Subtask B:
Lighting Controls: Technological Aspects

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ISES + IEA SHC
Solar Academy Webinar
24 September 2020

Lighting control:
the upper-level of the narrative of lighting design

Beyond energy efficient light sources: the next step

Participants to subtask B

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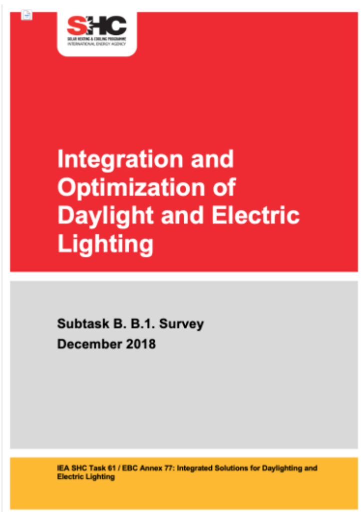
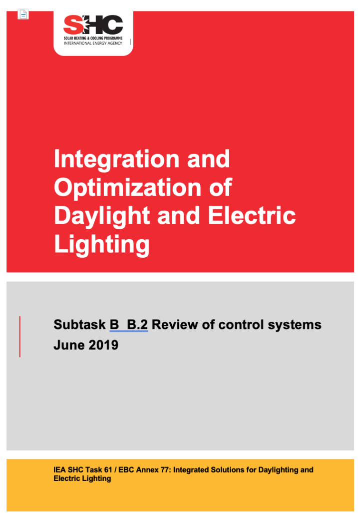
5 reports on their way…


Integration and Optimization of Daylight and Electric Lighting

Subtask B. B.1. Survey
December 2018

IEA SHC Task 61 / EBC Annex 77: Integrated Solutions for Daylighting and Electric Lighting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Subtask B B.2 Review of control systems
June 2019

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Subtask B – B.3-4 Trends and new systems November 2020

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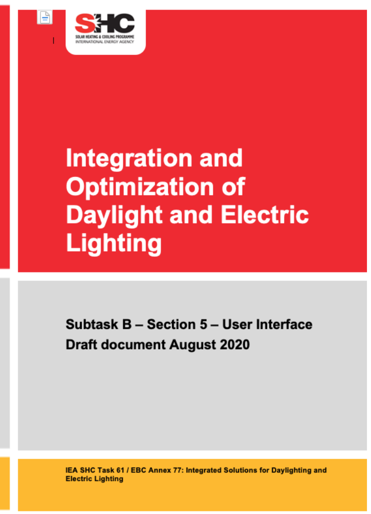
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Subtask B – Section 5 – User Interface
Draft document August 2020

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Subtask B – B.6 Link with Standardization activities
March 2021

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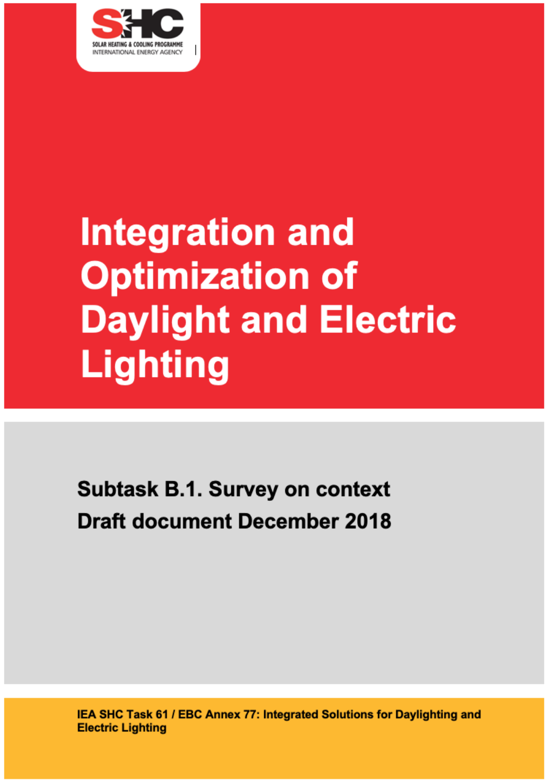
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Integration and Optimization of Daylight and Electric Lighting

