose fluorescent lamps by 2023 on account of their mercury content, which is declared as one of the top ten worst chemicals for public health by the World Health Organization. And thanks to years of research, there is now a better understanding of the impact the built environment can have on people's physical and mental health – especially with lighting. Widely adopted industry standards such as the EN 12464-1 (which specifies the optimal lighting requirements for humans in indoor workplaces) are giving more reference to the variability of light – and giving occupants more control over their lighting. We have certification systems such as WELL, BREEAM and LEED that prioritize the well-being of people in buildings. And finally, the impact of light pollution on our health, on wildlife and ecosystems is also under investigation.

Casambi's wireless lighting control technology contributes to the key objectives of sustainability, well-being and ecological responsibility in unique ways

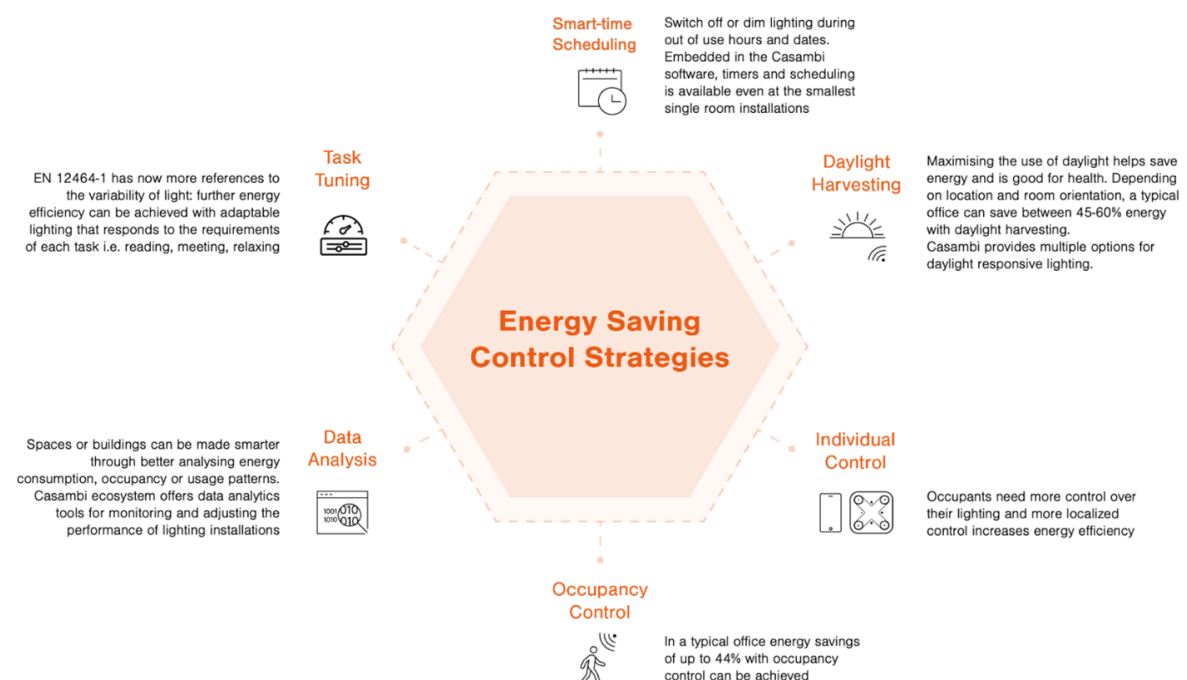
## About Casambi

Casambi's technology provides lighting designers and manufacturers with the ability to wirelessly link devices together enabling the creation of customizable smart lighting networks that are easily configured and controlled using the Casambi App. Casambi's modules can be integrated into anything from individual lighting fixture controls to industrial-scale solutions with cloud-based remote control, monitoring, and data logging. The company collaborates with all the leading luminaire, driver, LED board, LED lamp, and lighting control module manufacturers worldwide. And nonwireless luminaires can be endowed with wireless capabilities with the addition of Casambi's Bluetooth units or Casambi-enabled drivers.

## Sustainability

### Energy Efficiency

There are several strategies that enable energy saving in a lighting installation, including daylight harvesting, smart-time scheduling, task tuning and occupancy control. What makes Casambi unique with its ecosystem and software offering is that any of these strategies can be easily adopted at any point during the lifetime of an installation. All functionality settings are programmed in the Casambi App, and using wireless sensors, switches or other controllers from the Casambi Ecosystem further energy savings can be unlocked.

