

# well-being

Greater well-being through light

**HCL**  
SU(N)PPORT  
**UV-B**

**REGIOLUX**

The focus is on the human being.

# Light with impact.

**Our buildings are efficient.** Our lighting is often far from efficient! We design for energy efficiency, compliance with standards and visual precision. The luminance levels are correct, glare ratings are optimised and efficiency targets are met. And yet, crucial aspects are often overlooked:

Our bodies follow the natural cycle of day and night (the circadian rhythm), and daylight plays a crucial role in promoting alertness, concentration and rest. When we are outdoors, these factors are present in their full range.

However, when we are inside, exposure is significantly reduced: window glazing blocks virtually all of the UVB component of sunlight, and artificial lighting is often not adjusted to the time of day.

**Spaces function on a technical level. But vital signals are missing in terms of our physical biology.**

- » People spend approx. 90% of their day indoors.
- » The body's own vitamin D synthesis depends on the sun and its UVB light, which is substantially reduced during the winter months.
- » Light is the most important external influence in our circadian rhythm.
- » A lack of dynamic lighting can disrupt the structure of our day.

**Indoor spaces are visually optimised – but not designed with biology in mind.**

Modern architecture provides comfort, efficiency and functionality. What is generally lacking, however, is the conscious integration of biologically relevant light components. Discrepancies arise particularly in:

- » Office and administrative buildings
- » Care and nursing facilities
- » Schools and educational institutions
- » Buildings with long periods of occupancy

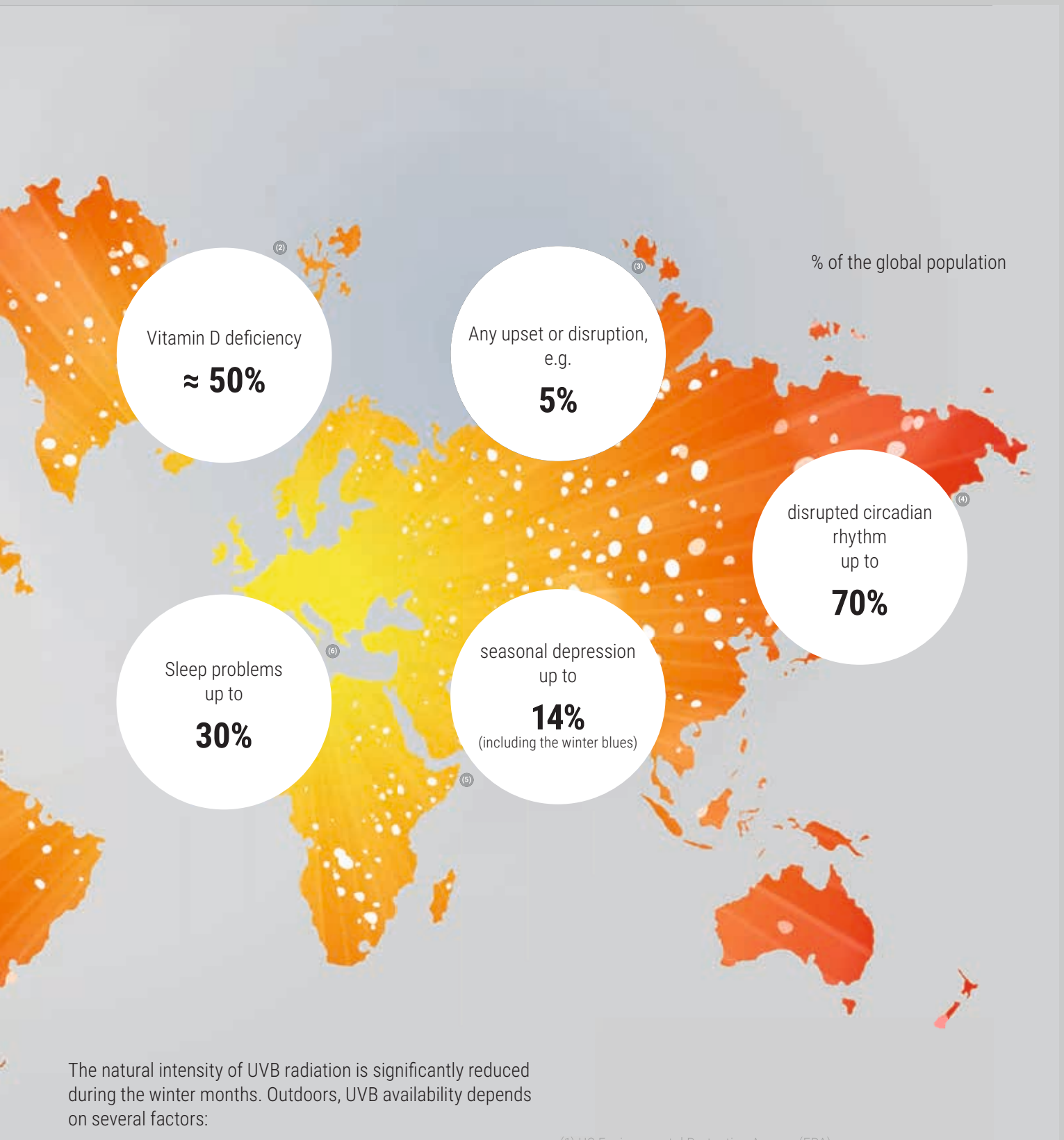
between our natural need for light and the artificial lighting environment.



