IEA Activities Towards Standardizations for Daylight System Characterizations and Hourly Rating Methods

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Bartenbach

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Fraunhofer IBP

VELUX Daylight Symposium 2019
9 October 2019, Paris

SHC SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

EBC Energy in Buildings and Communities Programme

founded 1976 (Prof. Dr. h.c. Ing. Christian Bartenbach)
Independent from manufacturers
90 employees, ca. 40 in lighting design
Locations: Aldrans, Austria
more than 10.000 projects worldwide

DAYLIGHTING DESIGN

ARTIFICIAL LIGHTING DESIGN

COMPLETE LIGHTING SOLUTIONS

RESEARCH & DEVELOPMENT

MATERIALS CONSULTATION

MODEL BUILDING & VISUALISATION

OUR RANGE OF SERVICES

Tailored to suit your needs

ARTIFICIAL LIGHTING DESIGN
COMPLETE LIGHTING SOLUTIONS

ARTIFICIAL LIGHTING
DAYLIGHTING DESIGN
MODEL BUILDING & VISUALISATION

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IEA SHC Task 61 / EBC Annex 77

Integrated Solutions for Daylight and Electric Lighting

From component to user centered system efficiency

Bartenbach
research & development

Fraunhofer
IBP

SHC
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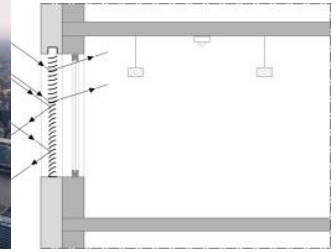
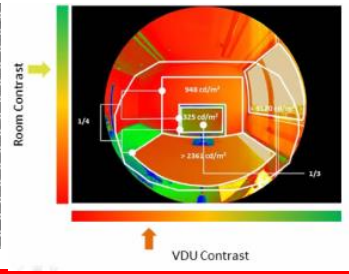
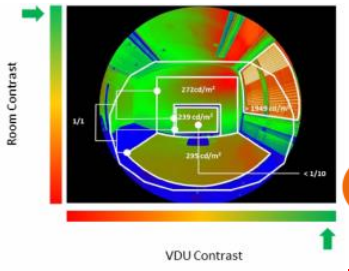
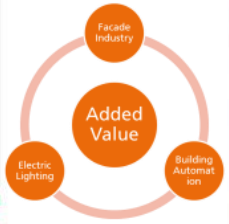
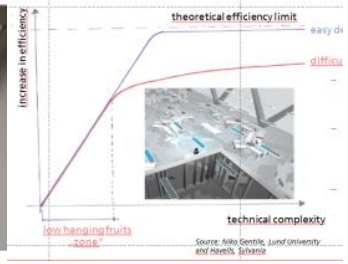









AUSTRALIA · AUSTRIA · BELGIUM · BRAZIL · CHINA · DENMARK · GERMANY · JAPAN · NETHERLANDS · NORWAY · SINGAPORE · SLOVAKIA · SWEDEN · SWITZERLAND · UNITED KINGDOM · USA

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

IEA SHC Task 61 / Annex 77

Subtask C: Design Support for Practitioners

Objective

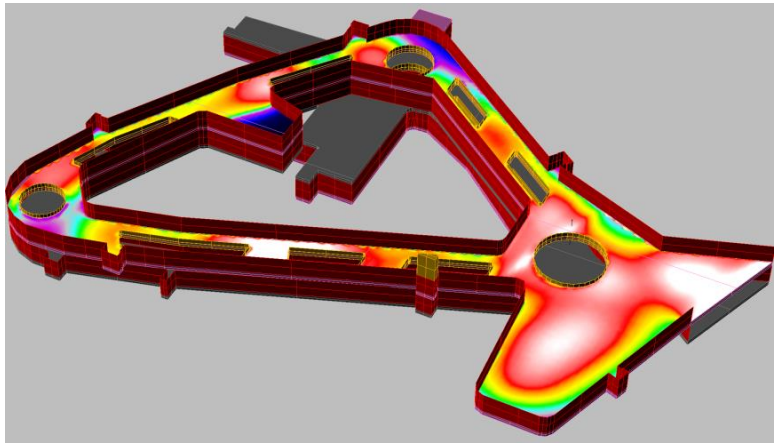
Focus on the application of technical innovations in the field of integrated lighting solutions in practitioners' workflows. Bring findings onto the desktops of designers by integration into widely used software tools, standards and codes, and design guidelines.

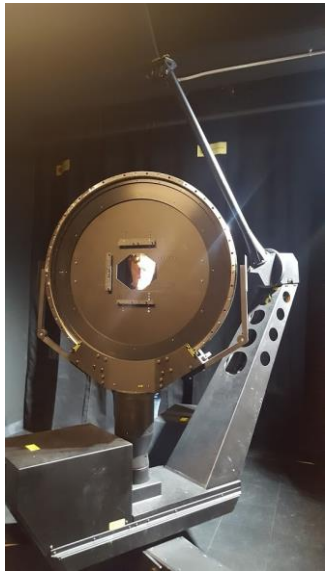
C.1 Review of state of the art design workflows

C.2 Standardization of BSDF daylight system characterization

C.3 Spectral sky models for advanced daylight simulations

C.4 Hourly rating method for integrated solutions

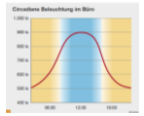




Hourly Rating Method

Overall model

Input

- Location, climate (TRY)
- User requirements (Profiles) 
- Space
- Components
  - Electric Lighting
  - Facade (Light and radiation)
  - Light-management
- Network (Light, Light with other trades)

Sub models

- **A:** Facade model: Daylight and solar radiation
- **B**: Electric Lighting
- **C**: Light Management
- **D**: Network Model
- **E**: User- and Usage Models
- **F**: Calculation Control

