Integrated Solutions for Daylight and Electric Lighting

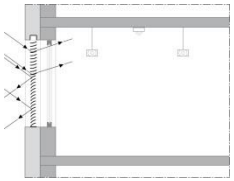
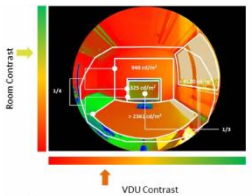
From component to user centered system efficiency

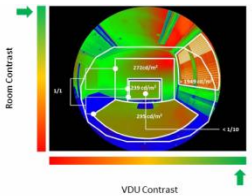
1/2018 – 6/2021

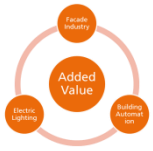
Motivation and Introduction to IEA SHC Task 61 / EBC Annex 77

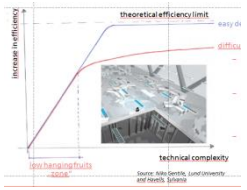
IEA SHC Solar Academy Webinar 25./26 September 2020

Dr. Jan de Boer, Fraunhofer Institute of Building Physics, Stuttgart, Germany





EBC Energy in Buildings and Communities Programme

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2 % Intensity increase of electric lighting

2% Increase of illuminated area

Each year since 2012

15 % of global electricity consumption

5% of green house gas

Rebound effects (low priced, versatile SSL)

Background

- Electric Lighting:
  - High efficient LED Systems, LEDs > 70% of market volume (Europe)
  - Digitalization of light

- Facade
  - 1,3 Billion m² of new facades per year (equivalent of the area of the city of London)
  - How this is done has huge impact on daylight supply

- General Trend: From Component to System solutions

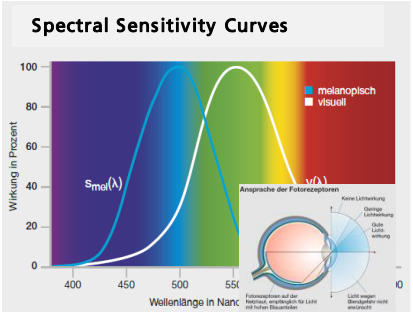
Motivation

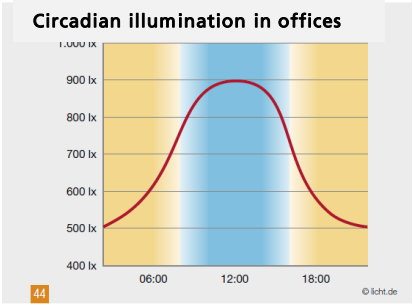
Open issues in the integration of day- and electric lighting

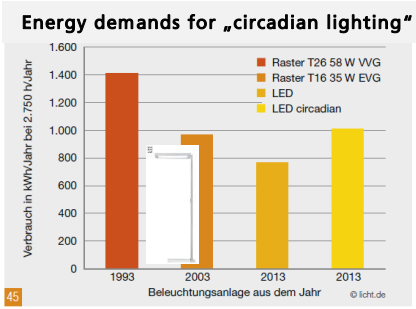
Open Issues

Example 1: User Perspective: Change in design and control parameters

- Lighting solutions have to meet not only visual but non-visual effects as well
- Different needs depending on age
- Implications:
  - Different / additional targets in lighting design
  - We will see higher illuminance levels part of the time: But will that necessary mean higher energy demands?
- New products, methods, solutions coming / required
  - New daylight dependent controls
  - New luminaires (higher intensities, variable spectra)
  - New rating methods (hourly, spectral)
  - Use Cases, scenarios (different for offices, education, health care, museums, industry)







