LIGHTING DAYS

STOCKHOLM, 06 DECEMBER 2023

SUSTAINABLE LIGHTING DESIGN :

HIGH QUALITY OF LIGHT AT MINIMAL ENVIRONMENTAL IMPACT

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15% OF TOTAL ELECTRICITY USE [3]

5% OF GLOBAL CO_2 EMISSIONS [4]

[3] UNEP. 2017 Accelerating the Global Adoption of Energy-Efficient Lighting Paris p 4
[4] UN. (2022). United Nations climate change. en.lighten initiative: https://unfccc.int/climate-action/momentum-for-change/activity-database/momentum-for-change-enlighten-initiative

NOVEMBER 2019 → DECEMBER 2022

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Bertil & Britt Svenssons Stiftelse för Belysningsteknik


SUSTAINABLE
LIGHTING
DESIGN
AN INTERDISCIPLINARY INVESTIGATION ABOUT THE INTEGRATION OF DAYLIGHTING AND ELECTRIC LIGHTING IN PRACTICE
ISABEL VILLAR & MAHA SHALABY

HOW DOES LIGHT AFFECT US AND THE ENVIRONMENT?

ABOUT THE PROJECT

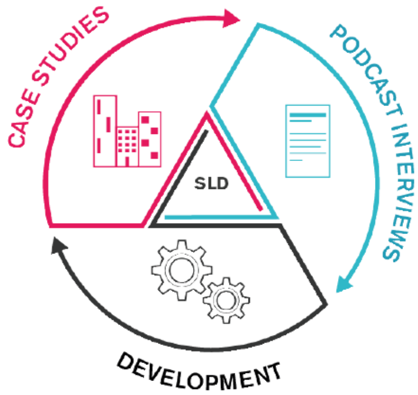
"SUSTAINABLE LIGHTING DESIGN IMPLIES A DESIGN THAT IS SUSTAIN-ABLE FOR THE PLANET AND ALL LIVING CREATURES IN IT"

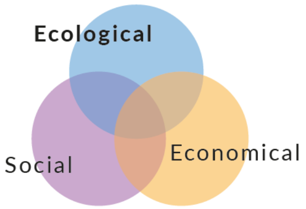
ISABEL VILLAR & MAHA SHALABY

Case studies:
Inviting researchers, institutions and industry representatives to share examples of realized best-practice projects in a case study format.

Podcast interviews:
Conducting interviews with key research-ers and practitioners with a focus on differ-ent topics related to the four key areas of the SLD project.

Development:
Test of digital tools, metrics and method-ologies to integrate daylight and electric light in the design process and generate new indicators.



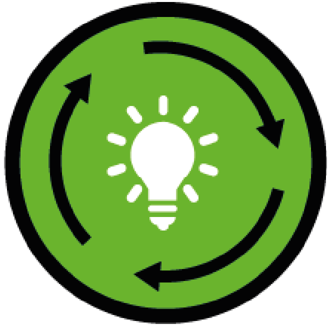


The three intertwined pillars of sustainability

ABOUT THE PROJECT

Health & well-being

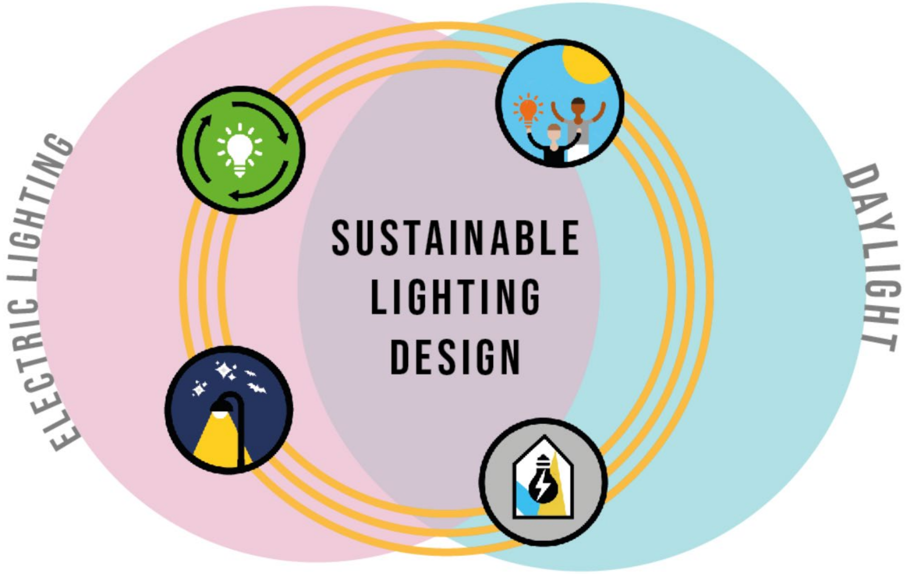
Energy efficiency



Circularity

Light pollution

ABOUT THE PROJECT



HEALTH & WELL-BEING

Light and darkness play a vital role in how we perceive and experience the world around us and in how the human body functions and performs. Light is intrinsically connected to our health and well-being and is the major trigger of our sleep-wake cycle and many other biological and physiological processes within our bodies. Light also has a direct impact on our mood, performance and numerous other aspects of our daily lives.