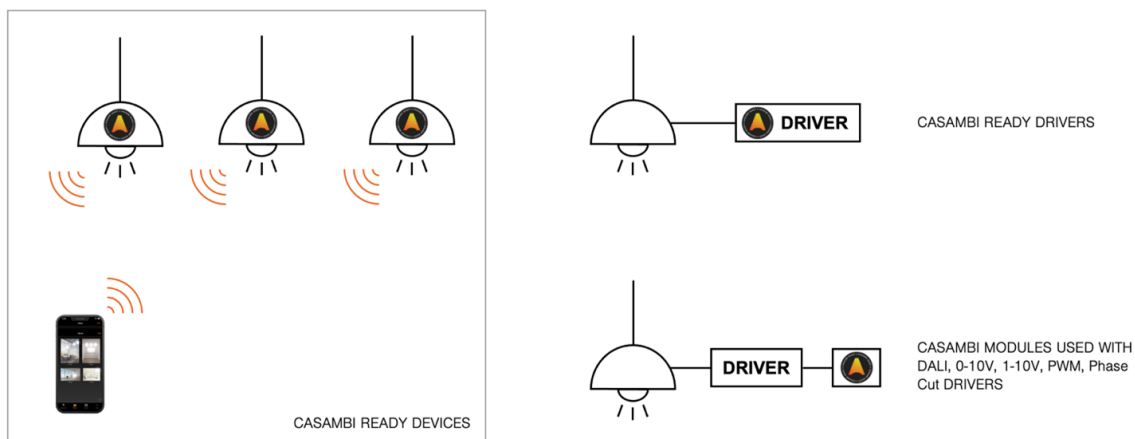


## Less Embodied Carbon

Casambi brings unprecedented simplicity to lighting controls. The elimination of control wires and extremely reduced hardware complexity translates to reduced material use and less embodied carbon throughout the building.

## Circular Economy

Reusability, adaptability, flexibility, and longevity are key values in a circular lighting economy. Casambi makes it easy to upgrade existing lighting systems to become more energy efficient or to gain new “smart” functionality. With an added Casambi Bluetooth module, existing luminaires, switches or even sensors can gain new life by becoming part of a wireless mesh lighting control network.



Parts harvesting is another loop in the circular economy for lighting. This entails recovering valuable parts in products or systems to reuse them later. Casambi Bluetooth units (CBUs), used as add-on elements to existing lighting can later become building assets. If an interior design is changed with new fittings and a new layout, the same CBUs can be reused time and time again.

## Future-proof System

Longevity is one of the key values on the path to sustainability. Any lighting system that is installed today is likely to remain in use for many years, which makes future-proofing the installations essential, to meet new incoming requirements.

With the accelerated efforts to reduce carbon emissions and energy consumption, countries throughout the world continuously roll out new standards or incentives for building systems to save more energy. Casambi brings full flexibility and future-proofness to lighting installations, as all new lighting settings are handled via software and not through complex hardware and wiring. It is easy to revisit and rearrange system configurations as per new regulations and efficiency requirements.

# Well-being

In a recent study\*, one in three office workers state that access to comfortable light (intensity and color) is important for their daily health, and count lighting as the #2 aspect that most affects their performance at work (with air quality being #1).