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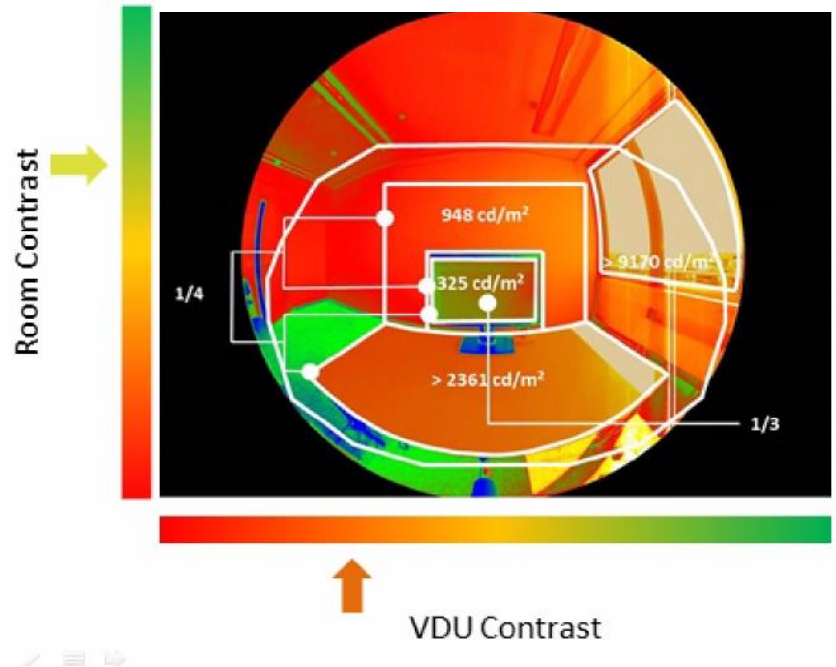
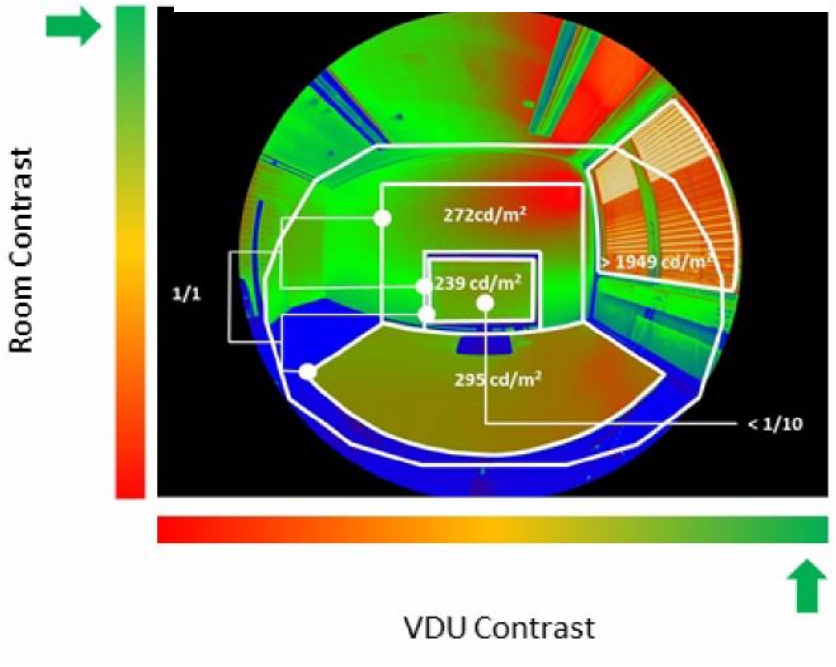
Open Issues

Example 2: Facade control is a daylighting problem

Without Glare Control



With Glare Control



Open Issues

Example 2: Facade control is a daylighting problem

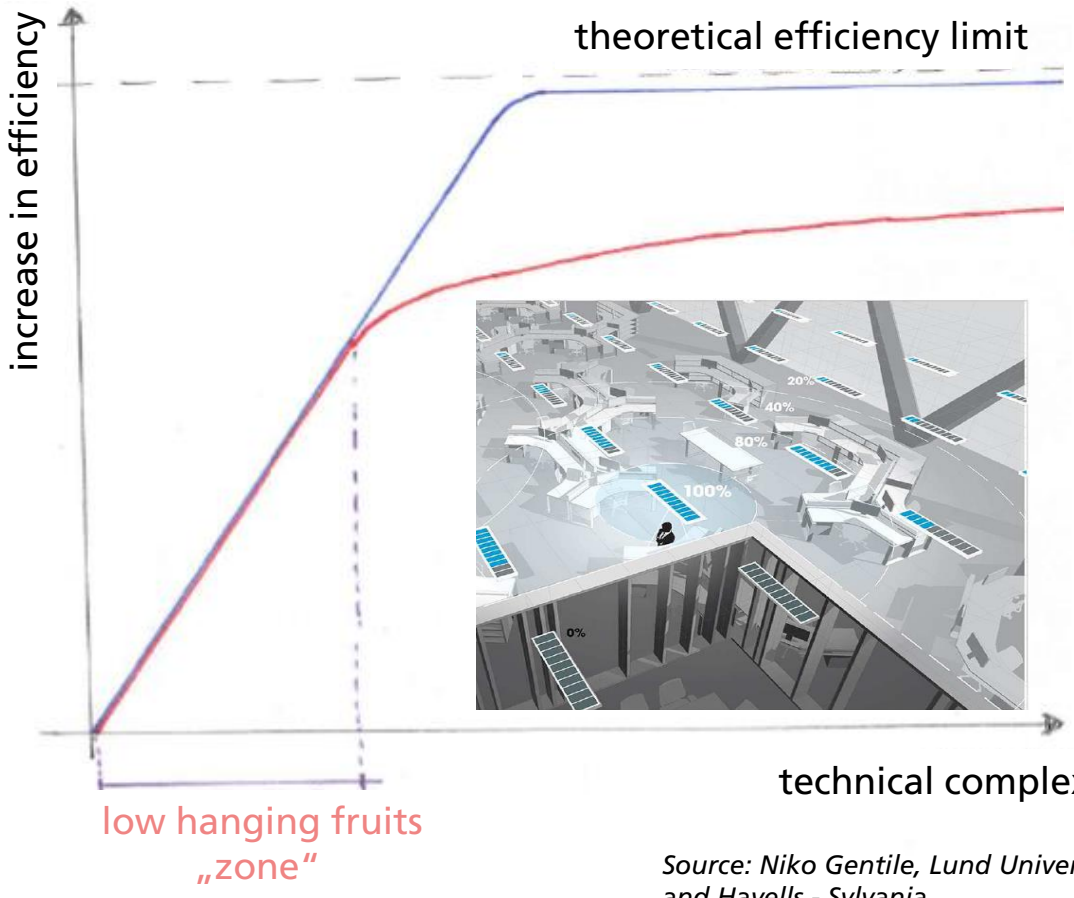
Without Glare Control | **With Glare Control**