The presence or absence of light, natural or electrical, can nurture our intrinsic needs for light but can also disrupt them. Overexposure to high amounts of light in the evening, specifically light in the blue spectrum, and reduced exposure to darkness, have been shown to negatively impact our biological system. Thus, access to plenty of natural light during the day, low levels of light during the evenings and darkness during the night are equally important to maintaining our natural circadian rhythm and helping us sleep better and be more energized in the morning.

When creating healthy environments, natural light offers the best lighting conditions for people to thrive and should, therefore, be the prime source of illumination in all types of buildings. Natural light does not only provide us with the time cues our biological system needs, but it also gives us a sense of space and time, playing a vital role in how we perceive our surroundings.

Controlling direct sun exposure, avoiding glare, bringing daylight further into the building and consciously working with the interior layouts based on daylight availability are all keys to optimizing the lighting design of a building and consequently reducing energy consumption for electric lighting. However, to improve daylight conditions in indoor environments, the target should first be considered at a city planning level to be able to have enough access to natural light from a building design perspective and then ultimately at the room level.

In regularly occupied spaces that lack sufficient daylight or in latitudes where daylight hours during the winter season are scarce, electric lighting that can follow the rhythm of natural light, such as in colour, temperature and intensity, can be beneficial in reducing the negative impact of low daylight exposure on human beings. However, it should never be the first solution to consider, as the benefits and qualities of daylight can never be replaced by electric lighting.

Electric lighting should therefore serve as a complementary source of light during the day and as a more important source of light during the night so that we can carry out our visual tasks without compromising our biological needs. However, electric lighting in the evenings should not necessarily achieve the same light levels that daylight can provide. It should rather aim to create a different type of lighting environment that brings a variation into how we perceive the space throughout the day and year.

To summarize, in order to support human health, when planning the lighting design for an indoor space, it is important to consider both natural and electric lighting, and plan the integration between the two based on daylight availability, the architectural design, interior layouts, user needs and the activities to be performed. This should result in a dynamic and flexible lighting scheme that naturally changes over time due to the intrinsic qualities of daylight and our ever-changing needs for light.

ENERGY EFFICIENCY

The current global energy crisis with respect to the production and supply of energy to meet the energy demand is not the only challenge we face; carbon emissions associated with non-renewable energy sources are also negatively impacting the planet and leading to global warming. With the increase in the world's population and the expansion of cities, it is becoming increasingly necessary to consciously and actively reduce our overall energy consumption and to focus on meeting our energy demands through renewable energy sources.

In the lighting industry, the introduction of LED light sources, a more energy-efficient and long-lasting alternative to previous light sources, has been considered as a significant step towards reducing the energy consumption from lighting systems. However, even though retrofitting public and industrial buildings with LEDs has led to a significant reduction in energy consumption, the perception that LEDs use almost no energy has paradoxically led to the use of more electric lighting, which in turn has resulted in an increase in overall energy use, especially in the residential sector. One strategy for solving the energy crisis is to approach it holistically tackling both daylight and electric light questions simultaneously. This can result in significant energy savings when planning our cities and buildings.

The sun, nature's most efficient energy source, provides light and warmth, which, if optimized correctly in buildings, can reduce a building's total energy use by up to 25% (as presented in section 3.4). By designing our cities better, allowing more sunlight to reach the buildings and reducing densification, many buildings can be naturally illuminated and heated, which, in turn, can reduce the heating loads.

Better planning and building design can be coupled with control systems that optimize the use of electric lighting, such as daylight harvesting systems and active and absence sensors. Depending on the building's function, the weather conditions at the location, and the users' profiles and lighting needs, the appropriate control system can save up to 30% of the electricity used by electric lighting.

Another major factor that affects energy use in lighting is user behaviour. For example, active users who consciously turn off the lights have the potential to save up to 65% more energy than passive users[5]. Therefore, educating people to use electric lighting only when necessary and turning it off when not, is a fundamental strategy for energy savings.

In order to further reduce energy consumption, it is crucial to set the illuminance thresholds responsibly. For example, an office floor plan does not require 500 lux from wall to wall, i.e., the work areas require more light than the circulation and relaxing zones. Street lighting should be dimmed when no vehicles, pedestrians or cyclists are present. This strategy can save enormous amounts of energy and even extend the life of the lighting system. Using this method, which recognizes when an activity is happening, no energy is wasted as lighting is only used when and where it is required.