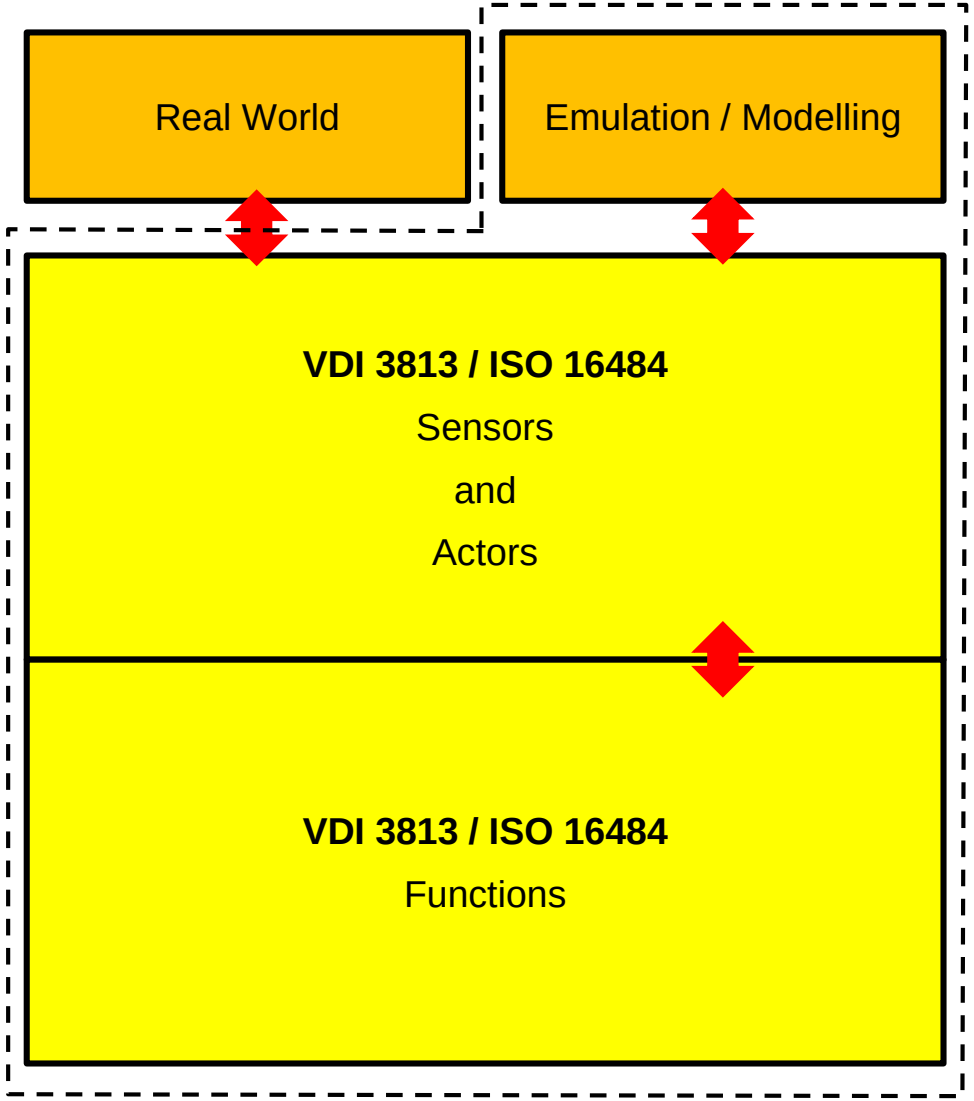
Output

- **Lighting**
  - Energy
  - Demand profiles
  - Illuminances
  - Daylight Autonomy
  - Light quantities
  - Match with solar model
- **Solar gains**
  - Energy
  - Demand profiles
  - effective g-Values
  - Match with lighting model
- **Effect on humans**
  - Glare indication
  - Lichting quantity ($v(\lambda)$)
  - Radiation at other sensitivities (e.g. $s_{mel}(\lambda)$)