Current Situation:
Sun- Glare Protection controlled by thermal (energy) parameters

Future, „Job to get done“:
Integrated approaches relating to the lighting conditions induced by the facade and electric lighting at the workplaces.

Open Issues

Example 3: Complexity vs. efficiency in lighting controls

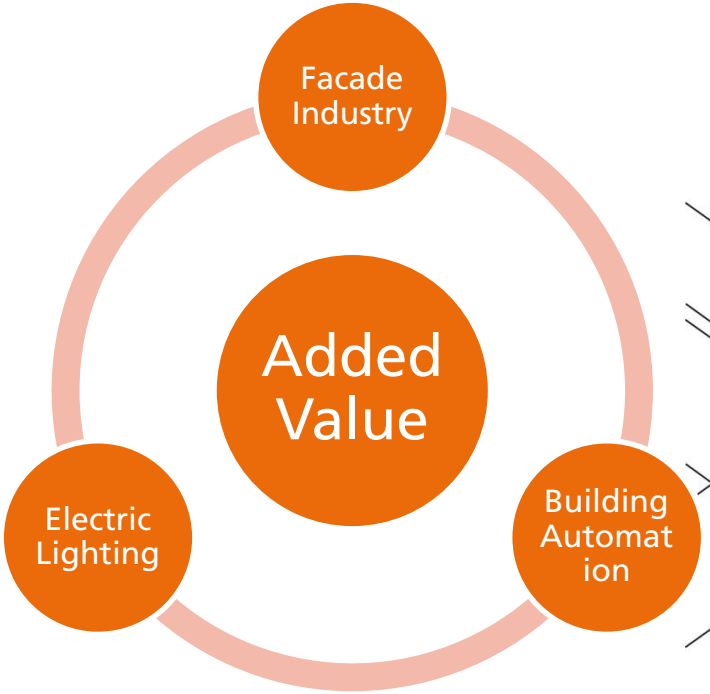


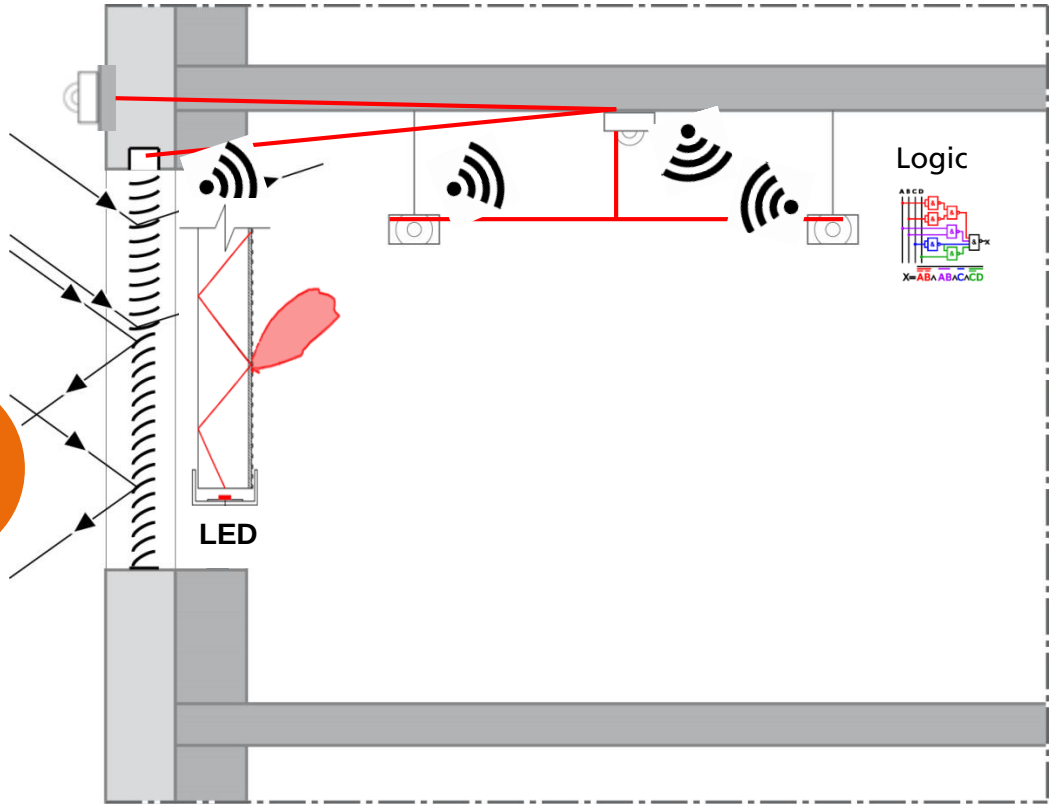
Source: Niko Gentile, Lund University and Havells - Sylvania

