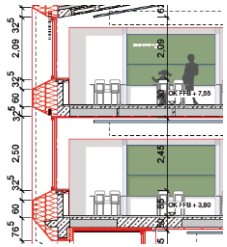
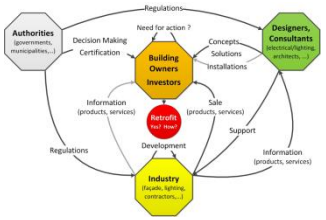
IEA SHC Task 50: *Advanced lighting solutions for retrofitting buildings*

The Lighting Retrofit Adviser

March 21st 2017, webinar

Simon Wössner, FHG-IBP, Stuttgart



Lighting Retrofit Adviser

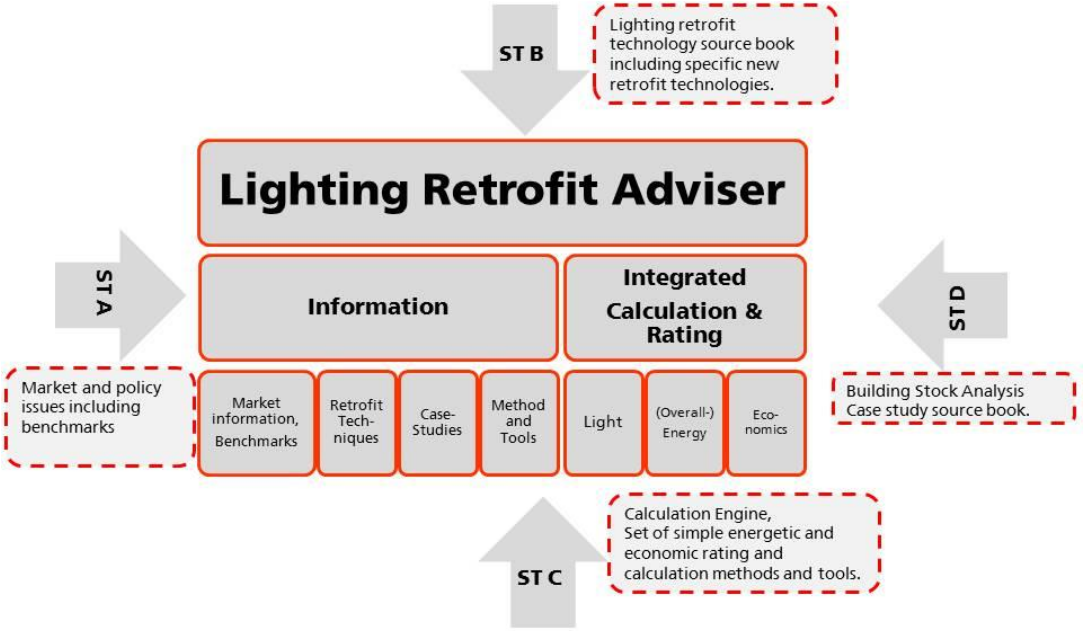
Objective: To develop an electronic interactive source book (Lighting Retrofit Adviser) including and presenting all Task results in an user-friendly and target group specific way