Time spent indoors  
up to

**90%**

If the indoor environment lacks sufficient natural light, this must be supplemented in an intelligent way. Not as a replacement for the sun, but as the next step in professional light planning.



The natural intensity of UVB radiation is significantly reduced during the winter months. Outdoors, UVB availability depends on several factors:

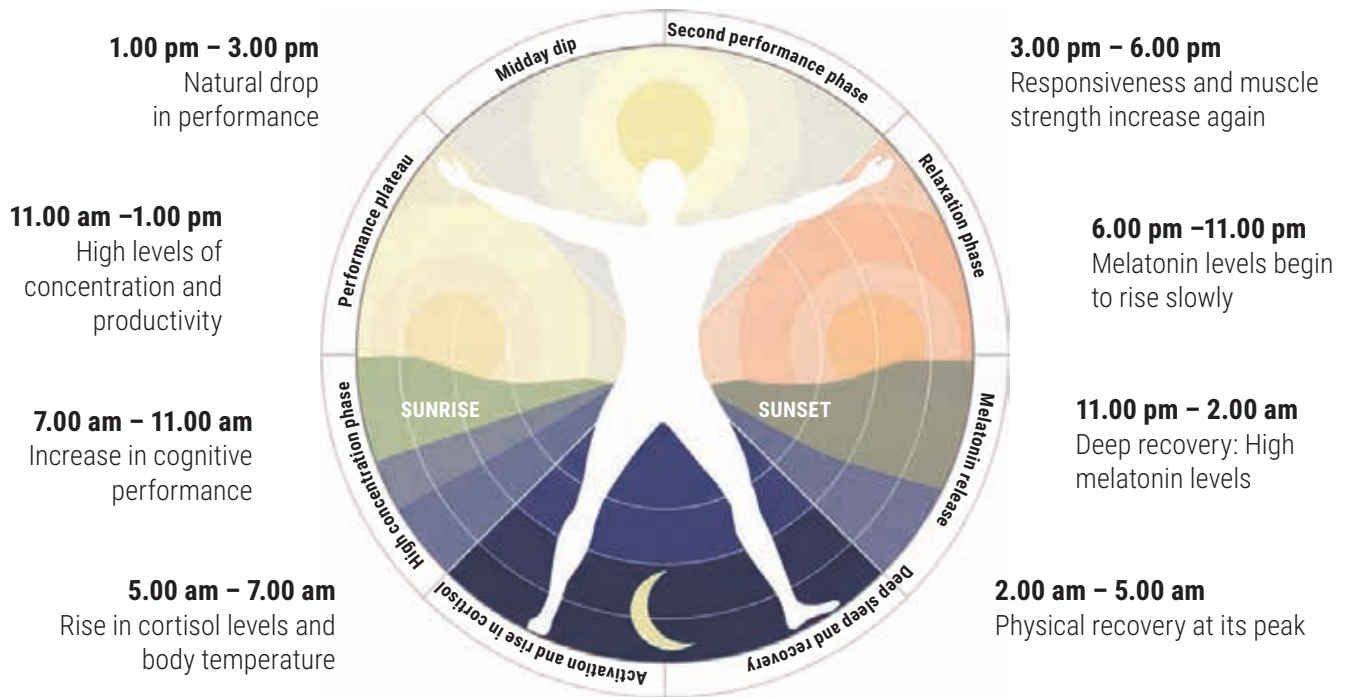
- » Sun elevation
- » Season
- » Geographical location
- » Duration of exposure