- Not everything that technically is possible, will be accepted.
- What are the potentials of „Smart & Connected lighting“ („intelligent software“, Wireless networks, IOT…).
- Balance between low complexity (simplicity) and high tech lighting solutions?

Open Issues

Example 4: Combine competencies: Market integration





Open Issues

Example 5: Codes / Regulations < - > Tools & Methods

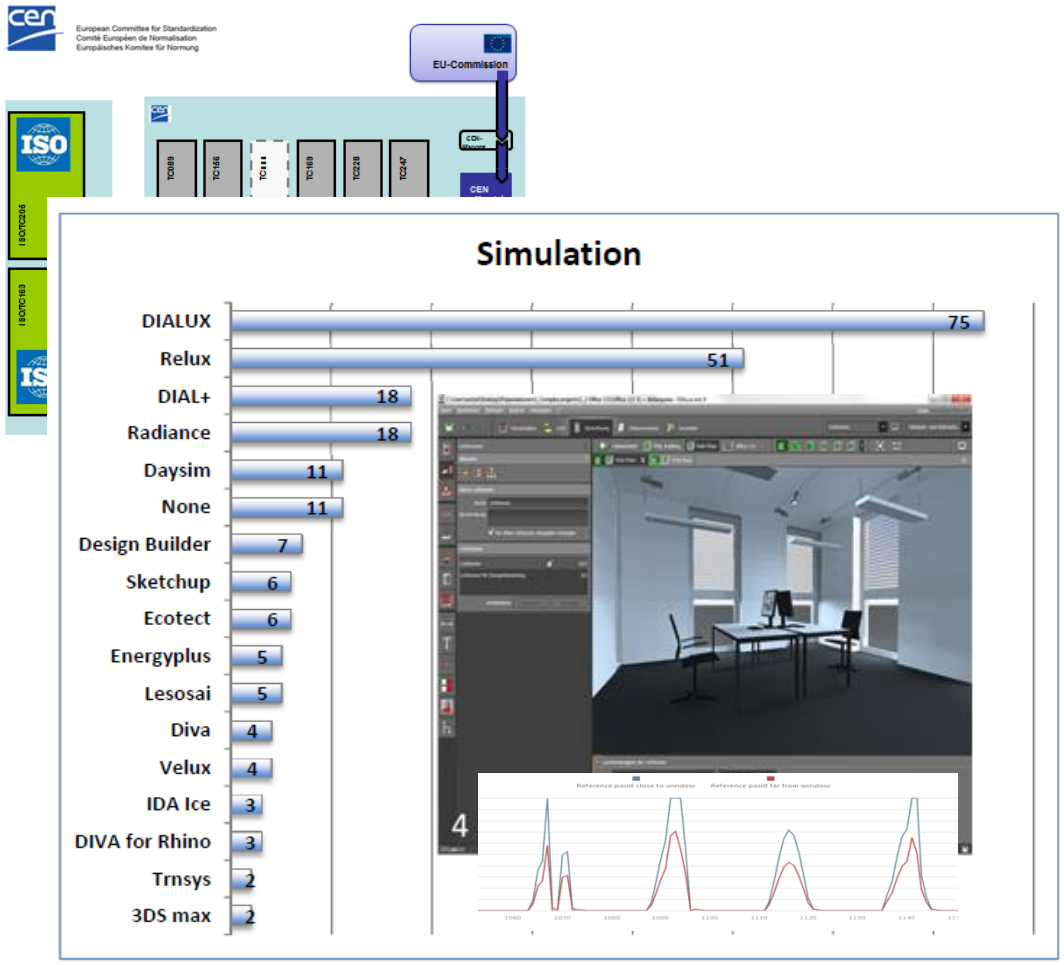
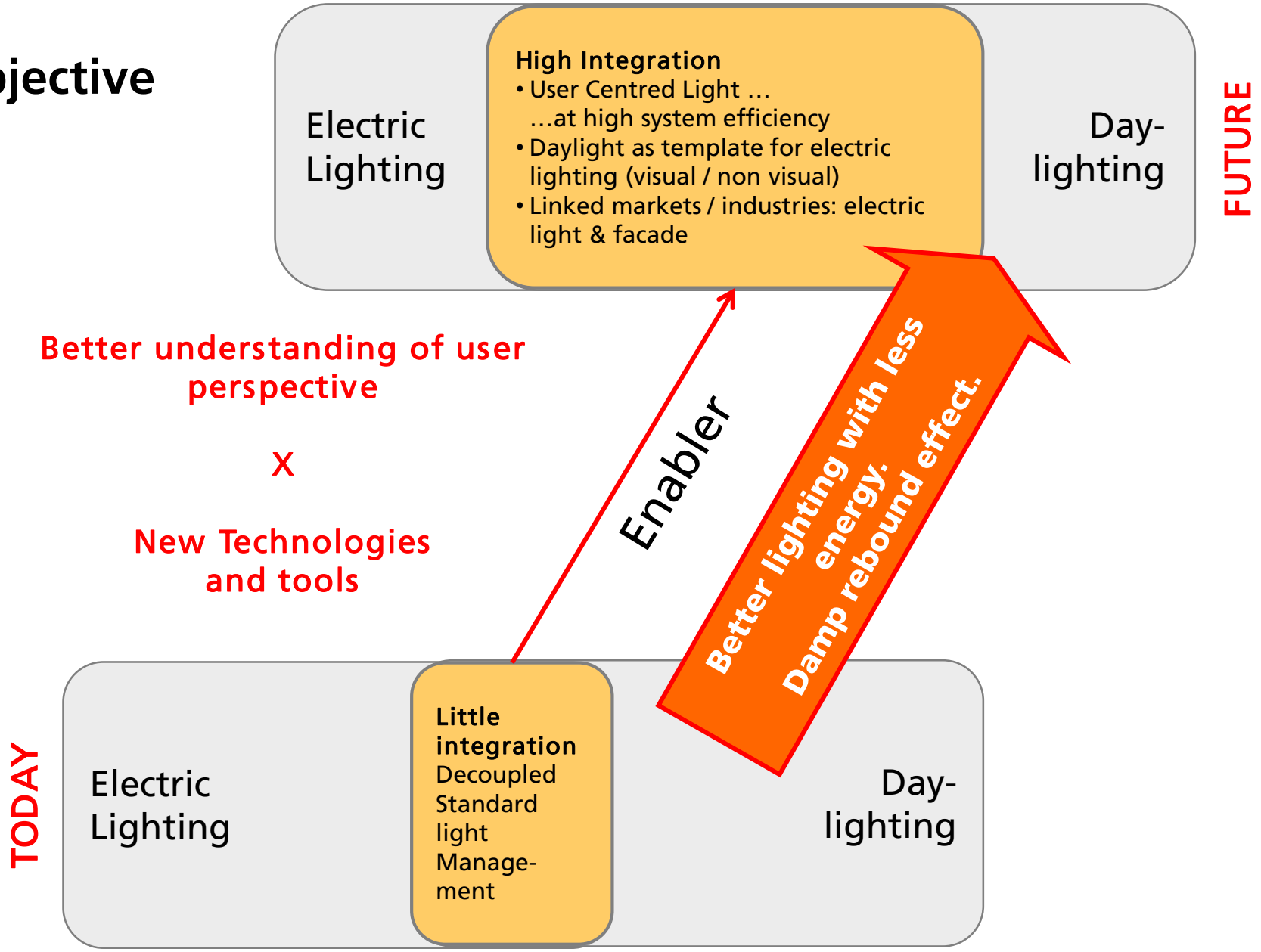


Figure 21: List of methods and tools used to handle Simulation in the retrofit process

- **System efficiency:** Triggered by energy policies (EU: „Nearly zero energy buildings“,…), cost
- Hourly and spectrally resolved methods required: for Standards (M480, CEN, ISO,…), for design tools.
- So far mainly research tools looked at
- Market leaders (**hundred thousands of users**) like Dialux, Relux are opening towards daylight and energy issues
- Basics of daylighting models developed in previous IEA work (T21, T31, T 50)

Objective



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Task Structure

IEA SHC Task 61 / EBC Annex 77

Integrated solutions for daylight and electric lighting

From component to user centered system efficiency

Operating Agent: J. de Boer, Germany

Subtask A

B. Matusiak, Norway

User Perspective, Requirements

Subtask B

M. Fontoynont, Denmark

Integration and optimization of daylight and electric lighting

Subtask C

D. Geisler-Moroder, Austria

Design support for practioners

(Tools, Standards, Guidelines)