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 adaptions



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

Ide

–

–

melden

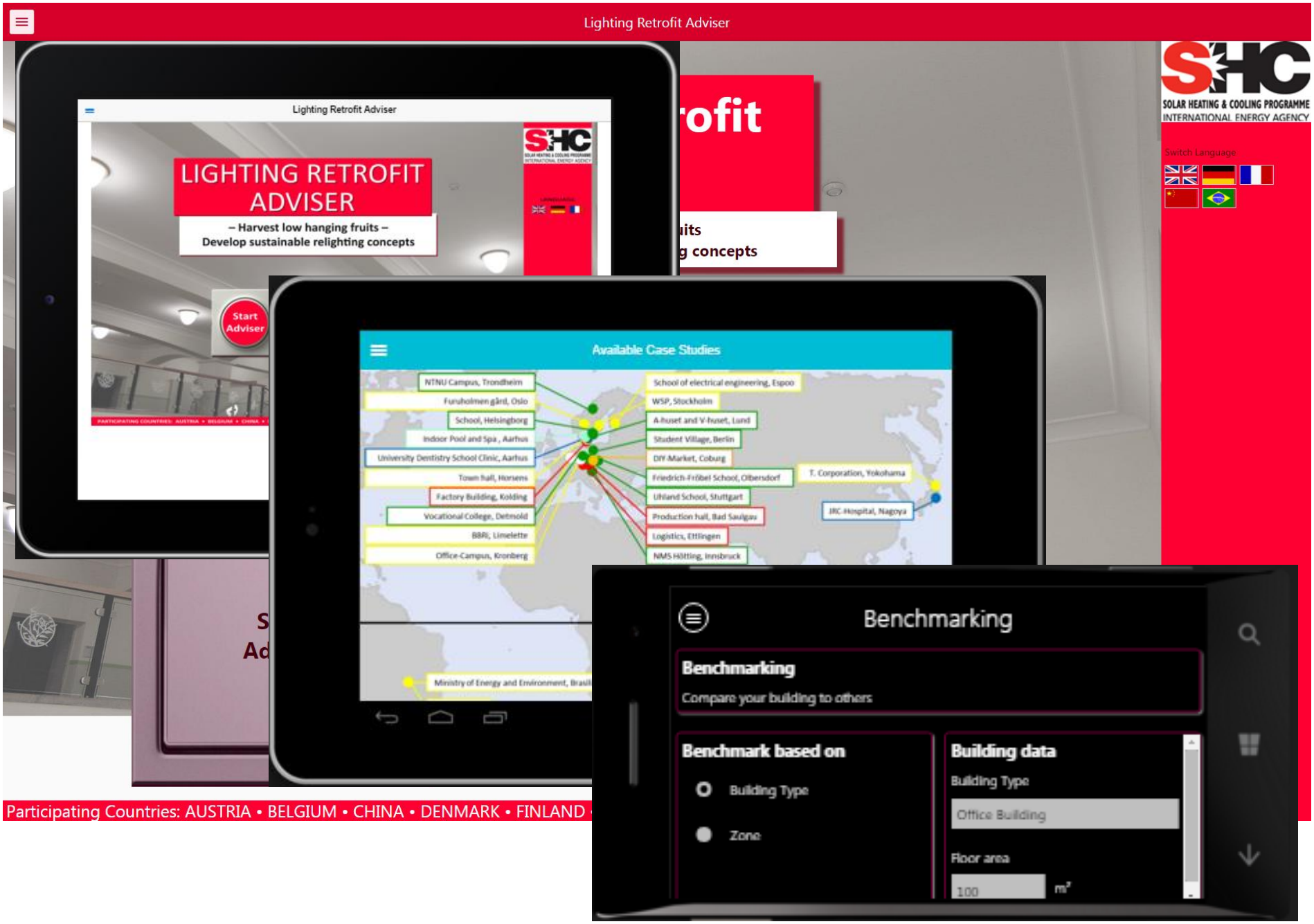
Lighting Retrofit Adviser

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
LIGHTING RETROFIT ADVISER
– Harvest low hanging fruits –
Develop sustainable relighting concepts
Start Adviser
rofit
its
g concepts
SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY
Switch Language
Available Case Studies
NTNU Campus, Trondheim
Furuholmen gård, Oslo
School, Helsingborg
Indoor Pool and Spa , Aarhus
University Dentistry School Clinic, Aarhus
Town hall, Horsens
Factory Building, Kolding
Vocational College, Detmold
BBRI, Limelette
Office-Campus, Kronberg
School of electrical engineering, Espoo
WSP, Stockholm
A-huset and V-huset, Lund
Student Village, Berlin
DIY-Market, Coburg
Friedrich-Fröbel School, Olbersdorf
Uhland School, Stuttgart
Production hall, Bad Saulgau
Logistics, Ettlingen
NMS Hötting, Innsbruck
T. Corporation, Yokohama
JRC Hospital, Nagoya
Ministry of Energy and Environment, Brasil
Benchmarking
Benchmarking
Compare your building to others
Benchmark based on
Building Type
Zone
Building data
Building Type
Office Building
Floor area
100
m²
Participating Countries: AUSTRIA • BELGIUM • CHINA • DENMARK • FINLAND

Lighting Retrofit Adviser

Harvest low hanging fruits
Develop substainable relighting concepts

Start Adviser

Direct component access

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

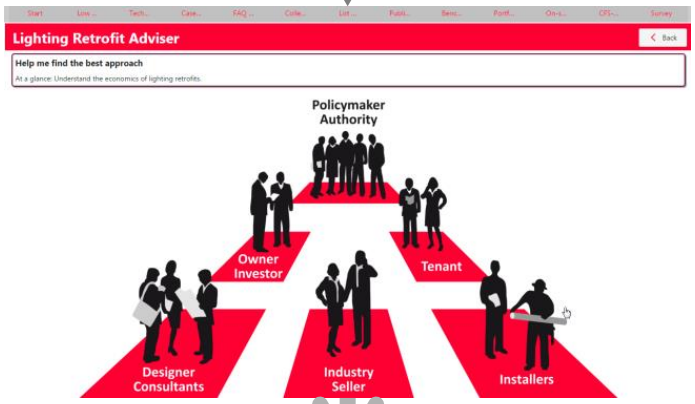
Switch Language

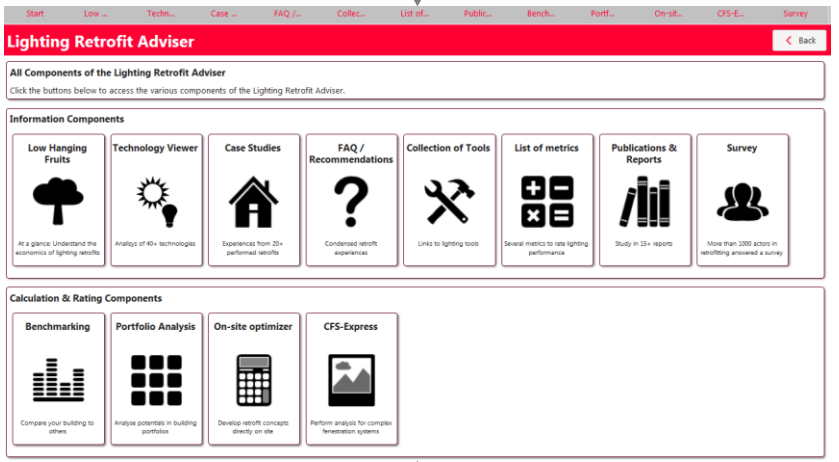
Participating Countries: AUSTRIA • BELGIUM • CHINA • DENMARK • FINLAND • GERMANY • JAPAN • NETHERLANDS • NORWAY • SLOVAKIA • SWEDEN • SWITZERLAND

