IEA SHC Task 50: Advanced lighting solutions for retrofitting buildings

The Lighting Retrofit Adviser

March 21st, 2017, webinar

Simon Wössner, FHG-IBP, Stuttgart
Lighting Retrofit Adviser

Objective: To develop an electronic interactive source book (Lighting Retrofit Adviser) including and presenting all Task results in an user-friendly and target group specific way

JWG.1 Software Specification (Concept, Architecture and software design)

JWG.2 Concept evaluation and proof

JWG.3 Implementation

JWG.4 Quality assurance, validation and national adaptations
Lighting Retrofit Adviser

Idea

– To have all outcomes combined at one place
  – tools
  – databases
  – “paperwork”: reports, publications...

– Prepared for different target groups
Lighting Retrofit Adviser

Idea

- To have all outcomes combined at one place
- Tools
- Databases
- "Paperwork": reports, publications...
- Prepared for different target groups
Lighting Retrofit Adviser

Idea

– To have all outcomes combined at one place
  – tools
  – databases
  – “paperwork”: reports, publications...
– Prepared for different target groups

– New way of dissemination – **Use an app for mobile devices**

– Additionally available as website (so to say as the traditional way)
Lighting Retrofit Adviser

Harvest low hanging fruits
Develop sustainable relighting concepts

Start Adviser

Direct component access

Participating Countries: AUSTRIA • BELGIUM • CHINA • DENMARK • FINLAND • GERMANY • JAPAN • NETHERLANDS • NORWAY • SLOVAKIA • SWEDEN • SWITZERLAND
LRA Structure

"Adviser"

"classic" component based approach
Stakeholder related information

Depending on your background find a quick access to relevant information related to lighting retrofits.
Learning about potential in your building (portfolio) and ways to initialize their allocation.

Problems from lighting retrofit

Motivation
Renting or selling buildings with up to date energy-efficient and well designed lighting facilitates sales, securing value of building.

Financial model
Lighting refurbishment can contribute not only to accelerating sales but also increase the perceived value, and increase selling price. Lighting refurbishment costs between 30 and 50€/m² reduces lighting electricity costs by 2 to 7 €/m²/year can lead to increasing rental value by 10-30€/m²/year due to combination of reduced operating costs and improvement in indoor quality.

Low hanging fruit
Owner and investors should look for low hanging fruits: existing installations where benefits associated to lighting retrofits are the highest, and the fastest. For instance installations used more than 4000 hours per year, with an electric power density more than 3 times the one of modern installations: more than 12 W/m² in offices and more than 25 W/m² in industrial buildings.

Suitable tools
- Low Hanging Fruits
- Benchmarking
- Portfolio Analysis

Additional information can be found here
- Report Earners / Benefits
Example picture only, to be replaced / updated.
All Components of the Lighting Retrofit Adviser

Click the buttons below to access the various components of the Lighting Retrofit Adviser.

Information Components

- **Low Hanging Fruits**: At a glance: Understand the economics of lighting retrofits
- **Technology Viewer**: Analyses of 40+ technologies
- **Case Studies**: Experiences from 20+ performed retrofits
- **FAQ / Recommendations**: Condensed retrofit experiences
- **Collection of Tools**: Links to lighting tools
- **List of Metrics**: Several metrics to rate lighting performance
- **Publications & Reports**: Study in 25+ reports
- **Survey**: More than 1000 actors in retrofitting answered a survey

Calculation & Rating Components

- **Benchmarking**: Compare your building to others
- **Portfolio Analysis**: Analyse potentials in building portfolios
- **On-site Optimizer**: Develop retrofit concepts directly on site
- **CFS-Express**: Perform analysis for complex fenestration systems
Total cost of ownership (TCO)

Key statements:

- Investing in an open space office has a payback time which is shorter than with a personal office, mainly due to the fact that general lighting is used for longer duration.
- In personal office, payback time gets closer from life of lighting products.
- The payback time for a personal office is approx. 16 years.

Reference installation

Typical new generation installation
IEA SHC Task 50 Advanced lighting solutions for retrofitting buildings
Redirecting blinds reflect daylight from sun and sky to the ceiling to provide improved daylight illumination even in the depth of the adjacent rooms. For optimal functionality, the upper surfaces are highly specular leading to somewhat increased maintenance costs. A retrofit solution for enhanced daylighting and improved visual comfort, especially suitable for deep rooms.

**Performance of redirecting blinds**

Compared to classical blinds, redirecting blinds generally consist of an upper surface of highly specular material and concave curvature. They are designed to reflect the maximum possible amount of daylight to the ceiling and thus to interior areas far from the façade. At the same time, the luminances below the horizontal plane are minimized to avoid glare.

