

Challenges - Sustainable Lighting Design

Isabel Villar, IAŁD / MSc. Lighting Design
IEA 4E SSL Expert Meeting, March 28th 2023

#whitearkitekter
@whitearkitekter

white



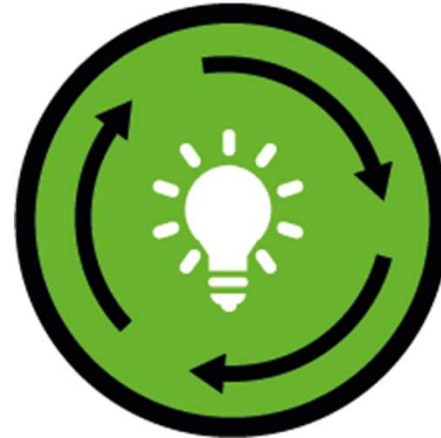




Health & well-being



Energy efficiency



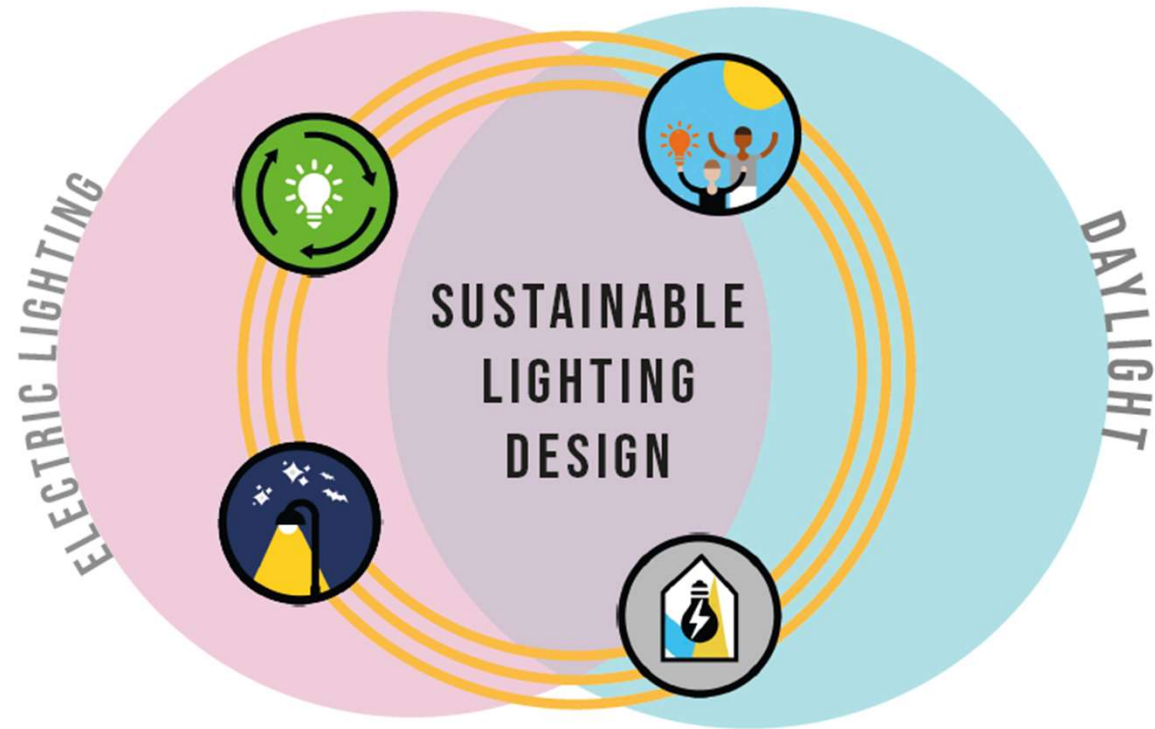
Circularity



Light pollution

1

Complexity, we are also a part of the ecosystem



Sustainable lighting design diagram



STANDARDS AND CERTIFICATIONS



ANSI/ASHRAE/IES Standard 90.1-2019
 (Supersedes ANSI/ASHRAE/IES Standard 90.1-2016)
 Includes ANSI/ASHRAE/IES addenda listed in Appendix I

Energy Standard for Buildings Except Low-Rise Residential Buildings (I-P Edition)

See Appendix I for approval dates by ASHRAE, the Illuminating Engineering Society, and the American National Standards Institute.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. Instructions for how to submit a change can be found on the ASHRAE website (www.ashrae.org/governance/maintenance).

The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-876-8400 (worldwide), or toll free 1-800-527-4773 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

© 2019 ASHRAE ISSN 1041-2336



SVENSK STANDARD
 SS-EN 12464-1:2021

Ljus och belysning – Belysning av arbetsplatser –
 Del 1: Arbetsplatser inomhus
 Light and lighting – Lighting of work places –
 Part 1: Indoor work places

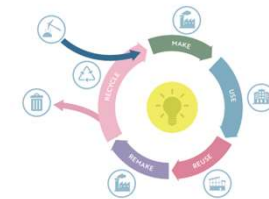


sis Svenska Institutet för Standarder

Svensk, europeisk, svensk, engelsk/
 Profil: 1010101-4
 ISO-mått och enheter: White A4/Metric A4 Customer number:
 Item: 102201-01



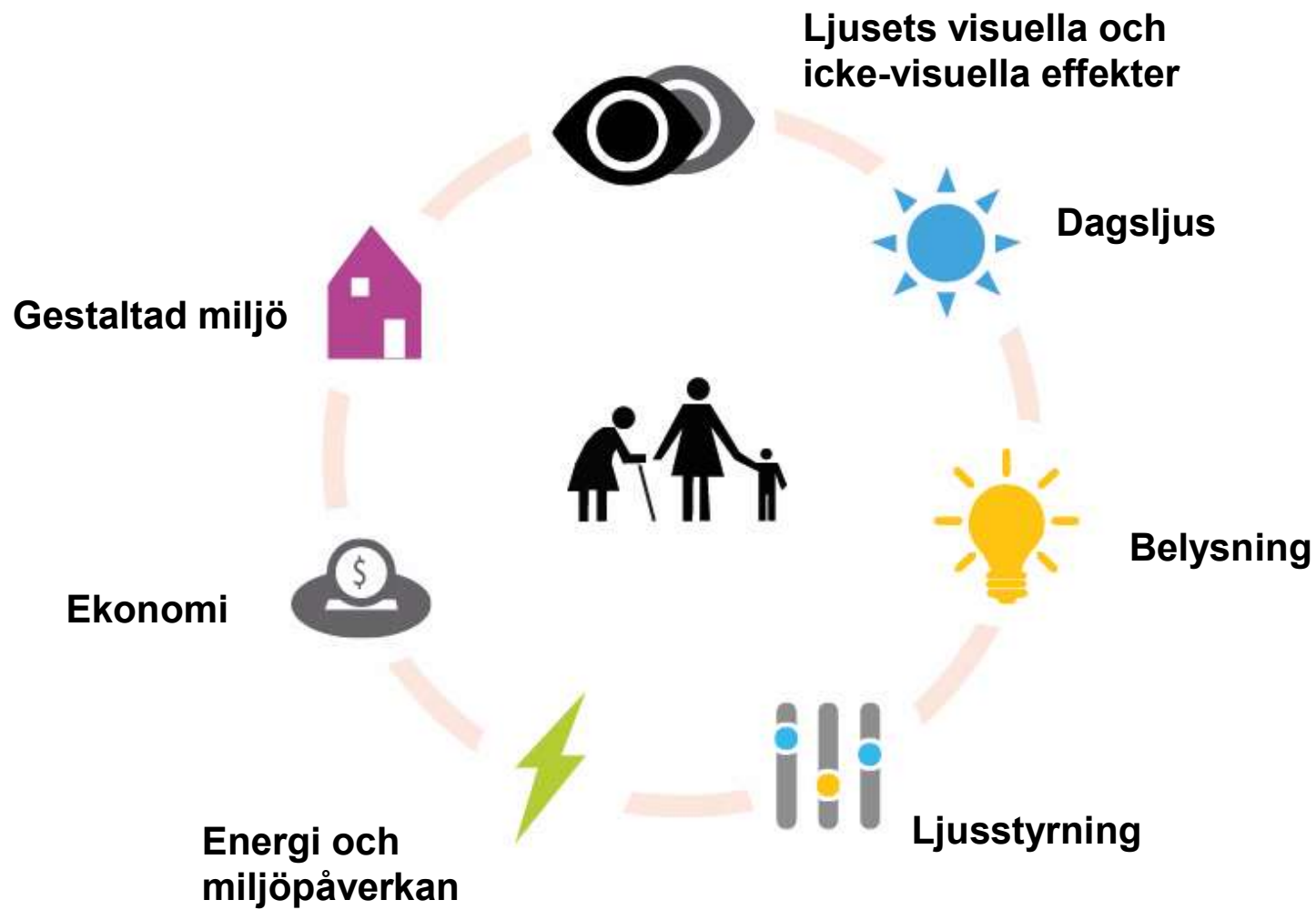
Creating a circular economy
 in the lighting industry



