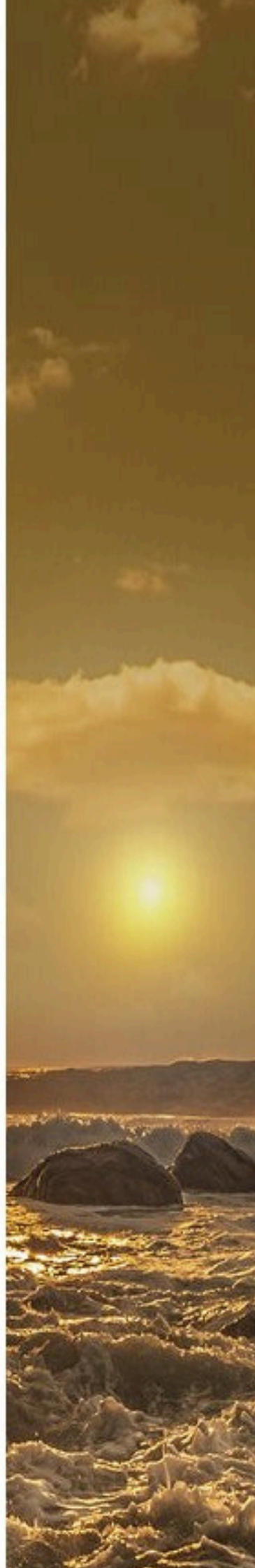
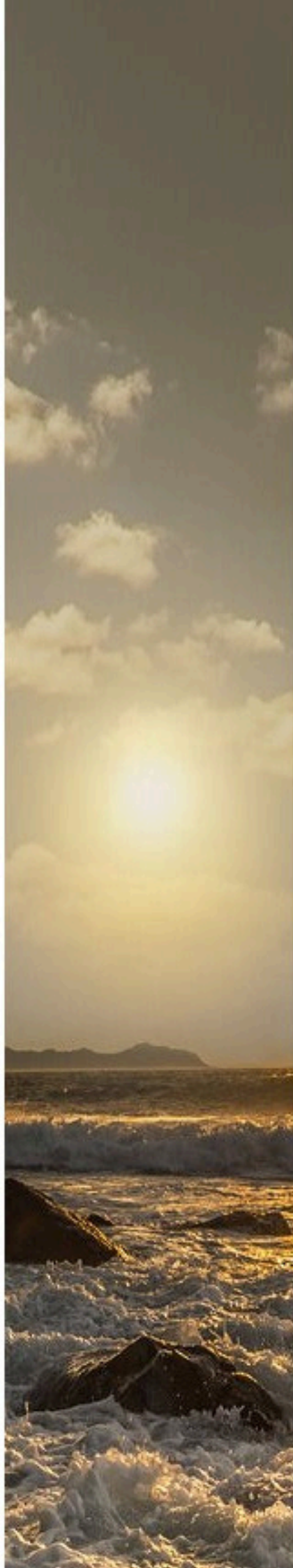
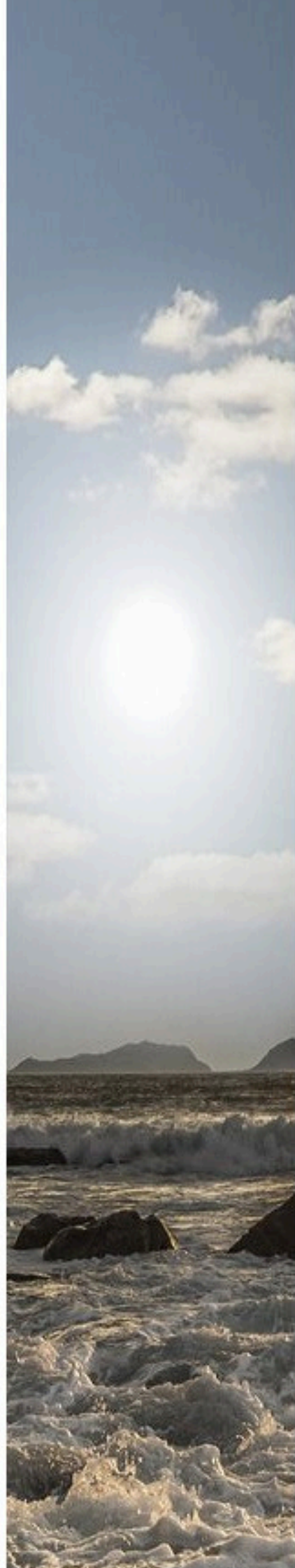




HUMAN CENTRIC LIGHTING

onework GmbH
2026

Human Centric Lighting
in offices and work environments





Human Centric Lighting

Human Centric Lighting (HCL) in office environments represents a paradigm shift in workplace design.

Unlike traditional, static lighting systems, which are primarily focused on energy efficiency and brightness, HCL takes into account the biological rhythms and physiological requirements of office workers.

The core idea is based on artificial lighting mimicking natural daylight variations and the 24-hour circadian rhythm to maximize alertness, concentration, and well-being.

Modern offices pose particular challenges: many employees sit all day under static fluorescent lighting without direct access to windows, leading to fatigue, eye strain, reduced cognitive performance, and long-term health problems.





Key benefits for office workers

Noticeable increased productivity and cognitive performance	page 06 - 07
Significant increase in alertness and vigilance, especially in the afternoon	page 08 - 09
Reduced eye strain and headaches	page 10 - 11
Improved sleep quality despite shift work	page 12 - 13
Significant improvement in mood and reduced symptoms of depression	page 14 - 15
Improved visual comfort and reduced eye strain	page 16 - 17
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Noticeable increased productivity and cognitive performance

This is one of the best documented and most economically significant effects.
University of Hamburg-Eppendorf (2015) – Flagship study:

A groundbreaking study investigated the cognitive effects of optimized HCL lighting in an office setting:

- Reading speed: Under optimal HCL conditions, reading speed increased by up to 30%.
- Error rate: Reduction in error rate by up to 45%.
- Mechanism: The reduction in mental effort required for concentrated work leads to long-term performance maintenance.

