Daylighting and Electric Lighting Solutions - Highlights and results

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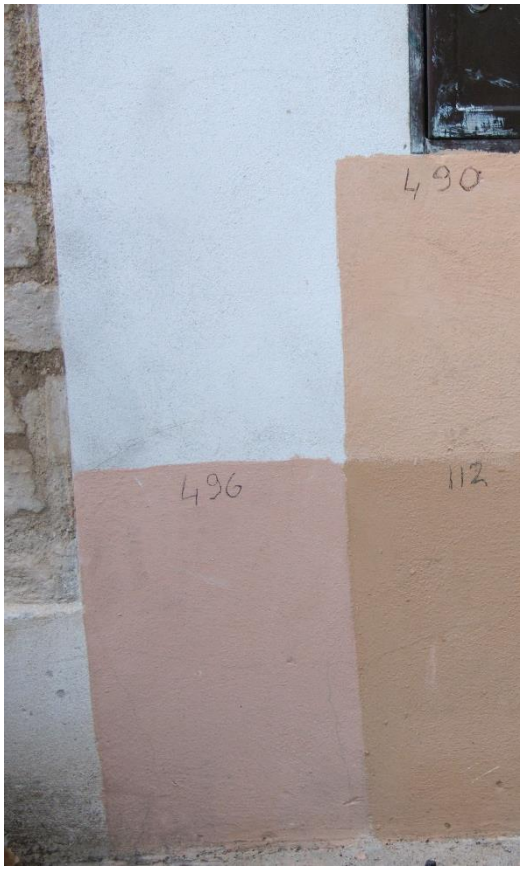
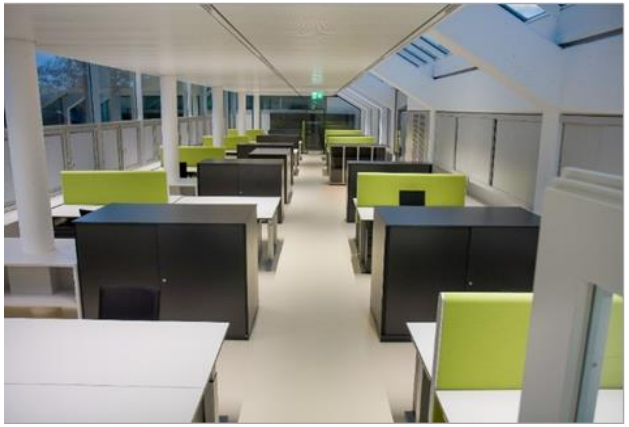
Searching for adequate retrofit solutions – how to rate and compare lighting technologies

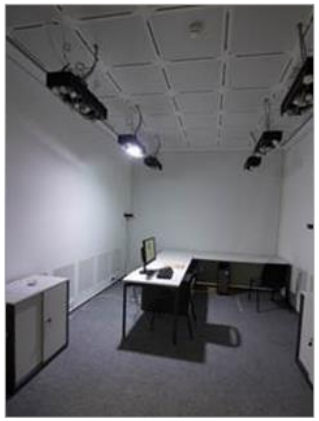
- Simple retrofits are widely accepted
- Promote state-of-the-art approaches – daylight and electric lighting
  - possibly higher cost
  - (further) reduction of energy consumption
  - improving lighting quality
- Aim: Support decision process

