

Low Carbon, High Comfort Integrated Lighting

IEA SHC Task Definition Phase: Status Report

Jan de Boer, FHG-IBP, Stuttgart Germany

Eleanor Lee, LBNL Berkeley

Barbara Matusiak, NTNU, Norway

David Geisler-Moroder, Bartenbach, Austria

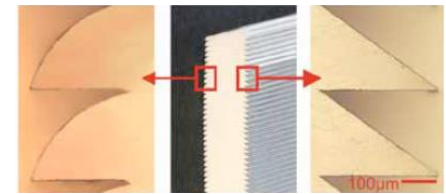
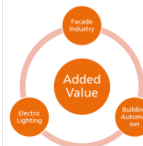
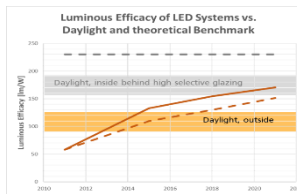
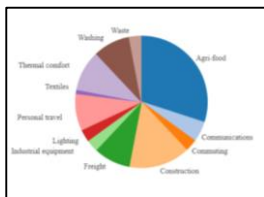
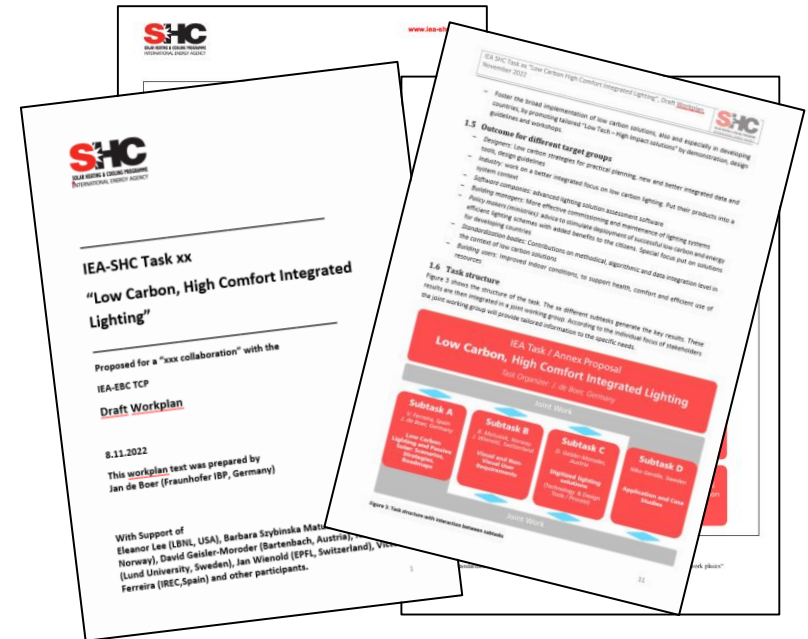
Niko Gentile, Lund University, Sweden

Jan Wienold, EPFL Switzerland

Victor Ferreira, IREC, Spain

and all contributing experts

November 29, 2022

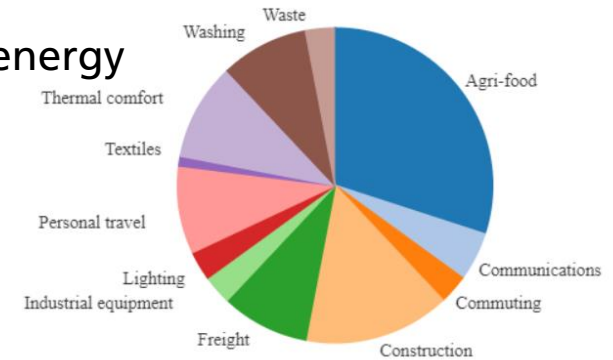


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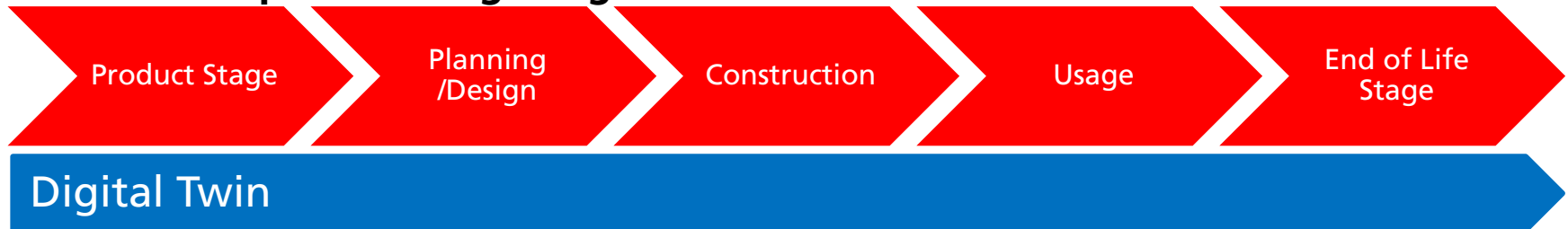
Lighting in context of decarbonization and energy efficiency

- Electricity for lighting accounts for 5% of the global greenhouse gas emissions and 15 % of the electrical energy consumption¹
- More and more directly taxed CO₂ emissions, rising electricity prices, higher competition for electricity
- Widening the rating perspective of lighting solutions to a more holistic view of its impact on CO₂ emissions deemed necessary

Greenhouse gas emissions by service - 50.6Gt CO₂e total



Carbon Footprint of “Lighting value chain”



Digitilization

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¹UNEP Report, Accelerating the Global Adoption of ENERGY-EFFICIENT LIGHTING, 2017

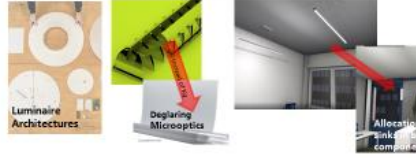
² <https://public.tableau.com/app/profile/rosamund.pearce/viz/Greenhousegasemissionsbyservice/Dashboard1>

Lighting value chain



Electric lighting

- LED transition on lamp level is generally performed, highly optimized
- Different on luminaire level. Potentials for decreasing the embodied energy:
 - a) Modular luminaire architectures: exchangeable optics, program smart use of 3D printed parts, recyclable components
 - b) Direct integration into building components and architectural details
 - c) new task lighting concepts



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Lighting value chain



Daylighting

- Embodied energy is dominated by façades.
- Same daylighting function for much less environmental impact
- Micro-optics for light redirection vs. standard solutions
- New, better color rendering electrochromic glazing making conventional glare protection obsolete
- Lighter constructions



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Lighting value chain



Same lighting and solar management with much lighter constructions

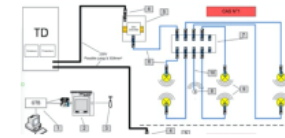
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Lighting value chain



Lighting controls

- Strongly growing use of lighting controls:
 - bigger standby losses and
 - increasing use of sensor hardware
- True costs?