Subtask B.1. Survey on context
Draft document December 2018

IEA SHC Task 61 / EBC Annex 77: Integrated Solutions for Daylighting and Electric Lighting

Survey on context of controls of lighting and shading

Interviews of more than 100 professionals in Denmark, China, Belgium, Norway, Poland, Austria, Sweden , Italy and Germany

On topics related to:

- Energy aspects (reduction of lighting consumption, benefits of shading…)
- Operational aspects (maintenance, commissionning, etc.)
- Desire from owners (future proof, costs,
- Occupant control (automatic vs manual , override, etc.)
- Consequneces on occupant comfort
- Control functionalities (open source?; connected to BMS)
- Other issues…

Integration and Optimization of Daylight and Electric Lighting

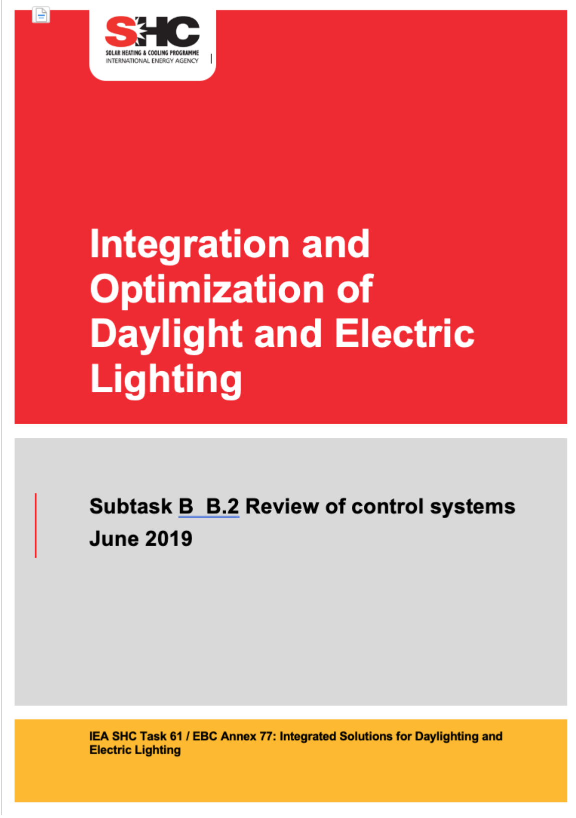
Subtask B.1. Survey on context
Draft document December 2018

IEA SHC Task 61 / EBC Annex 77: Integrated Solutions for Daylighting and Electric Lighting

Survey on context of controls of lighting and shading

Results so far:

1. Contribution to reduce lighting electricity consumption
2. Robustness and warranty
3. Easy Commissioning (and re-commissioning)
4. Standardized solutions
5. Investment costs and running costs
6. Simplicity of operation
7. Override (shading) . Manual control
8. Individual task / ambient controls
9. Glare control from windows
10. Concern for well-being of occupants
11. Future proof
12. Compatibility with BMS, HVAC
13. Wireless – Internet gateway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Subtask B B.2 Review of control systems
June 2019

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Review of systems

Review of « strategies »

Reducing energy use through
- Lighting only when spaces are occupied (occupancy sensors) or time based (fixed, adjustable)
- Dimming of swiching-off lights as a function of daylight
- Constant light output over duration of use
- Shading for visual comfort (protection from glare) and possible reduction of heat gains

Architecture
- Centralized / localized / mesh
- Closed loop / open loop / Internet of things (IoT)

Mapping of solutions as a fonction of the energy saving potential

Solutions and trends

Review of market structure and drivers

Residential and non-residential

Dimming vs on-off (sytem consumption?)