These results apply universally to various office tasks, as the mechanisms are based on ipRGC stimulation.

Dynamic lighting in the office – Zumtobel study (various workplaces):

With dynamic room lighting scenarios that use cool light in the morning and neutral to warm light in the afternoon:

- Improved alertness in the first and last third of the morning shift
- Significantly improved sleep quality upon returning from shift
- These effects are particularly well documented for the winter months

Practical implication:

A mere 30% increase in reading ability and error reduction means that a medium-sized company with 200 employees can achieve ROI amortization within just a few months.

Significant increase in alertness and vigilance, especially in the afternoon

The afternoon slump is a universal problem. HCL offers a non-pharmacological solution.

Dynamic LED Lighting Study (Zhang et al., 2020):

A peer-reviewed study of 15 participants over four months in specialized office modules:

- Significant increase in alertness in the afternoon under dynamic lighting compared to static lighting.
- This was documented by continuous behavioral monitoring and physiological measurements.
- The study showed that this represents a “potential solution to natural fatigue during the working day.”

Flinders University Night Shift Study (Scott et al., 2024):

One of the first highly controlled in-lab studies on circadian light control in shift workers:

- Psychomotor Vigilance Test (PVT) Lapses: Circadian-informed lighting reduced the number of attention lapses by ~50% (7.4 ± 5.0 vs. 15.6 ± 6.1 lapses, $p < 0.001$)
- Median Reaction Time: Significantly improved under circadian lighting
- These results apply not only to night shifts, but also to reduced afternoon fatigue in day-to-day business.



Reduced eye strain and headaches

Digital Eye Strain (DES) - Global Problem Statistics (2024):

A comprehensive report showed that 69-74% of people who routinely use computers and digital devices suffer from digital eye strain symptoms, with office lighting being the primary contributing factor.

Asadi et al. (2024) - Lighting Intensity and Eye Strain:

A cross-sectional study of office workers showed significant correlations:

- Lighting intensity and visual fatigue: Significant positive correlation
- ($p = 0.201$, $P = 0.029$)
- However, this also shows that suboptimal lighting (not optimal, not too bright) leads to eye strain
- Symptoms of strain: Headaches, reluctance to continue working, eye pain

Solution aspect - Optimal HCL:

Properly calibrated HCL reduces these symptoms by:

- Reduction of flicker effects thanks to high-quality LED systems
- Glare reduction through intelligently controlled anti-glare parameters
- Optimized color rendering (CRI) for visual clarity
- Ergonomic light intensities: 300-500 lux for standard tasks, higher for precision work

Practical consequences:

- Fewer headaches
- Increased ability to concentrate
- Less need for eye drops and doctor visits



Improved sleep quality despite shift work

Dynamic lighting in the context of night shifts (Nie et al., 2021):

A study with dynamic daylight-like lighting conditions for shift workers over 38 consecutive days:

- Melatonin rhythms: Stabilized peak melatonin times and increased melatonin levels at night
- Circadian rhythm strength: Significantly improved
- Sleep quality after night work: Significantly improved

The innovative system used tunable light wavelengths (CAF range 0.32-0.96, CCT range 2680-7314K) to create optimal conditions.

Flinders University study (Scott et al., 2024):

For night shift workers with circadian-informed lighting:

- Sleep prolongation: Participants slept 52 minutes longer by day 7 with circadian vs. control lighting (95% CI: 27.5-76.5 minutes; $p < 0.001$).
- This is a statistically and practically significant effect that dramatically improves recovery after shift work.

Jensen et al. (2015) - Shift workers' sleep efficiency:

A study using dynamic lighting in shift workers showed variable sleep efficiency rates based on shift type:

- After night shifts: 90.9% sleep efficiency (optimal nighttime sleep recovery)
- This is significantly better than the typical 70-75% for shift workers without HCL.





Significant
improvement in mood
and reduced symptoms
of depression

Circadian rhythm disruption and mood disorders (Walker et al., 2020):

A comprehensive analysis by the journal Nature revealed a bidirectional relationship between mood disorders and circadian rhythms:

- Artificial night light exposure (ALAN): Leads to depressive symptoms in humans
- Melatonin blockade: Artificial evening light suppresses melatonin and leads to sleep disorders that exacerbate depression
- Circadian-optimized lighting: Can reduce depression symptoms by stabilizing rhythms

Bipolar disorder and midday light therapy (American Journal of Psychiatry, 2017):

In bipolar patients, strong midday light between 12:00 p.m. and 2:30 p.m. showed:

- Reduction in mood swings
- Reduction in depressive episodes

These findings can be applied to office workers in general: Optimal midday light with blue components stabilizes mood.

Mechanism:

HCL works by:

- Serotonin increase: Morning blue light stimulates serotonin production ("happiness hormone")
- Melatonin rhythm stabilization: Warm, red light in the evening enables natural melatonin production
- Cortisol rhythm normalization: Normal cortisol curve leads to better stress resilience



Improved visual comfort and reduced eye strain

Ma et al. (2022) - Lighting parameters and visual comfort:

A detailed study on CCT and illuminance effects on visual comfort showed:

- Prolonged exposure to inadequate lighting: Leads to visual fatigue symptoms such as eye strain and headaches, as well as mental fatigue (stress, poor self-regulation).
- Optimal lighting: Increases visual comfort and task efficiency.