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Lighting value chain



Planning, Design Process

- Long lasting impact on the usage phase
- Numerous inefficiencies are known in lighting design
- Erroneous design processes result in over-installation
- Trade association's estimates are at 80% (!) of installed.



If planned: still highly manual, iterative process

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Lighting value chain



Architectural and design constraints

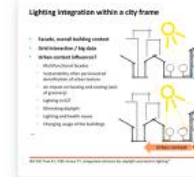
- Architectural and design constraints ask for a dense urban environments - interior and external impacts on urban factors.
- "Competition" for optimal functionality of facade solar vs. facade greening, difficulties to meet regulations.
- Of big importance here is a further alignment including visual and non-visual effects is driven comes along with a risk of energy rebounds: net efficiencies, if not properly integrated with daylighting
- Daylight mimicking is a more and more discussed rather on electric than on natural light and color

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"Renegotiating" the role of daylighting

"Competition" for façade area and functionality

In the urban context

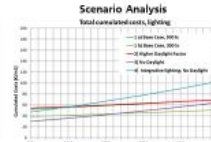
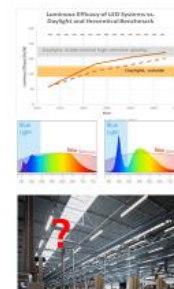


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"Renegotiating" the role of daylighting

"Only LED" an option?

Daylight Mimicking



allocation of additional floor area in dense urban



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Lighting Carbon footprint

Scenarios, strategies, roadmaps...



Technology and design employed

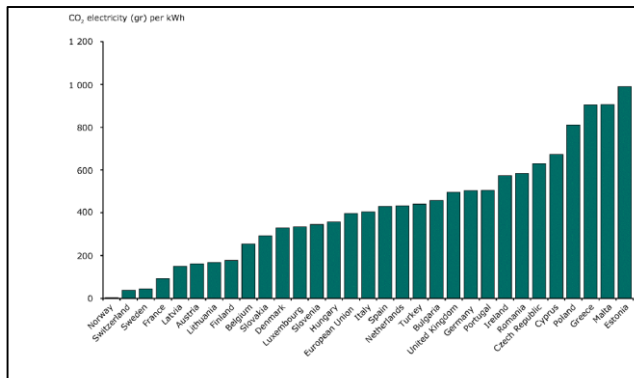
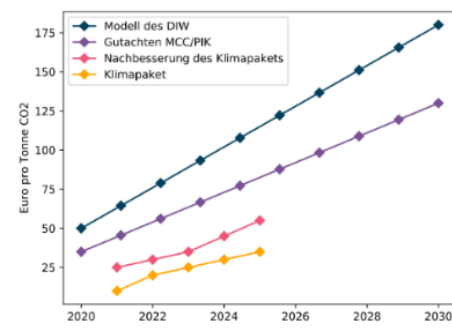


Figure 1: Production of CO₂ to generate 1 kWh of electricity in the European Union