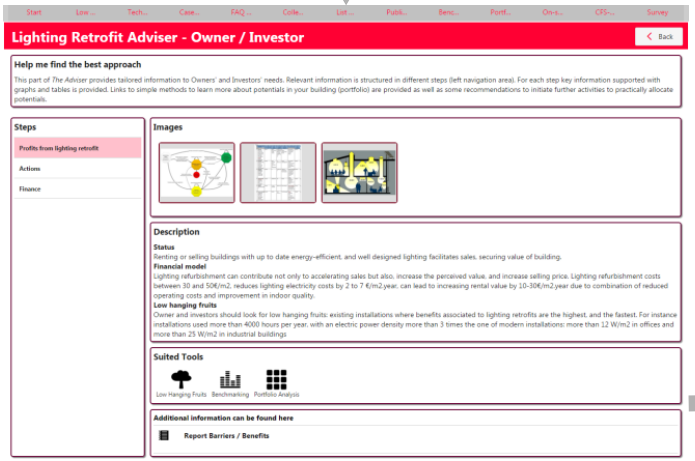
LRA Structure

„Adviser“

„classic“
component based approach

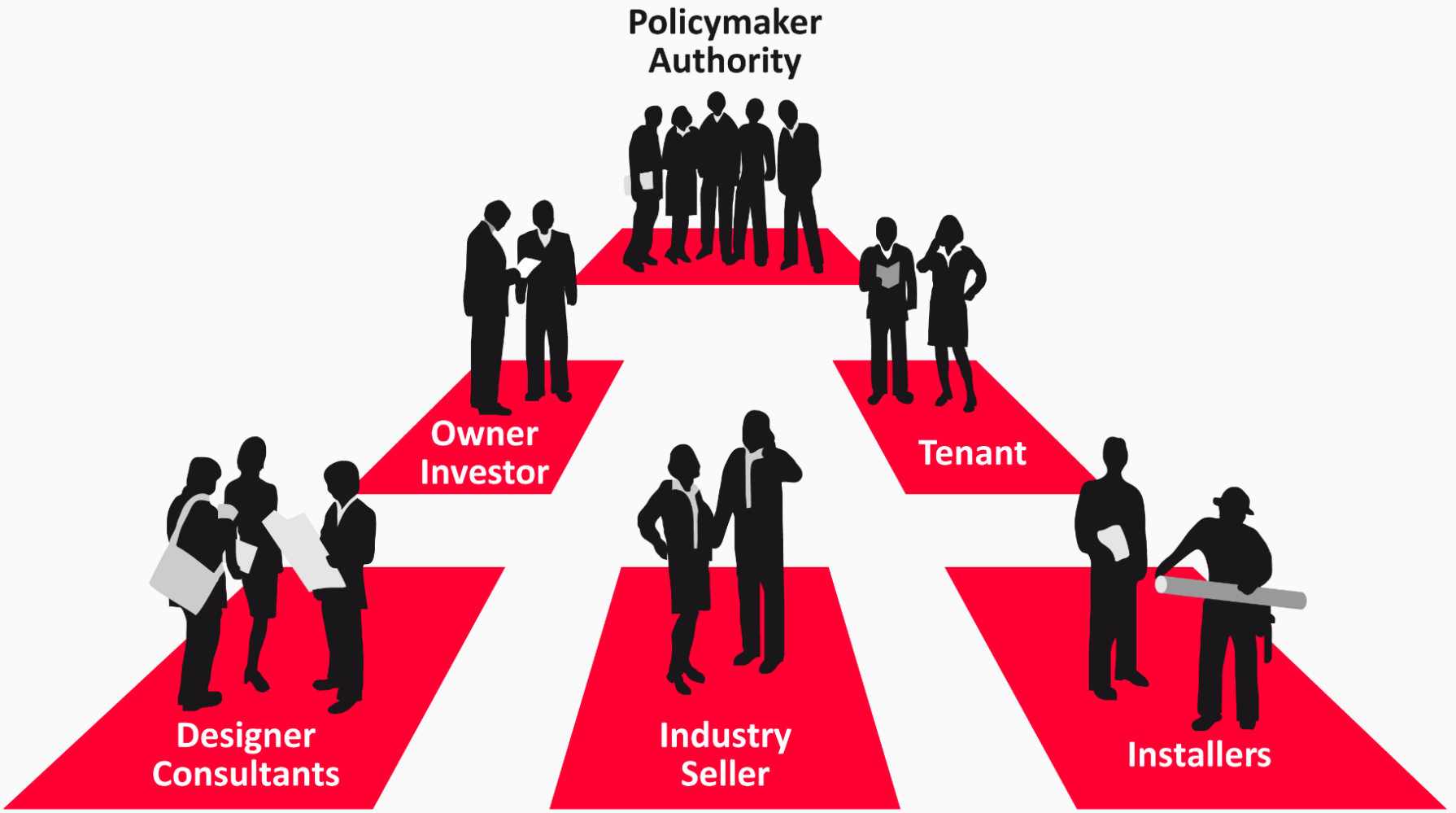






Stakeholder related information

Depending on your background find a quick access to relevant information related to lighting retrofits.



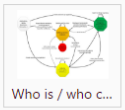
Stakeholder related information

This part of *The Adviser* provides tailored information to Owners' and Investors' needs. Relevant information is structured in different steps (left navigation area). For each step key information supported with graphs and tables is provided. Links to simple methods to learn more about potentials in your building (portfolio) are provided as well as some recommendations to initiate further activities to practically allocate potentials.

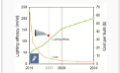
Topics

- Profits from lighting retrofit
- Actions to allocate benefits

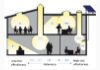
Images and tables:


Who is / who c...


Approaches

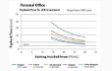

Time for changi...


Adding value b...


Good daylight ...

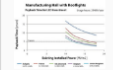

Facade retrofits...

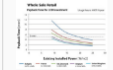
Lighting as part...


Favorouble pay...


Favorouble pay...


Favorouble pay...


Favorouble pay...


Favorouble pay...


ESCO Investme...

Profits 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 fruits
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

Suited Tools

Low Hanging Fruits Benchmarking Portfolio Analysis

Additional information can be found here

Report Barriers / Benefits

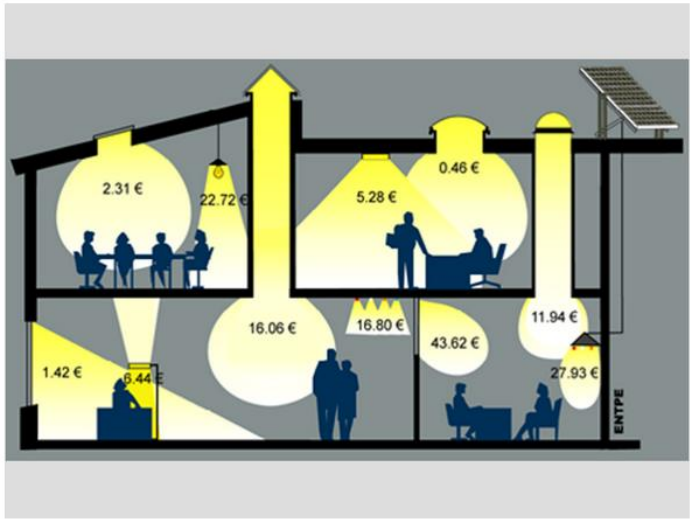
Lighting Retrofit Adviser - Owner / Investor

Back

Images

Hide popup

Example picture only, to be replaced / updated.