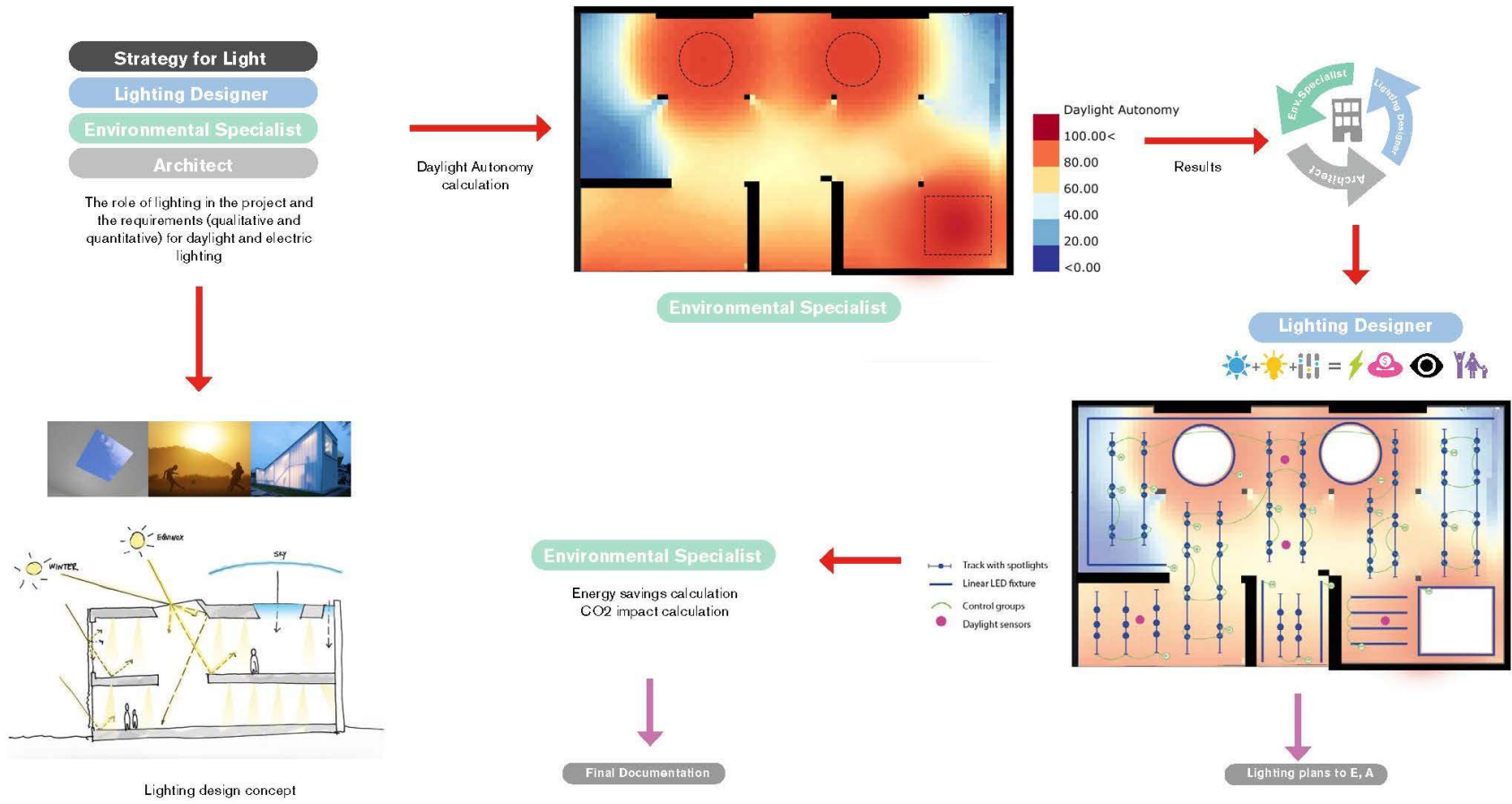
TM66: 2021



FACTORS AFFECTING A GOOD LIGHTING ENVIRONMENT



LIGHT IN THE DESIGN PROCESS- WORK FLOW



SOURCE VILLAR, SHALABY, 2018 WHITE ARKITEKTER



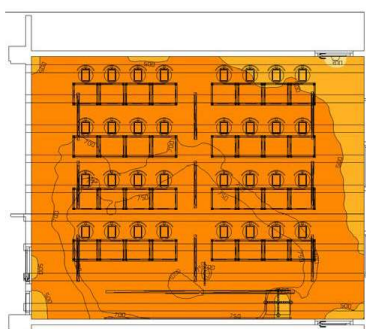
2

Implementation
of lighting
standards
12464-1:2021
(risk for
increased
energy use)

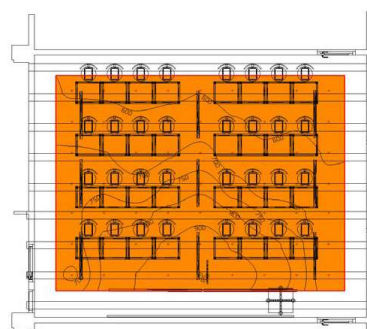


Energy consumption for surface mounted >
30-40% vs suspended alternative

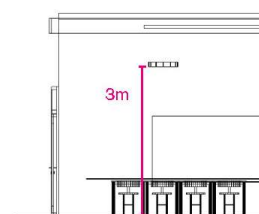
Alt 2_9st linjära pendelarmaturer med upp- och nedljus tvärs under träbalkar



Beräkningsyta **vagg-till-vagg**
Medel = 676 lux (500 lux)
Jämnhet = 0,44 (0,6) *



Beräkningsyta **mindre yta**
Medel = 714 lux (500 lux)
Jämnhet = 0,71 (0,6) *



Antal armatur= 9st
Lumen per armatur= 3 635lm
Effekt= 35W x 9 = 315W

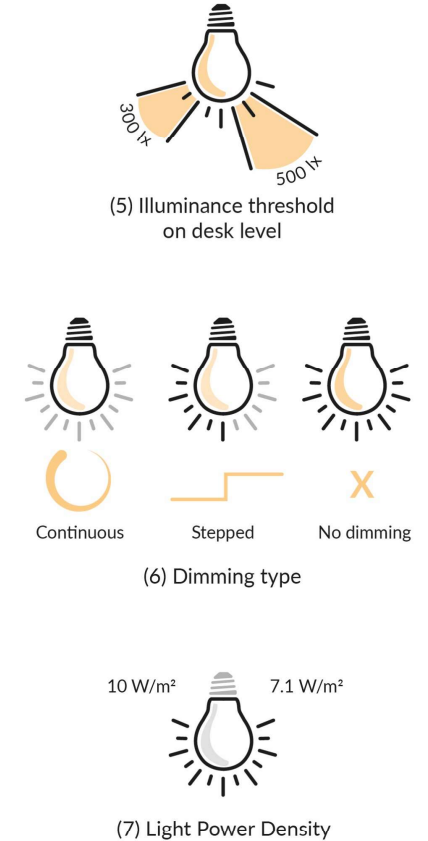
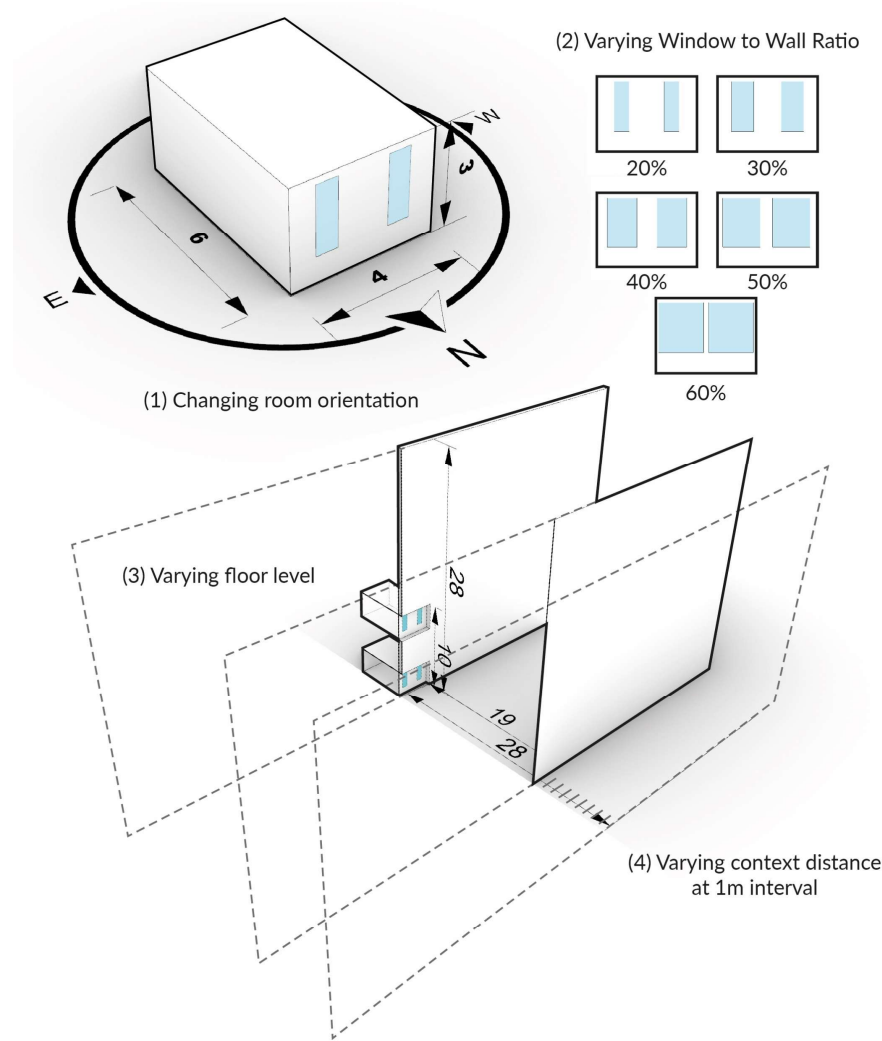
- + armaturplaceringen samordnar bättre med alla installationer
- minst populära ur ett gestaltungs-perspektiv
- fler armaturer, mer installations- och underhållskostnader

*Enligt belysningsstandaren krävs en medel belysning av 500 lux samt jämnhet av 0,6 på ett arbetsområde av 0,60x0,60m.

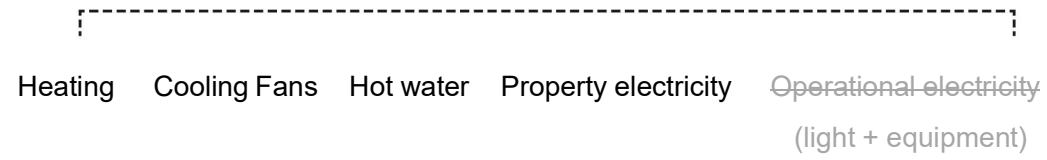
3

PARAMETRIC STUDIES

Understand that lighting has not only an effect on direct energy use, but also on heating, cooling and Co2 emissions.