- (1) US Environmental Protection Agency (EPA)
- (2) Frontiers in Nutrition (globale Meta-Analyse, 2023)
- (3) World Health Organization (WHO)
- (4) Roenneberg et al., Current Biology (Social Jetlag)
- (5) British Journal of Psychiatry
- (6) Sleep Medicine Reviews (Meta-Analyse)

Human centric lighting (HCL) brings temporal structure to the indoor space.

# Light in rhythm with the day

**Light is more than just brightness.** Alongside the obvious visual requirements, light also has a biological effect. Specialised receptors in the eye (which contain the photopigment melanopsin) react to specific spectral components – particularly in the blue range – and send signals to our internal clock.



Based on insights into the natural cycle of activity and rest.

## What HCL specifically changes

Instead of uniform lighting, the result is a natural, dynamic light pattern:

- » Cooler, energising light in the morning
- » Neutral light for stabilisation during the day
- » A relaxing, warmer lighting atmosphere for the late afternoon.

The intensity and spectrum adapt to the daily biological rhythm, and can be automated and carefully designed.



[www.regiolux.de/en/Service/Light-solutions/Human-Centric-Lighting](http://www.regiolux.de/en/Service/Light-solutions/Human-Centric-Lighting)

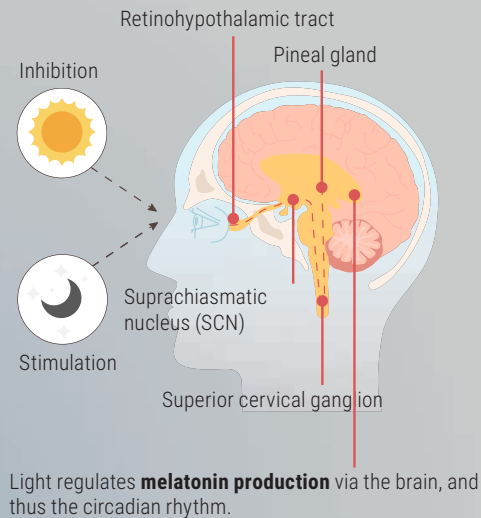


## Melatonin production throughout the day

Light regulates melatonin production and thus our sleep-wake cycle. Bright light during the day suppresses melatonin and promotes alertness and concentration. As the light fades in the evening, melatonin production increases and the body begins to wind down.

Human centric lighting replicates this natural cycle, thereby helping to maintain a stable natural (circadian) rhythm, improve performance during the day and promote more effective rest at night.

This is based on findings regarding the biological effects of light throughout the day.



### Effective use of light colour

Specific light colours stimulate the body's natural daily rhythm and are energising owing to a high blue component, and calming due to the warm light.