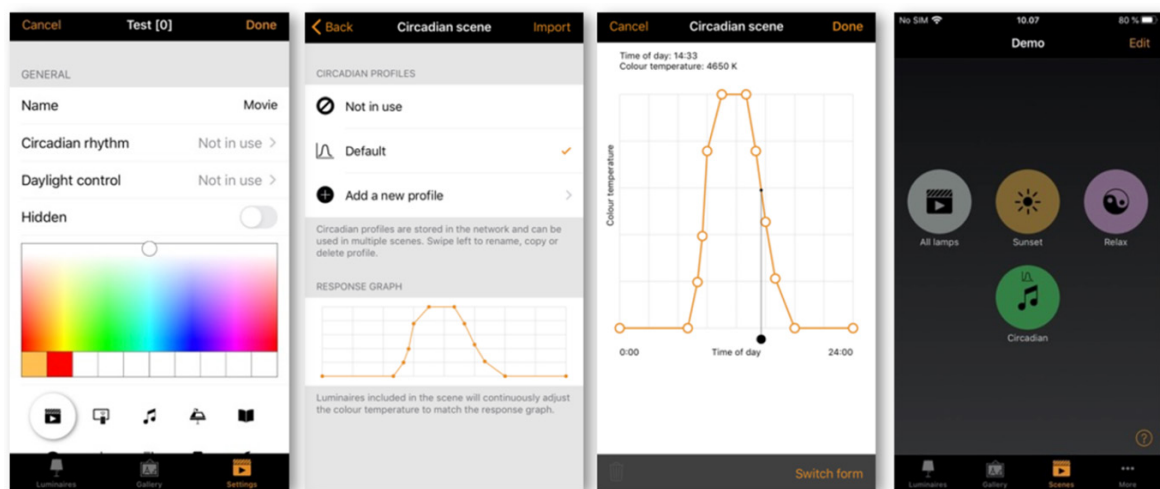
In October 2014, the International WELL Building Institute launched version 1.0 of the WELL Building Standard, the first building standard to focus exclusively on the health and well-being of the people in buildings. Lighting related requirements from WELL range from daylighting, glare control and the availability of personal control catering to individual needs, to the provision of dynamic lighting in tune with circadian rhythms. The standard's version 2.0 which was introduced in 2020 now requires enhanced occupant controllability of ambient lighting, reduced circadian phase disruptions and educating building occupants on circadian rhythm and the importance of daylight exposure.

Building certification systems such as BREEAM and LEED also have specific credits related to the well-being of building occupants. The credit in BREEAM also focuses on visual comfort through requirements such as glare control, daylighting, and more occupant control wherever possible. LEED has an entire credit category dedicated to the quality of indoor environments: Indoor Environmental Quality (EQ). For lighting, the prerequisites and credits include occupancy detection, automatic daylighting control, glare control and multizone control systems that enable occupants to adjust the lighting.

Casambi offers many ways to personalize light settings such as custom Circadian profiles or daylight control options. It is also possible to give occupants more control over their lighting at any time during the lifetime of the installation using wireless switches or the Casambi App.

## Circadian lighting

Using the Casambi App, it is possible to set personalized Circadian profiles for tuneable white lighting based on the time of day to remain in sync with the occupants' body clock. The users can also set and automatically run Circadian profiles specific for each month or season to mimic the changes in daylight for different times of the year.



## **Access to daylight and visual connection with outdoors**

Using Casambi-enabled daylight sensors and the daylight controls options available in the App, it is easy to maintain a well-balanced light scheme combining daylight and artificial light throughout the day.

Keeping a visual connection with the outdoors is also essential in balancing the body clock of people in buildings. Casambi can be used to control motorized blinds or roller shutters according to time or the amount of available daylight. When used with a light sensor, the blind actuators from the Casambi Ecosystem can provide automatic daylight glare control, thus improving the visual conditions indoors.

## **Comfortable lighting**

Task-based lighting requires flexibility whereby the lighting control system can help provide visual acuity by adjusting light intensity, color temperature or up/down distribution according to the performed tasks. Scene control options in the Casambi App make it easy to create multiple scenes or adjust light quality where needed.

For projects with daylight exposure and light sensors, the position of blinds or indoor light intensity can be adjusted automatically to provide more comfortable lighting conditions by reducing glare and excessive light.

## **Personalized light**

Wireless switches are an easy solution to give occupants more control over their lighting at any stage of the lighting installation. Adding new switches requires simple commissioning from the Casambi App. For some Casambi installations, it is also possible to scan a QR code to control (dim, change scenes/color/color temperature) one's overhead lighting from a web interface.

# Ecological Responsibility

Outdoor lighting carries ecological responsibility toward all living species that are affected by the effects of light. Research from the University of Exeter has identified that the transition to LED light sources for outdoor lighting is disrupting the sleep patterns in humans and other organisms, which can lead to a variety of chronic health issues over time. The blue wavelengths of LED lights can also alter the behavioral patterns of animals.

Building certification systems such as BREEAM and LEED require the reduction of light pollution through time-based scenes and adaptive light control strategies. Light pollution can be significantly reduced by using precision optic systems and downward emissions with the luminaires. Using specific lighting control strategies as an additional element is also essential. With Casambi, such lighting control strategies can be adopted for existing installations, by giving existing street lighting additional control capabilities using Casambi Ready Zhaga or Nema nodes.