External / internal shading

Motorized / non motorized shading

Security issues

Lighting control options

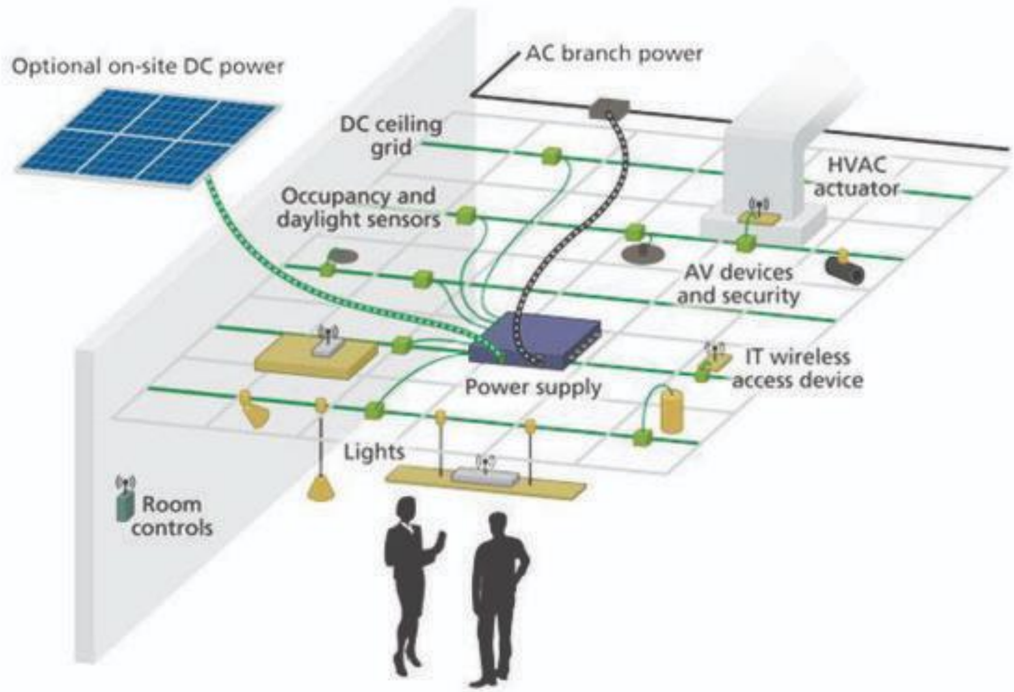
Ceiling lighting options (per lines or zones)