Retrofit Solutions





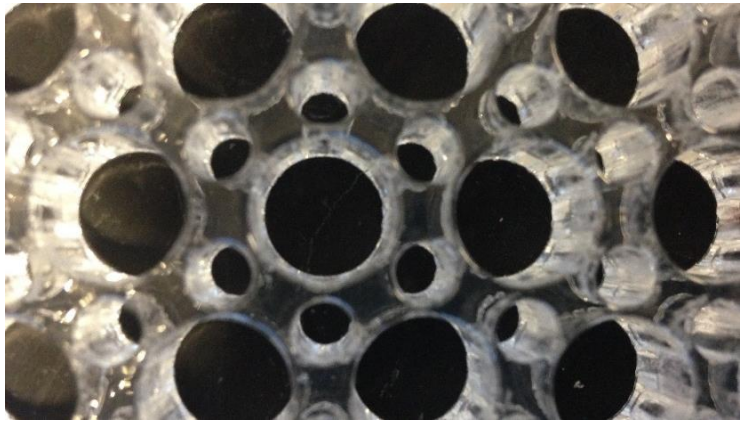
Retrofit Solutions



Retrofit Solutions



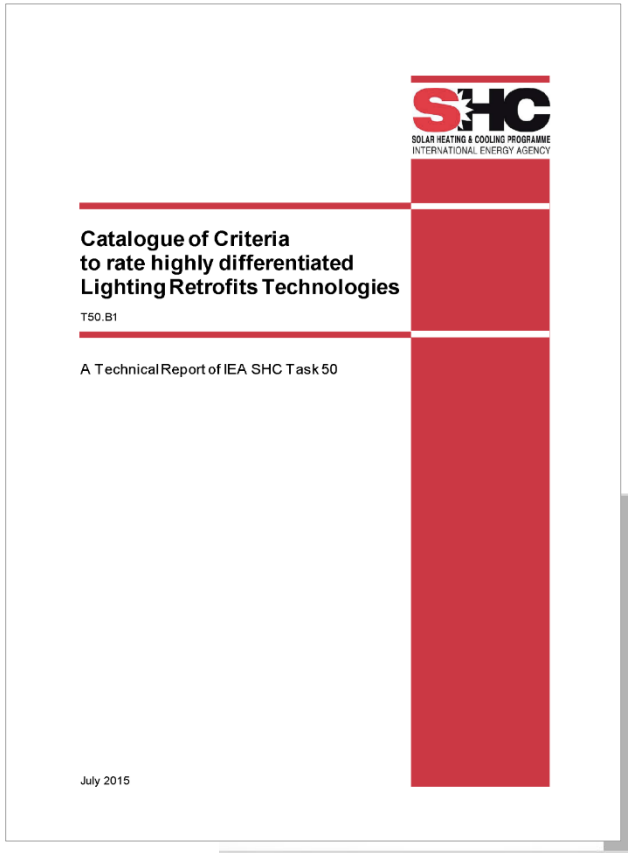


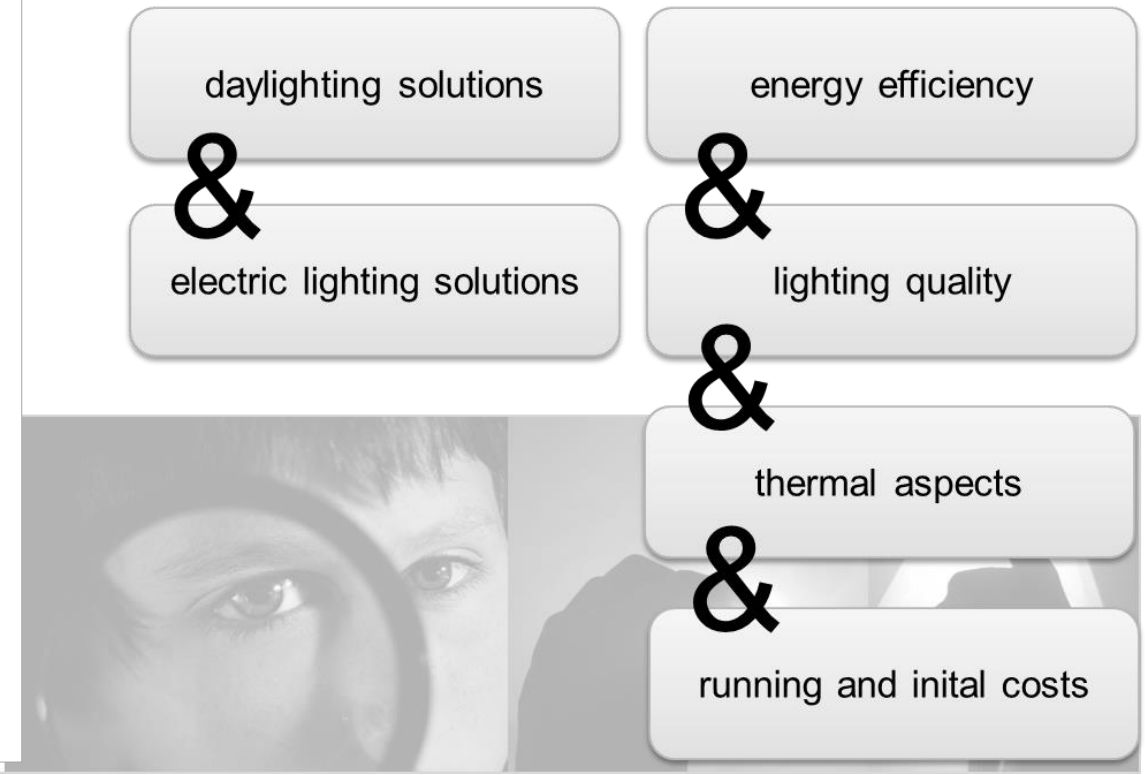


	Intervention type		
	Upgrade of existing situation	Use new components in existing situation	Redesign
Daylighting Product			
Daylighting Control System			
Electric Lighting Product	   		 
Electric Lighting Control System			
Building Interior			

	Intervention type		
	Upgrade of existing situation	Use new components in existing situation	Redesign
Daylighting Product			
Daylighting Control System			
Electric Lighting Product			
Electric Lighting Control System			
Building Interior			

Catalogue of Criteria