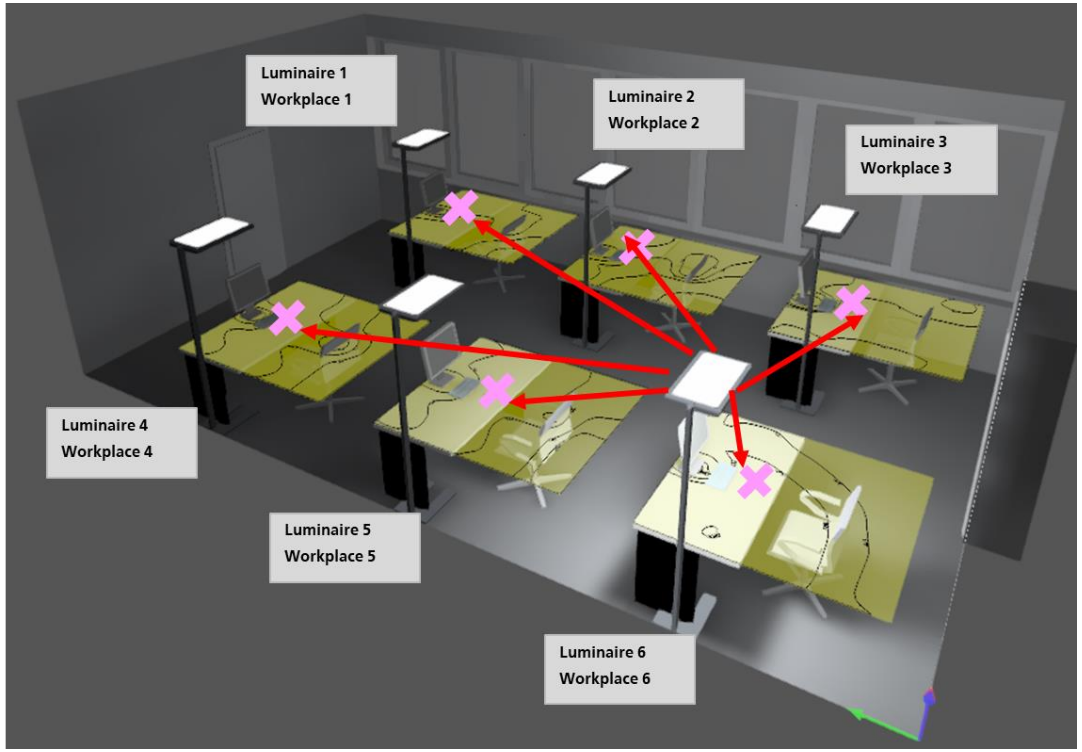
Relation to BACS

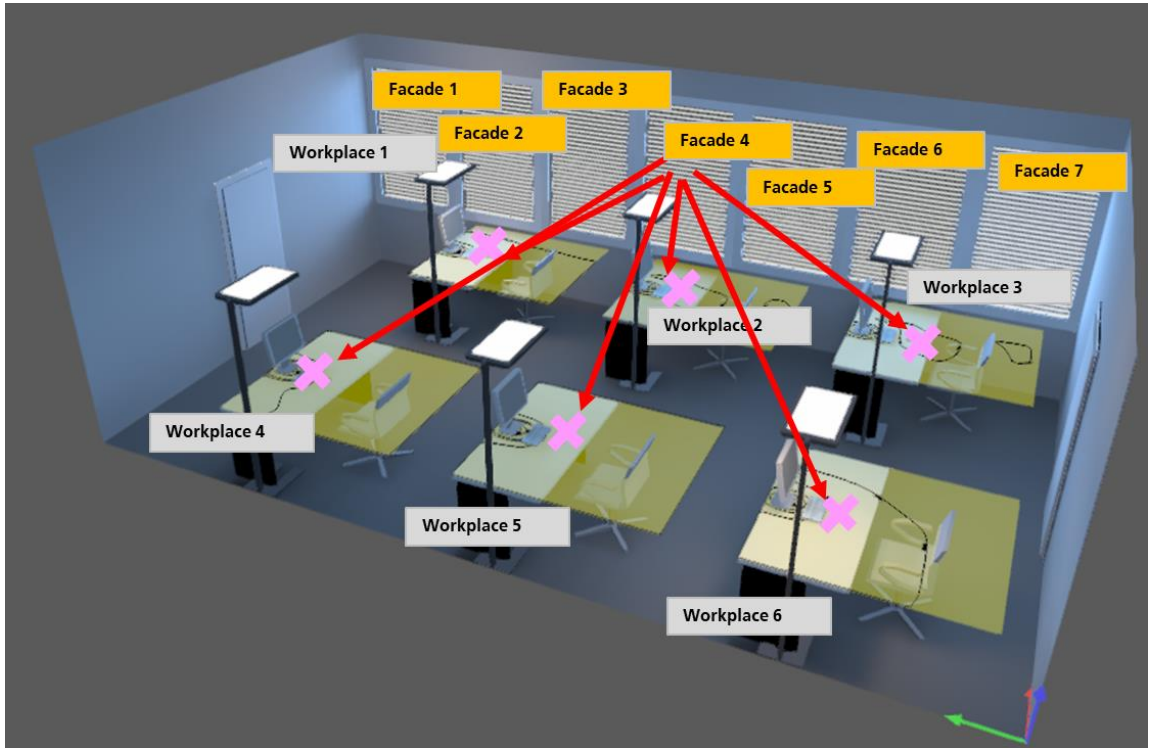
Translation into ISO 16484 logic

- “Emulation” / Modeling of inputs & outputs
- BMS: BACS logic
  - Sensors & Actors
  - Functions