Kahaki et al. (2022) - Subjective and objective office lighting assessment:

A combined subjective and objective study showed:

- Daylight + modern glare protection: Significantly improves cognitive performance and employee satisfaction
- Reduction of eye strain through adequate glare protection



Increased employee satisfaction and engagement

Zhang et al. (2020) - Long-term employee surveys:

Measured over 4 months using continuous subjective scales:

- Marginal benefit for mood: Demonstrable improvement in mood under dynamic lighting
- Satisfaction surveys: Daily and monthly surveys showed consistent improvements

Observations:

With dynamic lighting in various office scenarios:

- Improved psychophysical well-being during shift work
- Reduced physiological stress (measured by HRV, heart rate variability)

Environmental Satisfaction:

A study involving office relocation showed that the availability of good lighting is a critical factor for environmental satisfaction:

- Different lighting conditions led to significant differences in satisfaction scores
- The integration of natural light was particularly important

Improved stress tolerance and mental health

Zhang et al. (2020) - Stress reduction through dynamic light:

Physiological stress markers were measured using Empatica E4 (multisensory monitoring device):

- Although the study showed “no significant differences for mental stress” in the primary outcome, the interpretation showed that:
- Dynamic light may be a potential solution for reducing stress during the day for office workers while maintaining productivity.
- The hypothesis was that improved alertness + sleep + mood would reduce cumulative stress levels.

Improvement in vagal tone:

Dynamic light circulation during the morning shift significantly improved vagal tone (a marker for parasympathetic activity and relaxation capacity). This indicates better physiological stress regulation.



Faster recovery and fewer sick days

A.T. Kearney Economic analysis of industry and offices:

A study quantifies the potential economic benefits:

- Increased productivity
- Lower error rates
- Not to be underestimated: fewer sick days

The mechanisms are multifactorial:

- Better sleep → Stronger immune system
- Better mood → Reduced risk of burnout
- Higher alertness → Fewer mistakes + stress → Fewer physical symptoms (headaches, muscle tension)

Lampada.de (2024) - Integrative perspective:

With HCL in the office, it became clear that the investment is justified by:

- Reduced absenteeism due to illness
- Increased job satisfaction
- These are both direct (increased productivity) and indirect (fewer sick days) economic effects.





Specific effects for shift workers and night shift personnel

Problems associated with shift work (Marquié et al., 2014):

A long-term French study involving 3,000 female employees showed that:

- > 10 years of shift work: leads to cognitive decline equivalent to an additional aging process of 6.5 years
- Memory and thinking skills: significantly faster decline
- Recovery phase: after leaving shift work, recovery takes at least 5 years

HCL as a solution:

Circadian-informed lighting can significantly reduce these negative effects:

- Faster circadian adaptation to shift work through strategic light exposure
- Better cognitive performance during night shifts
- Better sleep after night shifts → Reduction in cognitive decline over time



Additional benefits: Economic and energy - related aspects

ROI (return on investment) and rapid amortization page 28 - 29

Energieeffizienz und Nachhaltigkeit page 30 - 31

Energy efficiency and sustainability page 32 - 33

Benefits for specific office scenarios page 34 - 35

Summary page 36 - 37

Final recommendation page 38 - 39



ROI (return on investment) and rapid amortization

LED + Smart Lighting ROI Analysis (Crown Lighting Group, 2025):

A detailed payback calculation showed:

- Typical ROI period: 18 months to 3 years
- ROI drivers:
 - Up to 75% energy savings through LEDs and control technologies
 - 15-30% HVAC savings through reduced heat generation from efficient lighting
 - Reduced maintenance and labor costs through LED longevity
 - Additional incentives: Utility rebates and 179D tax deductions

Energy savings (Luminatelighting Group, 2025):

LED task lighting with smart controls:

- Energy consumption: Significantly reduced compared to traditional halogen/incandescent bulbs.
- Heat load on HVAC: Significantly reduced, additional cooling cost savings.
- Maintenance costs: LED service life 50,000+ hours (compared to 1,000-10,000 hours for conventional bulbs).
- Frequency of replacement: Drastically reduced.

Lumenloop (2024) - Hybrid Work Context:

At 300-500 lux standard with smart controls:

- Savings of up to 80% thanks to energy-efficient systems
- Payback period: Depending on building size, typically 1-3 years

Total economic impact for an office building with 200 employees.

aspect	saving	time frame
energy	40-75% reduction	1-3 years ROI
maintenance	60-80% reduction	Immediately visible
productivity (+3-5%)	~€ 50-100k/year	6-12 months
sick days (-5%)	~€ 20-40k/year	12-24 months



Energy efficiency and sustainability

LED technology standards:

LED lighting with smart controls offers:

- 75% energy efficiency advantage compared to conventional lighting
- Additional 15-30% savings through intelligent controls (sensors, daylight harvesting)
- Long-term advantages: LED service life of 50,000+ hours means:
 - Less frequent replacement cycles
 - Reduction in electronic waste
 - Lower overall carbon footprint

Practical example (field study):

A single school switching to LED + LM:

- Old installation: 1,598 kWh/year; €489 cost; 0.96 tons of CO₂
- New LED + smart lighting: 188 kWh/year; €57 cost; 0.11 tons of CO₂
- Annual savings: 1,410 kWh; €432; 0.85 tons of CO₂
- These savings multiply in office buildings with 5-10 times higher energy consumption.