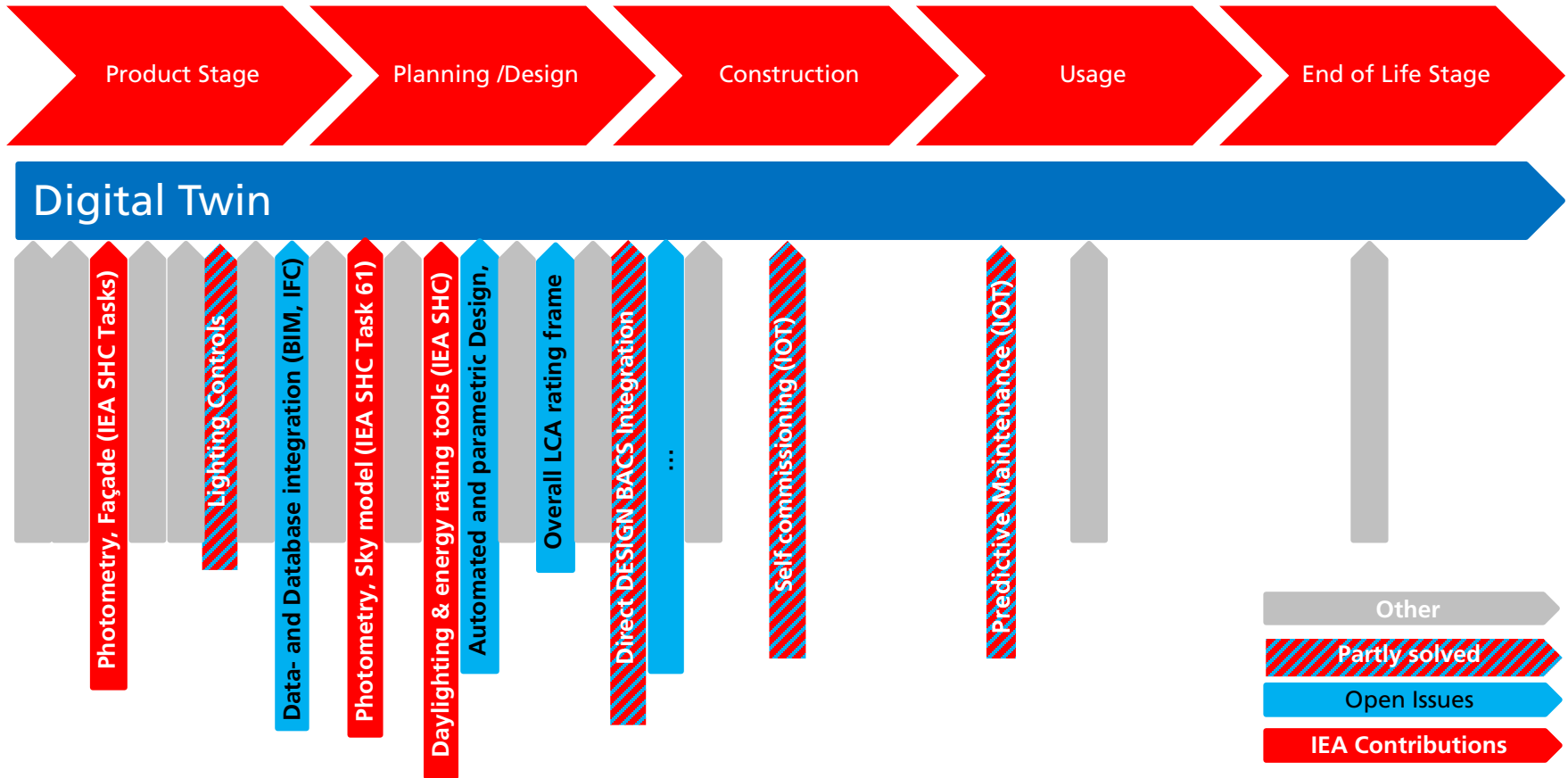
Supply side / grid context



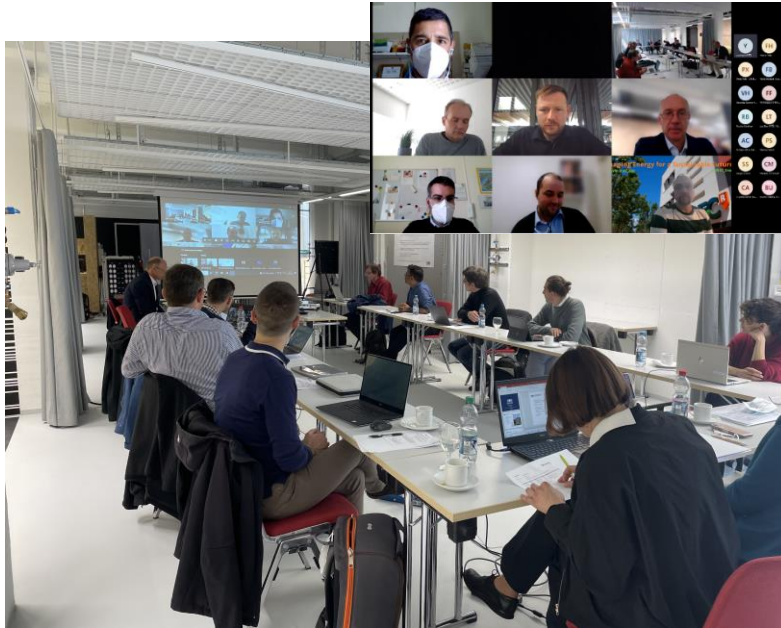
CO₂ eq. Kg per solution

+ Link to other trades...

Empowering by digitalization



2 Definition Workshops, Stuttgart (4/2022), Lund (10/2022)



47 participants from 17 countries
15 onsite, others online

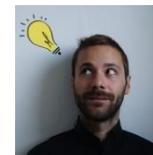


49 participants from 19 countries
19 onsite, others online

Task Definition Coordination / Management

TDP coordination team

- Task organization: Jan de Boer, Fraunhofer Institute of Building Physics for PTJ, Germany
- Subtask development:
 - Barbara Matusiak, NTNU, Norway
 - Eleanor Lee, LBNL Berkeley
 - David Geisler-Moroder, Bartenbach, Austria
 - Niko Gentile, Lund University, Sweden
 - Jan Wienold, EPFL Switzerland
 - Victor Ferreira, IREC, Spain



Draft Workplan



SHC Task xx Low Carbon, High Comfort Integrated Lighting

Proposed for a "xxx collaboration" with the IEA EBC TCP

Draft Work Plan

10.11.2022

This Work Plan text was prepared by
Jan de Boer (Fraunhofer IBP, Germany)

With Support of
Eleanor Lee (LBNL, USA), Barbara Szybinska Matus
Norway), David Geisler-Moroder (Bartenbach, Austria),
Lund University, Sweden), Jan Wienold (EPFL, Switzerland),
Ferreira (IREC, Spain) and other participants.

Content

- 1. Task Description
 - 1.1 Background
 - 1.1.1 Lighting, CO2 Emissions & Energy
 - 1.1.2 Potentials and barriers in lowering carbon emission in lighting
 - 1.1.3 Facade and Electric lighting market
 - 1.1.4 Relation to other IEA activities
 - 1.2 Why an IEA project
 - 1.3 Scope
 - 1.4 Objectives
 - 1.5 Outcomes

IEA SHC Task xx "Low Carbon High Comfort Integrated Lighting", Draft Workplan
November 2022

- Foster the broad implementation of low carbon solutions, also and especially in developing countries, by promoting tailored "Low Tech - High Impact solutions" by demonstration, design guidelines and workshops.
- 1.5 Outcome for different target groups**
 - Designers: Low carbon strategies for practical planning, new and better integrated data and tools, design guidelines
 - Industry: work on a better integrated focus on low carbon lighting. Put their products into a system context
 - Software companies: advanced lighting solution assessment software
 - Building managers: More effective commissioning and maintenance of lighting systems
 - Policy makers (ministries): advice to stimulate deployment of successful low carbon and energy efficient lighting schemes with added benefits to the citizens. Special focus put on solutions for developing countries
 - Standardization bodies: Contributions on methodical, algorithmic and data integration level in the context of low carbon solutions
 - Building users: Improved indoor conditions, to support health, comfort and efficient use of resources

1.6 Task structure

Figure 3 shows the structure of the task. The xx different subtasks generate the key results. These results are then integrated in a joint working group. According to the individual focus of stakeholders the joint working group will provide tailored information to the specific needs.

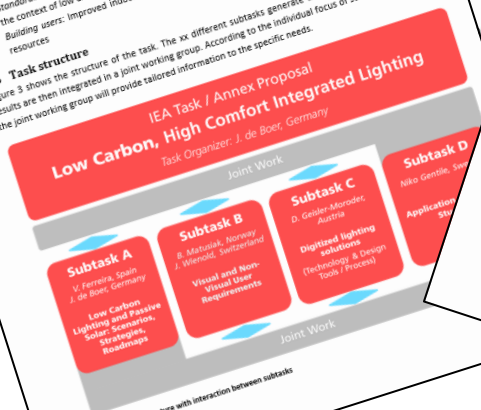
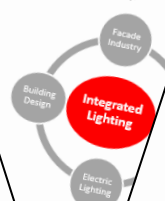


Figure 3. Task structure with interaction between subtasks

IEA SHC Task xx "Low Carbon High Comfort Integrated Lighting", Draft Workplan
November 2022

Integrative lighting including visual and non-visual effects is driving innovation in lighting technology. But it comes along with a risk of energy rebounds: more delivered lumens and lower luminous efficacies, if not properly integrated with daylight as shown in IEA Task 61. Construction / Commissioning / Usage / End of life stage levels. These phases can only be as performant as product quality and design processes allow. Task 61 has shown 3-4 kWh/m²a for offices are now possible, but this is far from being the standard (rather 10-20 kWh/m²a). Commissioning and maintenance processes need to be improved and become standard, otherwise efficiency is jeopardized. The better a product and solution architecture with e.g. long lasting recyclable components the lower the impact in the end of life stage will be.

1.3 Relevant market sectors
Appropriate energy efficient and sustainable lighting is driven by digitalization on all levels. Next level design tools (parametric, automated, VR/AR) and robust processes relying among others on basic work tools (parametric, automated, VR/AR) and robust energy rating algorithms); transfer of design data into building information models (BIM) and facade models, maintenance, grid integration level in a seamless data integration factor for future business models.



SHC TASK XX

LOW CARBON, HIGH COMFORT
INTEGRATED LIGHTING

November 2022

This Annex text was prepared by Jan de Boer of Fraunhofer IBP, Germany

IEA SHC TASK XX
LOW CARBON, HIGH COMFORT INTEGRATED LIGHTING

November 2022

Objective

The overall objective of the activity is to identify and support implementing the potentials of lighting (electric, façade: daylighting & passive solar) in the decarbonisation on a global perspective, while aligning the new integrative understanding of humans' light needs with digitized lighting on a building and a building related urban scale.