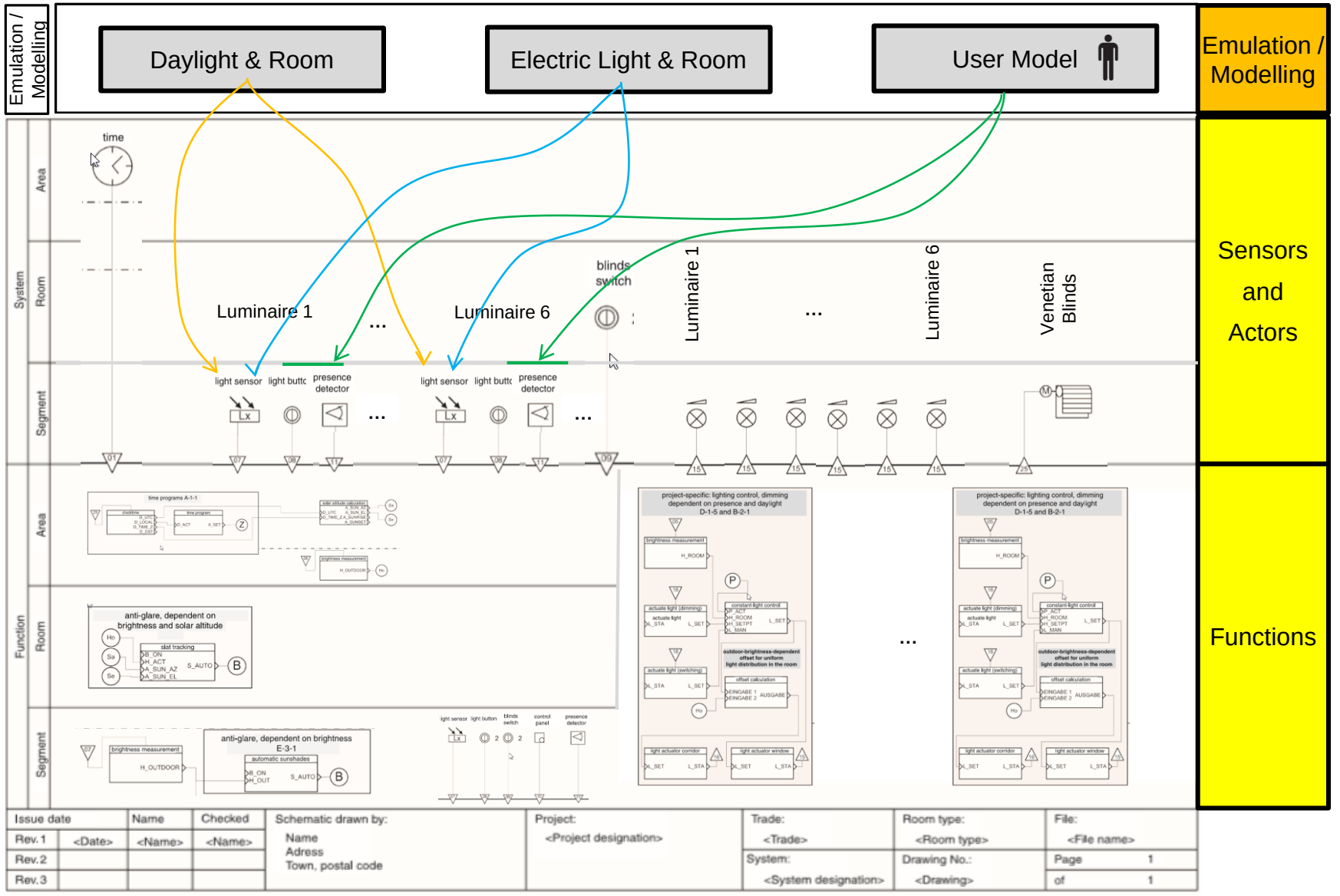


Integrated Daylight and Electric Lighting

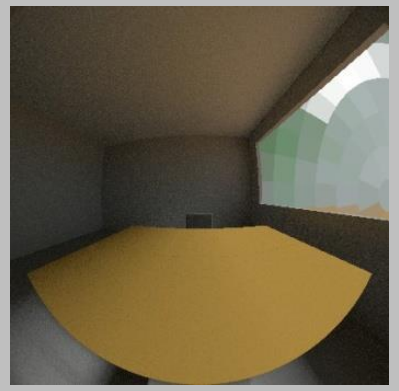




Formal „Room Control Schematic“ according to ISO 16484

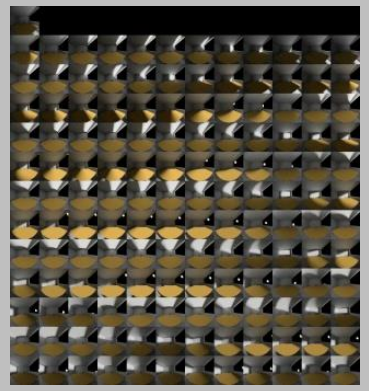


“Daylight Emulation”: Three-Phase-Method



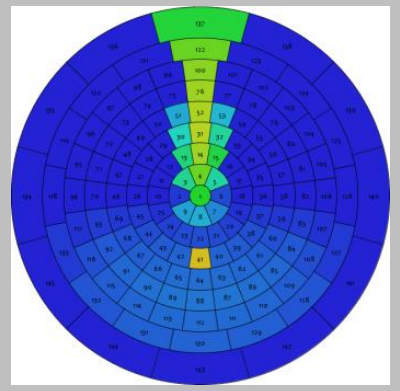
I
result

=



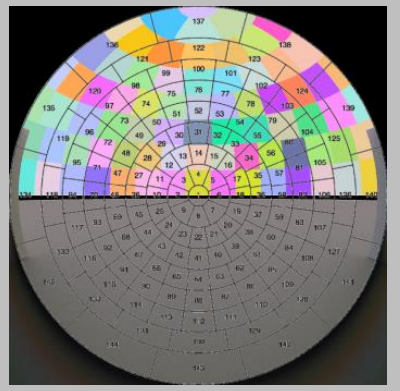
V
view matrix

*



T
BSDF

*



D
daylight matrix

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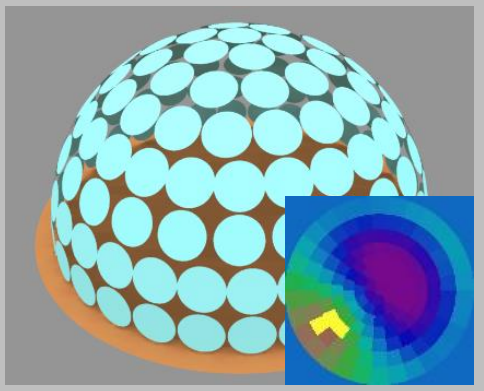
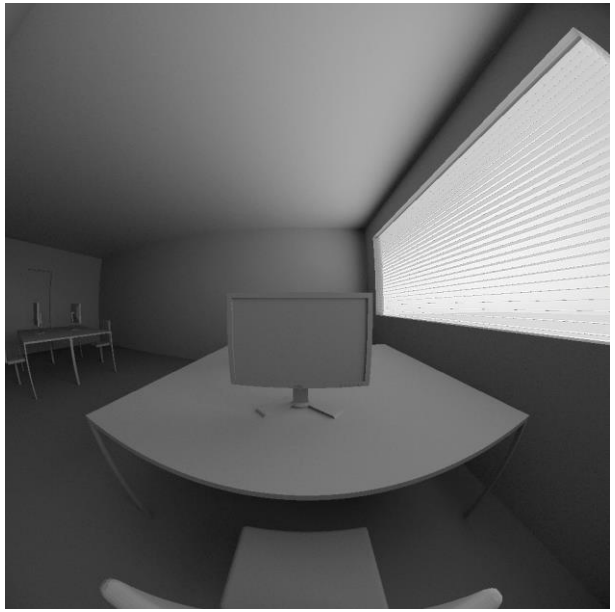
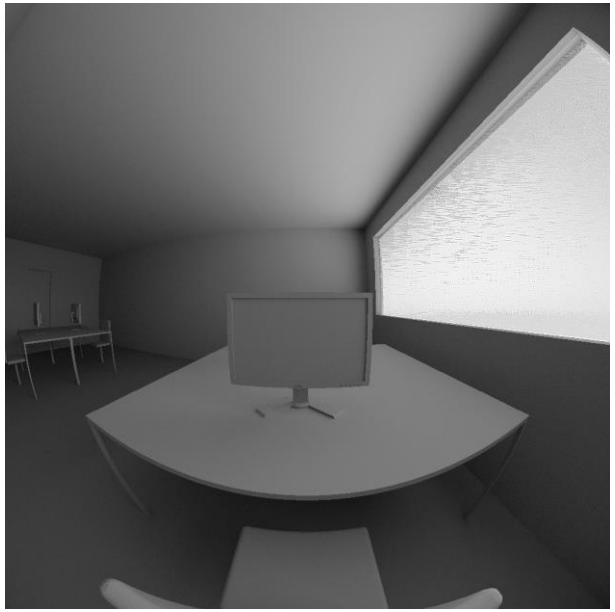
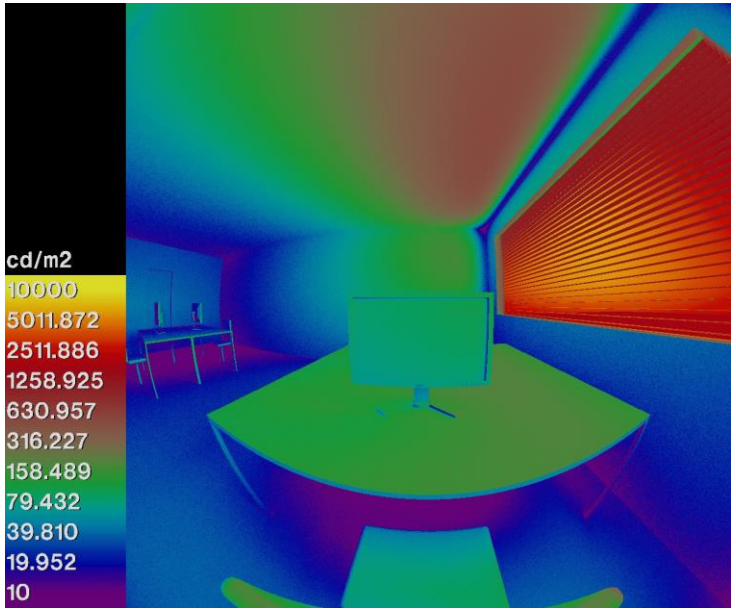