## Green Building Certification Systems

Casambi can support the implementation of sustainable and ecologically responsible strategies with lighting in a number of ways. Regarding the building certification systems, below is a summary of Casambi's contribution to achievable credits with BREEAM, LEED and WELL.

<b>BREEAM</b>	<b>Credits Achievable</b>	<b>Casambi Contribution</b>
<b>Management</b>		
Man 04 – Commissioning and handover	3	<ul style="list-style-type: none"> <li>• Commissioning and testing schedule and responsibilities</li> <li>• Commissioning building services</li> <li>• Handover</li> </ul>
Man 05 – Aftercare	2	<ul style="list-style-type: none"> <li>• Aftercare support</li> <li>• Seasonal commissioning</li> </ul>
<b>Health and well-being</b>		
Hea 01 – Visual comfort	2	<ul style="list-style-type: none"> <li>• Glare control</li> <li>• Daylighting</li> <li>• Zoning and occupant control</li> </ul>
<b>Energy</b>		
Ene 01 – Reduction of energy use and carbon emissions	2	Energy-saving control strategies
Ene 02 – Energy monitoring	2	Monitoring the energy consumption of the lighting system, also as part of other building management systems
<b>Pollution</b>		
Pol 04 – Reduction of nighttime light pollution	1	<p>Time-based scenes (all external lighting switch off between 23:00-07:00 – except safety and security lighting)</p> <p>Adaptive lighting for safety and security - switch off or dim down based on occupancy detection</p>

*BREEAM International New Construction Version 6 (INC V6)*

<b>LEED</b>	<b>Max. Credits Achievable</b>	<b>Casambi Contribution</b>
<b>Energy and Atmosphere (EA)</b>		
Prerequisite	-	Minimum energy performance (baseline: ASHRAE 90.1-2010: Energy Standard for Buildings Except Low-Rise Residential)
Prerequisite	-	Building-level energy metering
Optimize Energy Performance	1-20	<ul style="list-style-type: none"> <li>• Energy savings in interior and exterior lighting</li> <li>• Daylighting</li> </ul>
Advanced Energy Metering	1	Tracking building-level and system-level energy use to identify opportunities for additional energy savings
<b>Materials and Resources (MR)</b>		
Building and Material Reuse	2-4	Reuse or salvage interior elements
<b>Environmental Quality (EQ)</b>		
Interior Lighting – Lighting Control	1	<p>Individual occupant spaces: For at least 90% of the spaces, provide manual control to occupants with at least three lighting levels or light scenes (on, off, midlevel)</p> <p>Multi-occupant spaces:</p> <ul style="list-style-type: none"> <li>• Multizone control systems that enable occupants to adjust the lighting, with at least three lighting levels or scenes (on, off, midlevel).</li> <li>• Lighting for any presentation or projection wall must be separately controlled.</li> <li>• Switches or manual controls must be located in the same space as the controlled luminaires.</li> <li>• A person operating the controls must have a direct line of sight to the controlled luminaires.</li> </ul>
Daylight	1-3	<ul style="list-style-type: none"> <li>• Provide manual or automatic (with manual override) daylight glare-control devices for all regularly occupied spaces.</li> <li>• Reduce the use of electrical lighting by introducing daylight into the space</li> </ul>



Sustainable Sites (SS)		
Light Pollution Reduction	1	<ul style="list-style-type: none"> <li>• Zoning</li> <li>• Facade and landscape lighting (MLO LZ 3-4) automatically switched off from midnight until 6am</li> <li>• Internally illuminated signage: do not exceed a luminance of 200cd/m<sup>2</sup> at nighttime hours</li> </ul>