Implementation standards and best practices

In the morning (activation phase):

- Vertical illuminance at the eye: 250-500 lux
- Correlated color temperature: 5,000-6,500 Kelvin (cool, blue-enriched light)
- Melanopic EDI: At least 250-300 (better than CCT-based measurement alone)
- Effect: Maximum ipRGC stimulation → Melatonin suppression → Alertness

Mornings (increased concentration):

- Illuminance: 500-1,000 lux
- CCT: 5,500-6,500K
- Setting name: "Focus" or "Concentration"
- Ideal time window: 2-3 hours after starting work for maximum cognitive performance

Afternoon (energy phase + creativity):

- Gradual reduction: 400-600 lux
- CCT: 4,000-5,000K
- Setting name: "Energy" or "Balanced"
- Function: Overcoming the afternoon slump, promoting creativity

Late evening (relaxation phase):

- Dimmed light: 100-200 lux (if office is still in use)
- CCT: 2,700-3,500K (warm tone, red shift)
- Setting name: "Calm" or "Relax"
- Purpose: Preparation for sleep, melatonin production

Benefits for specific office scenarios

Flinders University findings (Scott et al., 2024):

In night shift workers with HCL:

- ~50% reduction in attention deficits during shifts
- 52 minutes longer sleep after shifts
- Faster circadian phase adjustment to shift work
- This is particularly relevant for industries with 24/7 operations (healthcare, IT, security)

Hybrid and Remote Work

Lumenloop (2024) - Hybrid Work Guidelines:

Similar guidelines are recommended for home office workers:

- Remote workers: At least 300-500 lux with adjustable task lighting
- Hybrid workers: Consistent lighting conditions between home and office reduce circadian stress adaptation
- Savings: Individual control over lighting conditions leads to higher satisfaction and better outcomes

Open-plan offices

In open-plan offices, distractions are a primary source of stress.

While HCL does not directly reduce noise disturbances, it has indirect positive effects:

- Better concentration: Optimal lighting and the associated ability to focus enable employees to remain concentrated despite distractions.
- Faster recovery after interruptions: Improved attention span means a quicker return to focus after interruptions.

Importance of quiet zones:

Studies show that in open-plan offices with quiet rooms available, the negative effects of distractions are greatly reduced:

- Distractions were less stressful for employees with access to quiet spaces
- Lighting optimization in these quiet spaces enhances their effectiveness





Summary

area	illuminance	CCT	function
individual workstation (Computer)	300-500 lux	4.000-5.500K	focus - eye protection
conference room	400-600 lux	5.000-6.000K	attention
breakroom/break	200-300 lux	3.000-4.000K	relaxation
precision work	500-1.000 lux	5.500-6.500K	visibility + focus

benefit	effect size	relevance
productivity/reading performance	+30% improvement	very high (costs time)
error rate	-45% reduction	very high (quality + safety)
afternoon fatigue (alertness)	significantly reduced	high
sleep after shift work	+52 minutes	high (for shift workers)
eye fatigue	-20-30% with optimal HCL	high (69-74% affected)
headaches	significantly reduced	moderate (10-15% of office workers)
depression symptoms	marginal to moderate	moderate (shift workers)
mood/well-being	marginal to moderate	moderate
employee satisfaction	+10-20% improvement	moderate (retention)
energy savings	-75% vs. conventional	high (payback)
ROI-period	18-36 months	very high (economic)



Final recommendations

HCL in office environments should be implemented as a priority if:

- Many office workers without access to windows: Artificial HCL can simulate the benefits of daylight
- Highly cognitively demanding tasks on a daily basis: The +30% increase in productivity quickly pays for itself
- Shift work or irregular working hours dominate: The effects on sleep and cognition are particularly valuable
- Old lighting systems (fluorescent): Replacement with LED + HCL offers maximum added value
- Energy savings are a goal: 75% savings with 18-36 months ROI

Implementation phase:

- Baseline assessment: Measurement of energy consumption, employee satisfaction, sick days prior to implementation
- Pilot installation: Start in 1-2 office areas/departments for evaluation
- Calibration and training: Employees understand the various settings and their effects
- Monitoring and optimization: Regular feedback loops and technical adjustments
- Scaling: Rollout to other areas after successful pilot phase