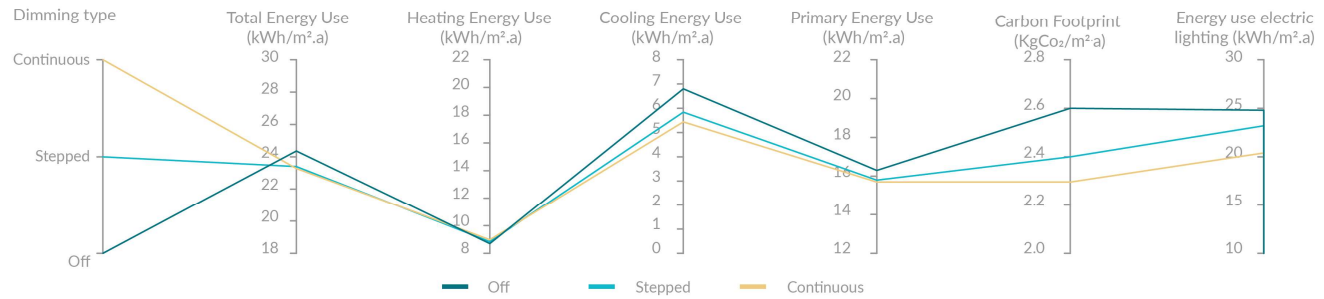


Primary energy



Dimming type- South facing room

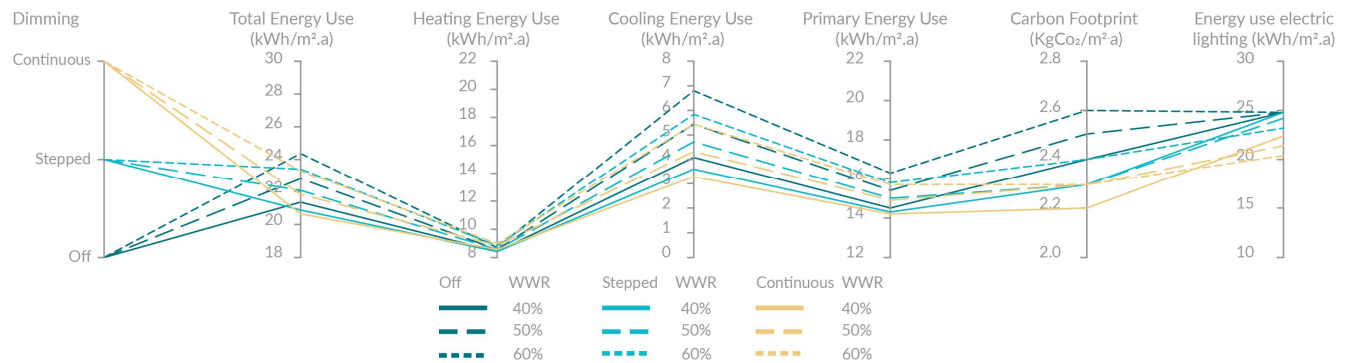
Window-to-wall ratio: 60%
 Distance to context: 28m
 Level: 2
 Direction: South
 Illuminance threshold: 500 lux
 Lighting Power Density (LPD): 10 W/m²



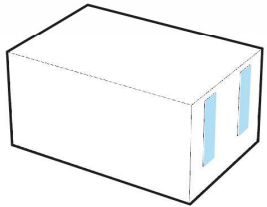
Under which daylight conditions does daylight harvesting / continuous dimming actually result in energy saving?

WWR and dimming type

WWR: 40-60%
 Distance to context: 28m
 Level: 2
 Direction: South
 Illuminance threshold: 500 lux
 Lighting Power Density (LPD): 10 W/m²

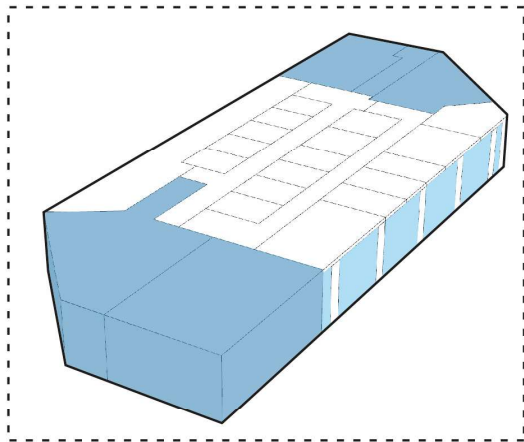


1 Single room

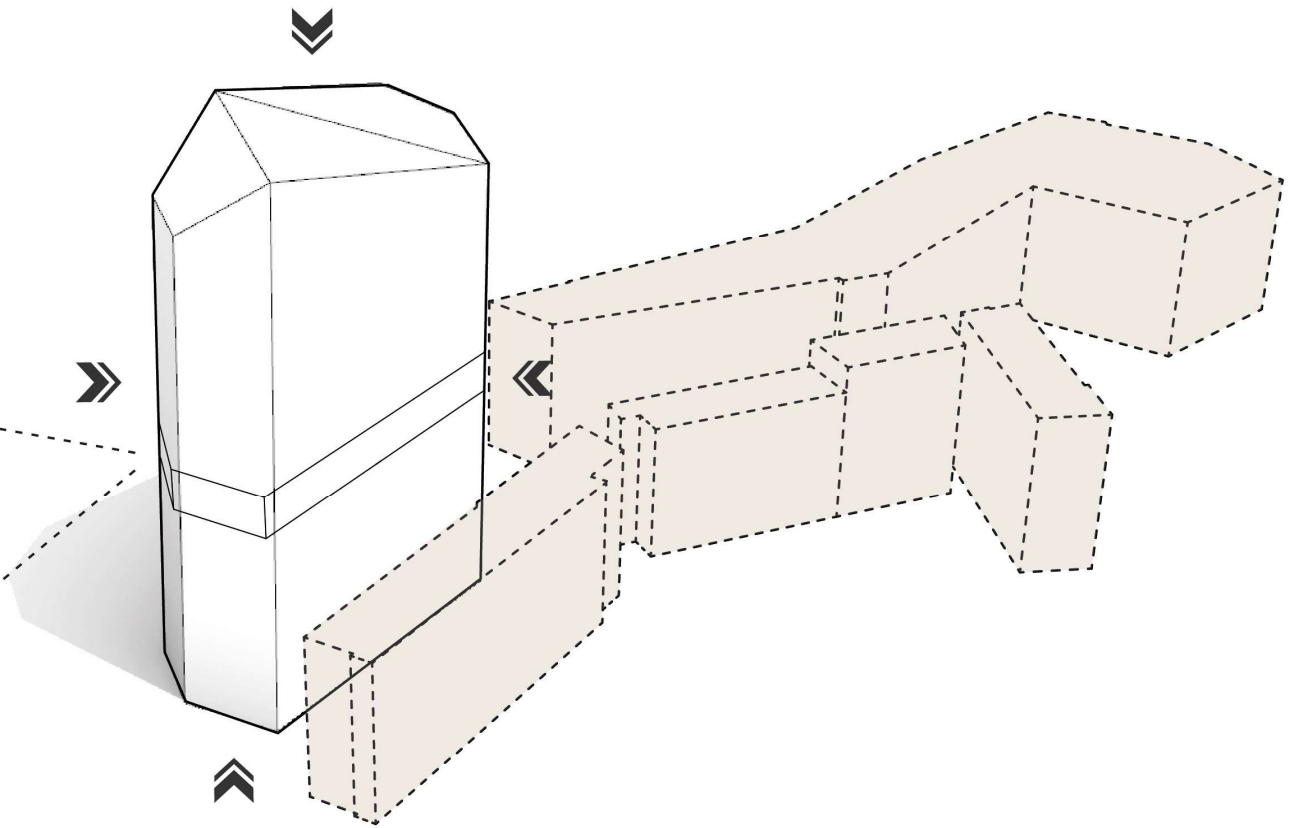


Research funded by  Berit & Britt Svenssons
Stiftelse för Belysningsteknik

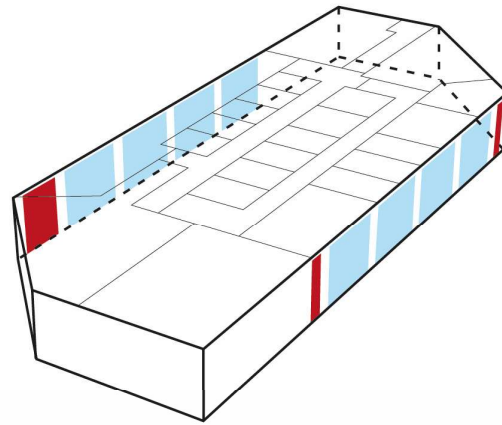
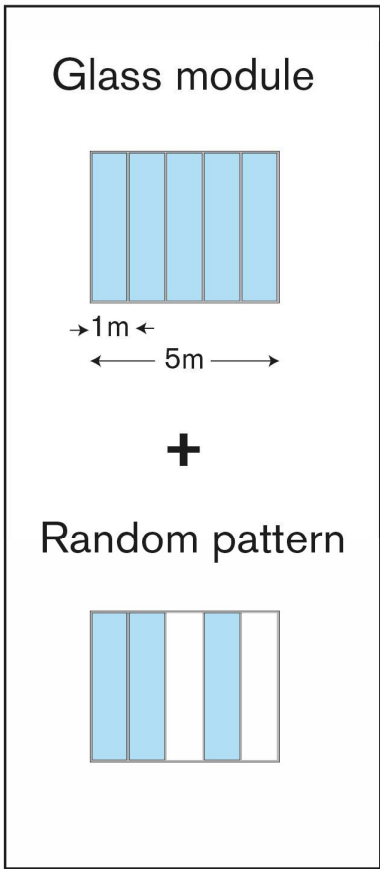
2 One floor plan