Lighting Retrofit Adviser

Back

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

Analisys 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 15+ 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

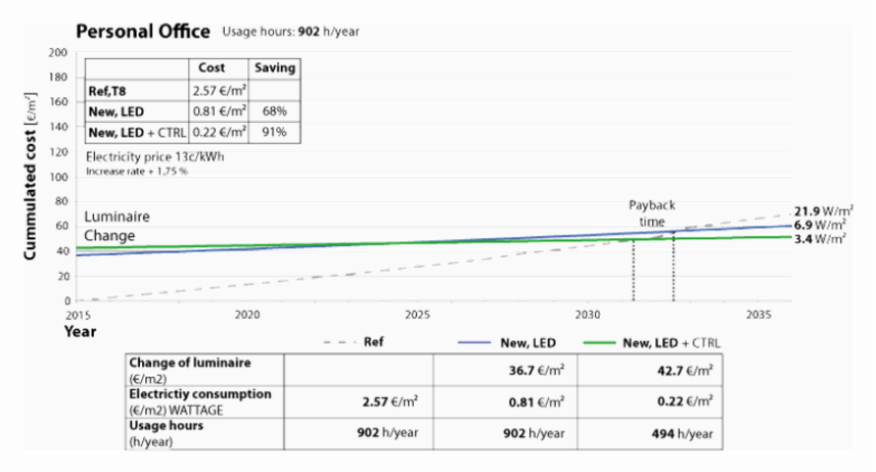
Develop retrofit concepts directly on site

CFS-Express

Perform analysis for complex fenestration systems

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Total cost of ownership (TCO)

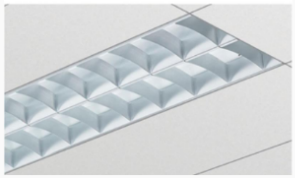


Key statements:

- 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

Technology Viewer

Technology Viewer

Analysis of 40+ technologies

Settings and further information:

Change sorting and apply filters

Compare solutions

Enable comparison mode

Go to comparison of solutions

Legend:

Evaluation of energy efficiency

Evaluation of lighting quality

Evaluation of thermal considerations

Reference case

Look at reference case

Daylighting

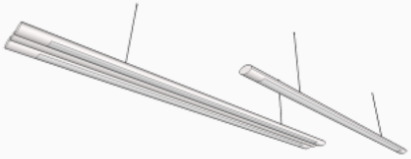
Redirecting blinds

For use of new components in existing situations

Microstructured glazing

Electric Lighting

LED luminaire replacements

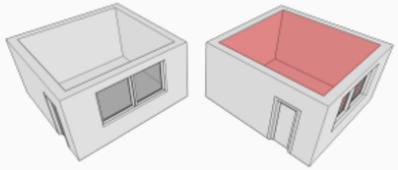


For use of new components in existing situations

LED retrofit for CFL downlights

Building Interior

Change of room surface reflectance



For an upgrade of existing situation

Change of partition height

Redirecting blinds

Back

Redirecting blinds

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.

Evaluation:

- Energy efficiency
- Lighting quality
- Thermal benefits
- Operational costs

Click on category to view detailed results

Media

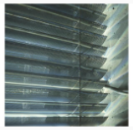
fixed redirecting blinds

redirecting blinds

redirecting blinds

© Bartenbach

redirecting blinds

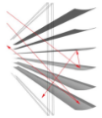


© Bartenbach

detail redirecting blinds

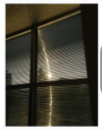
© Bartenbach

working principle sunbloc...



© Patentholder Dr.-Ing. Hel...

fixed redirecting blinds



Highlights:

- Increased visual comfort and lighting quality
- Energy savings through possible reduced demand for artificial lighting,
- Increased maintenance requirements, especially for exterior systems
- Higher initial costs compared to classical blinds

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 skylight, or for East / South / West oriented façades (on 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 wintertime.
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 overrule 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:

Ruck, N., Aschehoug, Ø., Aydinli, S., Christoffersen, J., Courret, G., Edmonds, I., Jakobiak, R., Johnsen, K., Kischkoweit-Lopin, M., Klinger, M., Lee, E., Michel, L., Scartezzini, J-L., Selkowitz, S. (2000) Daylight in buildings - a source book on daylighting systems and components. Report of IEA SHC Task 21 / ECBCS Annex 29, published by Lawrence Berkeley National Laboratory, Berkeley (USA).

Pohl, W. et al. (2012) Principles of Daylight Guiding Design. In Proceedings of International Light Simulation Symposium (ILISIS) 2012, Nuremberg, Germany.

Geisler-Moroder, D. (2013) Complex daylighting systems, In Proceedings of 8th EnergyForum, Bressanone, Italy.

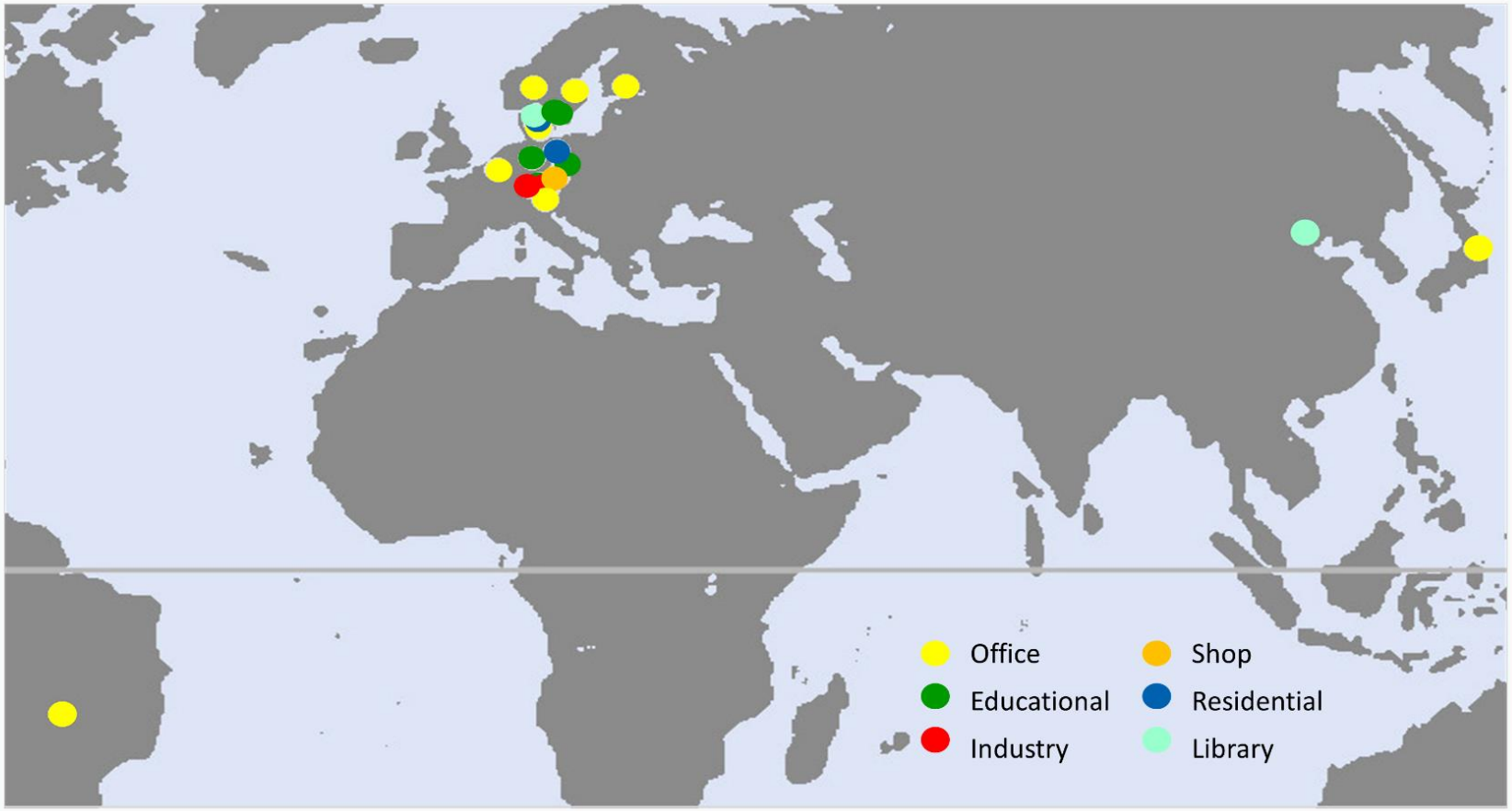
Köster, H. (2004) Dynamic daylighting architecture: basics, systems, projects. Birkhäuser Architecture, Springer Science & Business Media.