Example:
Criteria for Energy Efficiency

Daylighting

- Energy savings potential
- Light guiding into depth of the room
- Primarily using diffuse skylight
- Primarily using direct sunlight

Electric Lighting

- Energy savings potential
- Efficacy of component
- Directionality
  emitting angle / luminous flux reduction
- Power factor
- Dimmable

SOLAR HEATING & COOLING PROGRAMME
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Catalogue of Criteria to rate highly differentiated Lighting Retrofits Technologies

T50.B1

A Technical Report of IEA SHC Task 50

July 2015

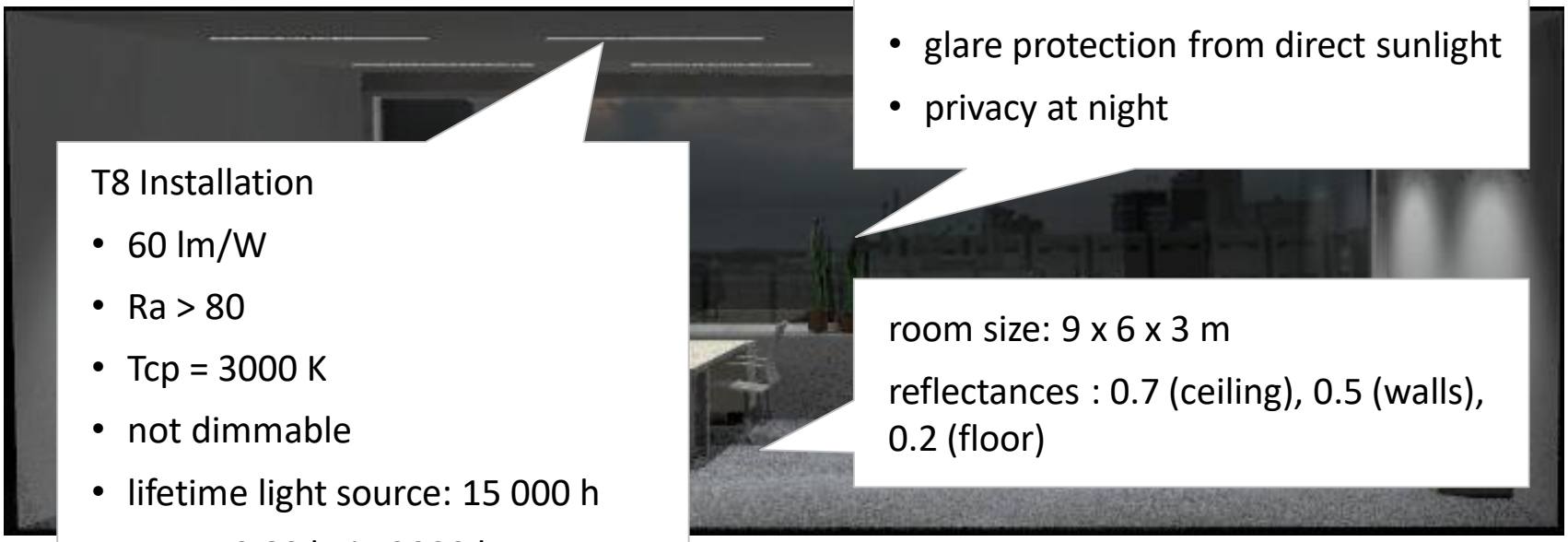
http://task50.iea-shc.org/data/sites/1/publications/Technical%20Report_T50_B1_final.pdf