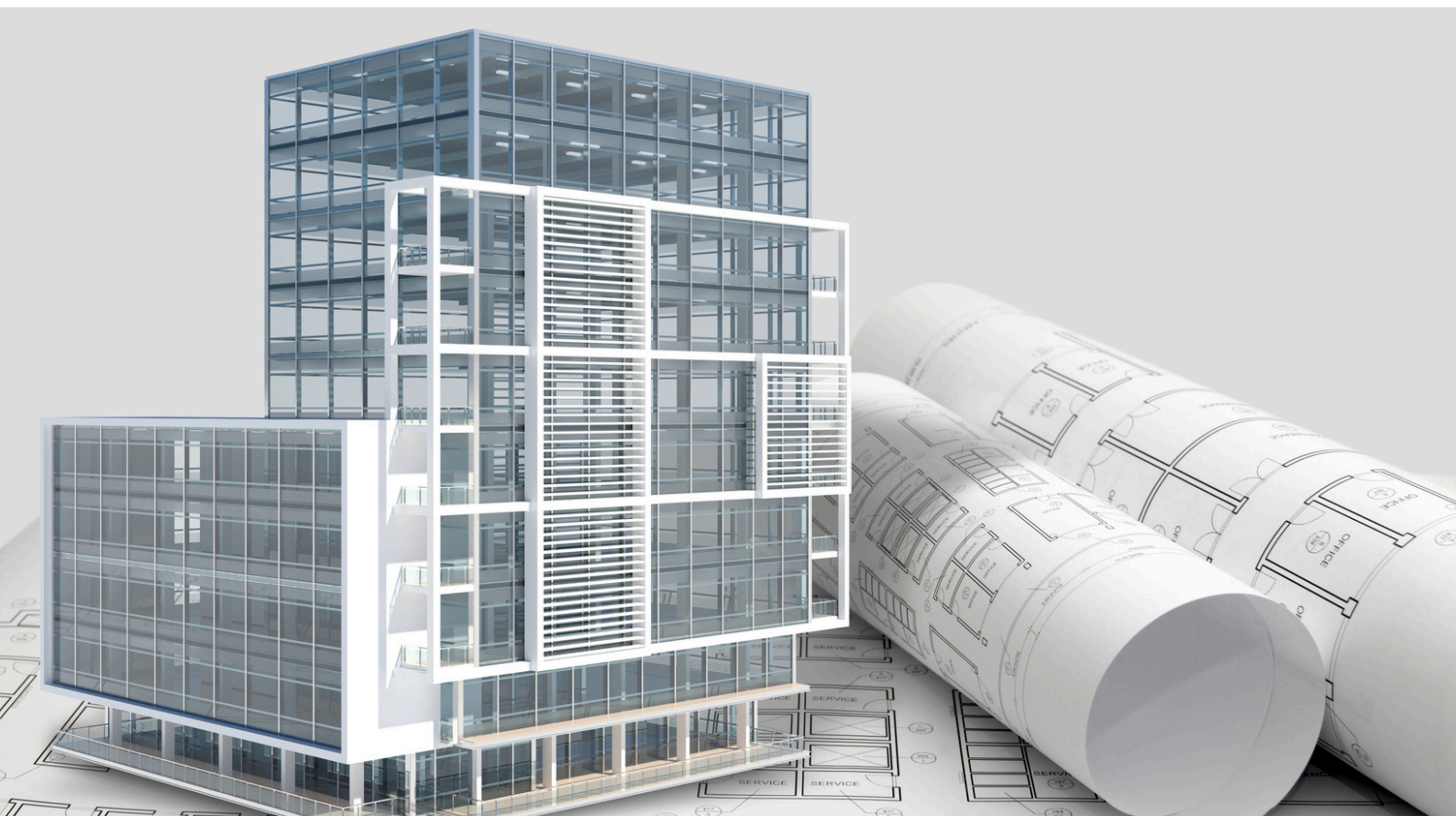
Successful
projects start
with the right decision



We believe in working environments that are more than just functional-spaces that inspire, motivate, and invite people to linger. Our vision is to create places where technology works in the background but is noticeable in everyday life: through intelligent control, sustainable systems, and an atmosphere that focuses on people's well-being.



Solutions for your project



onework CORE

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onework LUX

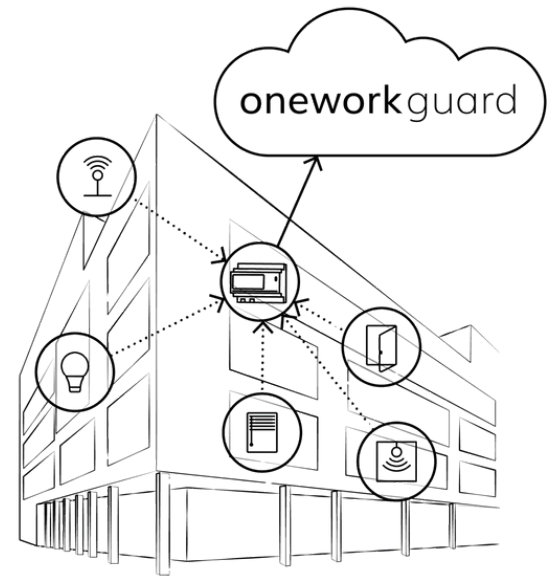
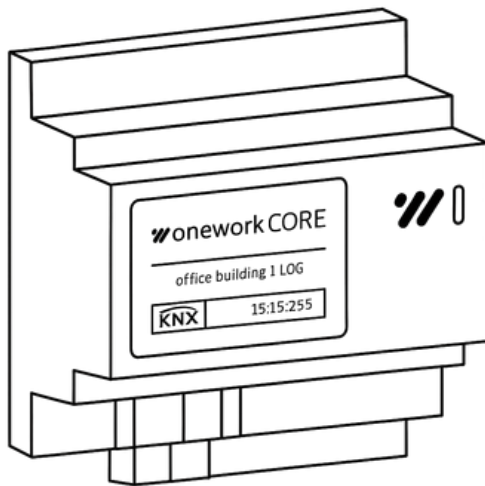
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onework TOUCH

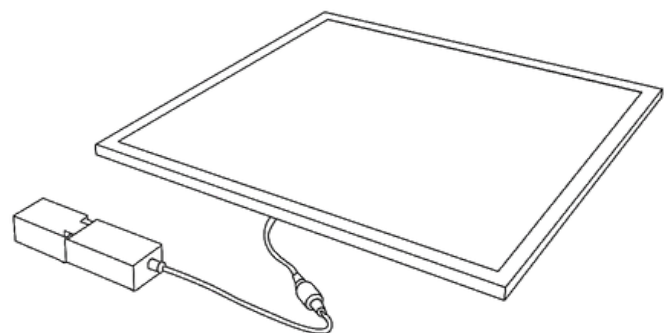
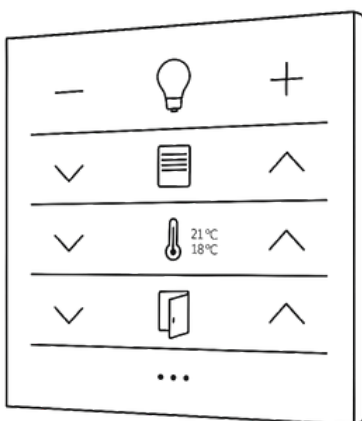
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onework GUARD

page 54 - 55



Unsere
Produkte
sind Ihr
Fundament



onework CORE

The onework CORE automates lighting, climate control, air quality, and glare protection - for efficiency, comfort, and a healthy indoor climate.