Task lighting per workplace

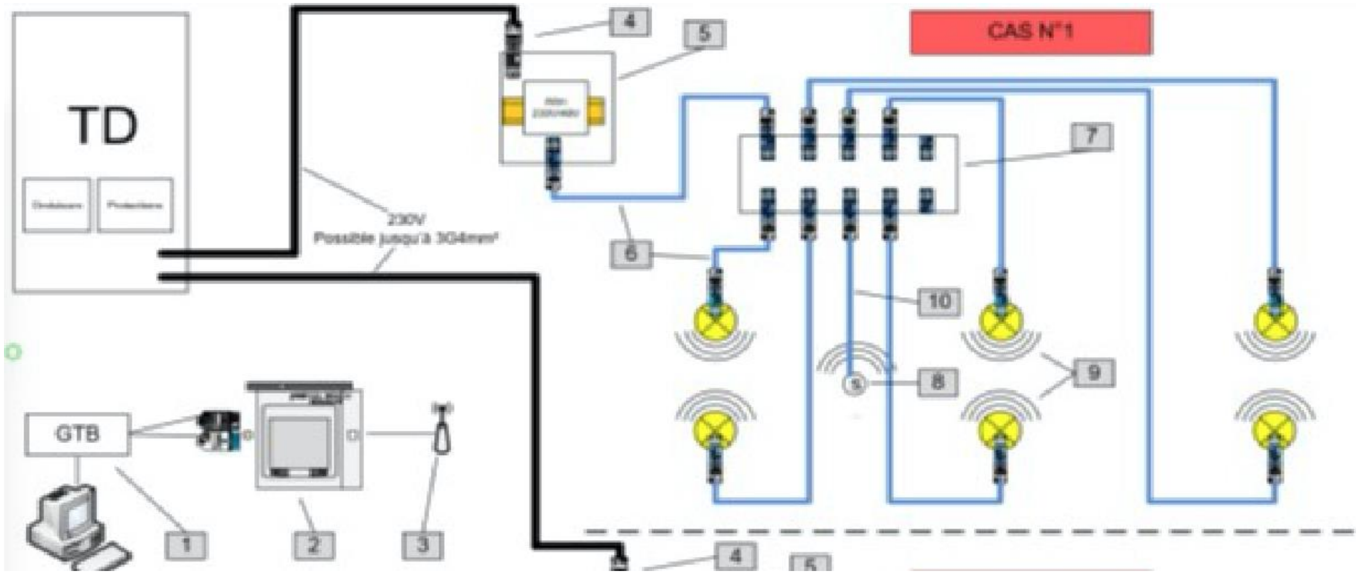
Solutions and trends

Strategies for communication (hardware)

Wired / wireless
Analog, phase dimming, DALI, DMX, KNX, Bluetooth, Zigbee, etc.
Centralized Gateway to Internet
Communication protocols
POE (Power Over Ethernet)
DC Powered (48 V)
Battery-less sensors and switche
Geolocalization chips (commissioning)



48 V DC Electrical Architecture



Suppression of AC/DC converters for each luminaires
Use centralized high efficiency converters (0.5 KW to 2KW, eff 95%)
Use plug ad play ceiling lights without need of electricians
Possible link to Photovoltaic power supply.
Will benefit of cheap components for electric automobile industry (48V DC)
Gateway to internet through wireless data exchange. (chip on light engine)
On-going tasks: standardization, certification, safety issues, etc.

Solutions and trends

Strategies for communication (software)

Protocols: frequency, Issues with distance, indoor/outdoor, energy use, data rate, triggering, latency, size, open application, etc.

Variable	Wi-Fi	Z-Wave	ZigBee	Thread	BLE
Year first launched in Market	1997	2003	2003	2015	2010
PHY/MAC Standard	IEEE 802.11.1	ITU-T G.9959	IEEE 802.15.4	IEEE 802.15.4	IEEE 802.15.1
Frequency Band	2.4 GHz	900 MHz*	2.4 GHz	2.4 GHz	2.4 GHz
Nominal Range (0 dBm)	100 m	30 – 100 m	10 – 100 m	10 – 100 m	30 m
Maximum Data Rate	54 Mbit/s	40-100 kbit/s	250 kbit/s	250 kbit/s	1 Mbit/s
Topology	Star	Mesh	Mesh	Mesh	Scatternet
Power Usage	High	Low	Low	Low	Low
Alliance	Wi-Fi Alliance	Z-Wave Alliance	ZigBee Alliance	Thread Group	Bluetooth SIG
Wide area coverage	✔	✔	✔	✔	✔
Power efficient	✖	✔	✔	✔	✔
High data bandwidth	✔	✖	✖	✖	✔

Bewertungskriterium	Gewichtung (in %)	Z-Wave	homematicIP	KNX RF	DECT ULE	WIFI	Bluetooth	Bluetooth LE	ZigBee	Thread	WISUN
Technologie	50%										
# Frequenzbänder weltweit	20%	2	0	0	2	3	3	3	3	3	0
Reichweite - Outdoor	10%	3	3	3	3	3	1	0	2	2	3
Reichweite - Indoor	10%	3	3	3	3	2	0	0	2	2	3
Reichweite - Von Indoor nach Outdoor	10%	3	3	3	3	1	0	0	1	1	3
Energieverbrauch	10%	3	3	0	3	1	0	3	3	3	3
Netzwerk-Topologie	5%	3	3	3	3	2	1	1	3	3	3
Datenübertragungsrate	5%	2	2	2	3	3	3	3	3	3	3
Nutzdaten pro Paket	5%	3	3	1	3	3	1	1	3	2	3
Triggering	5%	3	3	3	2	0	0	2	3	2	3
Antwortzeiten / Latenz	5%	3	3	3	3	3	1	1	3	3	3
Größe des Moduls	5%	3	3	3	2	3	3	3	3	3	2
Offene Applikationsprofile vorhanden	10%	3	2	2	2	0	1	1	3	0	1
	100%	275	225	185	260	200	125	155	260	220	215
		1	4	8	2	7	10	9	3	5	6