Subtask D

N. Gentile, Sweden

W.Osterhaus, Denmark

Lab and field study performance tracking

Joint Working Group

- Evaluation method for integrated lighting solutions
- Virtual reality (VR) based Decision Guide

Outcome for different target groups

- ***Designers:*** new and better integrated tools, system overview, design guidelines and system performance information (from lab and demo testing)
- ***Standardization bodies:*** integrated daylighting and electric lighting hourly energy rating method, spectral modelling including new datasets for facades and materials.
- ***Industry:*** work on the better integration of electric lighting and daylighting (façade)
- ***Software Companies:*** advanced lighting algorithms / software
- ***Building managers:*** more effective guidance on the calibration, ongoing adjustment and maintenance of integrated lighting control systems
- ***Policy makers:*** advice to stimulate deployment of successful, energy efficient lighting schemes with added benefits to the citizens.
- ***Building users:*** improved indoor conditions, to support health, comfort and energy efficiency

Who is behind the activity?

About 35 Experts from 14 countries

Research

Industry

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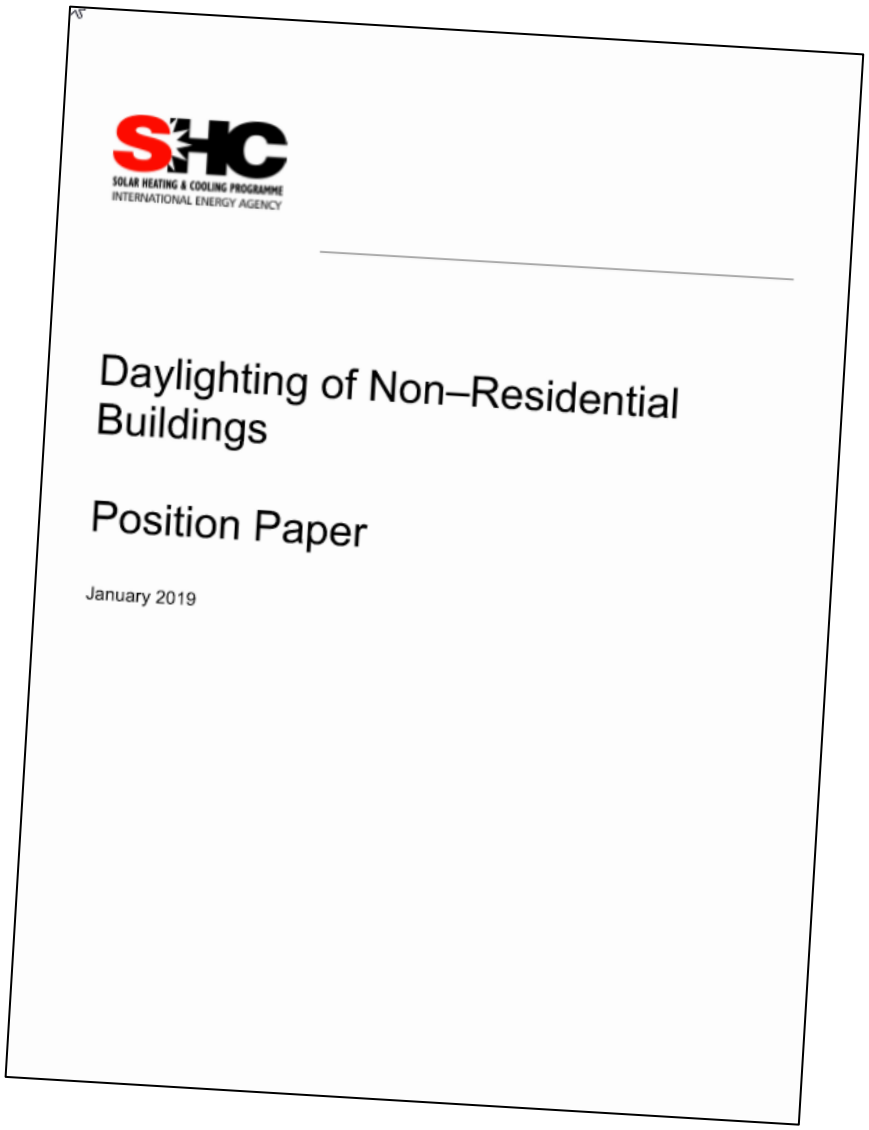