With its cross-functional room automation, onework CORE improves the quality of stay and energy efficiency of commercial real estate. onework CORE is a certified KNX device. It integrates all devices and components available in the room into the automation of lighting, temperature, air quality, and glare protection. Communication with peripheral devices takes place exclusively via the KNX bus. Overriding the room automation systems, e.g., using our onework TOUCH, is possible at any time.

Maximum control, minimum effort

We believe in spaces that are more than just functional - that inspire, motivate, and invite people to linger. Our vision is to create places where technology works in the background but is noticeable in everyday life: through intelligent control, sustainable systems, and an atmosphere that focuses on people's well-being.

Certified KNX device. It integrates all devices and components available in the room into the automation systems for lighting, temperature, air quality, and glare protection.

Control of up to 30 rooms



Light

Intelligent lighting control that automatically adjusts brightness and color temperature to daylight, presence, and usage.

- Human Centric Lighting (HCL) for more productive working environments
- Tunable White for dynamic adjustment from cool to warm white
- Scene control for meetings, presentations, and workspaces



Temperature

Automatically optimizes heating and cooling systems. Saves energy through smart use of solar heat and occupancy data.

- Energy harvesting: Use of solar energy for passive heating
- Automatic adjustment to room occupancy and outside temperature
- Integration of blinds for effective summer heat protection



Air quality

Monitors CO₂, VOC, and humidity in real time. Automatically optimizes air quality—for better health and productivity.

- CO₂ & VOC monitoring for a healthy indoor climate
- Automatic window control for optimized fresh air supply
- Ventilation recommendations for manual air quality optimization



Glare protection

Automatically controls blinds and shutters based on sun position, weather, and room usage. Reduces glare and saves energy.

- Calculation of dynamic limit values based on theoretical brightness
- Stable positioning with fewer unnecessary movements
- Consideration of shading, reflections, and dynamic light behavior

onework LUX

With human-centric lighting, precise optics, and state-of-the-art LED technology, onework LUX creates light quality of the highest standard.

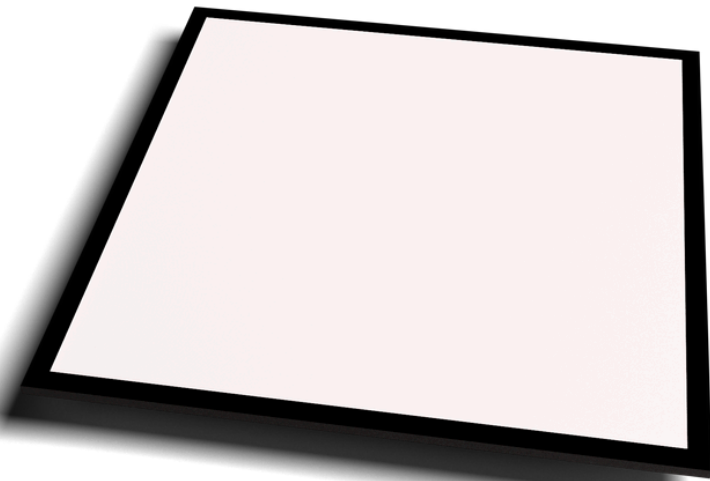


Stands for innovative lighting solutions that showcase both people and spaces. With state-of-the-art LED technology, clear design language, and maximum efficiency, our luminaires offer the highest level of lighting quality. Thanks to glare-free light distribution and precise optics, Onework LUX luminaires create uniform, pleasant illumination - perfectly tailored to the requirements of modern working and living environments.



Human Centric Lighting

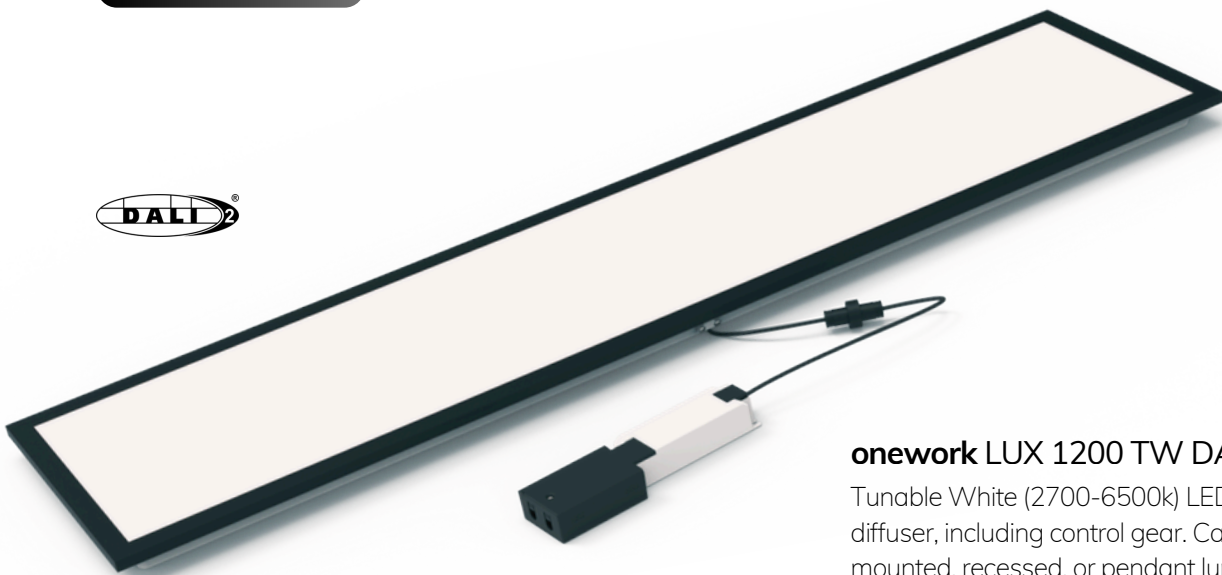
Light that can do more



onework LUX 600/625 TW DALI

Tunable White (2700-6500k) LED panel with prismatic diffuser, including control gear. Can be used as a surface-mounted, recessed, or pendant luminaire for system dimensions of 600mm x 600mm or 625mm x 625mm.