Appendix B: Catalogue of Criteria for Daylighting Retrofit Solutions

	much worse than baseline	worse than baseline	similar to baseline or not applicable	better than baseline	much better than baseline
Energy efficiency					
Energy savings potential	energy savings potential < -30 %	-30 % ≤ energy savings potential < -10 %	-10 % ≤ energy savings potential ≤ 10 %	10 % < energy savings potential ≤ 30 %	energy savings potential > 30 %
Primarily using diffuse skylight	no		yes		performs well under both diffuse skylight as well as direct sunlight
Primarily using direct sunlight	no		yes		performs well under both diffuse skylight as well as direct sunlight
Visual comfort					
Provides glare protection (overcast sky conditions)	no protection (or EN 14501 - Class 0)		depends (or EN 14501 - Class 1 & 2)		yes (or EN 14501 - Class 3 & 4)
Provides glare protection (direct sunlight)	no protection (or EN 14501 - Class 0)		depends (or EN 14501 - Class 1 & 2)		yes (or EN 14501 - Class 3 & 4)
Visual amenity					
View out (overcast sky conditions)	serious distortion / blockage (or EN 14501 Class 0 & 1)		minor distortion / blockage (or EN 14501 Class 2 & 3)		no blockage / distortion (or Class 4)
View out (direct sunlight)	serious distortion / blockage (baseline) (or EN 14501 Class 0 & 1)		minor distortion / blockage (or EN 14501 Class 2 & 3)		no blockage / distortion (or Class 4)
Light transmittance (overcast sky conditions)	less than -30 % (τv < 0.55)	less than -10 % (τv < 0.75)	small change τv = 0.75 - 0.80		more than 10 % (τv > 0.80)
Light transmittance (direct sunlight)	less than -30 % (τv < 0.07)		small change τv = 0.07 - 0.13		more than 30 % (τv > 0.13)
Colour distortion / fidelity selectivity (for D65) (overcast sky conditions)	affects R_a considerably (R_a< 80)		affects R_a slightly (80 < R_a < 90)		maintains R_a (90 < R_a < 100)
Colour distortion / fidelity (for D65) (direct sunlight)	affects R_a considerably (R_a < 80)		affects R_a slightly (80 < R_a < 90)		maintains R_a (90 < CRI < 100)
Privacy at night	minimal (or EN 14501 - Class 0)		medium (or EN 14501 - Class 1 & 2)		high (or EN 14501 - Class 3 & 4)

Comparison to baseline

Comparison to baseline



a clear double pane window
simple moveable venetian blinds

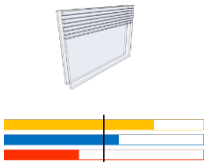
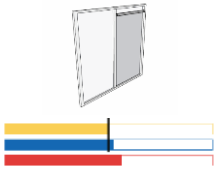
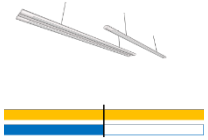
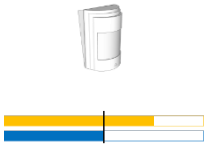
- a clear view out
- glare protection from direct sunlight
- privacy at night