Based on their optical design, redirecting louvers work for all façade orientations if designed for using sunlight, or for East / South / West oriented façades (in the northern hemisphere) if the primarily used daylight is sunlight. Some redirecting blinds consist of a reflector for elimination of summer sun radiation during high solar angles avoiding interior overheating and a light-shelf element improving sunlight reflection into the interior while providing glare protection in winter time.

Movable redirecting systems allow a good control of daylight illumination and solar gains leading to increased possible energy savings for heating and cooling as well as electric lighting. Most moveable redirecting blinds are operated automatically, with a possibility to override manually. Fixed redirecting louvers do not need to be controlled, but the full potential in terms of variable SHGCs and daylight transmittances cannot be tapped with such systems.

Some redirecting blinds are developed for exterior use, which need more cleaning to function properly. The majority of redirecting blinds are designed to be installed between two panes of glass or in double skin façades to reduce exposure to dust (interior) or dirt and snow (exterior). In a retrofit process this equals a trade-off between lower installation costs but higher maintenance needs for interior/exterior systems and vice versa for systems embedded between glass panes.

The view out can, depending on the design, be more or less restricted under sunny sky conditions.

The costs for redirecting systems are usually higher than for classical blinds. However, the benefits appear in significantly improved visual comfort (glare protection) and lighting quality (more homogeneous daylight distribution). While the system is more expensive than classical blinds, costs and efforts for installation are comparable.

**References:**


IEA SHC Task 50 Advanced lighting solutions for retrofitting buildings
IEA SHC Task 50 Advanced lighting solutions for retrofitting buildings
Benchmarking

Benchmark based on
- Building Type
- Zone

Building data
Building Type
Office Building
Floor area
100 m²

Enter the installed power for your building
- Absolute:
- Related to floor area:
Installed power
12 W/m²

Enter the electricity consumption for your building
- Absolute:
- Related to floor area:
Electricity Consumption
30 kWh/m²a

Benchmark - Lighting installed power of your building [W/m²]
National Survey
- Maximum: 31.55 W/m²
- Average: 16.61 W/m²
- Minimum: 10.3 W/m²

Benchmark - Lighting electricity Consumption of your building [kWh/m²]
National Survey
- Maximum: 31.23 kWh/m²
- Average: 16.1 kWh/m²
- Minimum: 6.86 kWh/m²
„CFS (Complex Fenestration System) Express“

The 3-Phase-Method and the LRA

RADIANCE 3-phase daylight coefficient method

- result
- view matrix
- BSDF
- daylight matrix
- sky distribution

\[
\text{result} = \text{view matrix} \times \text{BSDF} \times \text{daylight matrix} \times \text{sky distribution}
\]

- time-consuming pre-calculation
  - save in LRA database

- fast matrix calculation for every time step
  - perform online in LRA

IEA SHC Task 50 Advanced lighting solutions for retrofitting buildings
Fast daylight analysis over a year: Illuminances
On site optimizer

Energiesparleuchtan
Ohne Lichtmanagement

$Q_{\text{lighting}} \geq 25 \text{kWh/m}^2\text{a}$

LED-Downlight Technologie
Mit Lichtmanagement

$Q_{\text{lighting}} \leq 10 \text{kWh/m}^2\text{a}$
IEA SHC Task 50 Advanced lighting solutions for retrofitting buildings
FAQs - Glare occurs on computer screens and / or in the environment of the workplace

Problem in / Question about current situation

What can I learn from this LRA and how is it structured?

How can I rate the retrofit potential of my system/building (ener...

What would be a suitable (state-of-the-art) lighting solution for ...

When is the right moment for lighting retrofit?

Which requirements do I have to fulfill when retrofitting? And wh...

What range of pay-back rate can I expect?

I heard LED technology is still developing. Does it make sense ...

What is the most cost-effective solution for my case?

If I have only a certain amount of money, how can I find out wha...

If I have only a certain amount of money, what should I spend it ...
- short payback-time?

Problem in / Question about current situation

Glare occurs on computer screens and / or in the environment of the workplace

Answers / Possible solutions - Recommendations for retrofit / Where to find further information

The possibly first & most simple improvement is to check the orientation of your screen in relation to the facade. If possible the screen should be placed in a plane perpendicular to the facade, i.e. the view direction onto the screen parallel to the facade.

If no glare protection is provided so far at your workplace, flexible desktop based glare protections are the most simple and cheap solution.
Lighting Retrofit Adviser

Where to get it:

1. Platforms:
   1. www.lightingretrofitadviser.com
2. Mobile Devices:
   • Android:
   • iOS: Release date tba
   • Windows Phone: Release date tba

2. Languages
   – English
   – German
   – French (tba)
   – Portuguese (tba)
   – Chinese (tba)
Simon Wössner
Fraunhofer-Institute für Bauphysik

simon.woessner@ibp.fraunhofer.de

www.ibp.fraunhofer.de/wt