LEED v4 for Building Design and Construction

WELL	Credits Achievable	Casambi Contribution
<b>Preconditions</b>		
L01 – Light Exposure	-	<ul style="list-style-type: none"> <li>• Daylighting</li> <li>• Circadian rhythm</li> </ul>
L02 – Visual Lighting Design	-	Multizone control systems that enable occupants to adjust the lighting according to the tasks and the age group of the occupants.
<b>Optimization</b>		
L03 – Circadian Lighting Design	3	<ul style="list-style-type: none"> <li>• Circadian rhythm</li> <li>• Dim – light levels</li> <li>• Dim – light levels on a vertical plane (at the eye level of the occupant to simulate the light entering the eye of the user.)</li> </ul>
L04 – Electric Light Glare Control	2	<ul style="list-style-type: none"> <li>• Glare control</li> <li>• Type of luminaires – Choose correct optic, luminance and UGR. Casambi offers a huge Ecosystem of products.</li> </ul>
L05 – Daylight Design Strategies	4	<ul style="list-style-type: none"> <li>• Provide manual or automatic (with manual override) daylight glare-control devices for all regularly occupied spaces.</li> <li>• Reduce the use of electrical lighting by introducing daylight into the space</li> </ul>

L06 – Daylight Simulation	2	
L07 – Visual Balance	-	<ul style="list-style-type: none"> <li>• Light levels</li> <li>• Colour temperature</li> </ul>
L08 – Electric Light Quality	3	<ul style="list-style-type: none"> <li>• Zoning</li> <li>• Façade and landscape lighting (MLO LZ3-4) automatically switched off from midnight until 6am</li> <li>• Internally illuminated signage: do not exceed a luminance of 200cd/m<sup>2</sup> at nighttime hours</li> </ul>