Available Case Studies

Case Studies

Experiences from 20+ performed retrofits

- A-huset
- WSP
- School in Helsingborg
- Horsens Town Hall
- Dental School Aarhus ...
- Swimming Pool and S...
- Lozenberg
- Bartenbach
- Friedrich-Fröbel-Schul...
- Dietrich Bonhoeffer B...
- Baumarkt Coburg
- Flat in Berlin
- Studentendorf Schlac...
- Engine Construction ...
- Logistics hall
- Uhlandschule Stuttgart
- Taisei_Technical_Center



Case study viewer - WSP

Back

- Project Description
- Building Description
  - WSP office
    - Space Description
      - Daylighting
      - Electric Lighting
    - Performance Evaluation
      - Costs
      - Lighting Energy Use
      - Lighting Environment
      - User Perspective
    - Overall Conclusions

Main Retrofit Objectives

- Renovation of the interior
- Provide additional space for informal meetings
- Improving the daylight penetration
- Energy saving for lighting

Main Objectives For Retrofit Of Daylighting

- Improvement of daylight penetration

Main Objectives For Retrofit Of Electric Lighting

- Energy saving
- Improvement of electric lighting quality
- Improvement of aestethic appearance of the space

Main Objectives For Retrofit Of Controls

- Energy saving
- Customization of working area lighting

Project Description

The **WSP headquarter** consits of a 8-storeys building. Floors from 4th to 8th are used for (landscape) offices. The landscape offices are identical in geometry and orientation.
The company decided to restyle the offices. The original furnishing was worn-out. The interiors were completely renovated (floor, forniture, wall painting, ...) and the electric lighting was retrofitted. The facade was not involved in the retrofitting, but changes in the interior also aimed to improvement in daylighting.
The main project purpose was to improve the appearence of the offices. As secondary objective, the renovation aimed to save energy for lighting.
Storey 6th and 8th were renovated earlier than the others. At the time of monitoring, storey 7th was not yet renovated. Given the identical geometry and orientation, the monitoring compared storey 7th (pre-retrofit) and storey 6th (post-retrofit).

Benchmarking

Benchmarking

Compare your building to others

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:

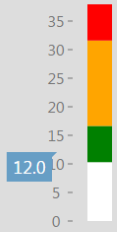
Installed power: 12 W/m²

Enter the electricity consumption for your building

- ( ) Absolute:
- (•) Related to floor area:

Electricity Consumption: 30 kWh/m²a

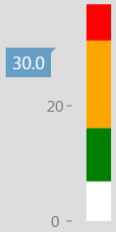
Benchmark - Lighting installed power of your building [W/m²]



National Survey

Maximum: 31.55 W/m²
Average: 16.61 W/m²
Minimum: 10.3 W/m²

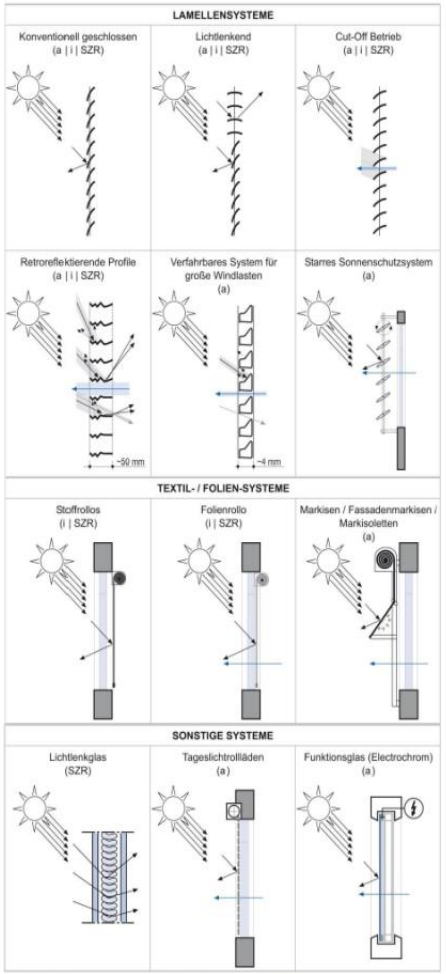
Benchmark - Lighting electricity Consumption of your building [kWh/m²]