Integration and Optimization of Daylight and Electric Lighting

Subtask B.2 Solutions and Trends
Draft document December 2018

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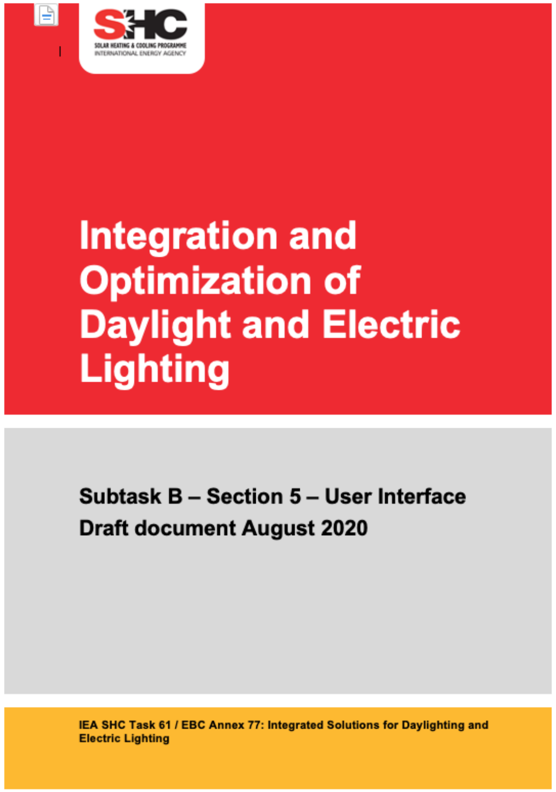
Lighting control as a "Pain Reliever" (or problem solver)	Lighting control as a source of "Value Creation" (offering new business opportunities)
Reduces lighting electricity use	Control specific lamps (wall washers, task, et.)
Makes lighting control more appropriate for occupants easier for occupants	New sensors and sensor location Open loop / closed loop
Make lighting control easier for occupants	Propose a user-friendly, simple and attractive interface
Make change of affectation of spaces easier (size of meeting rooms, size of offices, etc.)	Propose a full flexible module for control, beyond lighting (communication, displays, etc.)
Lighting controls when shades are pulled down,	Propose geolocalization services with lighting (LiFi)
Reduce glare from windows with shading	Easy commissioning and re-commissioning
Simplify closing of a house (global control)	Future proof (system which could adapt to evolutions of technology over time) : Updating through the internet: new software
Global warming increases risks of overheating, quality shading is necessary for more and more days	Interoperability (linked to other control systems and services, simplifies management, data, etc.)
Obstacles in deployment of DC powersupplies.	Make a house warmer during cold sunny days
Reburbishments	Make house cooler during warm sunny days
	Remote control from outside the building (facility management, user comfort)
	Anticipation of overheating: shading controls need to be more predictive and smarter (more data to collect)
	Flexibility can be related to future proof : update of systems
	Possibility to re-program the controls

Table: Analysis of lighting controls in relation with possible Value Proposition.