Proposed Structure

IEA Task / Annex Proposal

Low Carbon, High Comfort Integrated Lighting

Task Organizer: J. de Boer, Germany

Subtask A

*V. Ferreira, Spain
J. de Boer, Germany*

Low Carbon
Lighting and Passive
Solar: Scenarios,
Strategies,
Roadmaps

Subtask B

*B. Matusiak, Norway
J. Wienold, Switzerland*

Visual and Non-
Visual User
Requirements

Subtask C

*D. Geisler-Moroder,
Austria*

Digitized lighting
solutions
(Technology & Design
Tools / Process)

Subtask D

Niko Gentile, Sweden

Application and Case
Studies

Proposed Structure

IEA Task / Annex Proposal

Low Carbon, High Comfort Integrated Lighting

Task Organizer: J. de Boer, Germany

Joint Work

Subtask A

*V. Ferreira, Spain
J. de Boer, Germany*

Low Carbon
Lighting and Passive
Solar: Scenarios,
Strategies,
Roadmaps

Subtask B

*B. Matusiak, Norway
J. Wienold, Switzerland*

Visual and Non-
Visual User
Requirements

Subtask C

*D. Geisler-Moroder,
Austria*

Digitized lighting
solutions
(Technology & Design
Tools / Process)

Subtask D

Niko Gentile, Sweden

Application and Case
Studies

Joint Work

Subtask A:

Low Carbon Lighting and Passive Solar: Scenarios, Strategies, Roadmaps



Coordination: Victor Ferreira, IREC, Spain with support of Jan de Boer, FHI-IBP, Germany

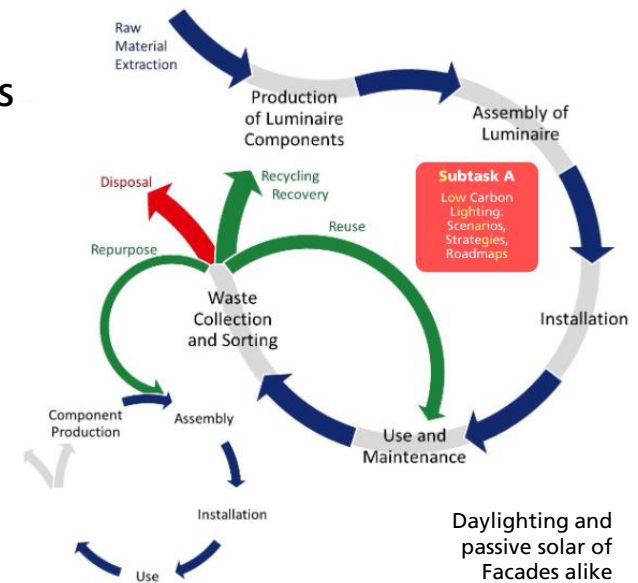
Objective: Based on existing first work on LCA for electric lighting (e.g. LEDs, luminaires) extend perspective to integrated lighting solutions including daylighting, facade systems, and controls. Set up of relevant scenarios (components, systems, local energy mixes, grid constraints, usage etc.). Evaluate with a tailored framework bringing together LCA / energy tools. From this parametric study develop “low carbon solution” strategies by intelligently combining new technical components and design concepts: Identify low hanging fruits, Illustrate the impact of no/bad/good design. Address business models in this context.

A.1. Status quo: Overview on data, methods, regulations

A.2. Catalogues of Scenarios

A.3. Framework for flexibly rating different scenarios

A.4. Design Guide, Strategies and Roadmaps



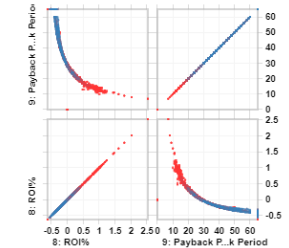
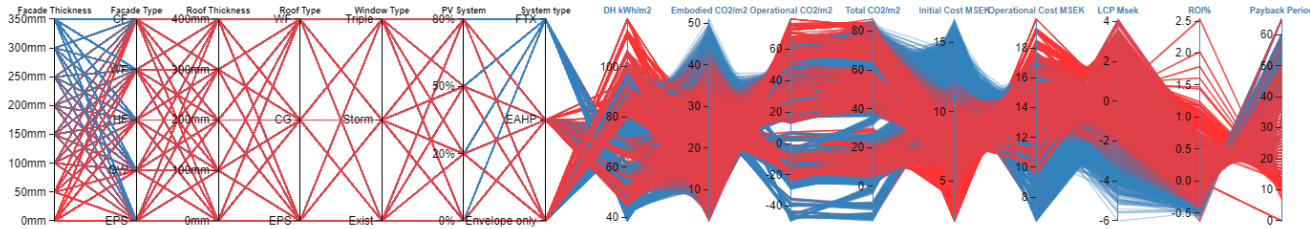
Design Explorer

Get Data

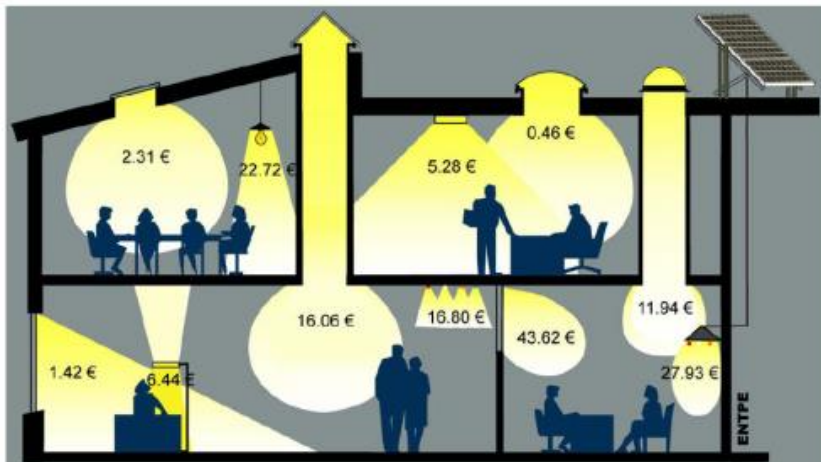
Reset Selection Exclude Selection Zoom to Selection Save Selection to File My Static Link Tutorial Services Info