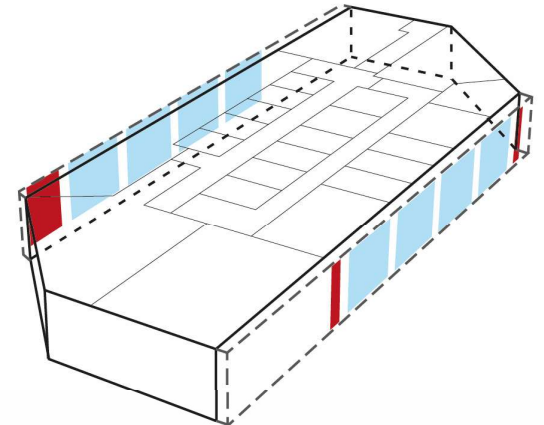
3 Entire building



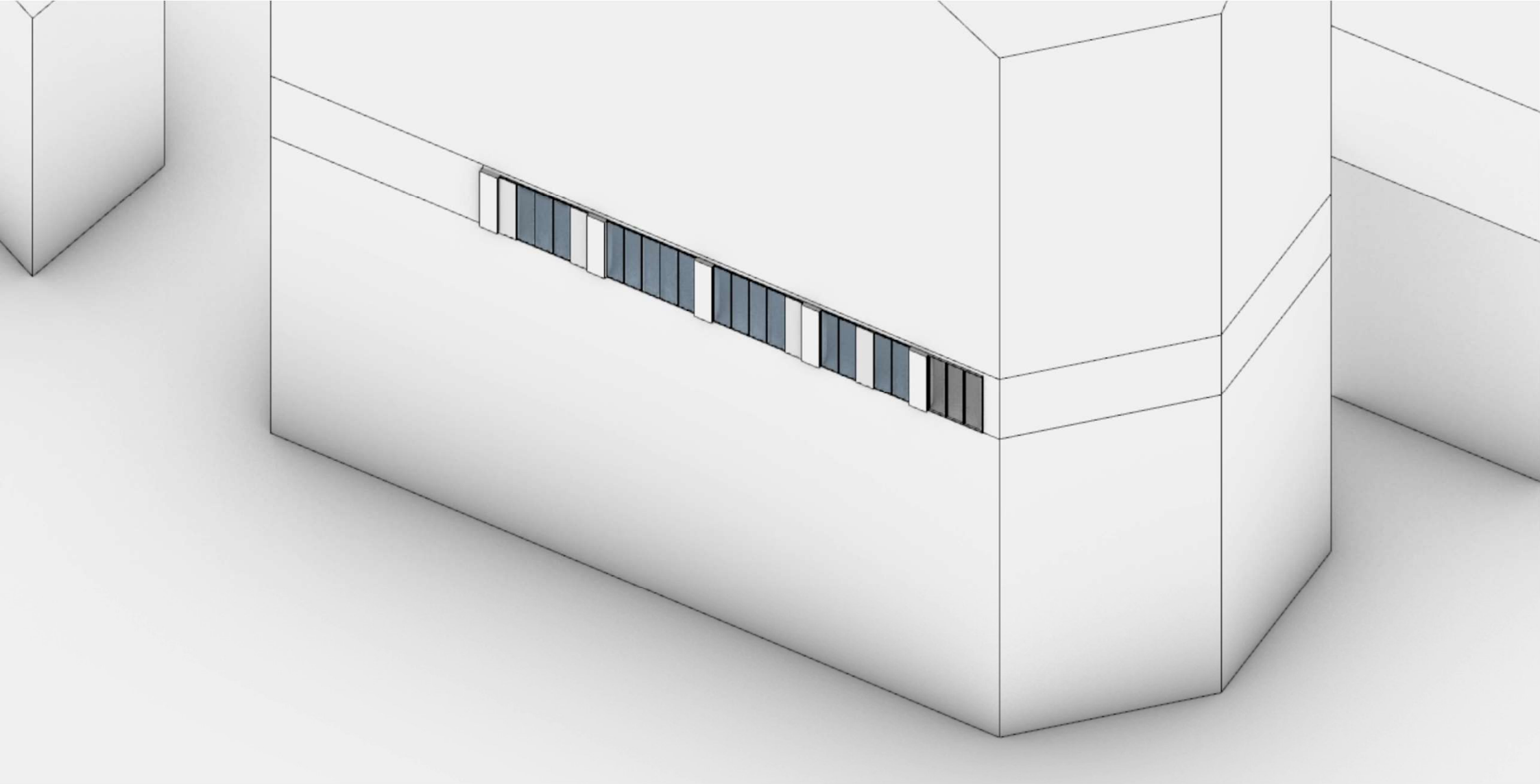
 Glass  Excluded areas  Context

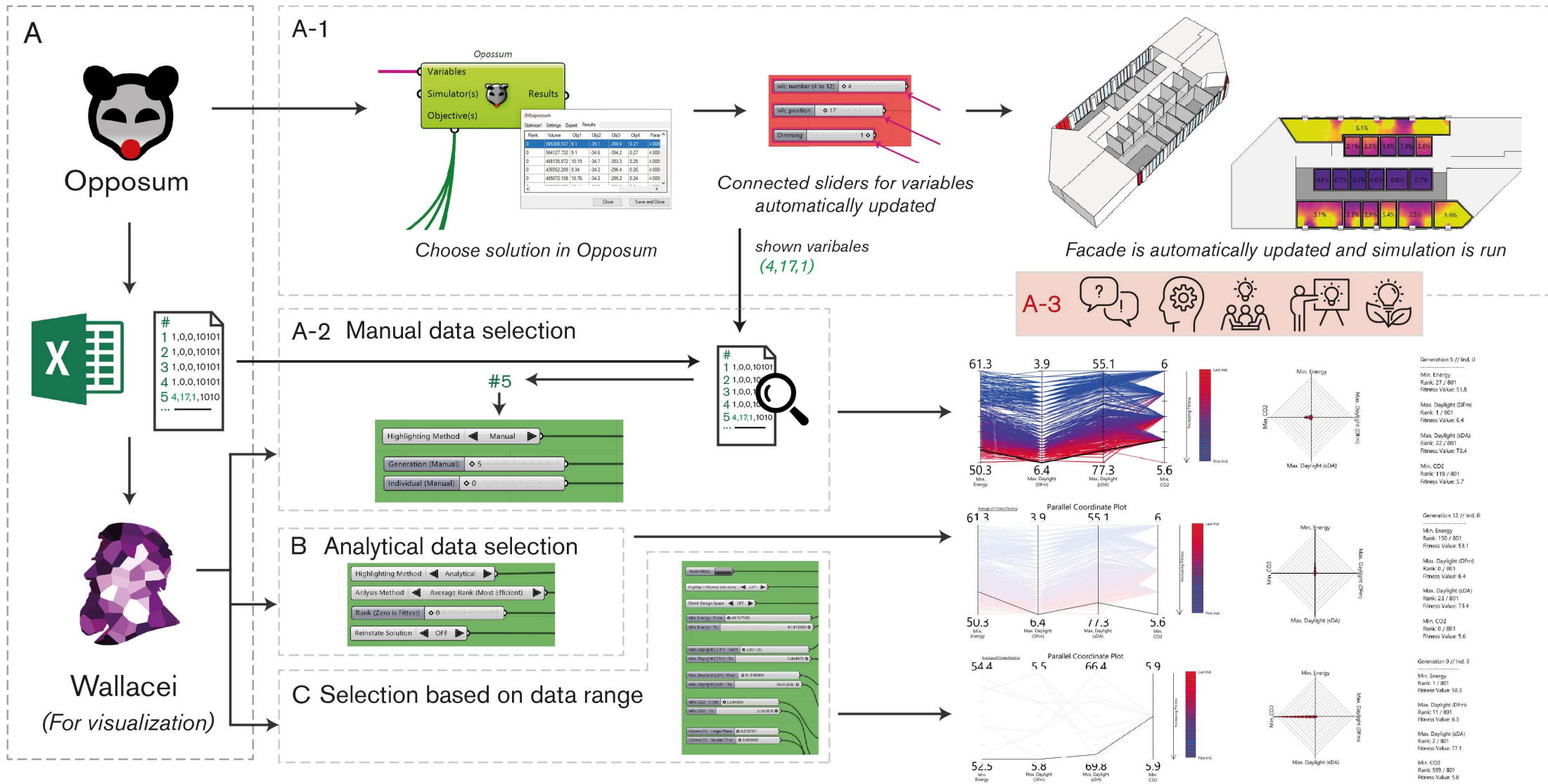


Energy model as a base



Simple daylight model

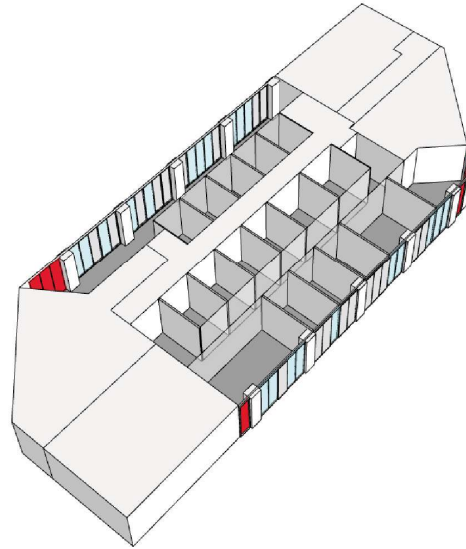




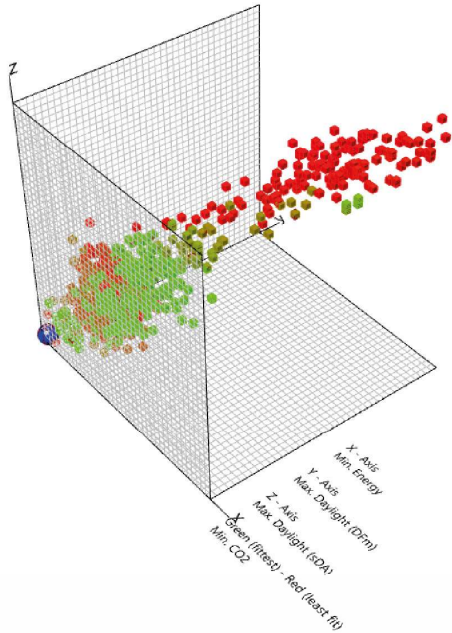
SECTION | SOLUTION #0 |

Best solution based on opposum (with dimming)

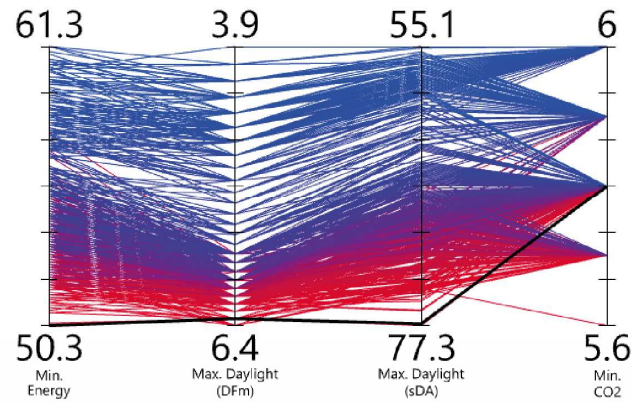
- Not all rooms have windows
- Best ranks for energy, DF, sDA
- Embodied carbon had very bad ranking
- After analysing this solution, it is not considered the best



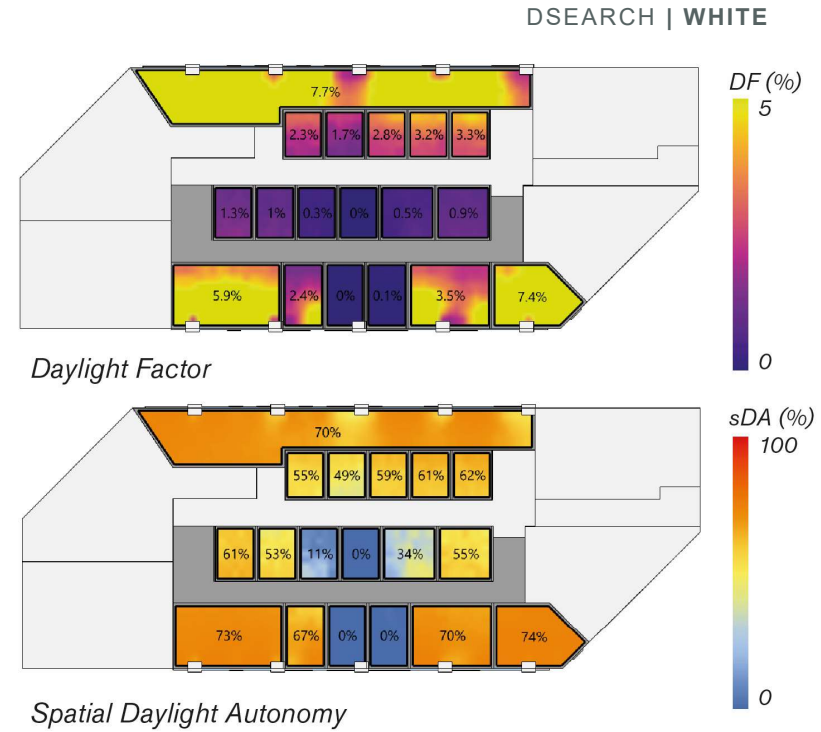
Window configuration



3D result preview

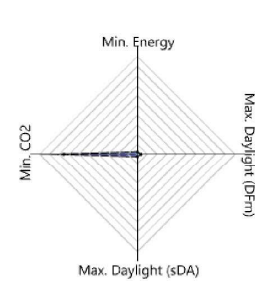
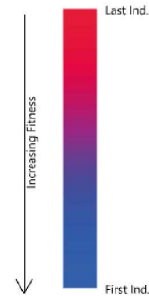