Integration and Optimization of Daylight and Electric Lighting

Subtask B – Section 5 – User Interface
Draft document August 2020

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User interfaces

Categories: naalog, figital, hybrid

Components

Trends

Link to energy savings,

Combined control of lighting and daylighting

Consequence on possible occupant satisfaction

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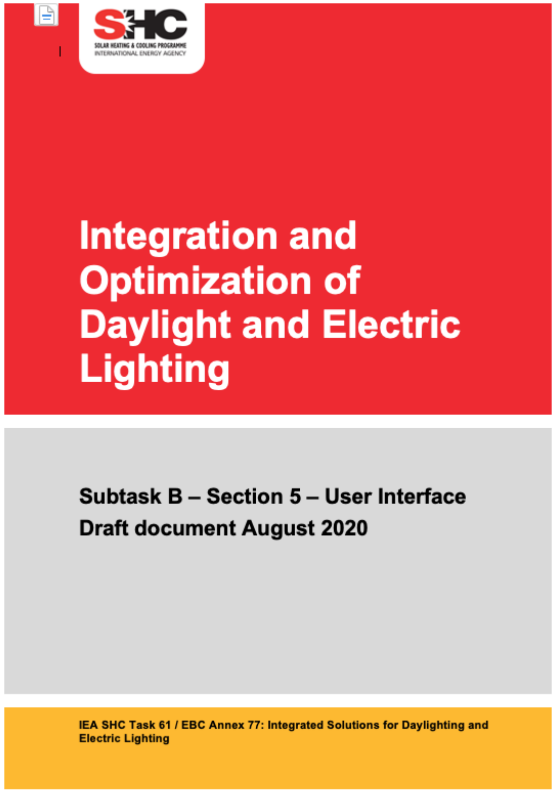
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Subtask B – Section 5 – User Interface
Draft document August 2020

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Figure 2 Example of UI: Phillips Hue App interface – from left: 1) different light by slider, and currently set sources with their intensity shown t color 2) Selection of lighting scenes 3) A color control over lighting in selected room ‘’Front Room’’.

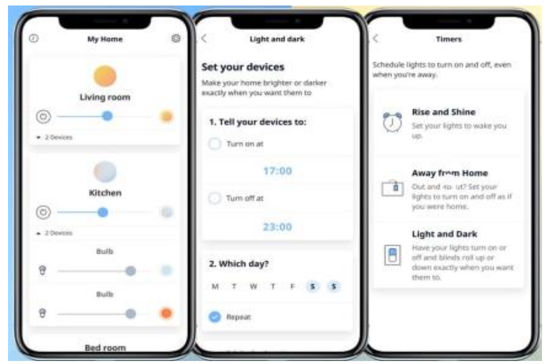
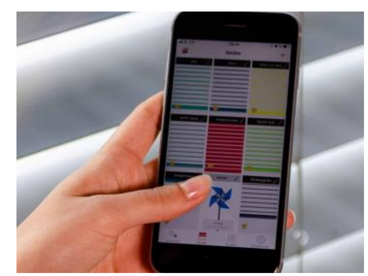
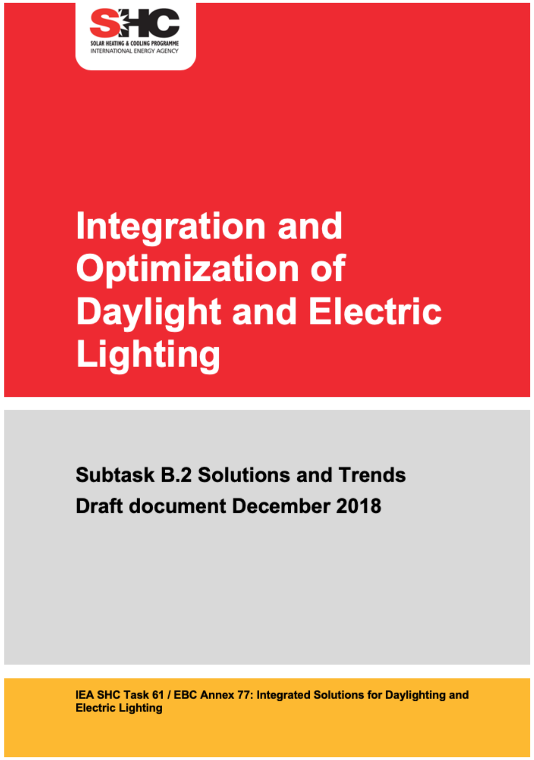


Figure 3 Example of UI: Ikea Smart Home App interface – from left: 1) Dimming of rooms and specific light sources. 2) Setting dynamic control using clock and calendar. 3) Setting dynamic control over lighting by defining scenes.