Available in
black and white



onework LUX 1200 TW DALI

Tunable White (2700-6500k) LED panel with prismatic diffuser, including control gear. Can be used as a surface-mounted, recessed, or pendant luminaire for the system dimensions 1200mm x 300mm.

Available in
black and white

DALI - dimmable

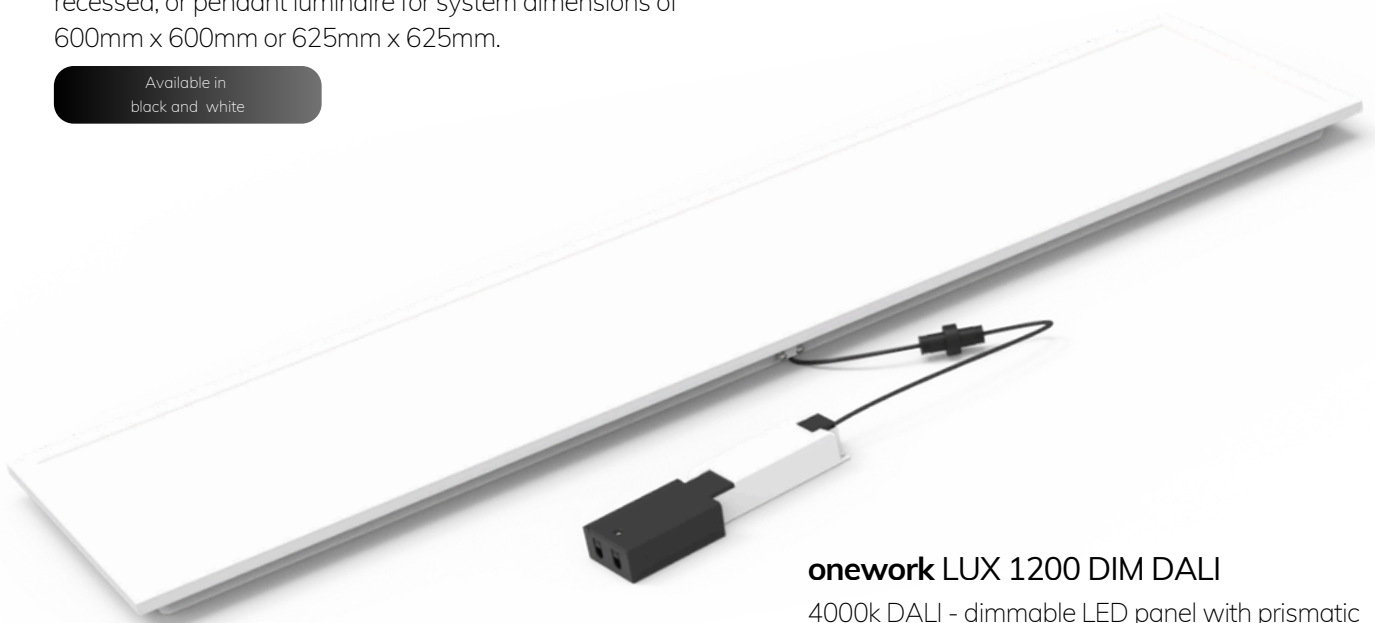
More control, more comfort



onework LUX 600/625 DIM DALI

4000k DALI - dimmable LED panel with prismatic diffuser, including control gear. Can be used as a surface-mounted, recessed, or pendant luminaire for system dimensions of 600mm x 600mm or 625mm x 625mm.

Available in
black and white



onework LUX 1200 DIM DALI

4000k DALI - dimmable LED panel with prismatic diffuser, including control gear. Can be used as a surface-mounted, recessed, or pendant luminaire for the system dimensions 1200mm x 300mm.

Available in
black and white



onework LUX TL TW DALI

Tunable White (2700-6500k) LED spotlight, incl. control gear. Can be used in track lighting systems.
Beam angle: 15°, 24°, 60°

Available in
black and white



Tunable White Tracklights

Dynamic lighting, precision on the track



onework LUX TL P TW DALI

Tunable White (2700-6500k) LED projection spotlight, incl. control gear. Can be used in track lighting systems. Beam angle: 45°

Available in
black and white





Linear light Clarity that makes an impact



onework LUX LL 1200 TW DALI

Tunable White (2700-6500k) pendant light, incl. control gear. For optimal lighting conditions, system dimensions: 1200mm x 70mm x 70mm.