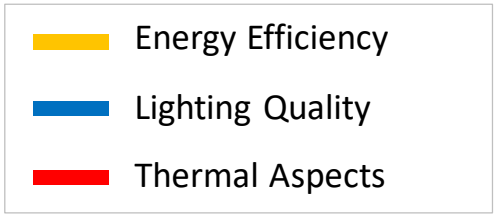
T8 Installation

- 60 lm/W
- Ra > 80
- Tcp = 3000 K
- not dimmable
- lifetime light source: 15 000 h
- LLMF: 0,89 bei 12000 h

room size: 9 x 6 x 3 m

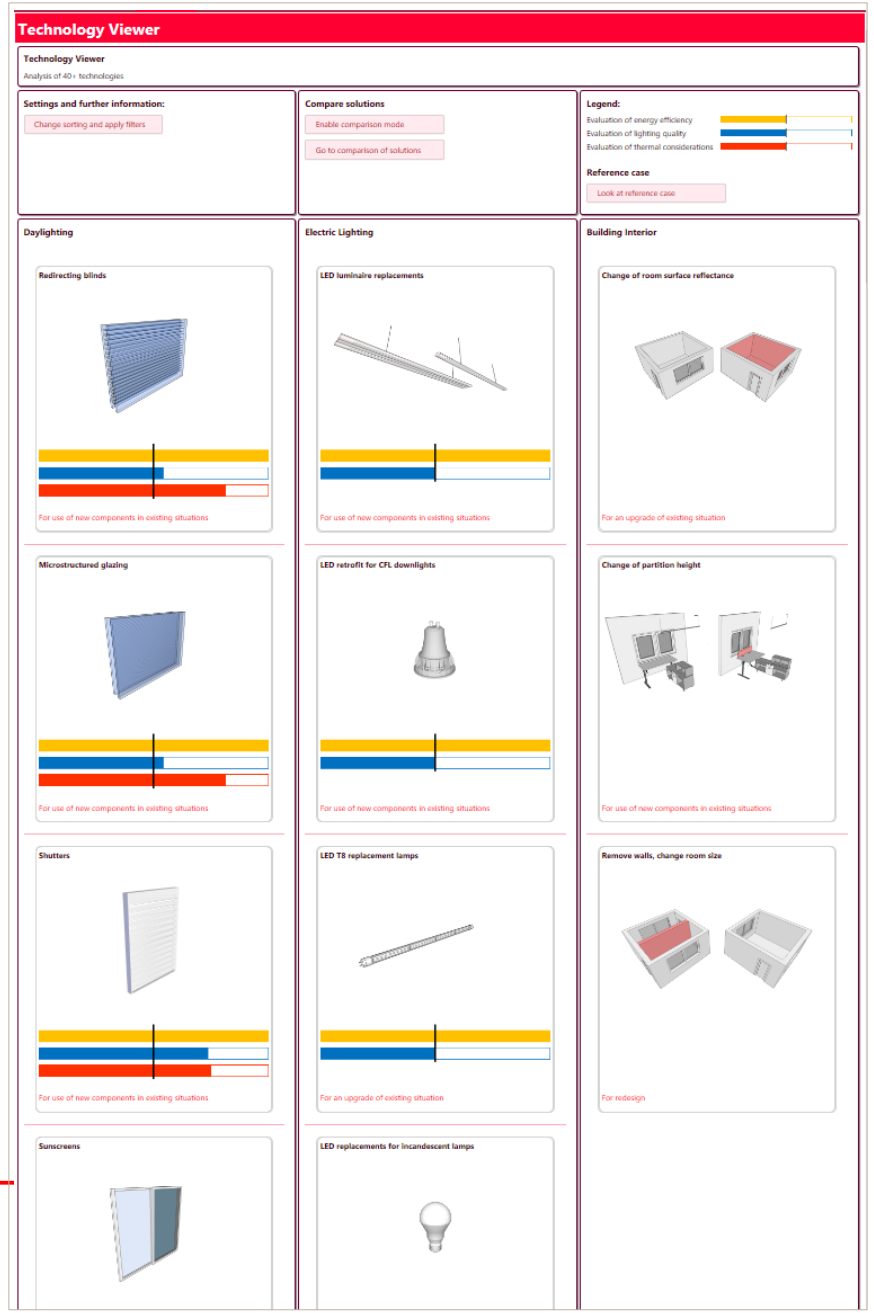
reflectances : 0.7 (ceiling), 0.5 (walls), 0.2 (floor)