Parallel plot diagram



Daylight Factor

Spatial Daylight Autonomy



Generation 0 // Ind. 0

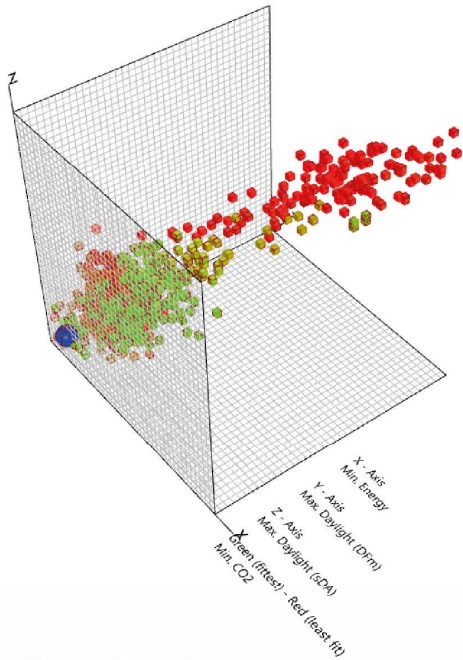
 Min. Energy
 Rank: 1 / 801
 Fitness Value: 50.3
 Max. Daylight (DFm)
 Rank: 11 / 801
 Fitness Value: 6.3
 Max. Daylight (sDA)
 Rank: 2 / 801
 Fitness Value: 77.1
 Min. CO2
 Rank: 599 / 801
 Fitness Value: 5.8

Diamond chart

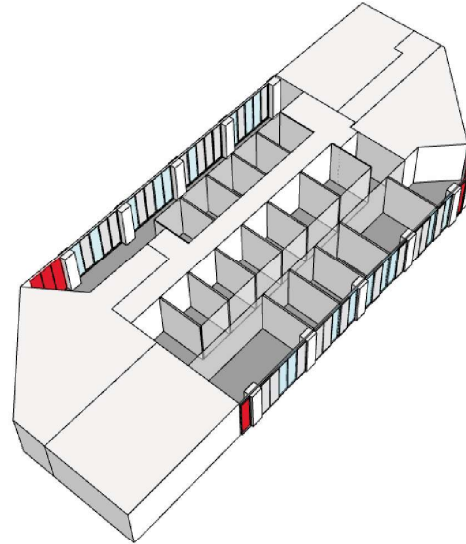
SECTION | SOLUTION #5 | REFERENCE

Best solution with windows in all rooms (including dimming)

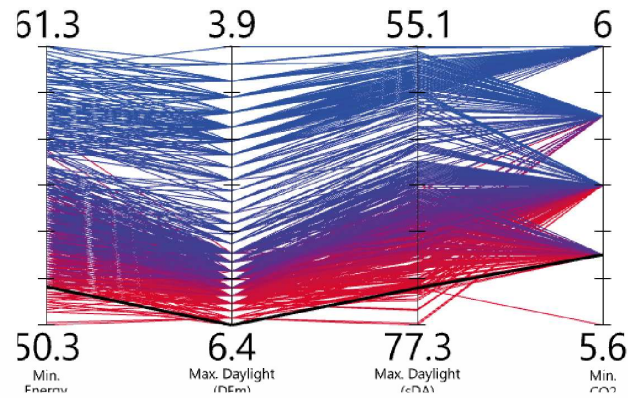
- Energy and carbon have high rank,
- However the energy and carbon values are already low in comparison to all results.
- High daylight values are achieved, achieves BBR.
- sDA > 55%, reaching 2 points in LEED.



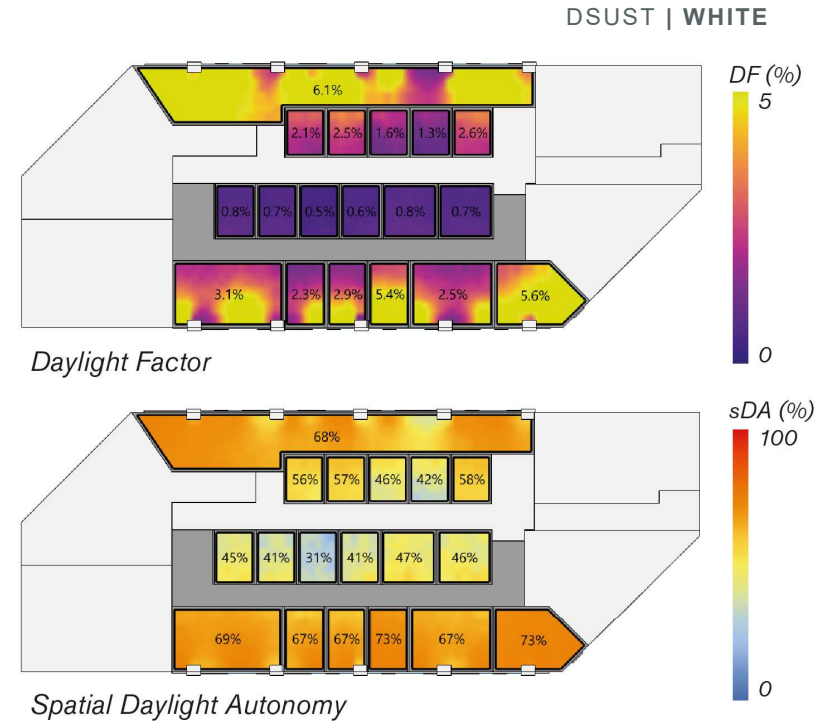
3D result preview



Window configuration

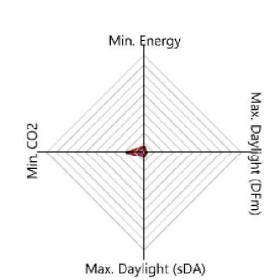
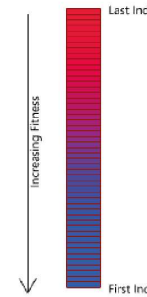


Parallel plot diagram



Daylight Factor

Spatial Daylight Autonomy



Diamond chart

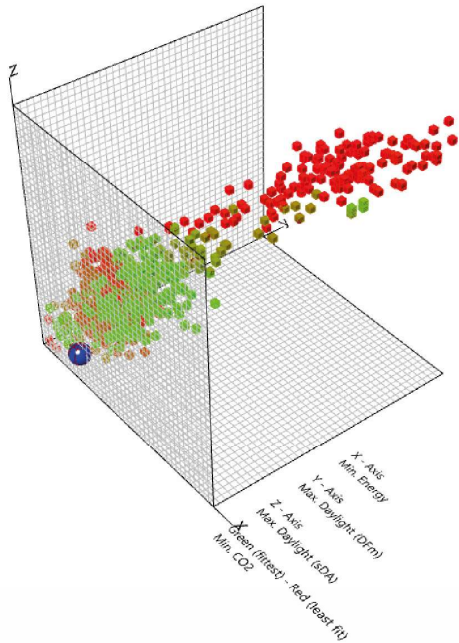
Generation 5 // Ind.

 Min. Energy
 Rank: 27 / 801
 Fitness Value: 51.8
 Max. Daylight (DFm)
 Rank: 1 / 801
 Fitness Value: 6.4
 Max. Daylight (sDA)
 Rank: 22 / 801
 Fitness Value: 73.4
 Min. CO2
 Rank: 119 / 801
 Fitness Value: 5.7

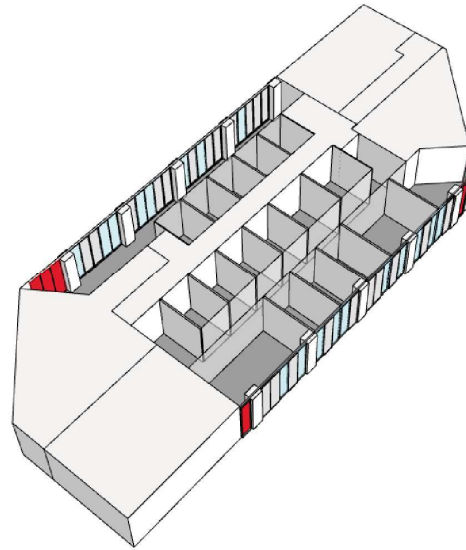
SECTION | SOLUTION #12 | REFERENCE

Second best solution with windows in all rooms (without dimming)

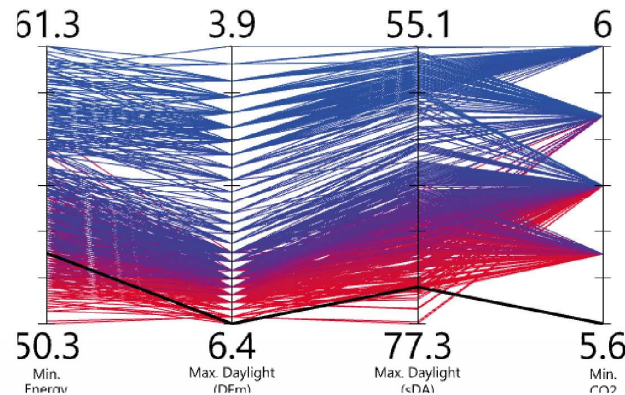
- Lower WWR in comparison to solution #5
- Overall results are very similar to #5
- Lower daylight results-
- Still achieves achieves BBR.
- sDA>55%, reaching 2 points in LEED.