Setting L M S

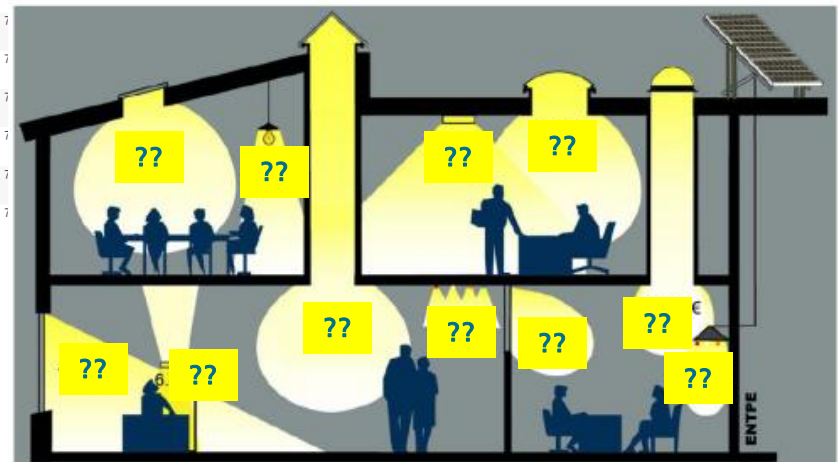
© 2019 Thornton Tomasetti



Facade Thickness	Facade Type	Roof Thickness	Roof Type	Window Type	PV System	DH kWh/m2	Embodied CO...	Operational C...	Total CO2/m2	Initial Cost MS...	Operational C...	LCP Msek	ROI%	Payback Period	System type	Rating
scid																
0mm	EPS	0mm	EPS	Exist	0%	118.96	3.42	79.26	82.68	2.14	19.94	0	0	0	Envelope only	0
0mm	GW	0mm	EPS	Exist	0%	118.96	3.42	79.26	82.68	2.14	19.94	0	0	0	Envelope only	0
8																
0mm	HF	0mm	EPS	Exist	0%	118.96	3.42	79.26	82.68	2.14	19.94	0	0	0	Envelope only	0



Annual costs (€/Mlmh) for various lighting and daylighting techniques, Source: Marc Fontoyont



Carbon Footprint (e.g. kgCO₂eq/Mlmh) for various lighting and daylighting techniques

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Subtask B:

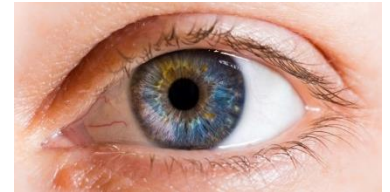
Visual and non-visual User Requirements

Coordination: Barbara Matusiak, NTNU, Norway and Jan Wienold, EPFL, Switzerland



Objective: Daylighting and lighting design is moving from a “photometric” or “visual” to a “spectral” definition of lighting quality including “non-visual” effects. Focus on understanding how lighting and daylighting schemes can address both – often contrasting - visual and non-visual requirements in an effective, resource efficient way, taking the built environment but also the surrounding in the big picture by means like intervention studies.

B.1. Improved understanding of visual discomfort for humans

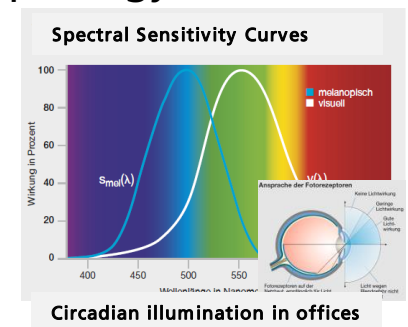


B.2. View preferences/descriptors for rooms with different visual stimuli and activities

B.3. Relation between the view out of the window and urban morphology

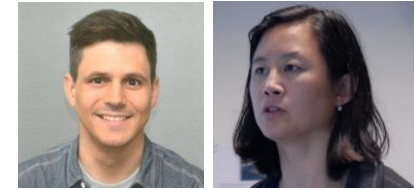
B.4. New developments for non-visual aspects

B.5. Measurements and assessment methods of non-visual aspects



Subtask C:

Digitized lighting solutions (Technology & Design Tools / Process)



Coordination: David Geisler-Moroder, Bartenbach, Austria with support of Eleanor Lee, LBNL, U.S.A

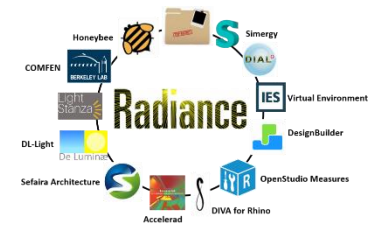
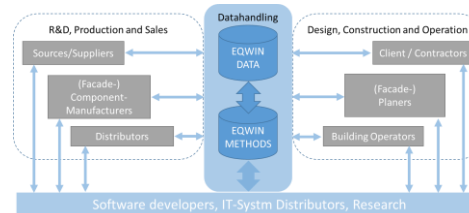
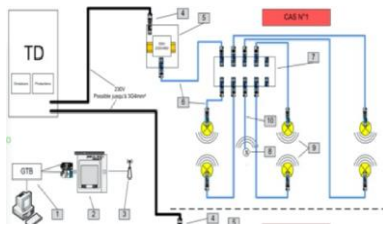
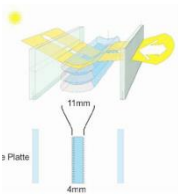
Objective: Evaluate and contribute to the digitization of lighting which is taking place at the **technology** and the **design process** level in its impact on a low carbon footprint

Technology: Review the state-of-the-art practice for digital component integration via the internet of things (IOT), as well as benefits for commissioning and maintenance of lighting installations

- C.1. System concepts for digitalized lighting solutions and combined daylight and solar utilization
- C.2. IOT and control systems

Design Tools / Process: Focus on the integration of lighting in the overall BIM workflow analyzing the current status. Design software will be evaluated regarding seamless data and workflows (connecting to BMS, "Human Lighting Interface", etc.), parametric and automated design options to better understand carbon impacts given temporal availability of clean energy, certification and code compliance calculations, and advanced communication options.

- C.3. BIM - continuous workflow for integrated lighting solutions and underlying data
- C.4. Simulation methods for integrative lighting design and VR possibilities



Subtask D:

Application and Case Studies

Coordination: Niko Gentile, Lund University, Sweden



Objective: Collect experiences from applications and case studies, with a focus on the environmental impact of their whole life cycle. And communicate opportunities and challenges to stakeholders wishing to build or retrofit daylighting and lighting in the least environmentally impactful way, while keeping the lighting quality high.