	Intervention
	Use new components in existing situation
Daylighting Product	 
Daylighting Control System	 
Electric Lighting Product	  
Electric Lighting Control System	  
Building Interior	 



Produktevaluation in

- Technology Viewer – Lighting Retrofit Adviser
- Source Book

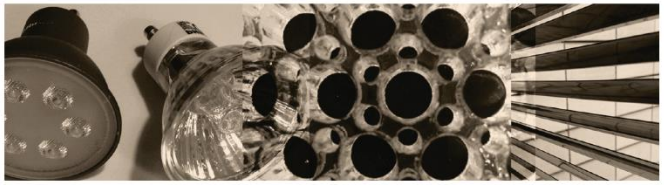


IEA SHC Task 50: “Advanced Lighting Solutions for Retrofitting Buildings“

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

DAYLIGHTING AND ELECTRIC LIGHTING RETROFIT SOLUTIONS

A SOURCE BOOK OF IEA SHC TASK 50
'ADVANCED LIGHTING FOR RETROFITTING BUILDINGS'



April 2016

Demand driven lighting control is a system consisting of an electric lighting solution and a control strategy to achieve a very high level of lighting quality and reducing the energy consumption at the same time. A control strategy and electric lighting solution to be used when lighting quality and personalization is very important.

>> Description:

Demand driven control solutions can optimize the energy consumption of the lighting system while maintaining high visual comfort for the occupants. The idea is to provide the room only with the necessary amount of light. In areas out of vision the level of illuminance can be reduced. The necessary amount of light is depending on the number of people, their position and their current task. Technically demand driven lighting systems generally consist of several luminaires that can be controlled separately. In addition a precise detection of the occupant's position with presence detection systems (PIR or camera based) is necessary. When the occupant is entering one zone of the room, the lighting for this part of the room is provided. Depending on the algorithm the adjacent zones can be dimmed to respectively lower illuminance level. Recently developed lighting systems use distributed intelligence to create a demand driven lighting system. Every luminaire is equipped with a presence sensor. If an occupant is detected, the luminaire will raise the light level and send a signal to the adjacent luminaires. The activated luminaires build an illuminated area that moves with the occupants when they change their position. In the case of several occupants in the room several light areas will be formed. When the room is completely crowded the whole area is illuminated.

Currently the demand driven control is developed further. With a set of deep image infrared sensors the position and viewing direction can be captured by the system. This information can be processed to determine the activity of the user and to dim the light to his needs. To provide the optimal lighting conditions the luminaires are extremely flexible regarding level, distribution and colour of the lighting. This way the system can change the whole lighting situation dynamically depending on the user, his task and the time of the day. User acceptance studies for single offices have been carried out and hints could be found that savings up to 40% are possible without reducing the user-acceptance of the lighting situation.

>> References

Woodward (2014): Distributed intelligence for energy saving smart-lighting

>> Highlights & Lowlights:

Increase in lighting quality and high amount of personalization

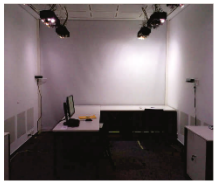
High reduction of energy consumption possible