L09 – Occupant Lighting Control	3	<ul style="list-style-type: none"> <li>• Zoning</li> <li>• Lighting systems have at least three lighting levels or scenes that allow for changes in light levels and have the ability to change at least one of the following: a) Color; b) Color temperature; c) Distribution of light by controlling different groups of lights or through preset scenes</li> <li>• All regular occupants have control over their immediate lighting environment through at least one of the following: a) Manual controls (e.g. switches or control panels) located in the same space as each lighting zone.; b) Digital interface available on a computer or phone.</li> <li>• Lighting for presentation or projection walls are separately controlled.</li> </ul>

# Case studies

## **The Panathenaic Stadium**

The Panathenaic Stadium in Athens is a glorious space. It's the only stadium in the world built entirely of marble and has a rich history dating back to 338 BC. But most people know it for being the starting point from where the Olympic flame sets off on its journey to the host cities of each Olympic Games. The famous monument has a seating capacity of 50,000 and its sheer scale makes it visible from many points throughout the Greek capital.

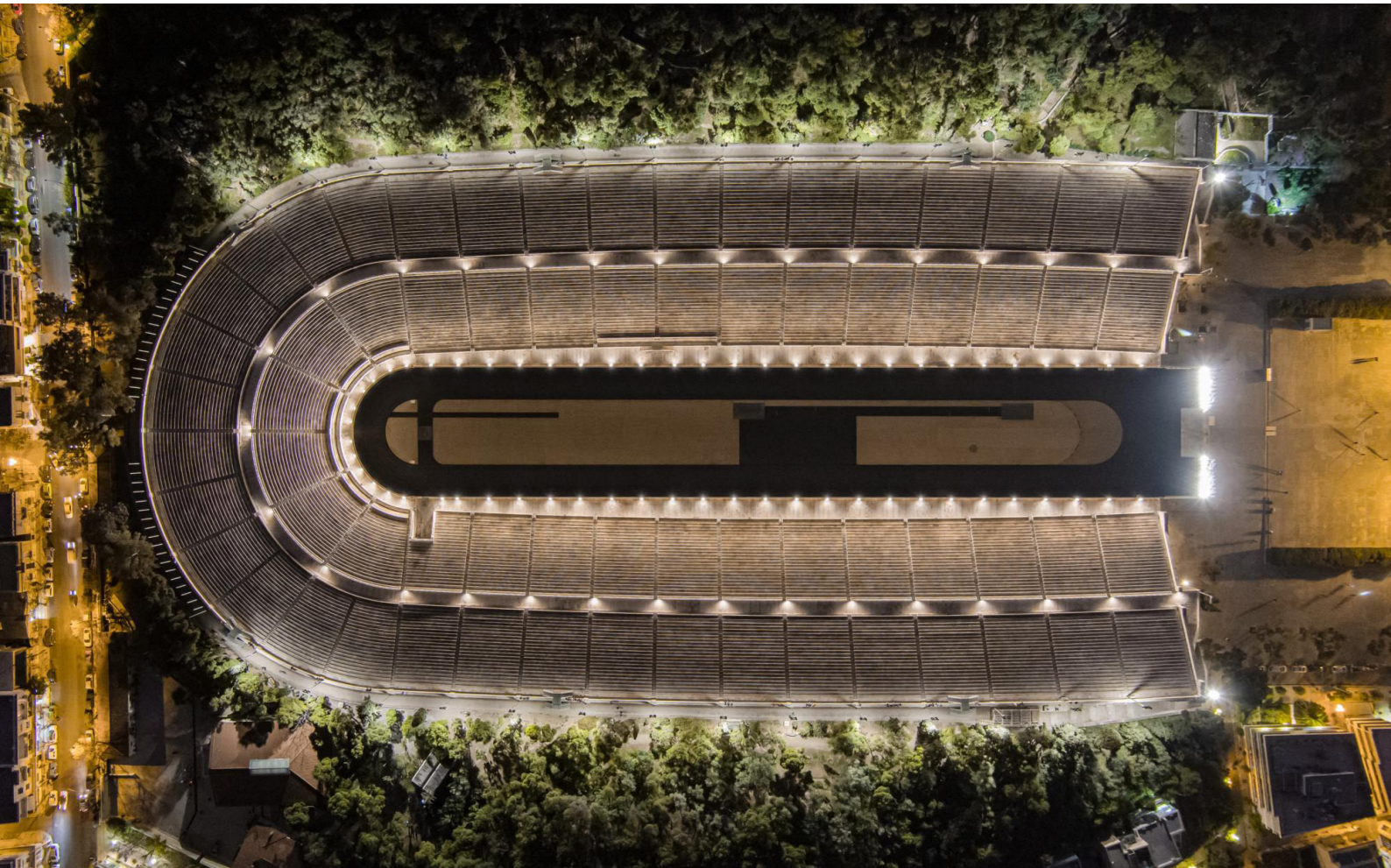
The Hellenic Olympic Committee considers it their duty to preserve and highlight the legacy of the site and its incomparable beauty. As such, they ordered a new wireless lighting system to replace the previous one, which was energy-hungry and highly light-polluting. They wanted a system based on modern environmental requirements, which would be able to control luminosity and color temperature as night falls.