Additionally, it is important to note that the energy used over the course of a lighting system's lifespan has the biggest environmental impact, with carbon emissions produced during the manufacture and transportation of a luminaire making up a minor portion of the total emissions produced. Compared to that, the emissions generated as a result of the energy consumed by the luminaire over its entire time of use are very high. This is another reason why it is important to optimize the number of luminaires, their efficacy (lm/W) and the lighting power density (W/m²).

[5] Reinhart, C. (2018). Daylighting handbook II. United States of America: Building Technology Press. p159-181.

CIRCULARITY

The current linear model we have in place for production threatens to exhaust the resources on our planet in a short time, while it is also creating enormous amounts of valuable waste that could be reused instead. Shifting towards a circular economy in the lighting industry is not easy. However, it is necessary in order to reduce the negative impact of the production and waste of lighting equipment on the environment. Implementing a circular model would therefore help in creating and preserving value and minimize waste.

There are many key factors to consider to succeed with a circular model in the lighting industry. From a design perspective, it starts by creating a lighting concept that satisfies the user's needs. This will reduce the amount of unnecessary and often unwanted lighting fixtures and associated electrical equipment, and more attention will be paid to putting the appropriate lighting fixtures in the right places at the right times.

When looking at the luminaires, EU regulations such as the Eco-design directive are already in place to ensure that the products are designed to be easily serviceable, repairable and upgradeable. This means that once the fixture is no longer required or it has reached the end of its lifespan, it can be repaired, upgraded and either sent back to the original user or sold to a new one as a new product. The last step in the circular model is to design the fixtures for recycling so that the maximum possible number of components can be recycled, and the minimum possible number turned into waste.

Increasing the lifespan of fixtures and the possibility of repair and refurbishment is essential to minimizing the harmful effects that lighting products have on the environment. Fixtures made of recycled aluminum, lenses made of recycled PMMA and cases made of a mix of recycled paper and plastic materials are already available in the market. If this trend continues, the use of raw materials could be greatly reduced in the near future.

Life cycle assessments (LCA) are one of the methods that can be used to compare the environmental impact of lighting fixtures over time. The CIBSE TM66 assessment tool is another alternative that can be used to assess the circular potential of lighting products.

Besides the need for smarter and more sustainable lighting product designs, there is also a need to investigate the conditions under which fixtures are purchased. New business models, such as 'light as a service' (LaaS) or offering 'buy back guarantee', are already being tested as new purchasing models that can motivate buyers to take better care of the products they buy but also return them to their producer or seller after use, with the aim of making them circulate to other users while also getting part of the investment back. However, even if these new business models sound promising, it will take some time before we can draw any conclusions on the positive impact they might have on reducing new production and waste.

The purchase of good quality lighting products that can maintain the quality of light and their value over time will hopefully direct decision-makers into purchasing circular lighting products instead of the buy-use-waste type of products of lower quality. Nevertheless, it will take years until there is a sufficiently large stock of products in circulation to reach a point where it will not be necessary to produce new ones.

LIGHT POLLUTION

Humans have been lighting their homes and streets for a very long time while ignoring our connection to the universe. One example of this is the fact that more than 50% of people in Europe have never seen the Milky Way due to light pollution, which is a side effect of the excessive or inappropriate use of outdoor lighting at night. Night gazing promotes serenity and relaxation and inspires wonder and originality.

Light pollution has adverse effects on many plants and animals, including bats, migrant birds and fish. In the case of humans, our circadian rhythm is closely connected to the light and dark cycle. We are active in the morning when exposed to natural light, and we need low light levels in the evenings to rest and sleep better. Light pollution affects our sleep patterns and sometimes even our visual comfort.

When illuminating cities, there is a misconception that safety, comfort and modern city planning can only be achieved when there is more light. Most major cities have huge billboards with advertisements and entire streets with illuminated facades that are hard to look at for a long period of time. Moreover, it is usual for street lighting to be on all night long, which not only wastes energy but also exposes humans to high levels of light at night. This negatively affects our circadian rhythm, the quality of our sleep and wastes energy. In addition to disrupting our biological processes, too much light at night can also strain the eyes due to glare and give people headaches due to flickering light.

Minimizing light pollution, reducing obtrusive light and regaining sight of our dark skies are vital for all living creatures. In this, lighting design has a crucial role to play. On a city level, by making an informed decision about how, what, and when we should illuminate a city while still providing spaces that are safe, comfortable and attractive during the darker hours. Lighting design can reduce light pollution through different strategies, these include choosing the right fixture and proper illuminance levels, directing the light towards the ground instead of the sky, placing fixtures responsibly to avoid light trespass and glare, reducing unnecessary façade lighting, using warmer colour temperatures, and dimming the light fixtures when they are not needed, such as in the case of street lighting. On a building level, avoiding uplights and having a control system that turns off the exterior lighting when it is not needed can reduce light pollution. It may also be beneficial to incorporate a lighting system that regulates the lighting in interior spaces that are used at night so that they are not overly illuminated.