S
sky distribution

BSDF?



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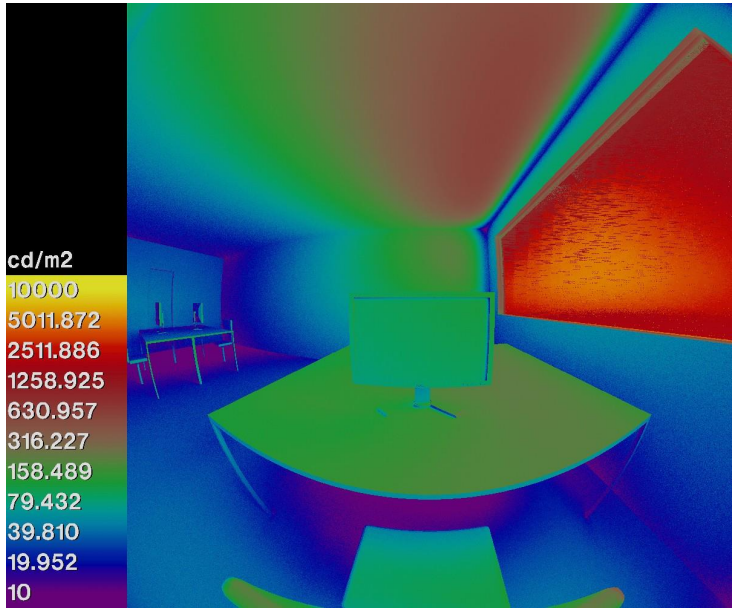
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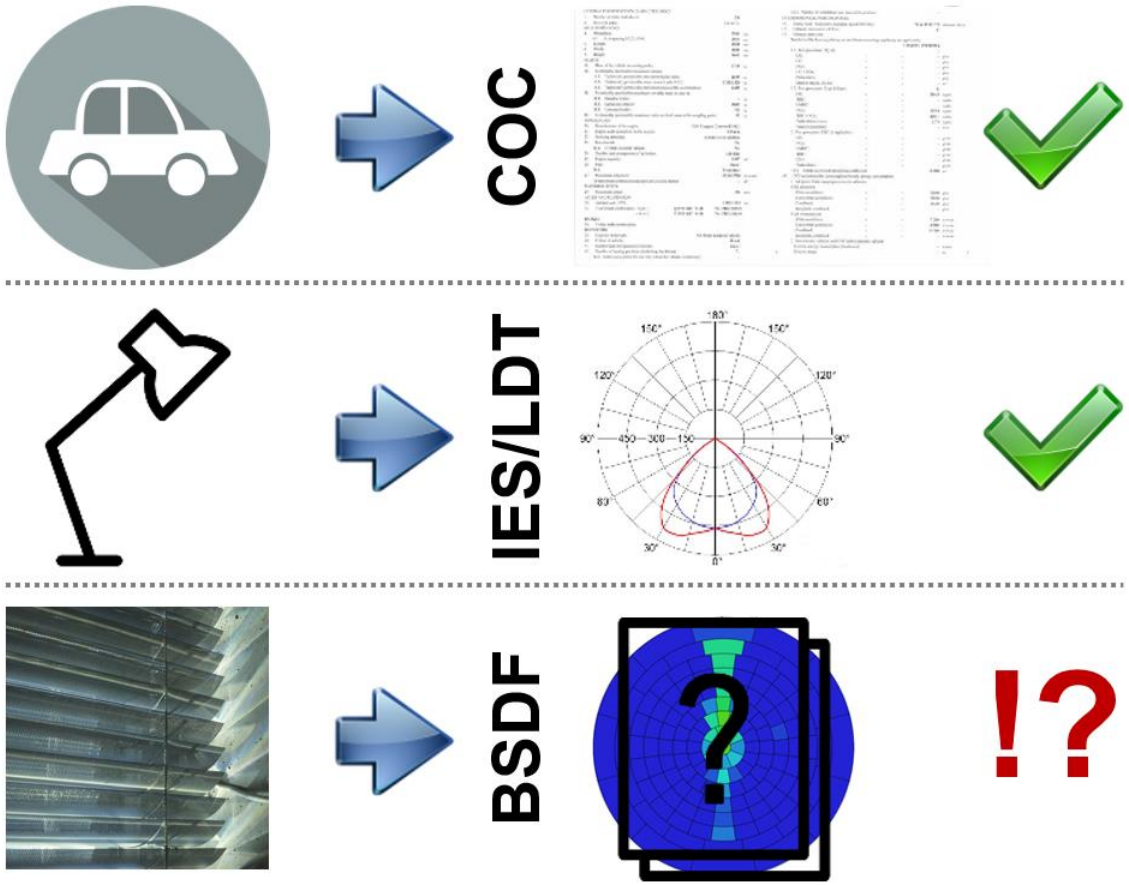
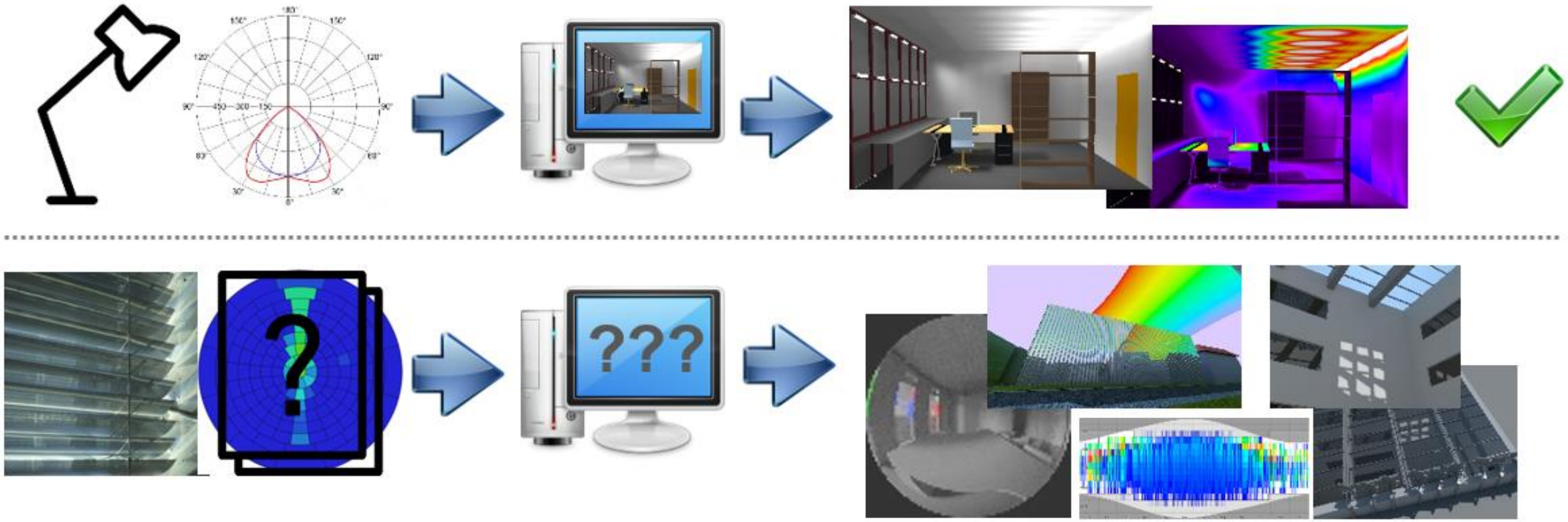
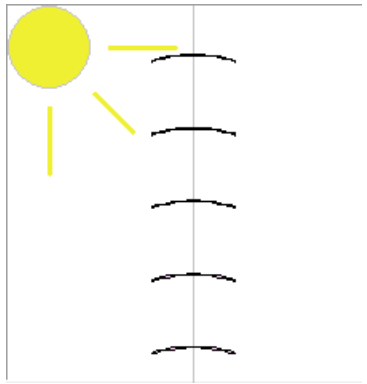
BSDF – Standardization