The new Casambi-controlled lighting system has significantly enhanced the sustainability claims of the venue. Light pollution has been reduced by 70+% and energy requirements by half.

Site: Panathenaic Stadium

Location: Athens, Greece

Casambi nodes: 61



## Registers of Scotland

Registers of Scotland installed a Casambi-controlled lighting system in its new BREEAM 'Excellent' rated offices at St Vincent Plaza in Glasgow.

The new 18,000 sq ft office brings together approximately 200 staff from various departments, who were previously spread across seven floors of an older building. In line with its ongoing digital transformation project, Registers of Scotland wanted to create an adaptable working environment for the staff at St Vincent Plaza, encouraging collaborative working, and with a strong focus on staff wellbeing. As part of this, the organisation chose to install 'human-centric' lighting, to support the employees' circadian rhythms and improve their alertness, contentment and productivity

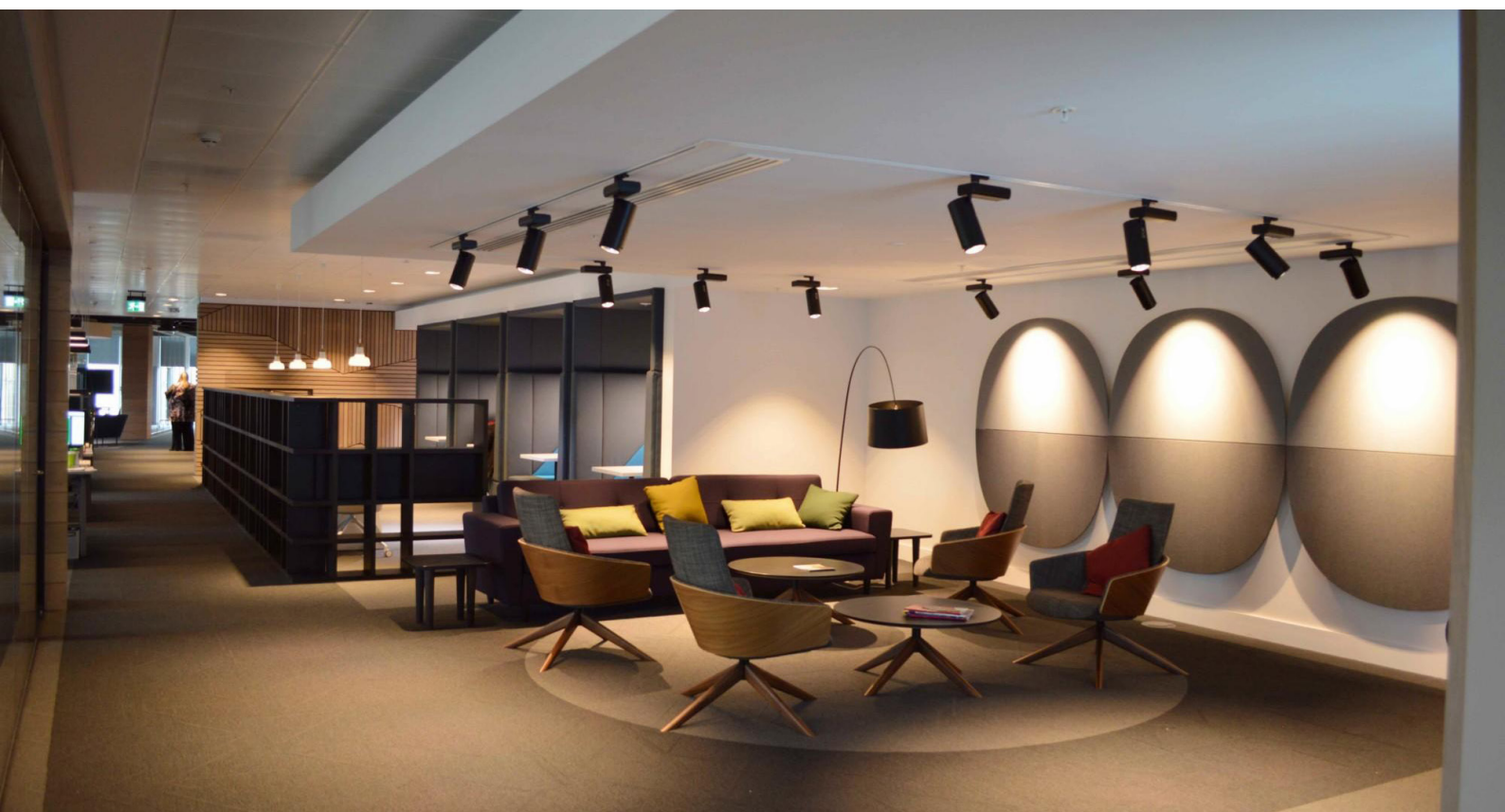
For Registers of Scotland, M&E consultant Atelier Ten, working with contractor EMTEC, needed a control system that could provide changes in colour temperature and intensity based on a time curve, including scene-setting and dimming to 0%, but that was also easy to install, easy to use and cost-effective. Casambi was the clear choice.

The Casambi system at St Vincent Plaza controls around 450 tunable white luminaires. The unique gallery feature of the Casambi system is also in use. The gallery lets users upload their own photos or plans of a space, mark the positions of the luminaires, and then use this to select and control them. At Registers of Scotland, this feature is used to provide detailed plans of different sections of the office so staff can easily find and control the lights in their area.

Site: Registers of Scotland Offices

Location: Glasgow, United Kingdom

Certification: BREEAM 'Excellent'



## DL/78

Casambi's wireless lighting control system played its role in Derwent London's DL/78 site being awarded the BREEAM Excellent Certification (Project-wide with maximum credits for Ene 01 15/15 – reduction of energy use and carbon emissions) and an EPC rating 'B'.

The Casambi wireless system played its role. It resulted in the elimination of many cables associated with lighting control. This is significant because, while the copper in the cables can be recycled, the insulation utilizes single-use thermosetting plastics, explains Alison.

Another advantage of the Bluetooth lighting control system is that it eliminates the need to reroute or install new control cables if the fittings are relocated or additional lights are added. A lighting track runs throughout most of the space which makes it easy to add light fittings and commissioning the fittings can take place via the lighting control system mobile or web app without needing commissioning engineers. This ties in well with the aim to allow maximum flexibility and material reuse.

Site: DL/78, 78 Charlotte Street, Co-Working, Cafe, private club

Location: London, England

Certification: BREEAM 'Excellent'



CASAMBI

[casambi.com](https://casambi.com)