Examples of Power symbols and relevant sources




Integration and Optimization of Daylight and Electric Lighting

Subtask B.2 Solutions and Trends
Draft document December 2018

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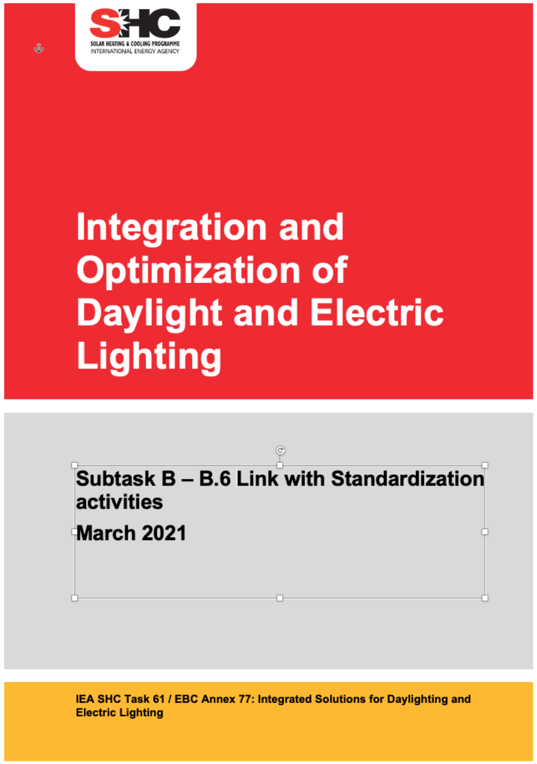
Global outcome / issues

- Effect on life time
- Reduced life time of lighting components (plug and play)
- Maintainance of flux output
- Holistic approach of costs: labor costs vs product costs
- Commissioning speed influencing technological choices


Integration and Optimization of Daylight and Electric Lighting

Subtask B – B.6 Link with Standardization activities

March 2021

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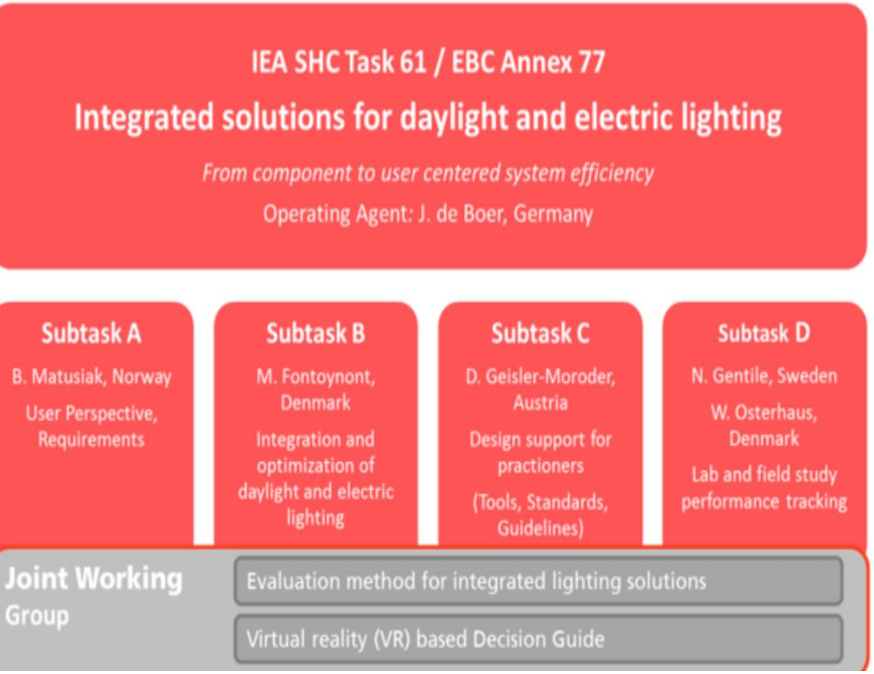
Review of Standards