There is more that can be done on a city level from a policymaking perspective. Some cities already have policies for using only dark-sky approved fixtures, using low-wattage and low-glare bulbs, turning off façade lighting after curfew and reducing the amount of artificial light in general. A good example of this is the adoption of a national policy against light pollution in France, in force since January 1, 2019. More policies are needed to enforce the dimming or switching off of the lighting from buildings that are not fully occupied in the evenings, such as offices and schools, as well as the preservation of darkness in woodlands and nature reserves.

Lastly, people's lighting choices have a major impact on reducing light pollution, both in their homes and in their workplaces. It is important in our everyday activities, to make active choices to reduce the use of unnecesarry lighting, such as by turning off lights that are not needed. While in big cities, it might be hard to reach a level where we can enjoy the night sky and stars, any reduction is beneficial to both our health and the health of other animals affected by artificial light at night.

2.1 RECOMMENDATIONS

RECOMMENDATIONS

HEALTH & WELL-BEING

- Optimize daylight in the early stages from the city level to the building and room level.
- Maximizing windows can cause glare problems that may lead users to lower their blinds, affecting the outside view and consequently lowering the amount of daylight in the room.
- Optimize the façade openings to ensure that rooms receive enough daylight, avoiding glare while providing outside views.
- Ensure that regularly occupied spaces get direct sun exposure during the morning and noon for at least half an hour for a large part of the year.
- The choice of materials and colors should be made consciously. It is recommended that rooms with little natural light have lighter colors on the walls, floor and ceilings to allow daylight to reach further into the room.
- Work closely with architects and interior designers to locate regularly occupied spaces in the best day-lit areas of the building.
- Design electric lighting to complement and not replace daylight.
- In high latitudes, to compensate for the lack of daylight hours during the winter, it is advisable to design electric lighting to provide enough light both horizontally and vertically without causing glare.
- Electric lighting should be brighter in the morning and dimmer in the evening.
- If possible, choose cooler colour temperatures for electric lighting in the morning and warmer colour temperatures in the evening.
- In offices and schools, having varied types of lighting environments in terms of light characters, intensities and light distributions is beneficial for well-being, concentration and mood.
- Avoid glare and flicker from light fixtures.
- Educate users on light hygiene, encouraging them to take a morning walk or perhaps have lunch outdoors to boost their circadian and immune systems.

ENERGY EFFICIENCY

- Inputting accurate values for electric lighting in energy simulations is crucial to give the right indication for buildings' energy use and consequent carbon emissions.
- Spreading awareness regarding people's behaviour towards electric lighting can massively reduce energy use due to lighting.
- Lower lighting power density is recommended as long as it meets the required illuminance levels to reduce the building's total energy and carbon emissions.
- Using daylight harvesting systems might not be the most efficient in Nordic countries. However, absence and presence sensors can contribute to significant energy savings.
- Optimizing the building form to eliminate deep and dark areas that only rely on electric lighting will reduce energy use over time.
- It is recommended to couple general lighting at lower illuminance levels with task lighting with individual control for energy saving.
- Lighting design concepts should aim to include both general lighting and decorative lighting to avoid having two separate layers of light that compete with each other and use unnecessary and unwanted energy.

CIRCULARITY

- Prioritize products that use recycled materials, such as recycled aluminum.
- Ask manufacturers for the environmental product declarations of their products.
- Make use of the CIBSE TM66 specifier assessment tool to compare products.
- Prioritize products that ensure reparability and upgradability.
- Consider specifying fixtures that are reused (upgraded or not after previous users).
- Aim to create a long-term relationship with your client so that they can reach out when they need to modify the lighting, whether fixtures' placement or light scenarios.
- When possible, choose timelessly designed fixtures that can be easily circulated in the future.
- Plan a flexible system that is easy to upgrade, add on and adapt.
- When possible, choose decorative fixtures that are likely to keep their value over time.