National Survey

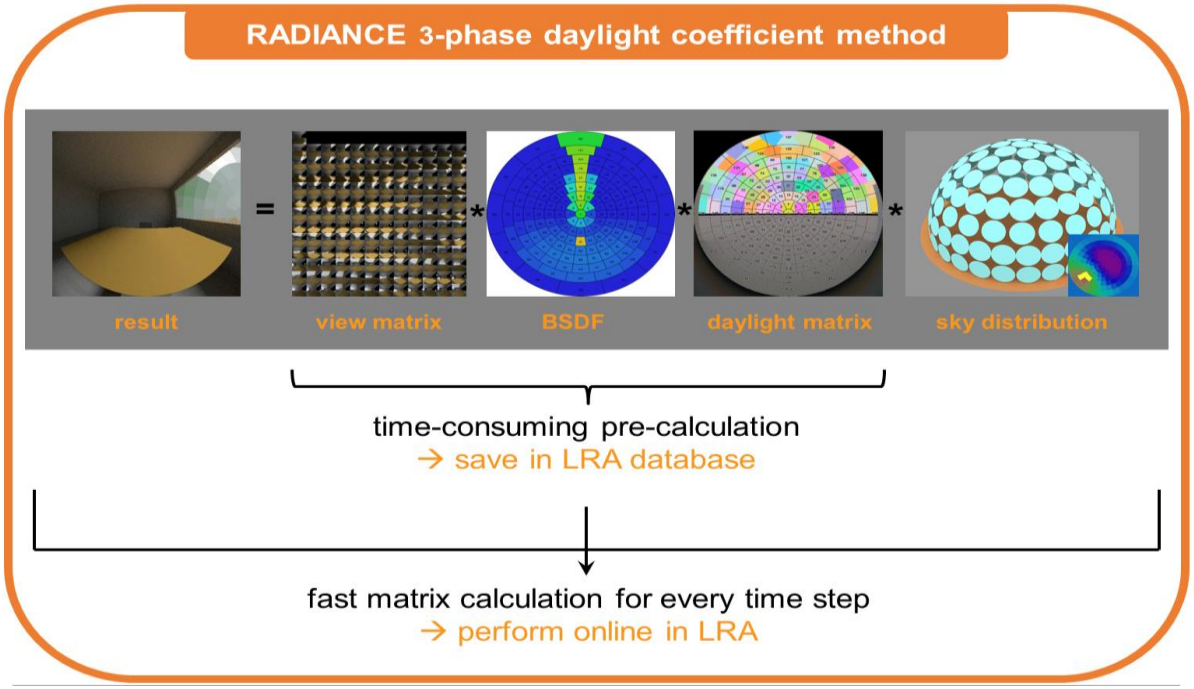
Maximum: 31.23 kWh/m²
Average: 16.1 kWh/m²
Minimum: 6.86 kWh/m²

