

# Potential of Energy Savings in Lighting by Optimized Control Systems

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# Disclaimer

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- First I have to make clear that a generalization of statements regarding the „savings potentials“ in lighting management is very difficult and should be banned.
- On the other hand I do know that this is exactly the request and will be finally the result of my presentation. I will take this challenge and I hope I can satisfy the audience providing general statements to easy, but acceptable calculations.
- I will concentrate on office areas, the principles may be adopted easily for other areas too.

# Approach:

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- To understand the savings potential it is mandatory to understand first the reference.
- With office lighting the installed lighting power ranges usually between 10 and 35 W/m<sup>2</sup>, some old systems use up to 80W/m<sup>2</sup>, but these have gone rare today.
- You may find the interval given too wide. Please note that 35 W/m<sup>2</sup> are REALITY, not by design but by practice. Especially systems originally planned to use only very low installed power (e.g. 10W/m<sup>2</sup>) tend to be pushed up in installed power by users applying various other sources like Desktop lights etc., this way ending up with installed 30W/m<sup>2</sup> and above.
- Installed power is only one part of the figures!

## **Factors of W/m<sup>2</sup> 1.: The lamps used.**

- „Factor 2 rule“: of lamp selection: FL (100) – CFL (50+) – LV Halogen (25) – Bulb (10) lm/W;
- High-pressure discharge lamps (HID) range typically between CFL und FL, depending on color rendering requests.
- White LED range today slightly above the bulb, in laboratory around LV Halogen.

**Selecting the light source is a direct and immediate factor to the W/m<sup>2</sup>.**

## Factors of W/m<sup>2</sup> 2.: The lighting setup.

- Lighting philosophy (direct, indirect, etc.)
- Selection of color, type and arrangement of the interior design.
  - White walls reflect light effectively, this saves energy
  - Small rooms / zones need more energy to achieve the brightness goal.
- The Efficiency of the luminaires and how they are placed
  - Higher efficiency of indirect lighting suspended luminaires is more than compensated by lousy ceiling reflection
  - Large spacing between single fixings saves investment, but uses more Energy to achieve the minimum illumination.

## Factors of W/m<sup>2</sup> 3: Design target / reality

- Typical lighting systems are designed to provide light also not only on work surfaces! (Paintings, decoration, etc.)
- Decorative parts of the lighting system usually make up a substantial part of the installed power.
- W/m<sup>2</sup> will be given in most drawings only for the base lighting system. Decorative parts are often dropped.
- Pole- and desktop lighting parts are often not in the drawings, and if, the type and consumption is often wrong!

# Use of installed power consumption:

- The reference before lighting control has to include “on-time”
- There are lots of useless discussions about that, and any values given create immediate protest. My experience in brief:
- Lights needed in the morning when entering the building will be ON all day.
- In open plan and large group offices lights will be on the all day always.
- Statements remain unchanged with or without sunblind and daylight redirection devices.

# Human factors

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- Of course there are cultural differences between humans.
- In actual installations that “Energy awareness” in small offices typically trades off with “forgot to switch off the lights in the evening“ in open plan offices.

# Single room reference

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- 8.5 hours worktime / day
  - \* 5 days a week
  - \* 47 weeks office operation
  - \* 0.5 (approx half the year there is sufficient brightness in the morning and lights will not be used.
- **= 1000 h / year usage.** (calculation base, without cleaning times in the evening etc.)
- Using 20 W/m<sup>2</sup> we are talking about **20 kWh/m<sup>2</sup> and year.** (Cleaning excluded)

# Group and open plan office reference

- 12 hours worktime / day
  - \* 5 (Days a week)
  - \* 50 weeks presence(no reduction for available daylight with manual switched systems in open plan!)
- =**3000 h / year usage**.(again without cleaning).
- Using 14 W/m<sup>2</sup> installed lighting power we are talking about **43 kWh/m<sup>2</sup>** and year (Cleaning excluded)

# The savings potential: (Presence)

- Presence control: Presence detectors switch off the lights if nobody is present (lights to be turned on manually!).
  - Savings in small offices approx **50%**,
  - Savings in open space offices typically **10%**, max. 20%.  
**Pay attention, a system in an open plan office has to be designed and networked carefully.**  
**It is insufficient to switch only workspace related lighting and neglect performance losses for the others.**  
**These figures are praxis results after the first year of operation.**

# **The savings potential: Daylight**

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Light sensors dim down slowly and switch lights off if available daylight is sufficient. A sophisticated blind automation system is needed to achieve daylight savings.

- **In single person offices daylight control saves ~ 50%,**
  - Savings will be seen especially in winter months
  - Savings may not be accumulated to the 50% saving of presence control!
- **In group and open plan offices sophisticated controls saves ~ 60%.**
  - Dependant on window configuration, room depth etc!
  - These savings will be seen mainly in summer,
  - Savings are cumulative to presence control.

# Situational Control savings

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User may select a lighting scene (milieu) which is appropriate to his intended use of the space.

- In small offices the savings will be approx 30% (mainly in wintertime)
- Using a sophisticated system the savings in open plan offices are ~ 15%.

# Performance killers

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- Insufficient automated glare control blind system
  - Risk of manually closed blinds: 50% Increase of energy use
- Linear sum of presence-, daylight-, and situational savings is not allowed.
- Performance requirements for open plan control systems are high.
  - Simpler systems achieve only half the saving
  - Poor systems lead to no or negative savings
- Look- down sensors are limited by concept
  - Typical result is 50% of potential

# The „Reality Factor“

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- Room geometry, orientation, window system, furniture, type of profession, working hours regulations, meeting and holiday replacement habits, overall quality of the lighting system, accessibility of the controllers as well as working climate are all influencing the saving results.
- Many of these are “soft factors” and very difficult to determine.
- With some of these there are figures available, but difficult to interpret and even more difficult to enter into calculations
- Proof of the savings should be made by measuring the used energy for a full year, but only after minimum 1 year of operation, and without telling the local users.

## Brief Figures (warnings apply!)

- In small offices a perfect system will save ~65%.
  - Typical saving will be approx 50%.
  - The total savings may be **10KWh / m<sup>2</sup>Year**
  - Savings are mainly in wintertime
  - Equipment: presence and/or daylight methods (manual on!)
- In open plan offices a perfect system will save ~60%.
  - Typical savings for sophisticated control are 50%
  - The total savings may be **22KWh / m<sup>2</sup>Year**
  - Saving are mainly in summertime.
- Standard systems in open plan will save ~25%.
  - The total savings may be **10KWh / m<sup>2</sup>Year**

# Warning and disclaimer

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- **WARNING:** The figures depend on granted acceptable glare control!
- **WARNING:** These figures may vary substantially with the details of a building; they are given for “average, modern, typical office buildings”.
- A generalization of statements regarding the „savings potentials“ in lighting management is very difficult and should be banned.
- The figures provided are average of larger samples and may vary substantially for any individual.

# Finish

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- Thank you for your attention.

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Do not hesitate to place any questions that  
cannot be answered immediately to  
[Walter.Werner@zumtobel.co.at](mailto:Walter.Werner@zumtobel.co.at)