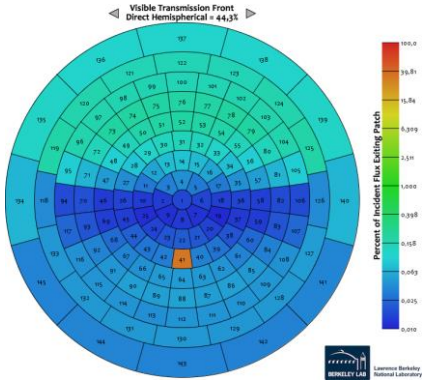


BSDF – Standardization



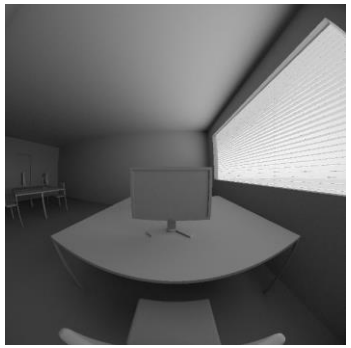
Sensitivity Analysis

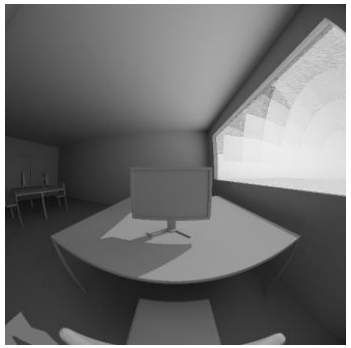


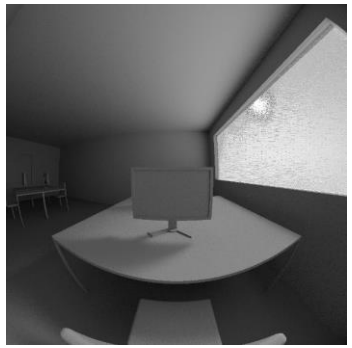


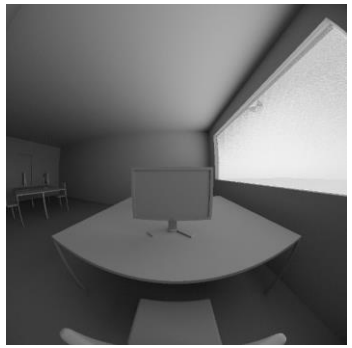
Blinds, 00deg tilt

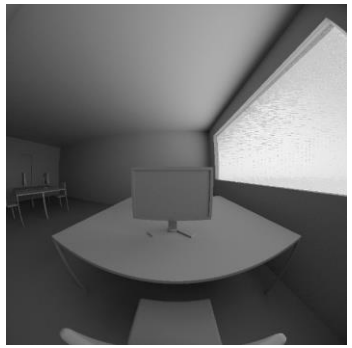
CIE Sunny Sky
21 March, 10am
Innsbruck, Austria (47.3N / 11.4E)

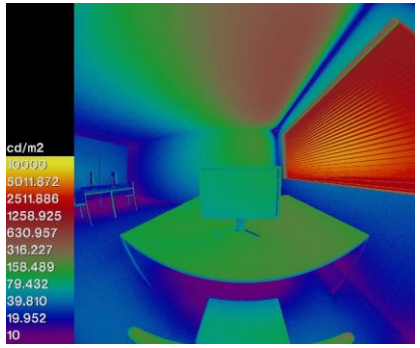












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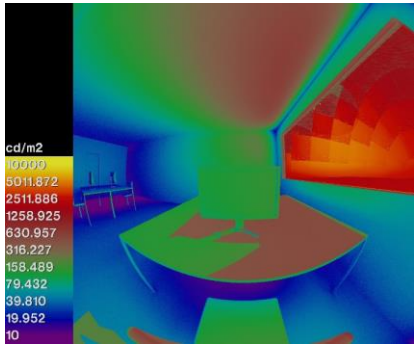