„CFS (Complex Fenestration System) Express“

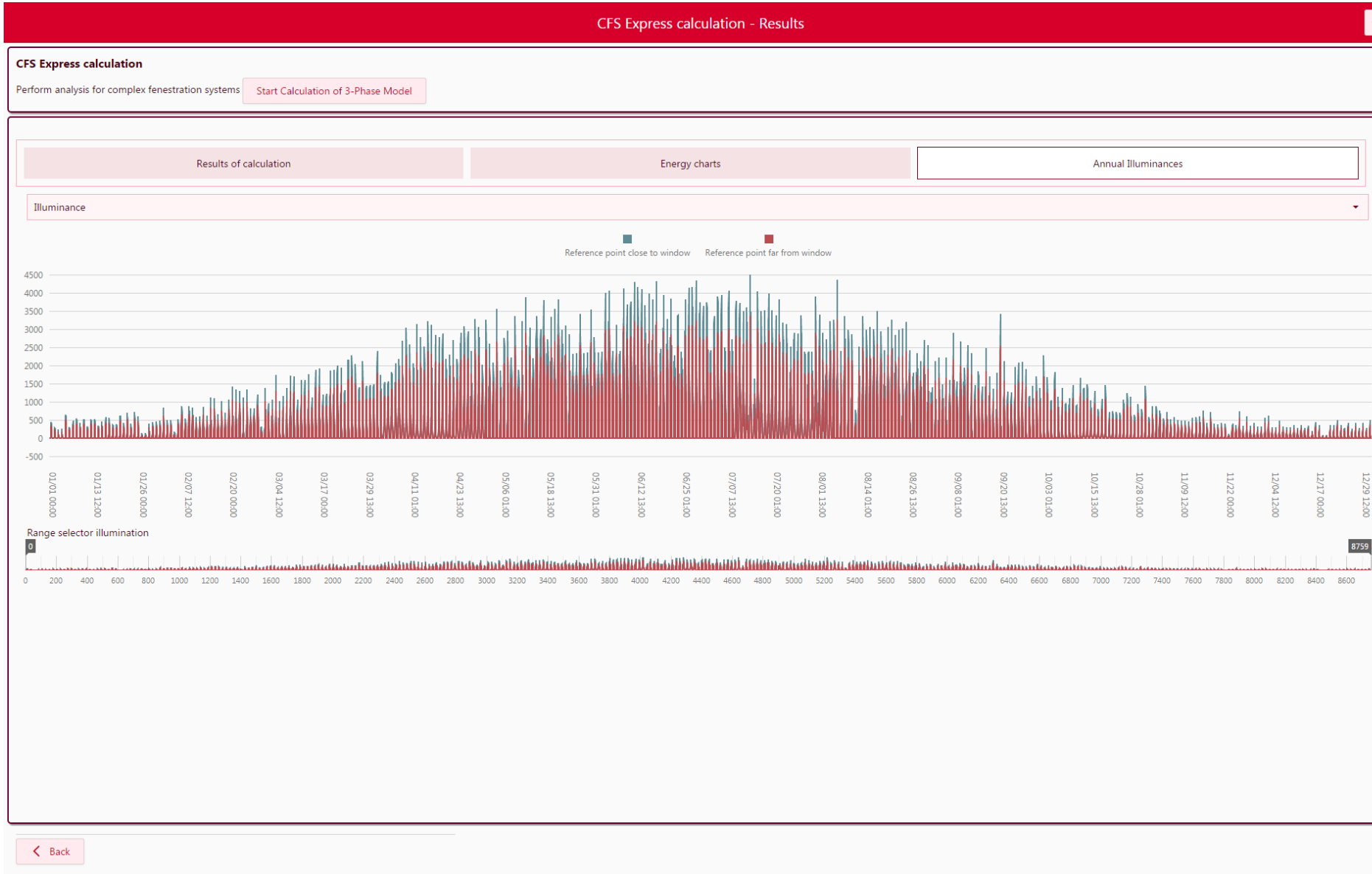


a: außenliegend; i: innenliegend; SZR: Scheibenzwischenraum

The 3-Phase-Method and the LRA



Fast daylight analysis over a year: Illuminances



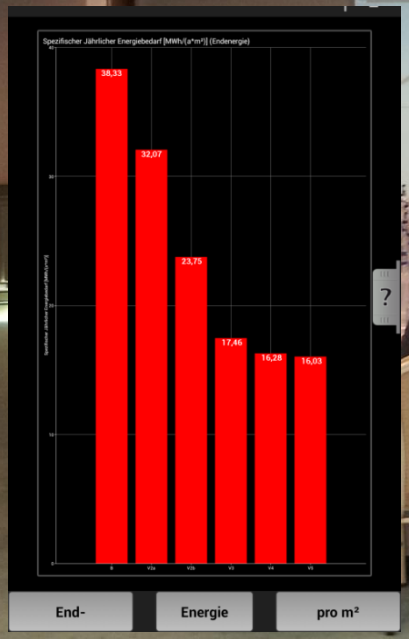
On site optimizer

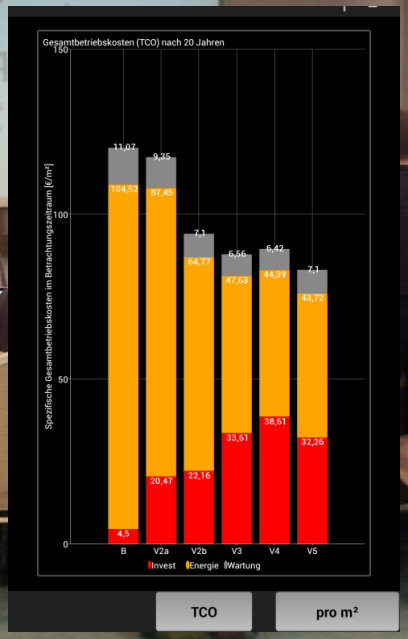
Energiesparlecuhten
Ohne Lichtmanagement

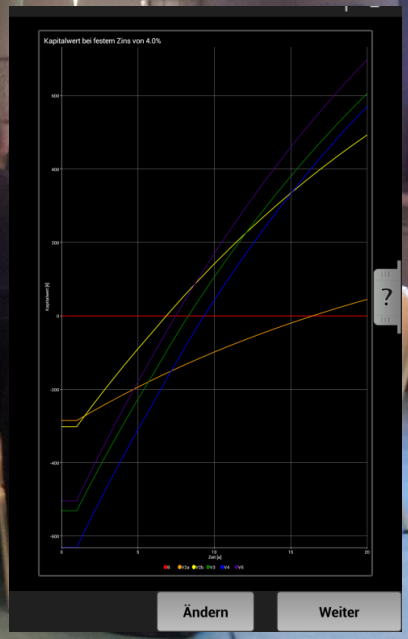
$Q_{lighting}$ >= 25 kWh/m²a

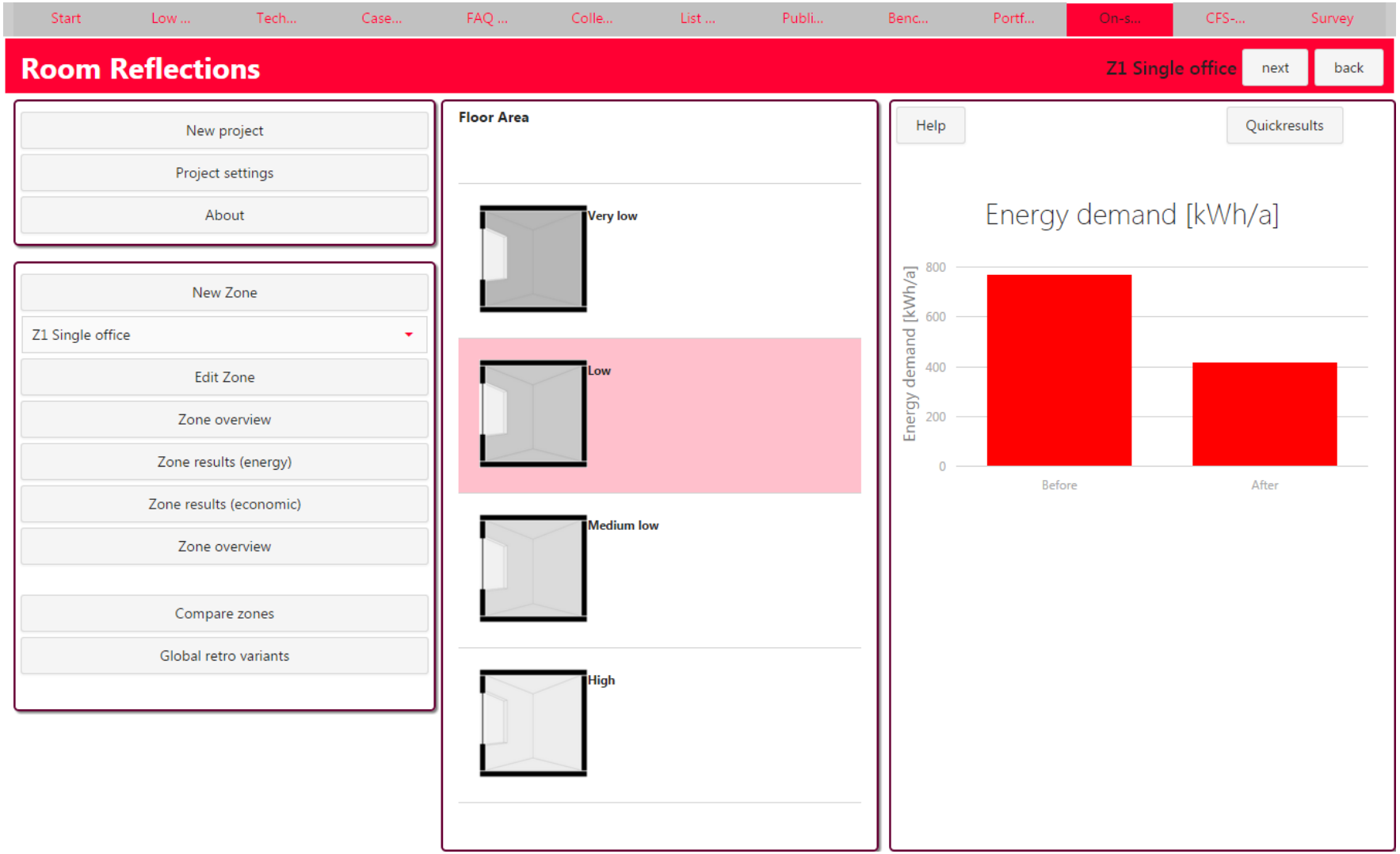
LED-Downlight Technologie
Mit Lichtmanagement