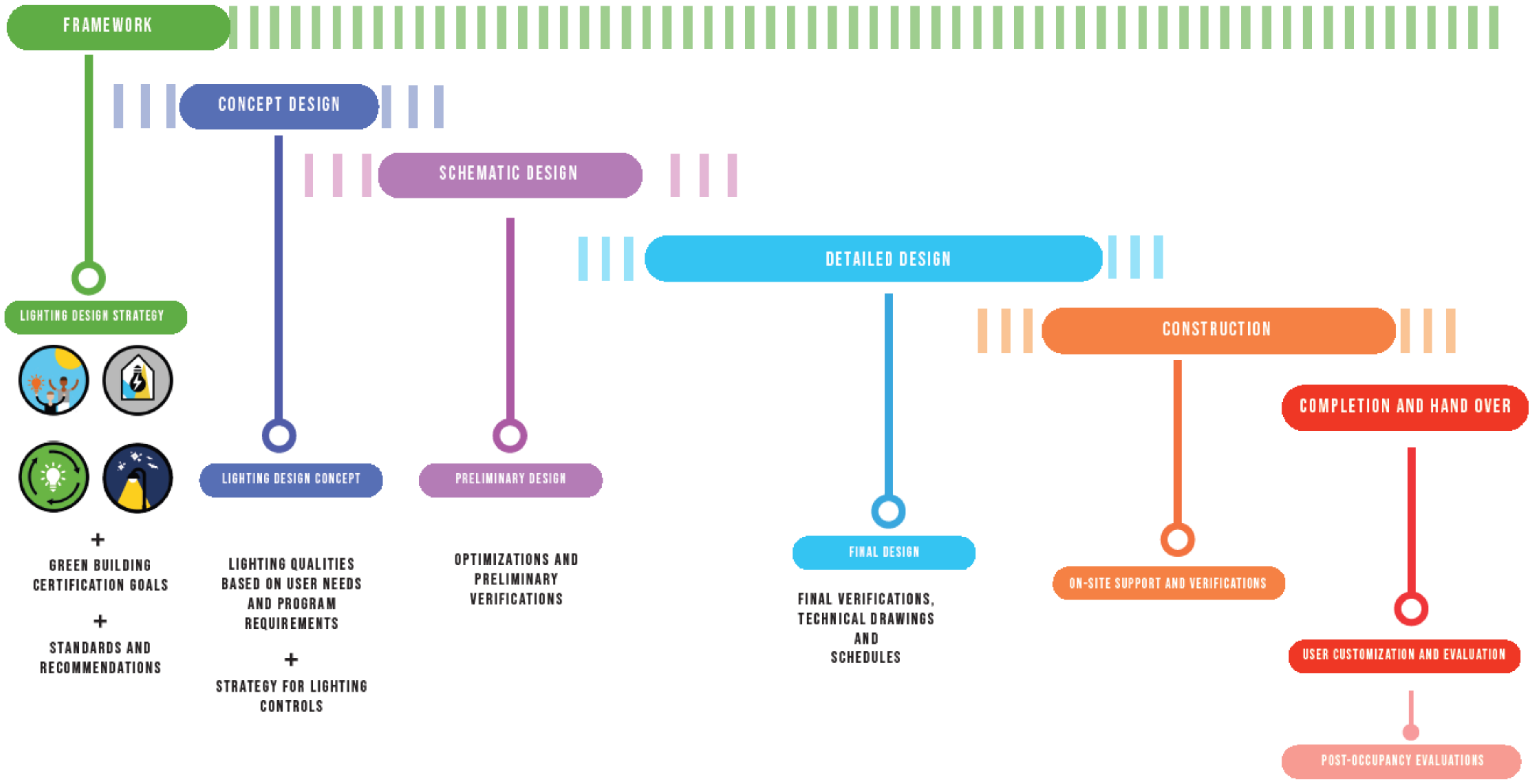
LIGHT POLLUTION

- Install lighting only where needed and have it on when needed.
- Use fully shielded fixtures that direct the lighting downwards. This will reduce the sky glow.
- Ensure that the light levels are not brighter than necessary.
- Incorporate controls to dim the lights or turn them off when they are not needed. This includes motion sensors, timers and time-based scenarios.
- Use warm colour temperatures, 3000K or below. Avoid using blue-enriched light.
- Investigate how the proposed lighting might impact wildlife and their habitat.
- Analyze your proposed lighting design using the BUG assessment parameters, Backlight, Upplight and Glare.
- Place your luminaires responsibly to prevent obtrusive light and light trespass.

OTHERS

- Meet the end users and have an open dialogue about their lighting needs so that the planned lighting can be adapted easily to fulfill them.
- Stay up to date on the latest research and innovations related to daylighting, lighting design, sustainability, light and health, circularity, materials, control systems, etc.
- Step out of your comfort zone by analyzing and reflecting on your lighting solutions from a sustainability perspective and dare to think outside the box.
- Educate people about the importance of sustainable lighting design.