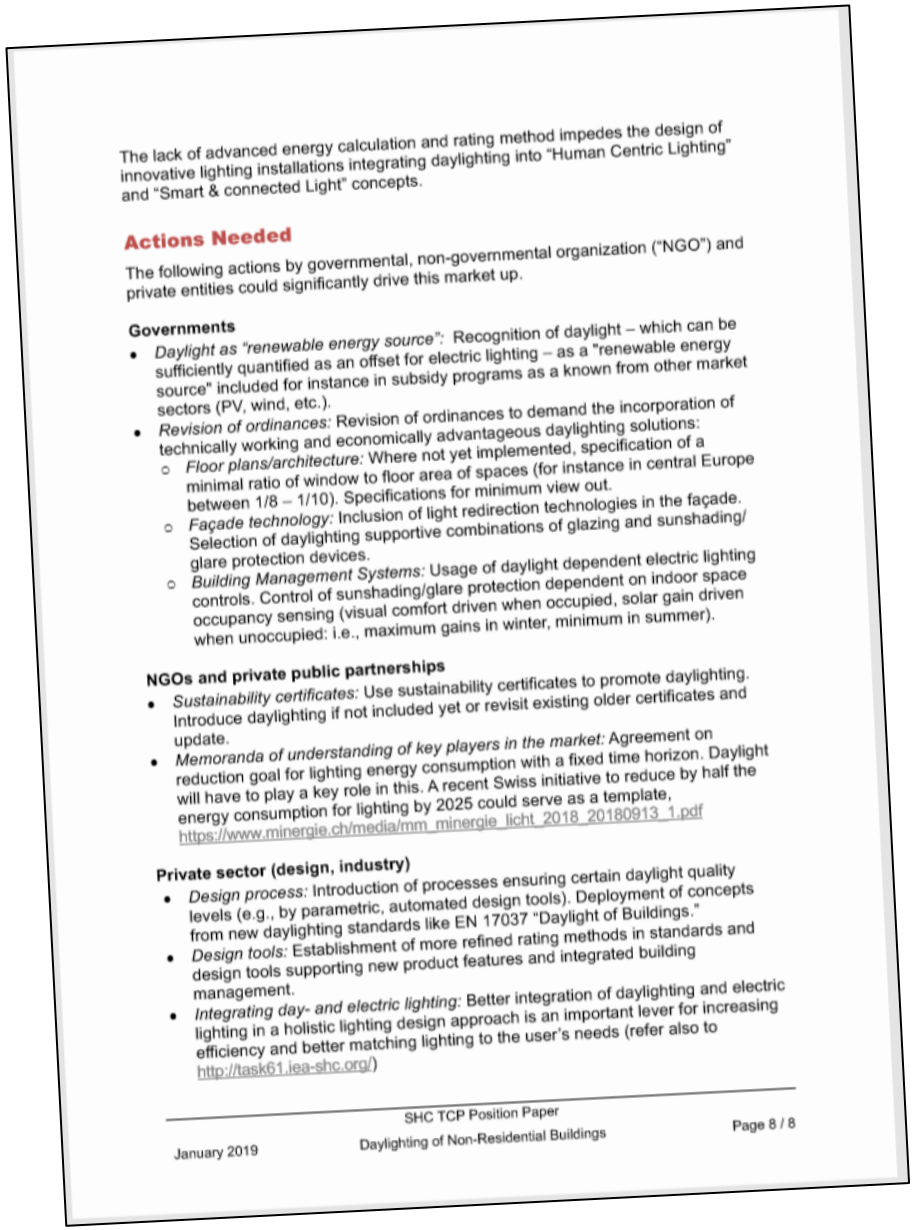

The lack of advanced energy calculation and rating method impedes the design of innovative lighting installations integrating daylighting into "Human Centric Lighting" and "Smart & connected Light" concepts.

Actions Needed

The following actions by governmental, non-governmental organization ("NGO") and private entities could significantly drive this market up.

Governments

- *Daylight as "renewable energy source":* Recognition of daylight – which can be sufficiently quantified as an offset for electric lighting – as a "renewable energy source" included for instance in subsidy programs as a known from other market sectors (PV, wind, etc.).
- *Revision of ordinances:* Revision of ordinances to demand the incorporation of technically working and economically advantageous daylighting solutions:
  - *Floor plans/architecture:* Where not yet implemented, specification of a minimal ratio of window to floor area of spaces (for instance in central Europe between 1/8 – 1/10). Specifications for minimum view out.
  - *Façade technology:* Inclusion of light redirection technologies in the façade. Selection of daylighting supportive combinations of glazing and sunshading/ glare protection devices.
  - *Building Management Systems:* Usage of daylight dependent electric lighting controls. Control of sunshading/glare protection dependent on indoor space occupancy sensing (visual comfort driven when occupied, solar gain driven when unoccupied: i.e., maximum gains in winter, minimum in summer).