D.1. Catalogue of case studies



D.2. Evaluation procedure

D.3. Data collection and analysis

D.4. Lessons learned

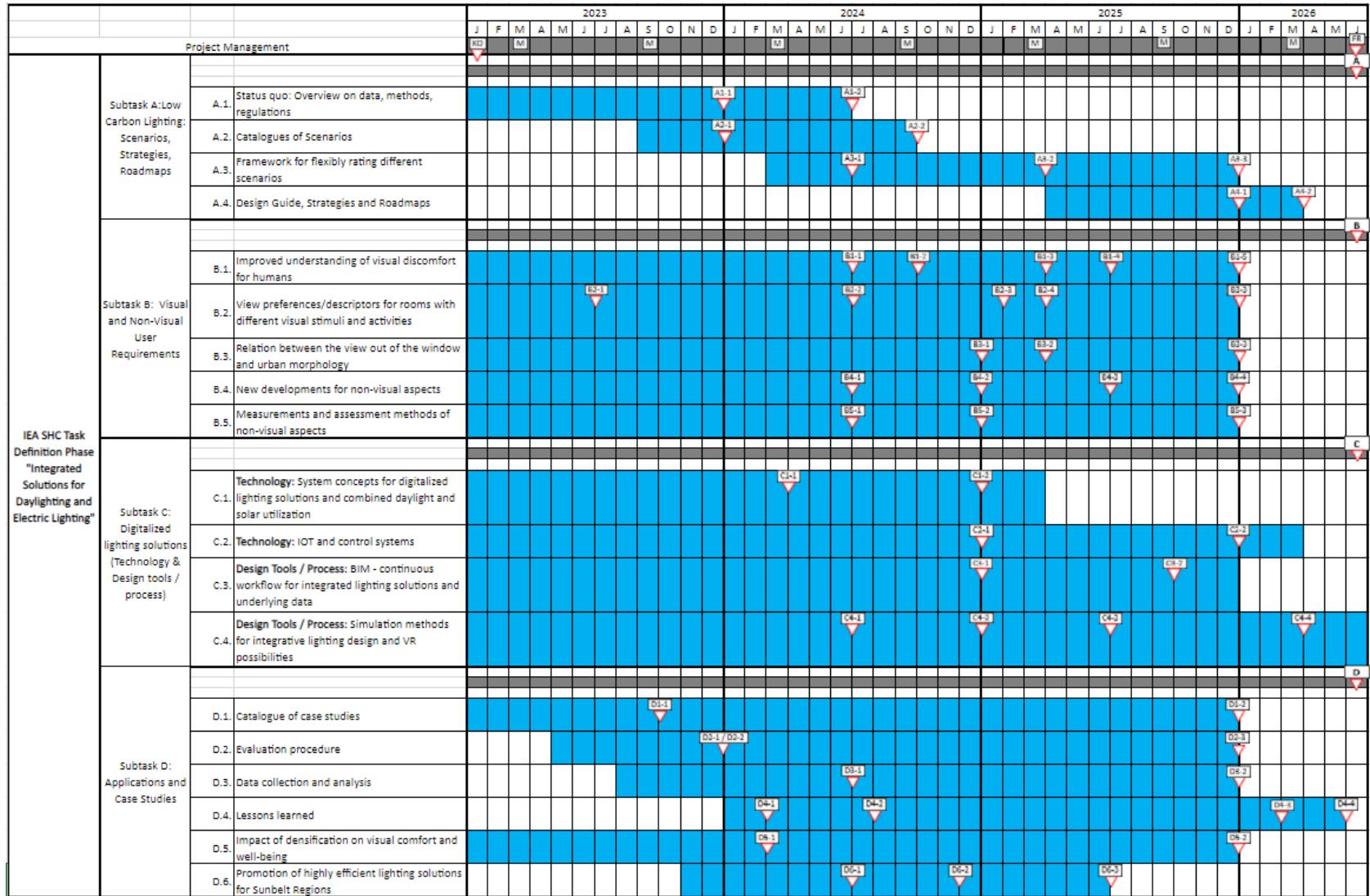


D.5. Impact of densification on visual comfort, well-being, and resources used

D.6. Promotion of highly efficient lighting solutions for Sunbelt Regions, GN-SEC