2.2 THE DESIGN PROCESS



FRAMEWORK
CONCEPT DESIGN
SCHEMATIC DESIGN
DETAILED DESIGN
CONSTRUCTION
COMPLETION AND HAND OVER
LIGHTING DESIGN STRATEGY
+
GREEN BUILDING CERTIFICATION GOALS
+
STANDARDS AND RECOMMENDATIONS
LIGHTING DESIGN CONCEPT
LIGHTING QUALITIES BASED ON USER NEEDS AND PROGRAM REQUIREMENTS
+
STRATEGY FOR LIGHTING CONTROLS
PRELIMINARY DESIGN
OPTIMIZATIONS AND PRELIMINARY VERIFICATIONS
FINAL DESIGN
FINAL VERIFICATIONS, TECHNICAL DRAWINGS AND SCHEDULES
ON-SITE SUPPORT AND VERIFICATIONS
USER CUSTOMIZATION AND EVALUATION
POST-OCCUPANCY EVALUATIONS

FRAMEWORK

LIGHTING DESIGN STRATEGY

- Formulating a lighting design strategy, including project goals for health and well-being, energy efficiency, circularity and light pollution reduction, depending on the project type.
- Setting green building certification and building code goals for daylight, electric lighting and energy performance.
- Identifying challenges and possible synergies between daylight and electric light specialists.
- Reviewing the standards and recommendations applicable to the project.
- Creating a checklist and a plan for studies, verifications and synergies between specialists, architects and interior designers throughout the building design process.
- Communicating the lighting design strategy with all stakeholders in the project.

CONCEPT DESIGN

LIGHTING DESIGN CONCEPT

- Creating a lighting design concept for both interior and exterior environments based on user needs, program requirements and the framework above. This can be described through text description, illustrations, reference images, diagrams and renders.
- Determining a strategy for lighting controls (passive users, active users, daylight harvesting, etc.).
- Evaluating user schedules and activities to be performed.
- Running preliminary studies for daylight, sunlight and needs for shading.
- Carrying out daylight design studies from an architectural perspective and optimizing design solutions.
- Evaluating different shading alternatives in case of overheating potential and glare probability.

SCHEMATIC DESIGN

PRELIMINARY DESIGN

- Optimizing daylight and electric lighting design according to the project objectives.
- Preliminary verifying the lighting design sustainability goals, standards and green building certifications.
- Daylight and electric light calculations. This includes EML calculations for evaluating circadian stimulus from both daylight and electric light.
- Carrying out preliminary energy simulations.
- Determining the lighting fixture placements, types and technical specifications.
- Test lighting and mock-ups to evaluate the end result and other qualitative parameters such as glare.
- Setting schedules for lighting controls.
- Coordinating with other consultants, including electrical and energy consultants.
- Advising on fenestration properties, materials and interior layouts.
- Designing shading systems and optimizing facades.

DETAILED DESIGN

FINAL DESIGN

- Further developing the lighting design concept on a more detailed level than the schematic design.
- Conducting final verifications of lighting design sustainability goals.
- Conducting final verification of documents showing compliance with standards and green building certifications.
- Verifying technical drawings, luminaire specifications and control schedules.
- Test lighting and mock-ups.
- Carrying out final daylight and electric light calculations.
- Performing final energy calculations.
- Determining the specifications of facade materials.
- Performing shading system specification and mounting.

CONSTRUCTION

ON-SITE SUPPORT AND VERIFICATIONS

- Providing on-site support, follow up and evaluation of the lighting design proposal.
- Answering possible questions that can arise during the construction phase.

COMPLETION AND HAND OVER

USER CUSTOMIZATION AND EVALUATION

- Adjusting the light levels and control system according to user needs and preferences.
- Focusing directable light fixtures.
- Programming the lighting system based on the lighting control strategy (daylight harvesting, sensors and pre-defined light scenarios).
- Providing guidance to users and maintenance teams on the manoeuvrability of lighting control and user interfaces as well as the maintenance of the lighting system.

POST-OCCUPANCY EVALUATIONS

- Post-occupancy evaluation for both daylight and electric lighting.
- Monitoring the building's energy performance.
- Continuous update of lighting controls to fulfil the ever-changing lighting needs of users.