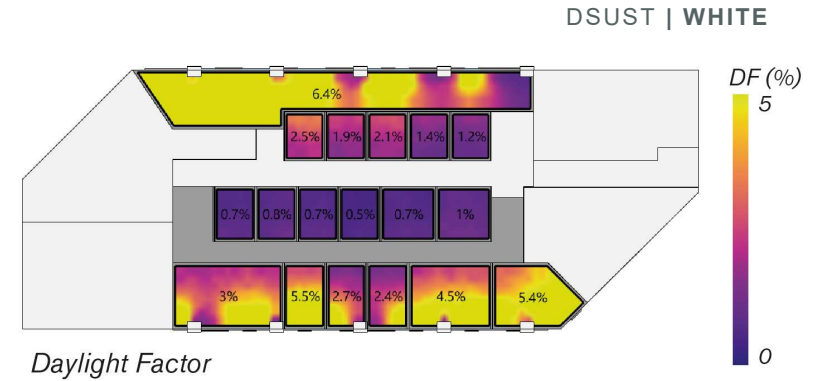
3D result preview



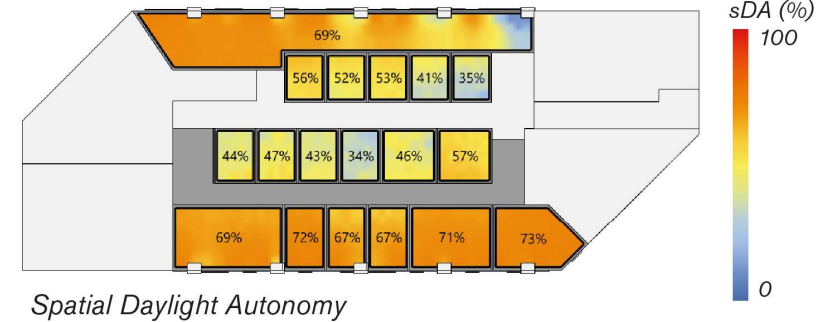
Window configuration



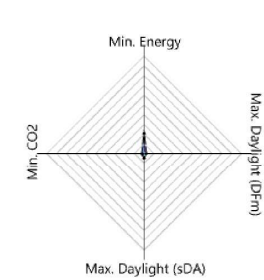
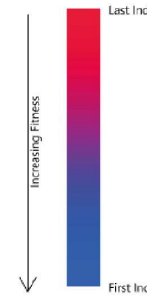
Parallel plot diagram



Daylight Factor



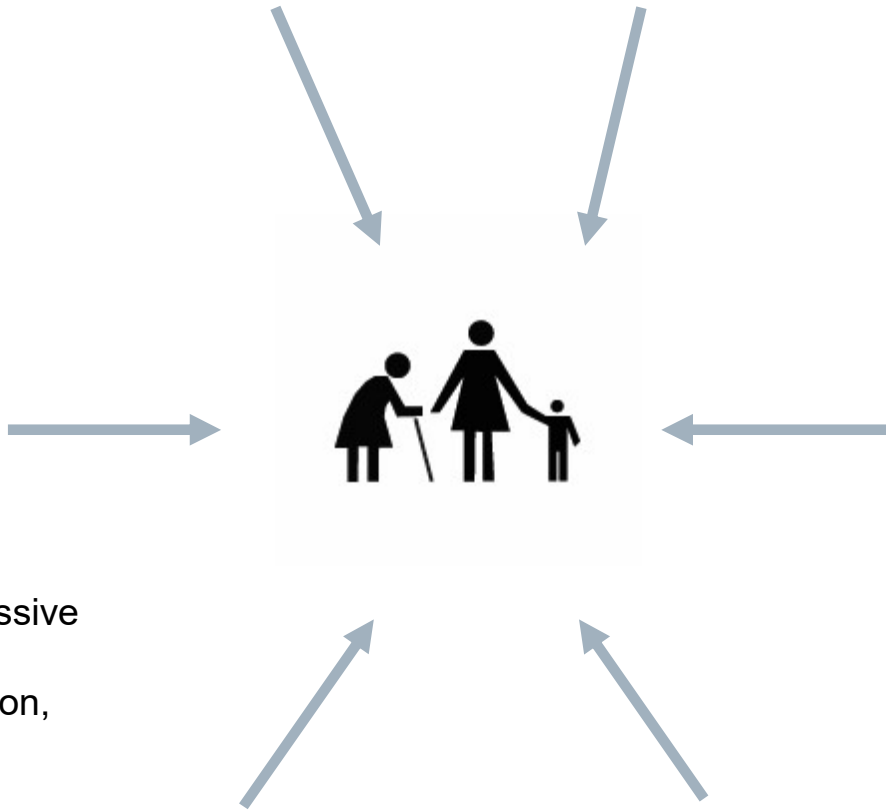
Spatial Daylight Autonomy



Diamond chart

Generation 12 // Ind
 Min. Energy
 Rank: 150 / 801
 Fitness Value: 53.1
 Max. Daylight (DFm)
 Rank: 0 / 801
 Fitness Value: 6.4
 Max. Daylight (sDA)
 Rank: 23 / 801
 Fitness Value: 73.4
 Min. CO2
 Rank: 0 / 801
 Fitness Value: 5.6

4

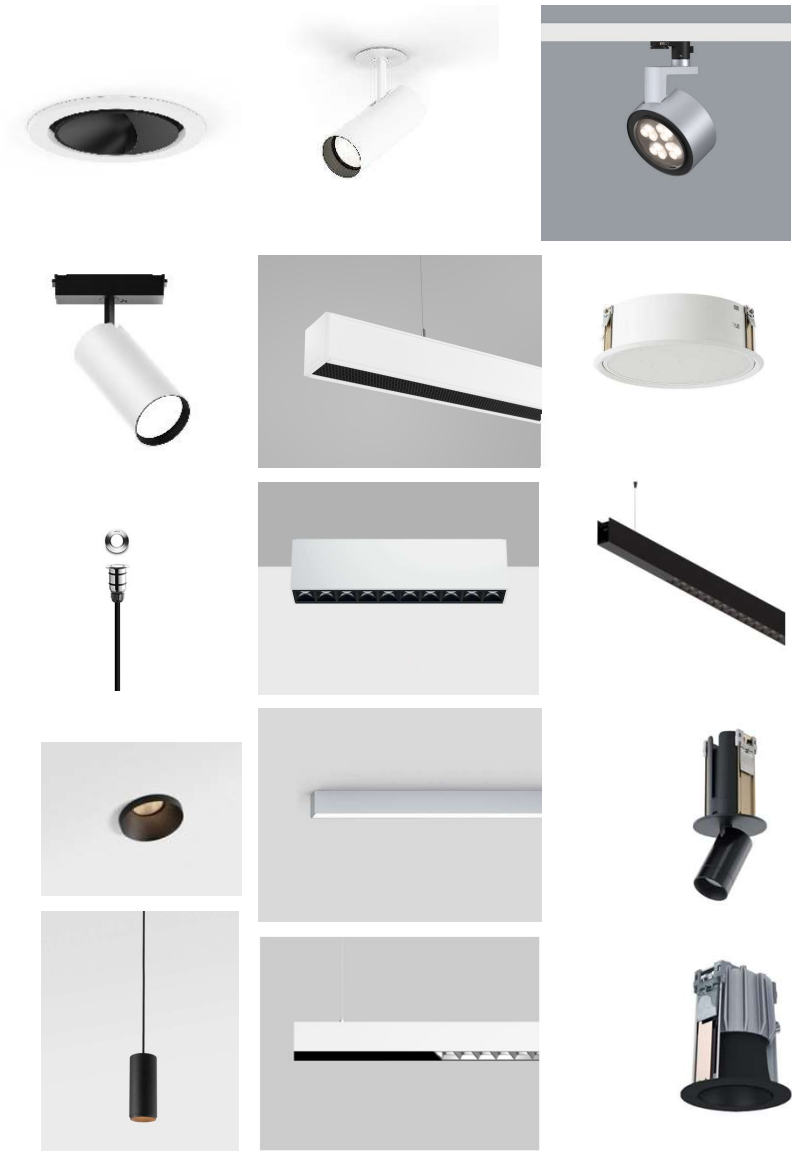
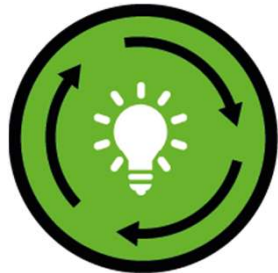
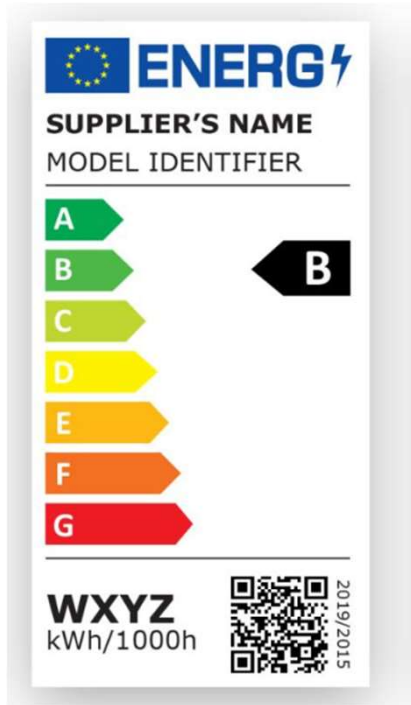


Is "smart lighting"
smarter than us?
Active users vs passive
users, "power to
the users", education,
habits...



5

From private consumers to professional specifiers.







↑
Handboken finns
här!



Thank you !