$Q_{lighting}$ <= 10 kWh/m²a

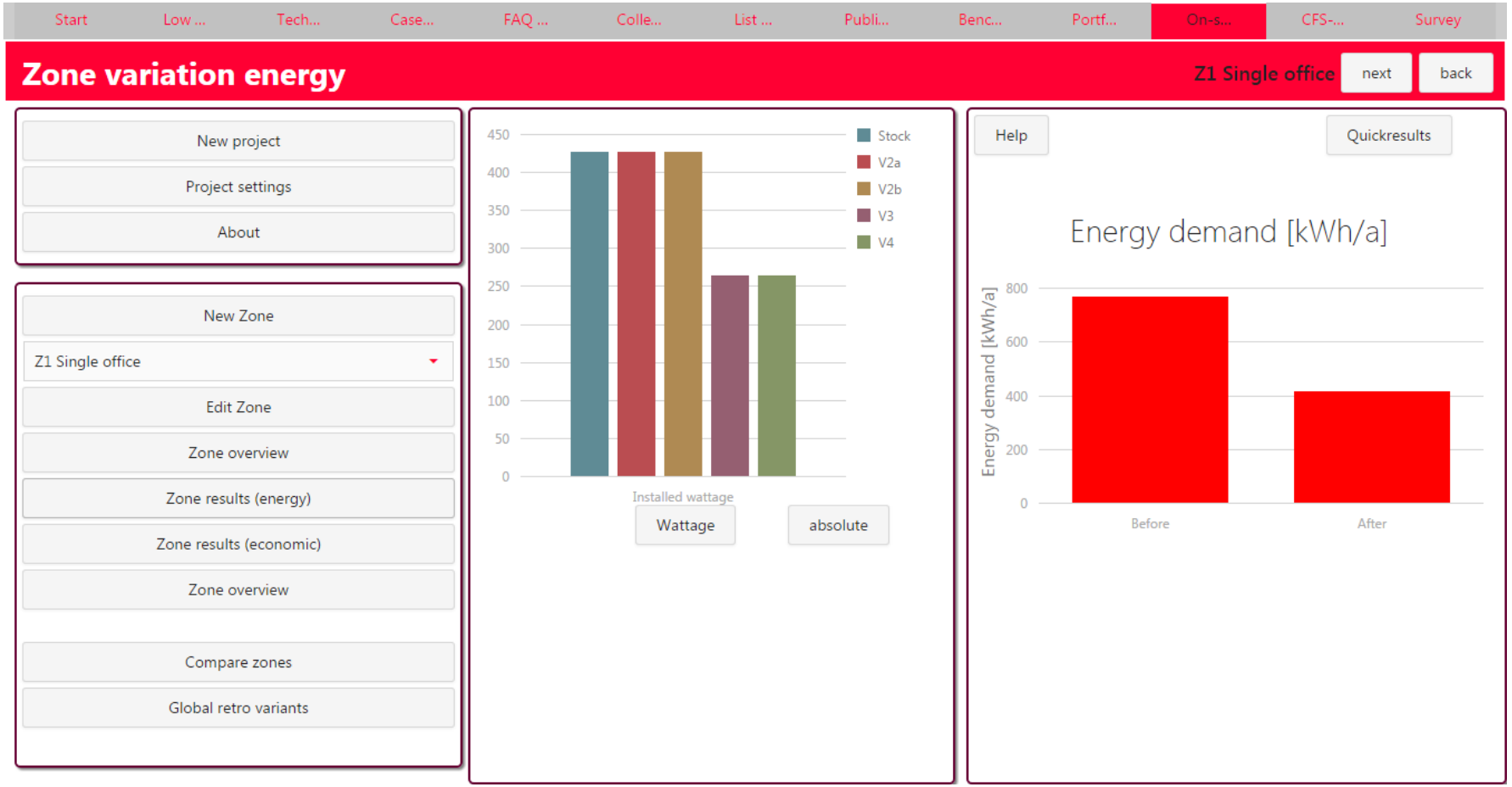








SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY


Start
Low ...
Tech...
Case...
FAQ ...
Colle...
List ...
Publi...
Benc...
Portf...
On-s...
CFS-...
Survey
Zone variation energy
Z1 Single office
next
back
New project
Project settings
About
New Zone
Z1 Single office
Edit Zone
Zone overview
Zone results (energy)
Zone results (economic)
Zone overview
Compare zones
Global retro variants
450
400
350
300
250
200
150
100
50
0
Stock
V2a
V2b
V3
V4
Installed wattage
Wattage
absolute
Help
Quickresults
Energy demand [kWh/a]
Energy demand [kWh/a]
800
600
400
200
0
Before
After

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

FAQ / Recommendations

All information is described in a general manner and may thus be adaptable only partly to your specific situation.

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 sence ...

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...

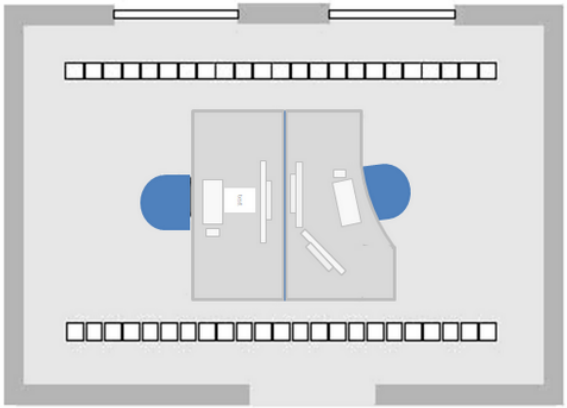
If I have only a certain amount of money, what should I spend it ... - short payback-time?

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 parrallel 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**: https://play.google.com/store/apps/details?id=app.gRetrofitAdviser
        - *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