CASE STUDIES

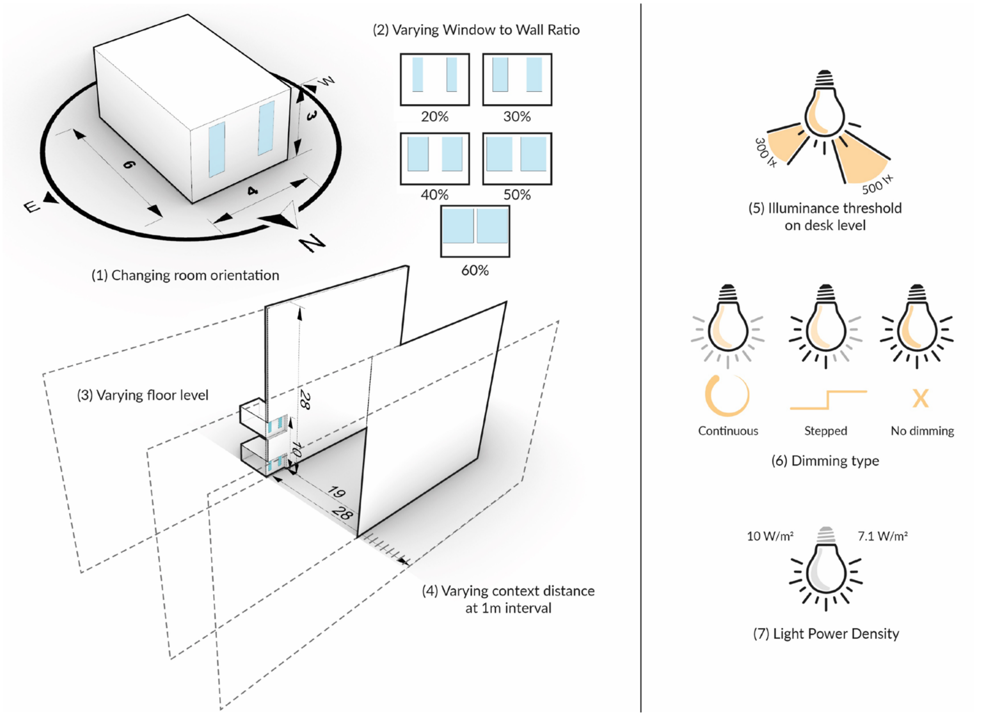
3.1 INTEGRATING DAYLIGHTING AND ELECTRIC LIGHTING IN THE RETAIL SECTOR

3.2 CIRCULAR LIGHTING DESIGN IN COMMERCIAL BUILDINGS

3.3 SYNOPSIS: CURRENT AND FUTURE CHALLENGES FOR EVALUATING AND MEASURING DAYLIGHT IN SWEDEN

3.4 OPTIMIZING DAYLIGHT AND ELECTRIC LIGHT TO REDUCE ENERGY USE AND CARBON FOOTPRINT

3.4 OPTIMIZING DAYLIGHT AND ELECTRIC LIGHT TO REDUCE ENERGY USE AND CARBON FOOTPRINT

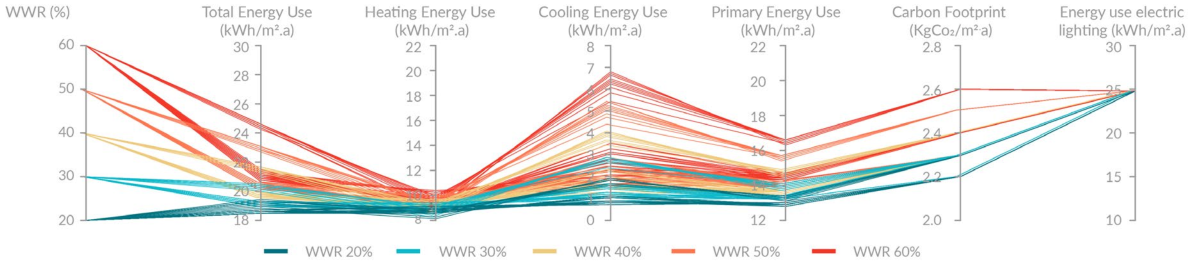


Understand that lighting has not only an effect on direct energy use, but also on heating, cooling and CO_2 emissions.

CHANGING THE WWR IN RELATION TO THE LIGHTING POWER DENSITY (LPD)

WWR with LPD 10 W/m²

Distance to context: 19-28m
Level: 2
Direction: all four directions
Illuminance threshold: 500 lux
Dimming type: off
Lighting Power Density (LPD): 7.1 W/m²



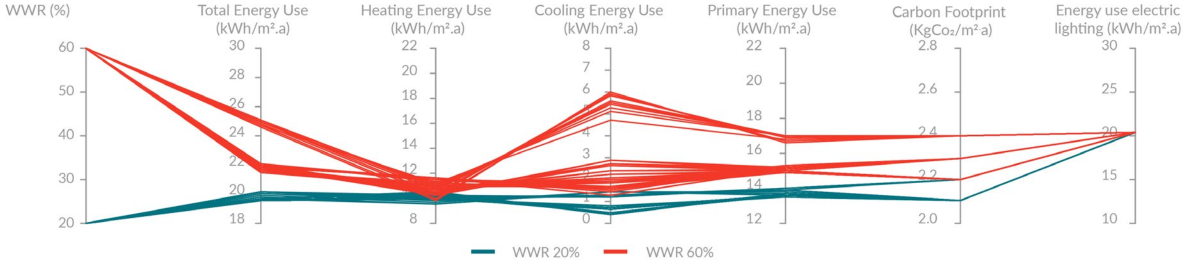
↑ 20%-40%

↑ 5-11%

↑ 4% CO_2

WWR with LPD 7.1 W/2

Distance to context: 19-28m
Level: 2
Direction: all four directions
Illuminance threshold: 500 lux
Dimming type: off
Lighting Power Density (LPD): 10 W/m²