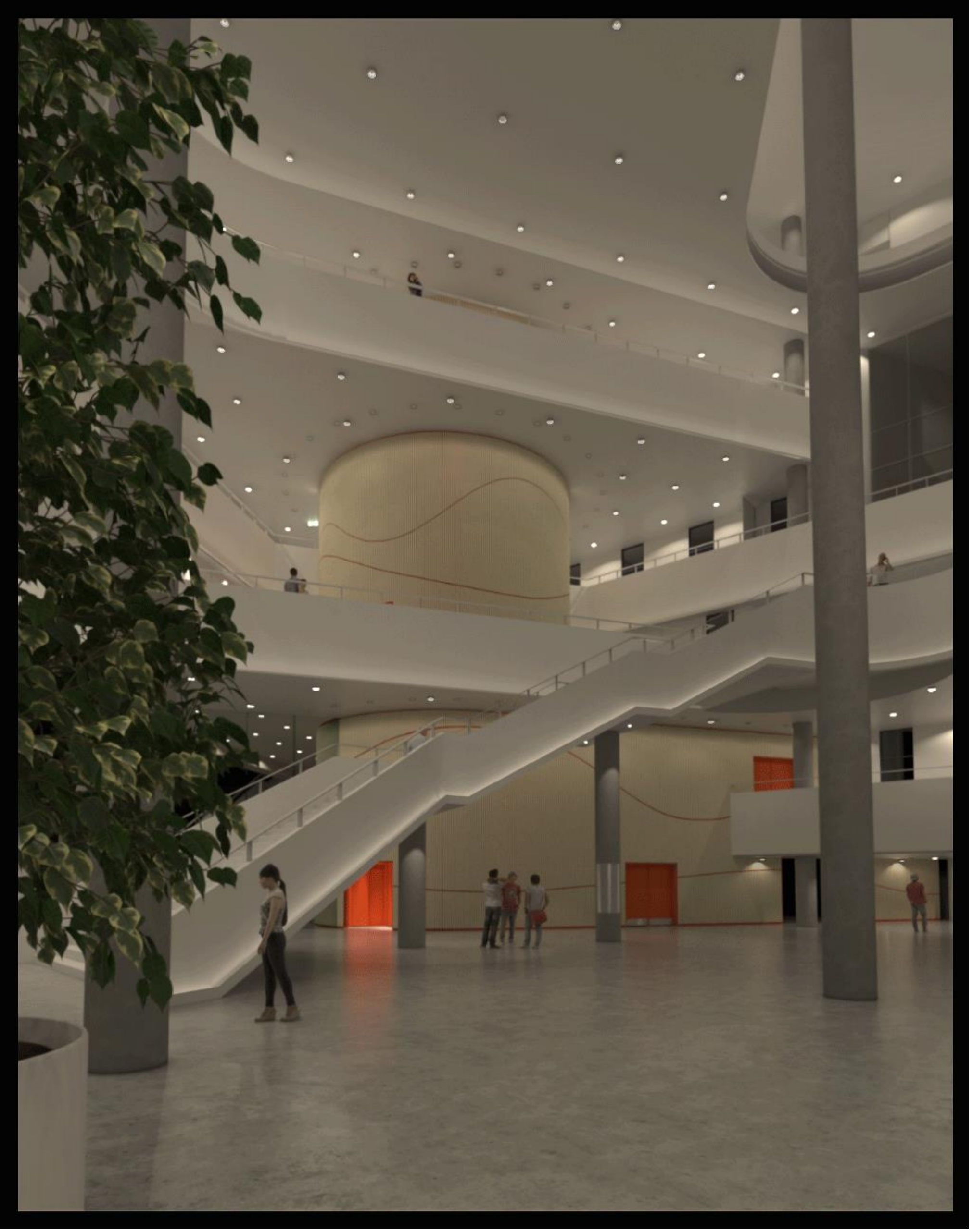
- Relevant standards
- New standards being developed
- Need for standards.



Virtual reality (VR) based Decison Guide

Interactive on-line tool showing examples of solutions being proposed and tested

<u>(Little demo)</u>



Three chanels demo, with electric power monitored.

To link lighting control and lighting effects and facilitate understanding of optimal power management.

SBi – 24/09/2020