NGOs and private public partnerships

- *Sustainability certificates:* Use sustainability certificates to promote daylighting. Introduce daylighting if not included yet or revisit existing older certificates and update.
- *Memoranda of understanding of key players in the market:* Agreement on reduction goal for lighting energy consumption with a fixed time horizon. Daylight will have to play a key role in this. A recent Swiss initiative to reduce by half the energy consumption for lighting by 2025 could serve as a template, https://www.minergie.ch/media/mm_minergie_licht_2018_20180913_1.pdf

Private sector (design, industry)

- *Design process:* Introduction of processes ensuring certain daylight quality levels (e.g., by parametric, automated design tools). Deployment of concepts from new daylighting standards like EN 17037 "Daylight of Buildings."
- *Design tools:* Establishment of more refined rating methods in standards and design tools supporting new product features and integrated building management.
- *Integrating day- and electric lighting:* Better integration of daylighting and electric lighting in a holistic lighting design approach is an important lever for increasing efficiency and better matching lighting to the user's needs (refer also to http://task61.iea-shc.org/)

https://task50.iea-shc.org/Data/Sites/1/publications/IEA-SHC-Daylighting-Non-Residential-Buildings-Position-Paper.pdf

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The lack of advanced energy calculation and rating method impedes the design of innovative lighting installations integrating daylighting into "Human Centric Lighting" and "Smart & connected Light" concepts.

Actions Needed

governmental organization ("NGO") and

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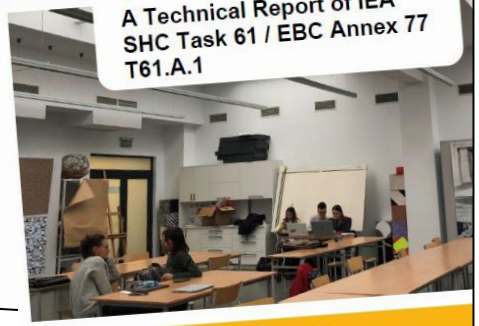
Literature review of use needs, toward user requirements

A Technical Report of IEA SHC Task 61 / EBC Annex 77
T61.A.1



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Integrated Solutions for Daylighting and Electric Lightin
From component to user centered system efficiency

IEA SHC Task 61 / EBC Annex 77
Integrated Solutions for Daylight & Electric Lighting

Newsletter 1

Overview and first results

May 2020

IEA SHC Task 61 / EBC Annex 77

Integrated Solutions for Daylight and Electric Lighting

FROM COMPONENT TO USER CENTERED SYSTEM EFFICIENCY

BACKGROUND AND OBJECTIVES

Lighting accounts for approximately 15 % of the global electric energy consumption and 5 % of greenhouse gas. Projections by the IEA show that if governments only rely on current policies, global electricity use for lighting will grow from around 2 900 TWh to around 4 250 TWh by 2030. Due to the world's growing population and the increasing demand for electrically driven services in emerging economies the increase will occur despite constant improvements in energy efficiency of lighting systems.

During the last years the focus shifts towards digitalized lighting. This offers the chance to overcome problems in the integration of daylight and electric lighting: (New) technologies equipped with sensors, "intelligent software" and wireless data communication introduce large possibilities to bring the separate market sectors of electric lighting and façade technology closer together.

Research and developments in the field of energy efficient lighting techniques encompassing daylighting, electric lighting and lighting controls combined with activities employing and bringing these techniques to the market can contribute significantly to reduce worldwide electricity consumptions and CO_2-emissions.

Task 61 will generate diverse outcomes for different stakeholders:

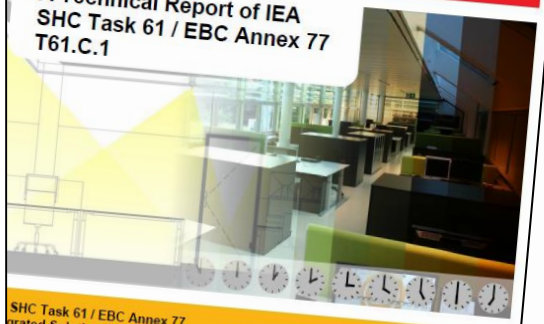
- **Designers**: New integrated tools, system overviews, design guidelines, system performance information.
- **Standardization bodies**: Integrated daylighting and electric lighting hourly energy rating method, spectral modelling (skies, components).
- **Industry**: Better integration of electric lighting and daylighting (façade) technologies.
- **Building managers**: More effective guidance on the calibration, ongoing adjustment and maintenance of integrated lighting control systems.
- **Policy makers**: Advice to stimulate deployment of successful, energy efficient lighting schemes with added benefits to the citizens.
- **Building users**: Improved indoor conditions to support health, comfort and energy efficiency.

This newsletter presents first results of IEA Task 61 addressing current topics in the integration of daylight and electric lighting.

Content

Workflows and software for the design of integrated lighting solutions

A Technical Report of IEA SHC Task 61 / EBC Annex 77
T61.C.1



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…use light intelligently.

Alexander Lervik,
Designer,
Stockholm