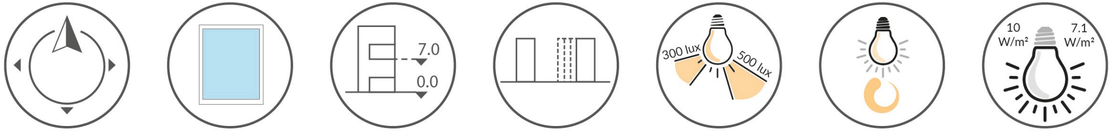


↑ 20%-60%

↑ 4-10%

↑ 4-5% CO_2

RESULTS SUMMARY



Direction	WWR	Level	Distance	Illuminance	Dimming	Light Power Density	Total energy use (kWh/m².a)	Carbon Foot print ($KgCo_2$/m².a)
South/North	40%	2	19-28m	500 lux	Off	10 W/m²	↓8%	↓4%
All directions	60%/ 40%	2	19-28m	500 lux	Off	10 W/m²	↓6-12%	↓8%
All directions	40%	0/ 2	19-28m	500 lux	Off	10 W/m²	↓19-24%	↓11-12%
All directions	40%	0	19m/28m	500 lux	Off	10 W/m²	↓3%	↓4%
South & North	40%	2	19-28m	500/300 lux	Continuous	10 W/m²	↓0.5-1%	↓5%
South	40%	2	19-28m	500 lux	Off/Continuous	10 W/m²	↓2-3%	↓4-8%
All directions	40%	0 &2	19-28m	500 lux	Off	10/ 7.1W/m²	↑4-5% *	↓4%

--/ The base case -- The variable with corresponding results * Energy increases in this scenario

FIND THE REPORT HERE!

Podd

Sustainable Lighting Design

Isabel Villar and Maha Shalaby

5 ★ (11)

> 4500 plays

18% United States
11% Sweden
9% Germany
7% United Kingdom
4% Denmark, Norway
….

The Sustainable Lighting Design project: a holistic approach for a healthier and more sustainable future

Sustainable Lighting Design

In this episode, Maha and Isabel give a summary about the outcomes and main findings of the "Sustainable Lighting Design" project and review the reasons that led them to start the project. The project, funded by Ber...

25 aug. · 42 min 23 sek kvar

Visual delight in architecture: the role of window views

Sustainable Lighting Design

In this episode, we talk with Lisa Heschong, architect and founding principal of the Heschong Mahone Group (HMG), a building science consulting firm, where she led groundbreaking research showing the relationship...

jan. 2022 · 46 min 18 sek kvar

Chronobiology : the nature of our circadian rhythm

Sustainable Lighting Design

In this episode, we talk with Dr. Till Roenneberg, President of the World Federation of Societies for Chronobiology, and former President of the European Society for Rhythms Research. He has initiated and...

dec. 2021 · 49 min 8 sek

Bridging the gap between technology and application: light's quality and energy efficiency

Sustainable Lighting Design

In this episode, we talk with Naomi Miller, lighting designer, and Senior Lighting Research Scientist at the United States Department of Energy - Pacific Northwest National Laboratory. Naomi's work focuses on...

juli 2021 · 27 min 48 sek kvar

Circularity in lighting design: strategies to minimize the environmental impact of lighting systems

Sustainable Lighting Design

In this episode, we talk with Sebastian Knoche, leader of Trilux lighting research team and an active member of the European Repro-Light research project. Repro-light is a European research project that aims to support...

apr. 2021 · 7 min 23 sek kvar

Protecting the dark sky: the environmental impact of light pollution and what we can do about it

Sustainable Lighting Design

Pete Strasser is the Technical Director of the International Dark Sky Association, IDA. IDA is a non-profit organization, whose mission is to "preserve and protect the nighttime environment and our heritage of dark...

jan. 2021 · 1 min 17 sek kvar

Linking WELL certification with practice: a special focus on light

Sustainable Lighting Design

Gayathri Unnikrishnan is a lighting Designer and Vice President of the WELL standard development and Concept Lead for light at IWBI. In this Podcast we will be getting some insights into the Light feature in the...

aug. 2020 · 50 min 15 sek kvar

Daylighting and lighting under the Nordic sky: findings from research and practice

Sustainable Lighting Design

Marie- Claude is an associate professor at the Department of Architecture and the Built Environment at Lund university in Sweden and an expert on sustainable design at White Arkitekter. She recently published the bo...

juli 2020 · 49 min 38 sek kvar

Thank you !

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