CCREEE RCREEE
EACREEE SACREEE
ECREEE SICREEE

Milestones



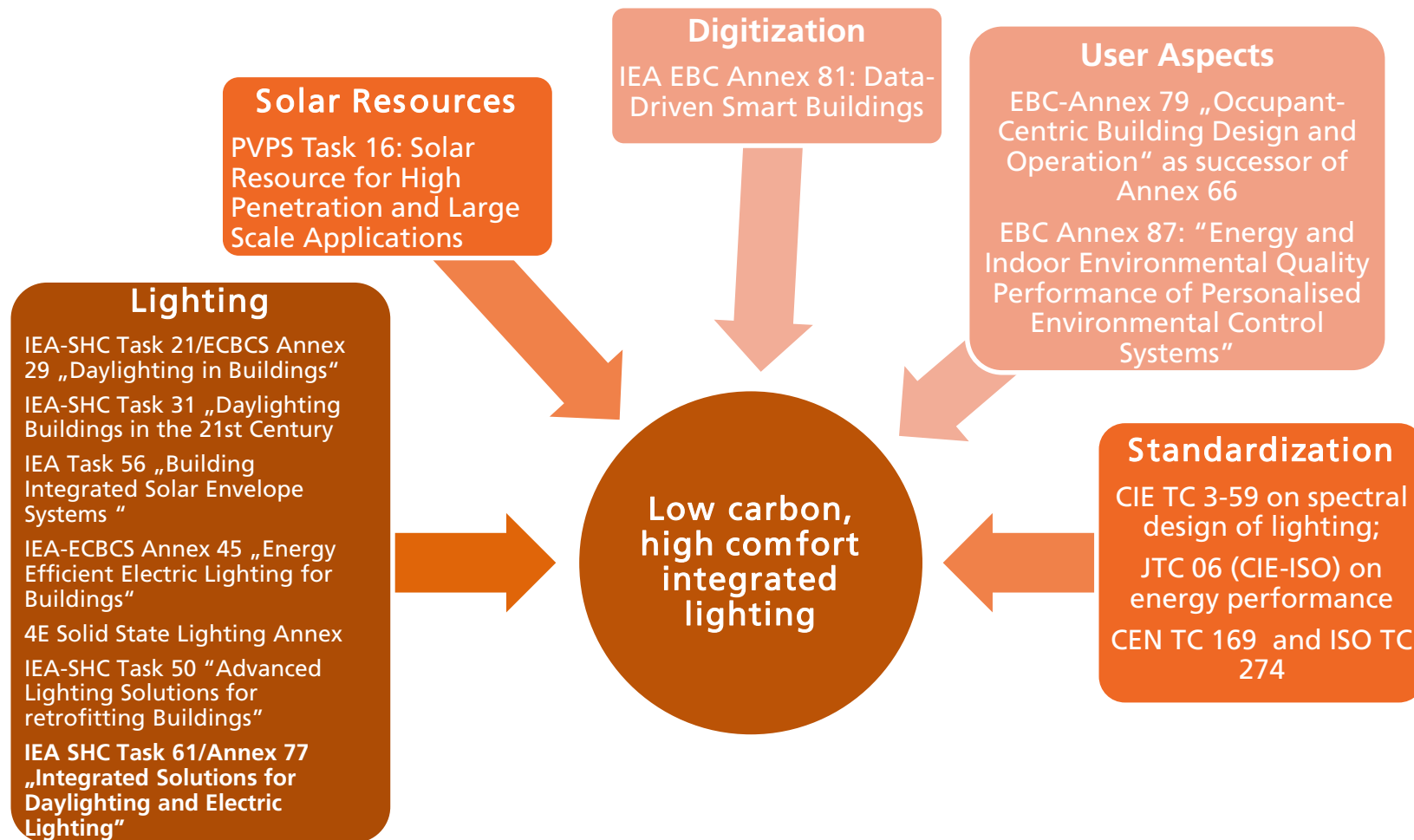
Joint Work

Main aspects of work integration between the 4 subtasks

Overview on subtask joint activities and possible overlaps, 8.11.2022

	A.1 Status quo: Overview on data, methods, regulations	A.2 Catalogues of Scenarios	A.3 Framework for flexibly rating different scenarios	A.4 Design Guide, Strategies and Roadmaps	B.1 New developments for visual aspects	B.2 New developments for non-visual aspects	B.3 Relation between the view out of the window and urban morphology	B.4 New developments for non-visual aspects	B.5 Measurements and assessment methods of non-visual aspects	C.1 System concepts for digitalized lighting solutions	C.2 Daylight and solar utilization in facade and roof	C.3 IOT	C.4 BIM - continuous workflow for integrated lighting solution	D.1 Catalogue of case studies	D.2 Evaluation Procedure	D.3 Data collection and analysis	D.4 Lessons learned	D.5 Impact of densification on visual comfort	D.6 Promotion of highly efficient solutions for sunbelt regions
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D.4 Lessons learned																			
D.5 Impact of densification on visual comfort																			
D.6 Promotion of highly efficient solutions for sunbelt regions																			
Joint activities, please specify, in which Subtask the results will be documented																			
Interaction between activities, please specify who is expecting what																			
Possibly overlapping activities, please make proposal to resolve																			

Relation to ongoing or previous SHC Tasks, EBC Annexes and other Programs



Expressed Interest: Research

Country	Organisation	Interest in Subtask			
		A	B	C	D
Australia	Queensland University of Technology		X		X
Austria	Bartenbach	X	(X)	X	
	HELLA	X		X	
Belgium	Université catholique de Louvain		X	X	X
Brazil	Universidade de Brasília		X	(X)	X
Canada	University of Toronto			X	
China	Beijing University of Technology	X	X		
	China Academy of Building Research	X	X		X
	Soochow University	t.b.d.			
Denmark	DTU Civil Engineering		(X)	X	X
Germany	Fraunhofer-Institut für Bauphysik	X		X	(X)
	Fraunhofer-Institut für Solare Energiesysteme			X	
	Priedemann Fassadenberatung GmbH			X	X
Italy	Construction Technology Institute (ITC-CNR)		X		(X)
	Sapienza Università di Roma		(X)		X
	University of Campania		X	X	(X)
	University of Naples Federico II		X	X	
Japan	Kyushu University		(X)	X	
Norway	NTNU		X		
Poland	Gdansk University of Technology		X	(X)	X
Spain	IREC – Fundació Institut de Recerca en Energia de Catalunya	X	(X)	(X)	(X)
Sweden	Lund University		X		X
Switzerland	Empa - Swiss Federal Laboratories for Materials Science and Technology	X		X	(X)
	EPFL		X		X
	Idiap Research Institute			X	(X)
	Lucerne University of Applied Sciences and Arts	(X)	X	X	
Türkiye	University of Istanbul	X	X		X
United Kingdom	University of Cambridge		X		X
U.S.A.	Lawrence Berkeley National Laboratory			X	(X)
	Oregon State University		X		

Since Workplan submittal: Netherlands, TU-Delft



Expressed Interest: Industry

Country	Company	Short name /Abbreviation
Austria	Hella, Sunshading	HEL
	Bartenbach	BL
Denmark	Velux	VEL
China	t.b.d. Luo Tao is contacting companies	
Germany	Different trade associations (electric lighting and façade)	TA
	Interpane	IP
	Priedemann Façade Lab	PFL
Norway	Norconsult	NoC

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HELLA

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AGC INTERPANE

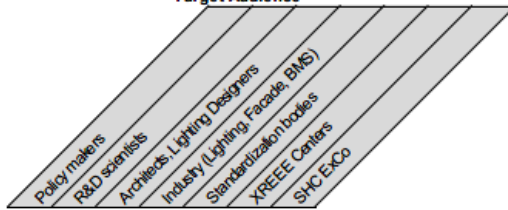
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Norconsult 

Task # Information Plan

Task Duration:

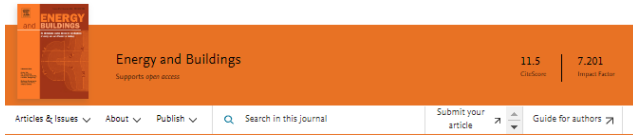
Target Audience



										#	Title/Proposed Title	Format	Task Month
Subtask A										A1	Survey on data sources, methods and regulations	Internal document (not public)	12
										A2	Catalogue of scenarios	Internal document (not public)	21
	X		X	X						A3	Simple tool to rate LCA / GWP	SHC website	36
			X							A4	Design guideline	SHC website	36
	X			X						A5	Roadmap	SHC website	39
	X		X	X						A6	Report "Low Carbon Lighting: Scenarios, Strategies and Roadmaps"	SHC website	42
Subtask B										B1	Documentation B.1-B.5 as working documents	Internal documents (not public)	36
		X	X	X	X					B2	Information material on "New developments for non-visual aspects" as report or short video	SHC website	36
		X	X	X	X					B3	Report "Visual and Non-Visual User Requirements"	SHC website	42
Subtask C										C1	Documentation C.1-C.4 as working documents	Internal documents (not public)	36
		X	X	X						C2	Refactored Radiance core tools	Software via SHC Website	30
										C3	White paper on current state-of-the-art of lighting simulation software tools for visual and non-visual performance evaluation.	White Paper (Public)	36
	X	X	X	X						C4	Report "Digitalized Lighting Solutions for low carbon build environments – Status quo and outlook"	SHC website	42
Subtask D										D1	Documentations D.1-D.5 as working documents	Internal document (not public)	36
	X	X	X		X					D2	Information material about D.5 "Impact of densification on visual comfort and well-being" as report or short video	SHC website	36
		X	X	X						D3	Report "Low carbon daylighting and lighting solutions: practical applications"	SHC website	42
TCP/Other	X	X	X	X	X						Task webpage	SHC website	2
	X	X	X	X	X						Task brochure (optional)	SHC website and Print	2
	X	X	X	X	X		X				TCP Annual Report contribution (1 per year)		annually
	X	X	X	X	X						Task Highlight report (1 per year)		annually
	X	X	X	X							Position Paper (ExCo needs to approve request to omit)		42
	X	X	X	X							Solar Update articles (minimum during and end)		24/42
								X			Task Status report (2 per year)		twice per year
								X			Final Management report		42
								X			Mid-term Task evaluation		21
								X			Final Task evaluation		42
	X	X	X	X							Solar Academy webinar	Workshop	30
									X		"Low Tech, High Impact" Lighting solution for sunbelt regions	Workshop	30
		X	X	X							Special journal issue for scientific papers	Wiley or Elsevier or other	42
X		X	X		X					Industry Workshops each face to face task meeting	Workshop	twice per year	

*A Task report is an official document of the Task that is approved by the Task Publication Committee. They do not include conference papers and presentations.