Installation needs calibration

Very high investment costs

85

86



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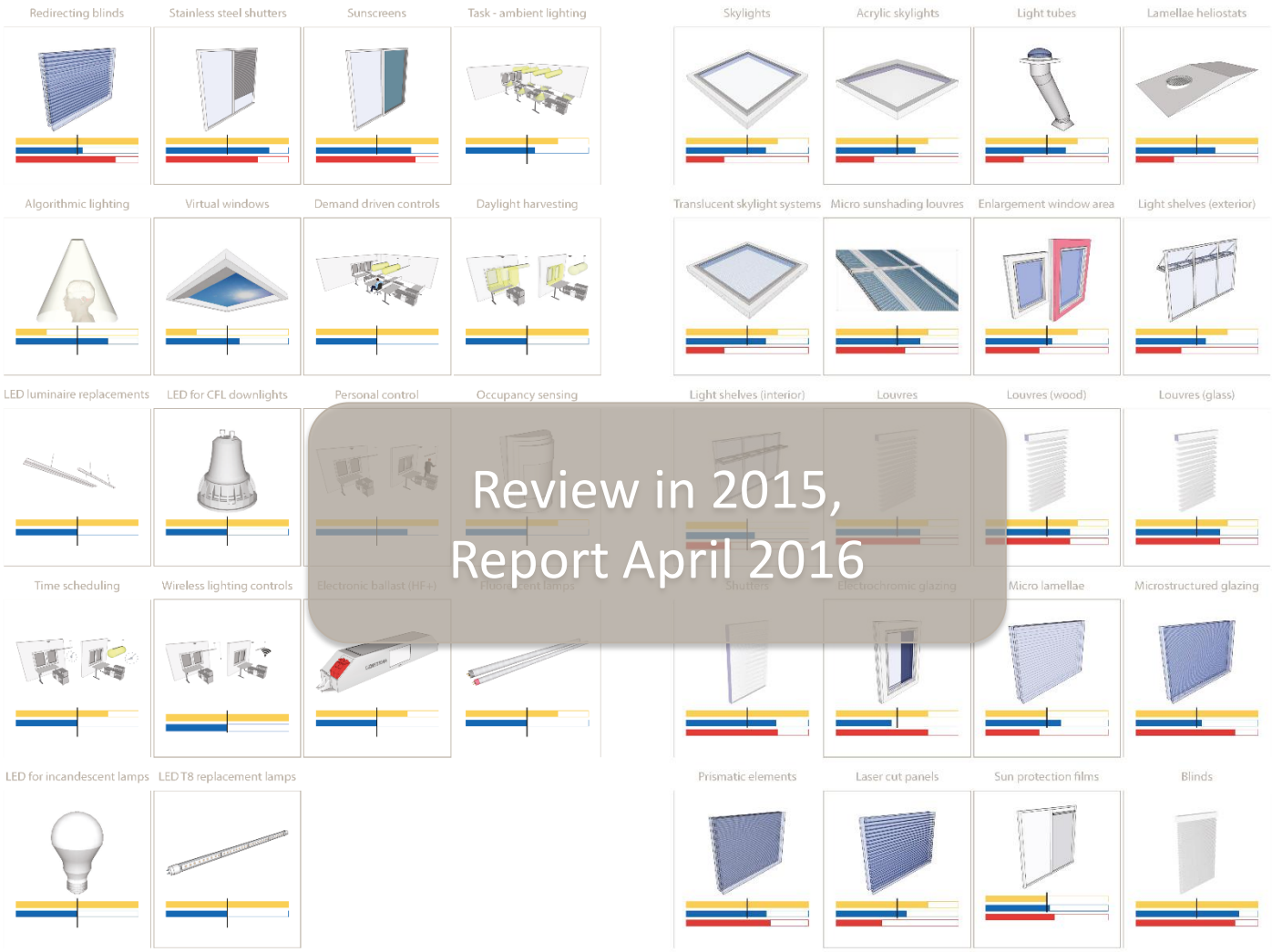

Review in 2015,
Report April 2016

Summary of Technology Review

Economical retrofits to reduce energy consumption for electric lighting

- replacing a lamp or adding interior blinds,
- a task - ambient lighting concept,
- occupancy sensing,
- personal control in daylit spaces,
- daylight responsive lighting control through switching,
- time scheduling,
- wireless controls (occupancy and daylight responsive), and
- replacing an magnetic ballast with an electronic ballast

Retrofits that additionally address non-economic or indirect economic benefits

- daylighting retrofit solutions, generally higher investment costs
- redesign of electric lighting installation and lighting controls

Searching for adequate retrofit solutions – how to rate and compare lighting technologies

The work conducted within IEA Task 50, Subtask B allows to

- evaluate a large variety of systems
  product families only,
- make a sensible, first, decision for
  a selection of lighting retrofit solutions.

Promote solutions that increase lighting quality,
especially daylighting solutions

Thank you for your attention

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