Isabel Villar / MSc. Lighting Design
Isabel.villar@white.se

white

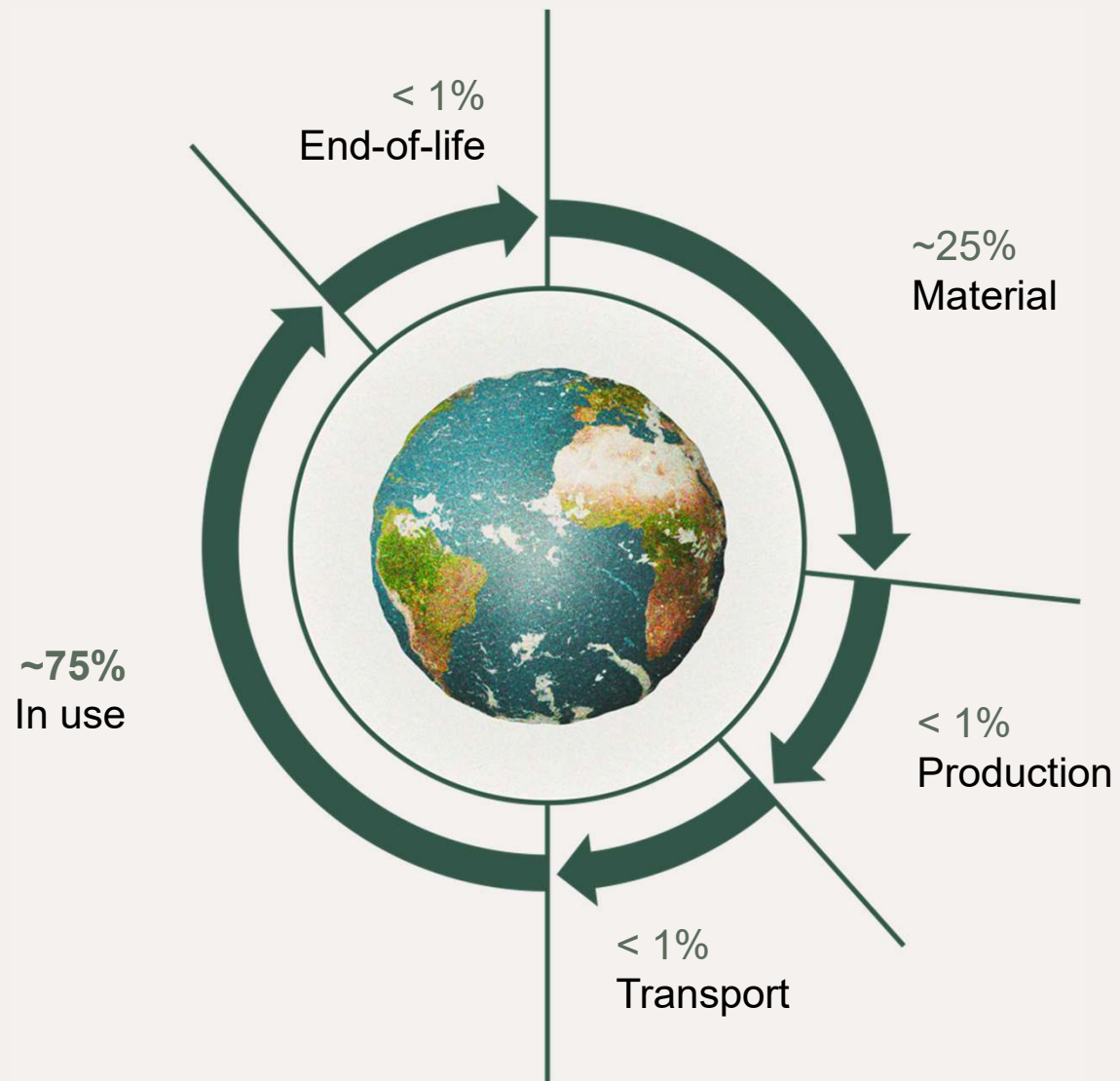
FAGERHULT

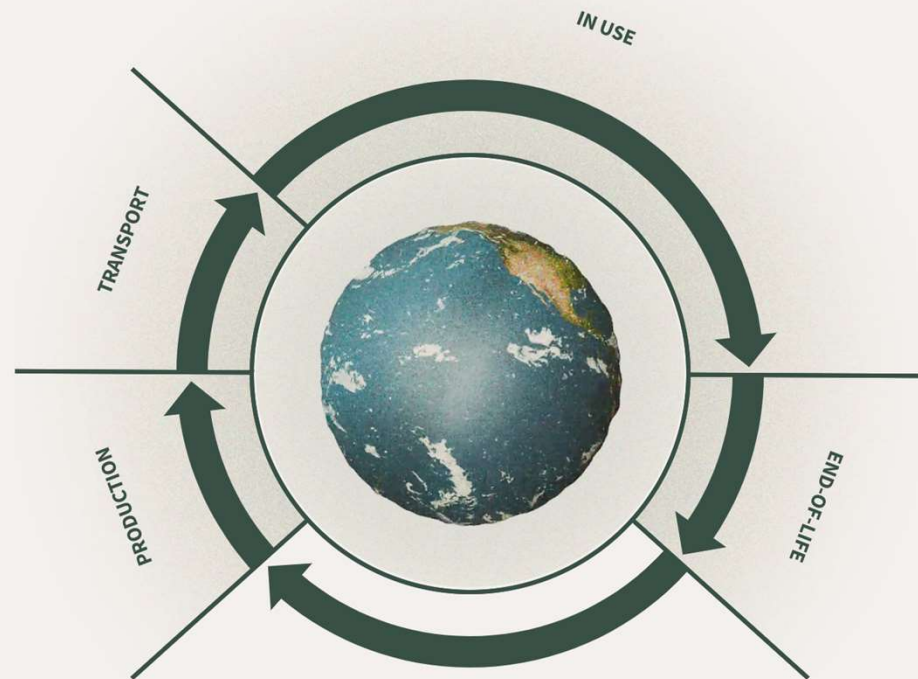
Light for better living.

[OUR VISION]

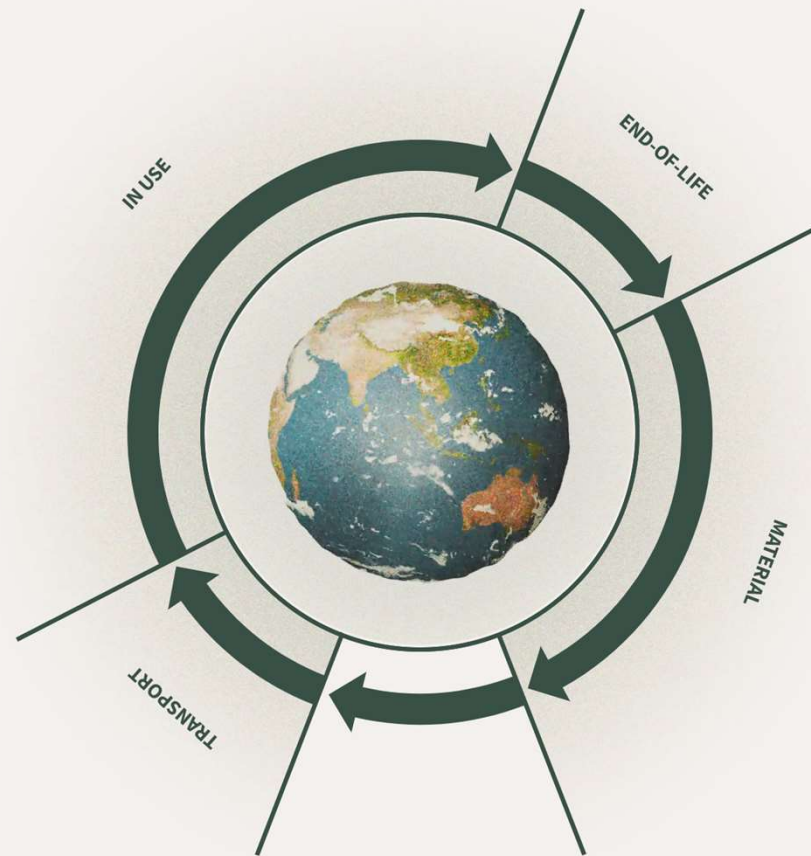
A STRUCTURED SUSTAINABILITY
WORK

**Through thorough analyses,
we have gained insight into our
environmental impact from both
products and our own operations.**