Addendum to IEA SHC Task 61 / EBC Annex 77



Integrated Solutions for Daylighting and Electric Lighting

Edited by Jan de Bree, Eleanor S. Lee, Niko Gentile, Werner Osterhaus
Last update: 30 September 2021

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A study on the application of solar mo efficiency



Editorial Integrated solutions for daylighting and electric lighting

1. Introduction

The International Energy Agency's (IEA) Solar Heating and Cooling (SHC) Programme initiated the Task 61 Integrated Solutions for Daylighting and Electric Lighting/Energy in Buildings and Communities (EBC) Annex 77 in 2018 for several reasons. First, a focus solely on increasing source efficacy via light-emitting diodes (LEDs) was not enough. Lighting accounts for approximately 15 percent of global electric energy consumption and about 3 percent of greenhouse gas emissions. Despite increased source efficacy with LEDs, user demands for higher quality lighting and rebound effects as a result of low priced, more versatile electric lighting have led to a significant increase in worldwide lighting energy consumption, where more light is now being used less consciously. Second, the potential of improving lighting controls and daylight integration in this rapidly evolving field was not being adequately addressed. Both the lighting and facade markets have seen significant technological advancements and developments towards digitalized smart and connected lighting over the past decades but both market sectors still operate independent of the other, missing out on opportunities to achieve greater efficiency and better user-centered outcomes. And third, electric lighting and daylighting are typically dealt with by two separate communities and market sectors. Integrated solutions are achieving slow market penetration due to practical barriers across the design through commissioning phases of construction.

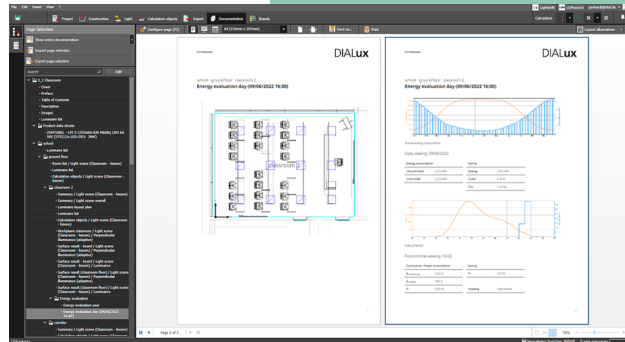
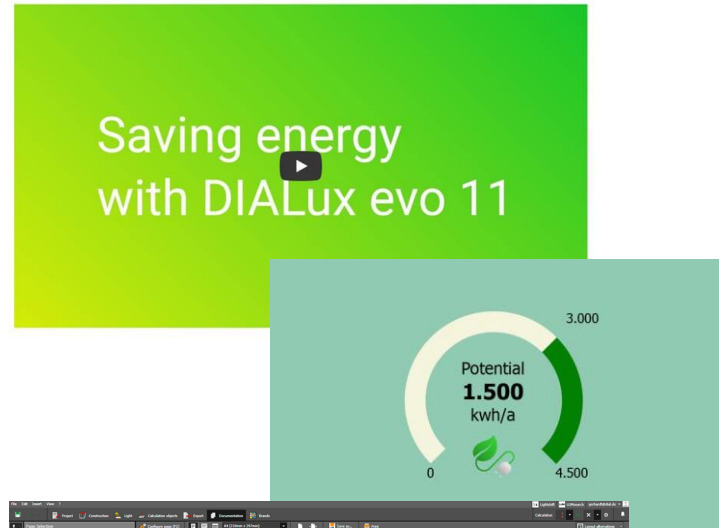
On the other hand, satisfactory solar shading and glare protection solutions are available for some applications but are non-optimal for daylight and view. For integrated solutions, it is now possible to achieve 4 kWh/m²-a site energy use for lighting (i.e., office applications), but achieving this level of performance is far from being standard. There is immense relevance and added value in integrating sun protection with artificial lighting. Lighting is not just one technology delivering one service like a radiator delivering heat. Lighting has to be designed specifically for multi-criteria user needs, that is, for what people are doing and in which context. The importance of this is still growing and will need to be better integrated into design processes, standards, and lighting controls. Controls managing light in the field of vision, for example, is an upcoming area. For facades, a big disruptive step might be on the brink in the field of switchable glazing systems. Micro-optics offer new design options that are more resource efficient for LED luminaires and facade applications. Via the IEA SHC research platform, the separate research agendas of various nations with differing areas of focus and mandates for mitigating climate change contributed to a larger vision with shared knowledge, building on expertise acquired over the course of decades, and enabling real time exchanges between experts and with industry



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IEA SHC Task / EBC Annex Proposal „Low carbon, high comfort integrated lighting“



Technology Position Paper

Integrated Day- and Electric Lighting in Non-residential Buildings

November 2022

Challenge	Action needed
Harvest 'low hanging fruit' in electric lighting	<ul style="list-style-type: none"> Replace old lighting installations with LED technology. Request luminaire efficiencies >150 lm/W. Refocus from decisions based on pure investment costs to total cost of ownership.
Strengthen the role of daylighting	<ul style="list-style-type: none"> Recognize daylight – which nowadays can be sufficiently quantified as a substitute for electric lighting – a "renewable energy source" – allowing for inclusion in subsidy programs as known from other market sectors (PV, wind, etc.). Use sustainability certificates to promote daylighting, if not included, or revisit existing certificates and update. Demand a minimal window to floor area ratio, e.g., in central Europe between 1/8 and 1/10. Revise ordinances to demand technical and economical advantageous daylighting solutions, such as: <ul style="list-style-type: none"> Daylight-supportive combinations of glazing and sun shading/glare protection devices Light redirecting fenestration, and Daylight and occupancy sensitive electric lighting controls also integrated with facades (i.e., visual comfort driven when occupied, solar gain driven when unoccupied).
Widen the rating perspective of lighting	<ul style="list-style-type: none"> Put lighting into the perspective of its impact on decarbonization. Foster LCA approaches for rating integrated lighting.
Rethink products	<ul style="list-style-type: none"> Make product architectures⁵ more sustainable. Push product design based on micro-optics for LED luminaires and façades applications. Support development and implementation of disruptive façade technologies like switchable glazing systems, ideally in combination with vacuum glazing, to drastically lower a façade's embodied energy.
Improve Design Processes	<ul style="list-style-type: none"> Make planning of lighting installations mandatory. Foster employment of new available integrated design and rating tools, which in part automatically indicates not yet allocated potentials. Introduce processes ensuring certain daylight quality levels (e.g., parametric, automated design tools). Use design strategies that prompt energy efficient behaviors. Support the deployment of concepts from new daylighting and electric lighting standard (e.g., EN

⁵ Product architecture is the organization (or chunking) of a product's functional elements.

Organisational Matters / Issues for the EXCO

- Planned duration 3,5 years: 1/2023-6/2026
- Participation of your experts greatly appreciated
- Kick-off planned: 17th-19th of April 2023, Aversa, Italy
- Collaboration with EBC:
 - Istanbul EXCO meeting: Commitment for collaboration, Level still open
 - Interested to join via EBC: Brasil, Italy, Japan, Sweden, USA.
 - Liason officer („Annex Adviser“)