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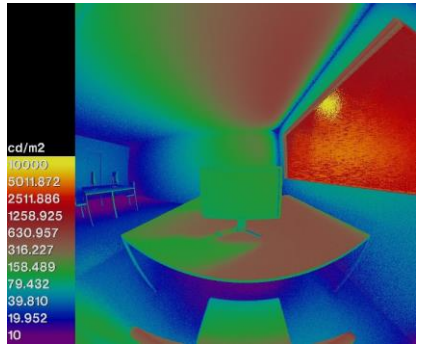

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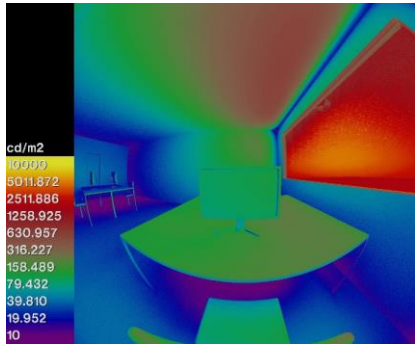

tt46 aBSDF
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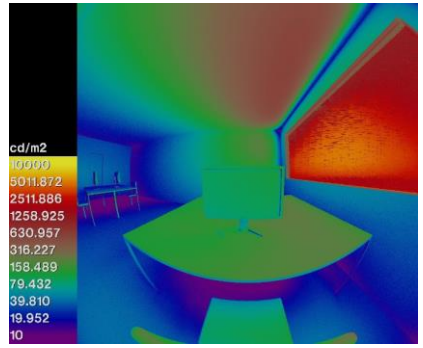


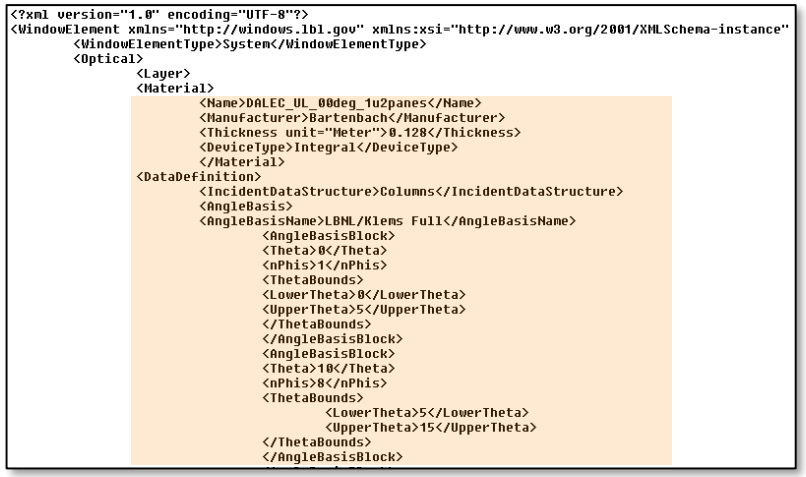
tt46 BSDF
Ev 1530 lx
DGP 0.26

BSDF – Discretization and data format

Established data formats

name	input resolution	output resolution	currently used by software
WINDOW6 standard basis	Klems (145)	Klems (145)	WINDOW7, Relux, Radiance
IEA 21	Tregenza (145)	5deg full, i.e. 5°x5° (1297)	Relux, Radiance, Dialux
Shirley-Chiu	variable (limitation through data size)	variable (limitation through data size)	Radiance

XML file format



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Work in progress…

Venetian blinds

Task	Simulation method	System characterization / BSDF
Daylight Factor	Raytracing possibly mkillum continuous sky model	(a) Geometry (b) Low-res BSDF
Point-in-time illuminance for overcast / sunny sky	Raytracing continuous sky model	(a) Geometry (b) Low-res BSDF
Point-in-time glare metric for overcast / sunny sky	Raytracing peak extraction continuous sky model	(a) High-res BSDF (b) Low-res BSDF (with peak extraction)
Point-in-time rendering for overcast / sunny sky	Raytracing peak extraction continuous sky model	(a) High-res BSDF (b) Low-res BSDF if peak extraction
Annual illuminance metric	DC-method or 3-PM	Low-res BSDF
Annual glare metric	5-PM peak extraction	Low-res BSDF and (a) Geometry or (b) High-res BSDF or (c) Low-res BSDF (only if PE)

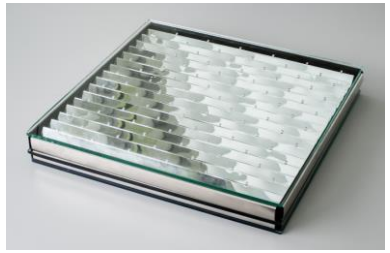
Work in progress…

Aim

The „right“ system data for

- Transparent systems[1]
- Woven shades
- Venetian blinds
- Specular blinds / grids
- Micro-/Nano-structured systems
- Prisms, LCPs