Available in
black and white

Downlights

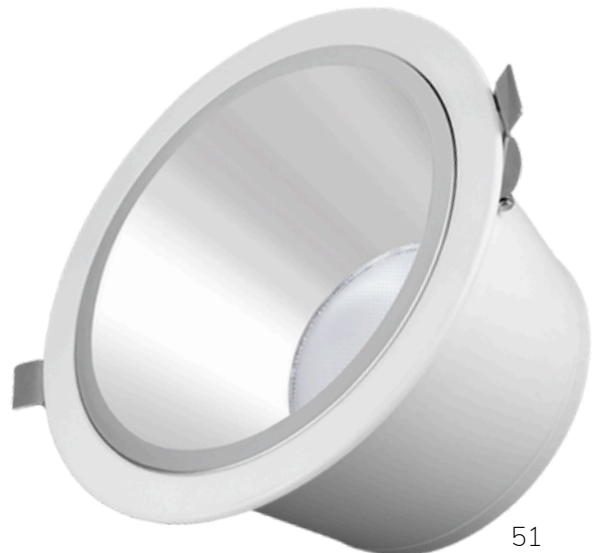
Discreetly powerful, visibly effective



onework LUX DL 180 TW DALI

Tunable White (2700-6500k) downlight with prismatic diffuser, including control gear. Can be used as a recessed luminaire for the system dimensions 180mm x 92mm.

Available in
black and white



onework TOUCH

The intuitive 4-inch onework TOUCH control panel combines lighting, climate, shading, and scene control in one elegant interface.



The onework TOUCH is a 4-inch touch display for intuitive and efficient building control. Developed for seamless integration into KNX systems, it combines modern design with the familiar operation of a classic push button. Thanks to its customizable user interface, the onework TOUCH enables precise control of lighting, shading, climate, and scenes - all with a single touch.

Everything under control With just one touch

onework TOUCH

onework TOUCH is a modern touch control panel that brings together all room control functions on a single, intuitive user interface. Whether lighting, temperature, air quality, shading, or individual scenes - all relevant functions can be intelligently controlled with just a few touches.



Full KNX compatibility

Manufacturer-independent and flexible for use in any KNX environment.



Intuitive operation

Button-based interface for maximum user-friendliness - no adjustment necessary.



Versatile control

Lighting, blinds/shutters, windows, temperature, and scenes with just one tap.



Advanced features

Automatic/manual detection, window instructions, and intelligent automation with onework CORE.

onework GUARD

The cloud-based fault reporting management system onework GUARD detects errors in real time, analyzes causes, and provides proactive recommendations for action.



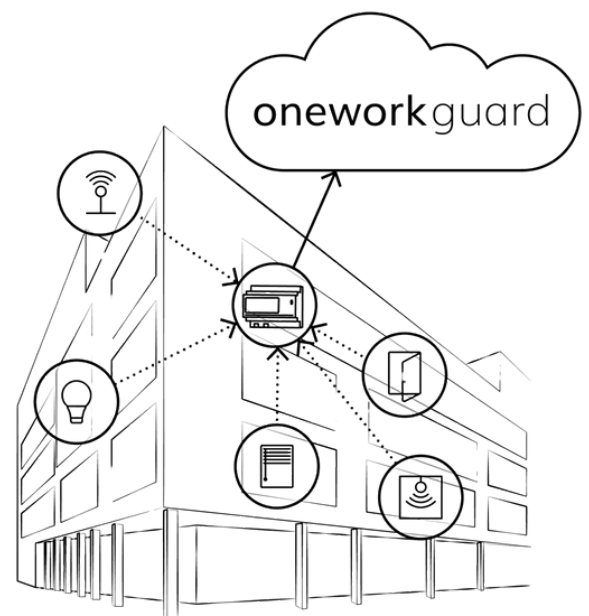
The development of onework GUARD is funded as an innovation project called guard building management system (guard BMS) as part of the Schleswig-Holstein state program Economy 2021–2027 (LPW 2021) and proportionally by the European Regional Development Fund (ERDF). The aim of the project is to create a cloud-based, manufacturer-independent building management system for KNX-based commercial properties that uses a digital twin and AI-supported algorithms to detect errors in real time, analyze causes, and provide proactive instructions for rectification. The system is complemented by the ETS app “Project Health Check,” which automatically avoids configuration errors in KNX projects. This innovation reduces operating costs, increases energy efficiency, and improves the quality of stay - a future-proof milestone for modern buildings.

Fully protected, monitored at all times, always one step ahead

onework GUARD

onework GUARD, the digital twin of the building infrastructure, is a cloud-based fault reporting management system for KNX bus systems. It enables demand-oriented monitoring of devices and data points. Alarm rules can be predefined and individually configured. Alarms and their effects are clearly displayed and system statuses are vividly visualized.

SaaS



Visualize system states



Define custom alarm rules



Aggregation of sensor data



Processing of alarm and status messages



Monitor devices and data points



Analyze malfunctions and make recommendations



Automatic error analysis



building
better
workplaces
together



Standards and literature

DIN EN 12464-1 Light and lighting –

Lighting of workplaces, Part 1: Indoor workplaces

The following standards are relevant to the workplace:

DIN EN 12464-2 Light and lighting –

Lighting of workplaces, Part 2:

Outdoor workplaces

DIN 5035-7 Lighting with artificial light –

Part 7: Lighting of rooms with

computer workstations

DIN EN 12665 light and lighting

Basic terms and criteria for

defining lighting requirements

DIN V 18599 Energy assessment of

buildings – calculation of useful, final, and primary energy demand for heating, cooling, ventilation, domestic hot water, and lighting

DIN 5035-7 Lighting with artificial light –

Part 7: Lighting of rooms with

computer workstations

DIN SPEC 5031-100 Radiation physics in the optical range and lighting technology –

Part 100: Non-visual effects of light on humans mediated by the eye – Quantities, symbols, and effective spectra

DIN SPEC 67600 Biologically effective lighting –

planning recommendations. This document provides planning recommendations for living spaces that may be workplaces or non-workplaces. It also includes areas where uses may overlap or mix.

ASR A3.4 Technical rules for workplace lighting

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onework GmbH
Koboldstraße 4
24117 Kiel

www.onework.de