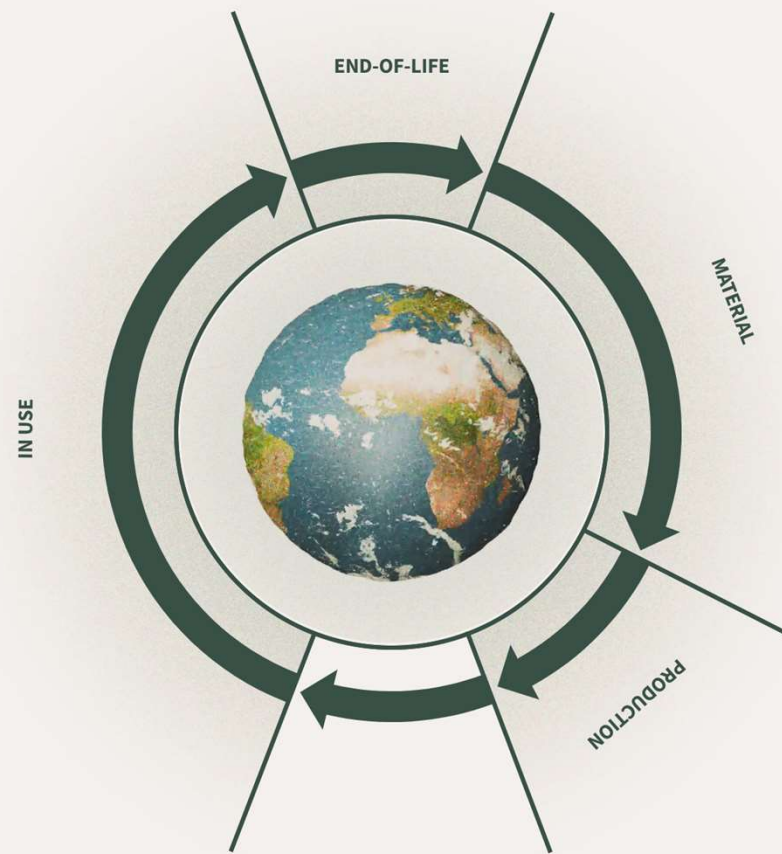




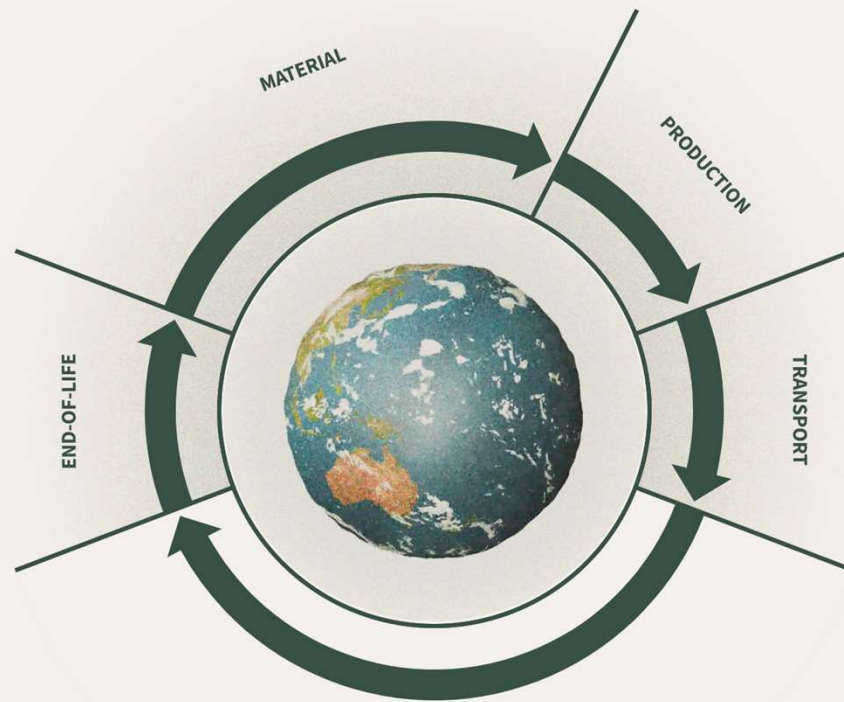
Material
~25%



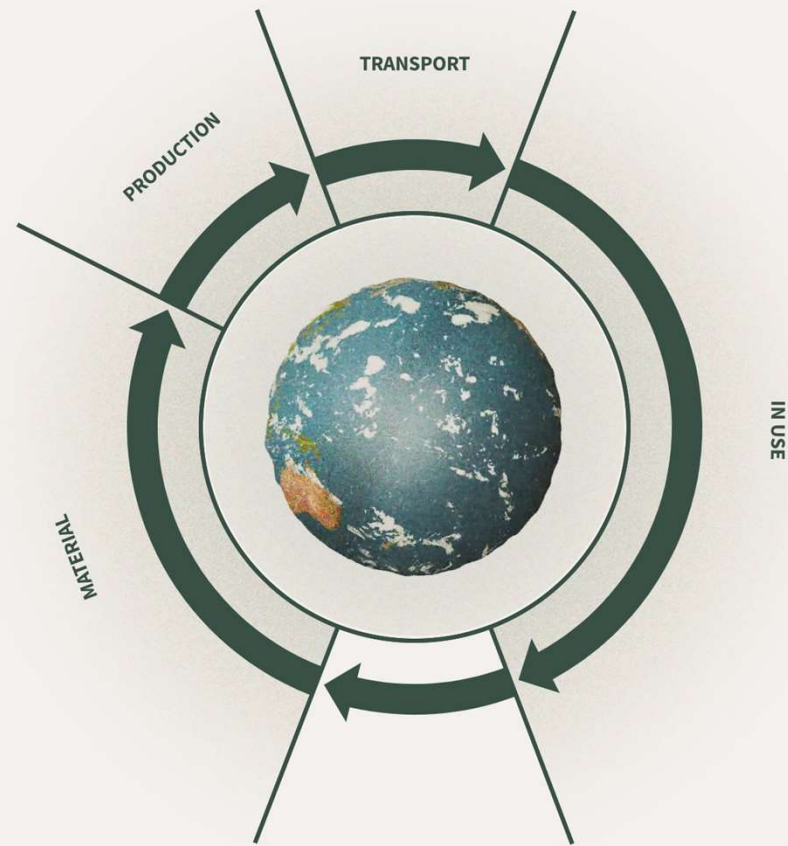
**Production
< 1%**



**Transport
< 1%**



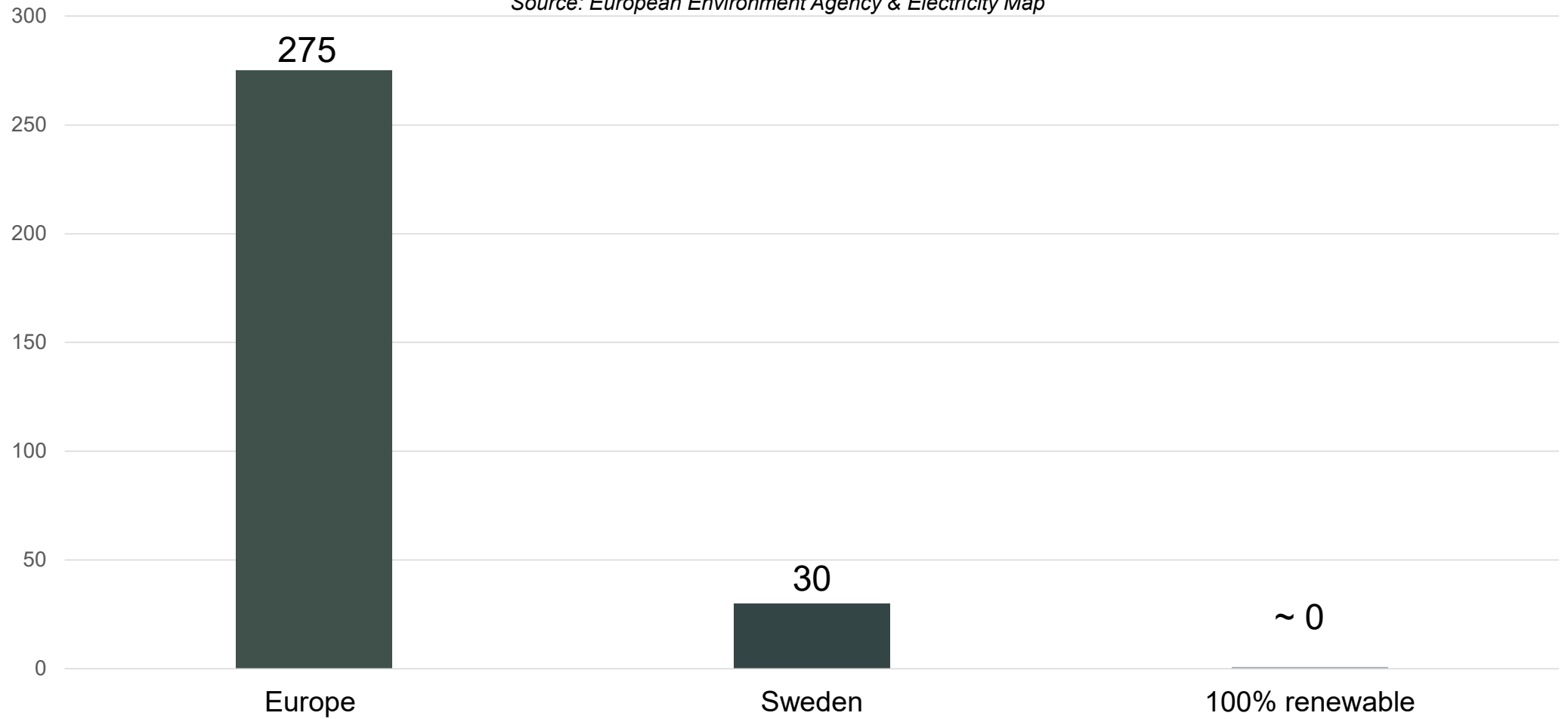
**In use
~75%**

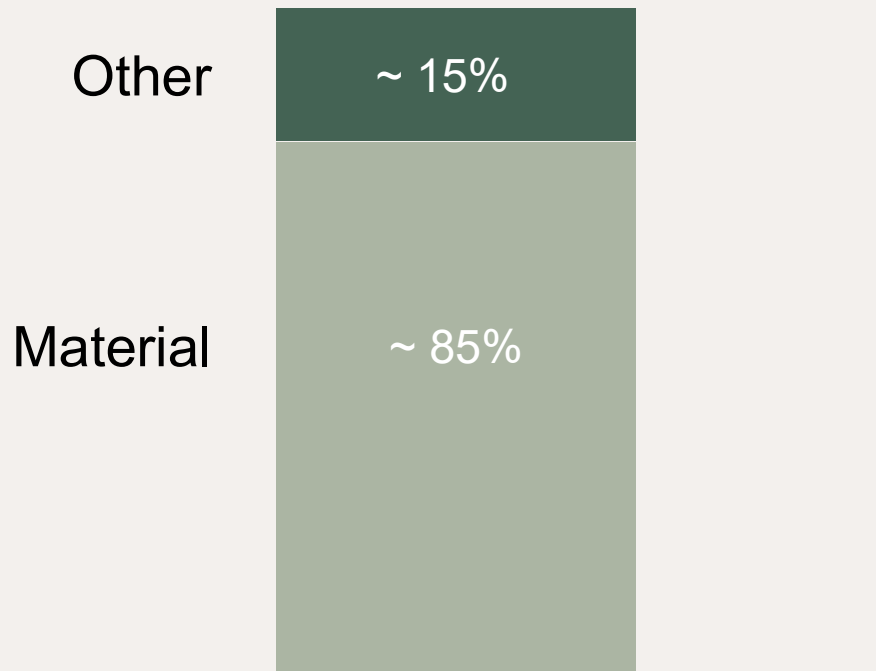


**End-of-life
< 1%**

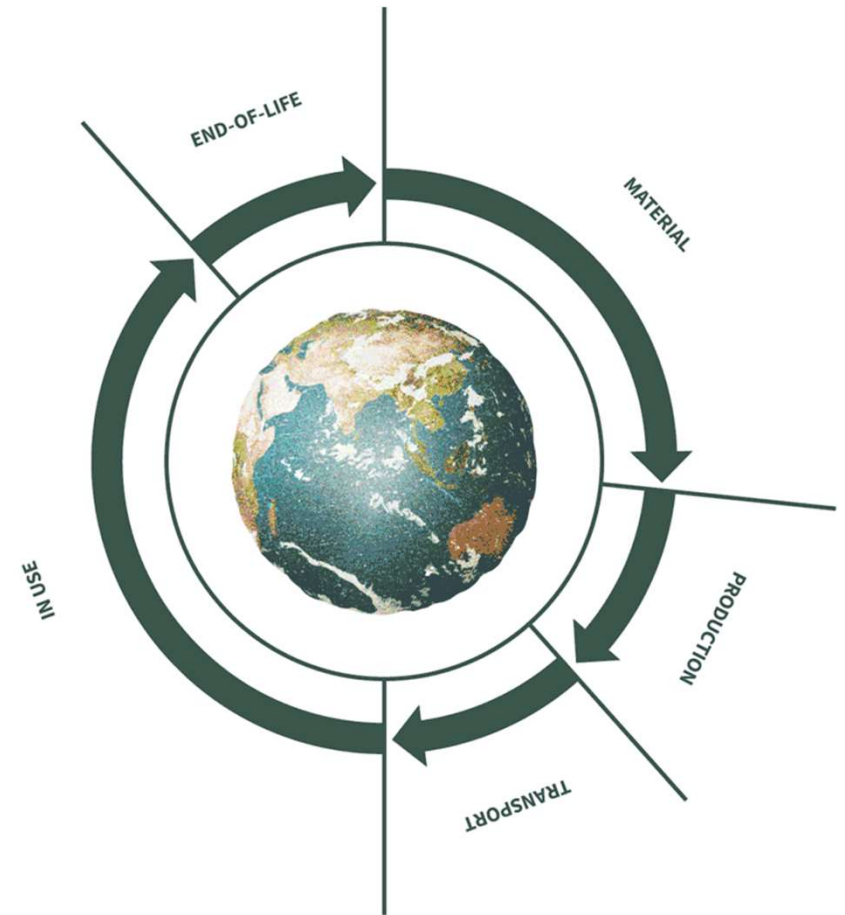
g CO₂e/kWh (2021)

Source: European Environment Agency & Electricity Map





Client with 100% renewable energy





Our sustainability promise