[1] Clear / electrochromic glazing, films

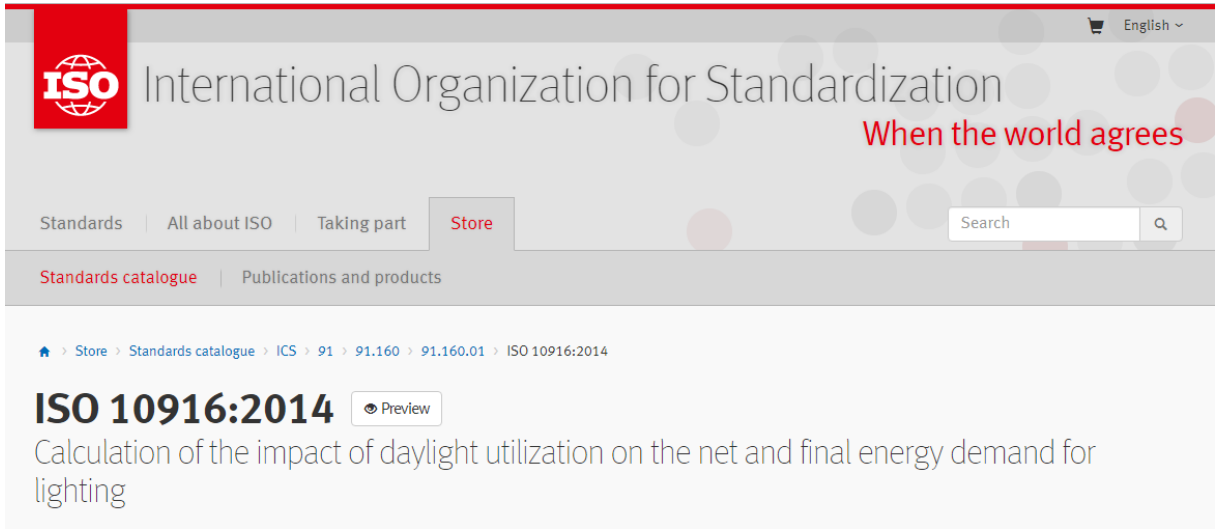


Work in progress…

Task Force „Revision of ISO 10916“

Proposed new scope

- extend ISO 10916 to an hourly based (annual) estimation of the daylight supply in buildings
- based on location and local climate data
- include facades with and without shading systems
- allow to model different daylighting control strategies including linkage with electric lighting systems (e.g. indoor occupation sensing)
- appropriate interface with BACS formalism



Acknowledgments

Funding by the Federal Ministry of Austria for Transport, Innovation and Technology through the project

„IEA SHC Task 61 / EBC Annex 77“

managed by the Austrian Research Promotion Agency FFG is gratefully acknowledged.

Federal Ministry
Republic of Austria
Transport, Innovation
and Technology

FFG
Forschung wirkt.

IEA FORSCHUNGS KOOPERATION

Funding by the German Federal Ministry of Economic Affaires and Energy through the project

„EnOB: MEET Lichtplanung - Methoden zur effektiven Erschließung von Energieeinspar-potentialen in der Kunst- und Tageslichtplanungs-praxis von Gebäude “

managed by the Project Management Jülich PTJ is gratefully acknowledged.

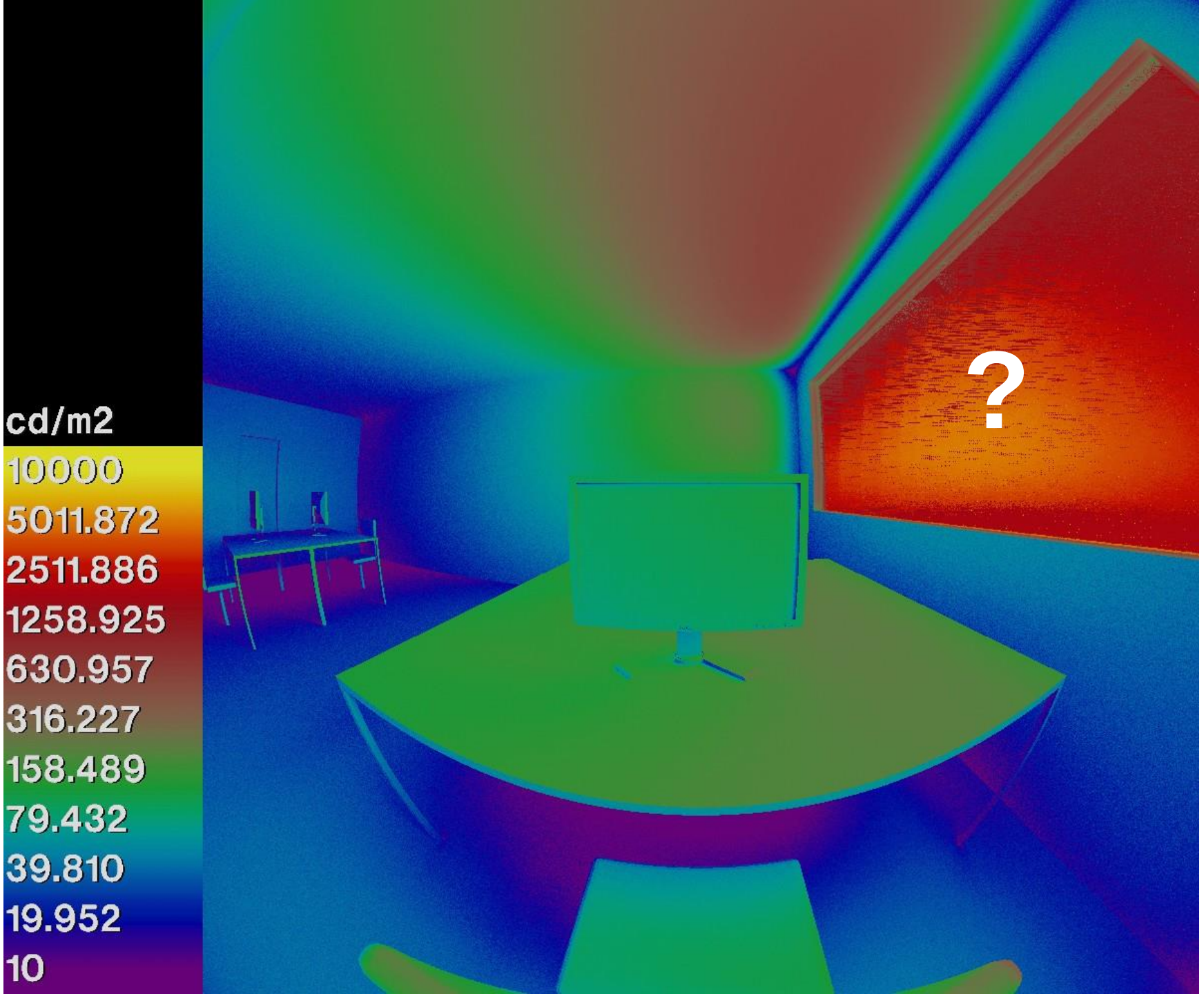
Federal Ministry
for Economic Affairs
and Energy

Projektträger Jülich
Forschungszentrum Jülich

Fraunhofer
IBP

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

EBC
Energy in Buildings and
Communities Programme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