### Achieve the perfect lighting level

The correct level of light energises the body, aids concentration and remains visually pleasing and energy-efficient.



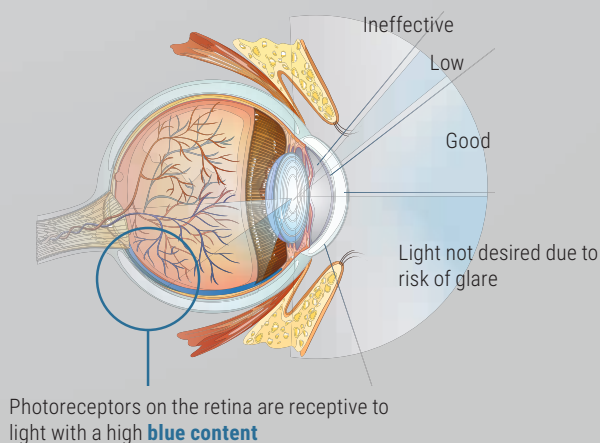
### Controlled lighting throughout the day

Light that changes throughout the day helps to regulate the body's natural rhythms and boosts both performance and recovery.



### Effective positioning of lighting in a room

Light has an effect where it is perceived and should be correctly positioned in the room to maximise its physiological impact.



## Activation of the photoreceptors

Light not only affects our vision but also has a direct effect on our biological processes. Photoreceptors in the eye are particularly sensitive to light with a high blue component and influence alertness and attention.

Human centric lighting makes targeted use of this effect to boost concentration, productivity and well-being throughout the day.

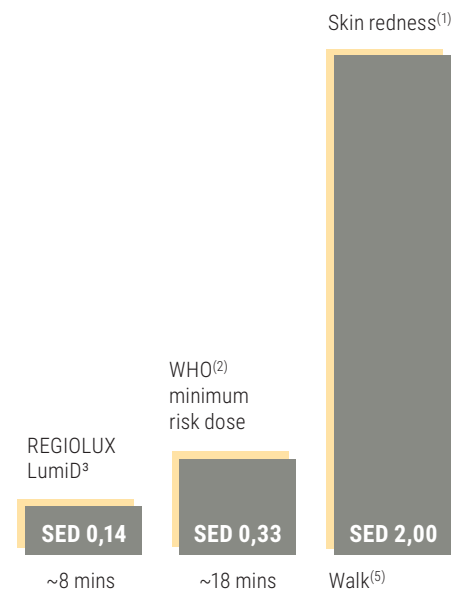
Based on findings regarding the biological effects of light on the eye.

Based on Signify Philips VitaUp® technology

# LumiD<sup>3</sup> UVB emitter

**A natural approach.** Technically implemented. The issue of controlled light supplementation arises if the indoor environment lacks a biologically relevant light component. With LumiD<sup>3</sup>, we are integrating Signify's Philips VitaUp® UVB technology – developed and researched by this leading provider – into a practical, comprehensive solution.

LumiD<sup>3</sup> delivers a targeted UV dose of 0.14 SED over a period of 8 hours under the emitter, thus remaining within the safe range based on the WHO findings, even for the most sensitive skin types.



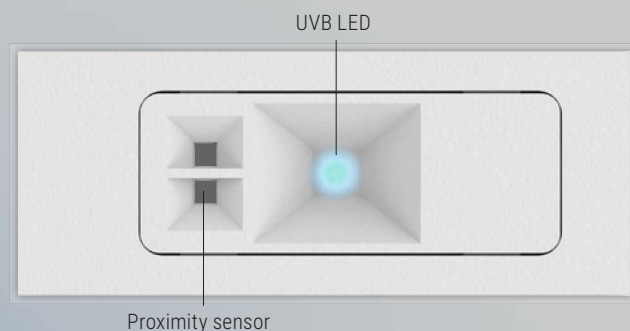
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*Light influences our mood, health and general well-being. We use a combination of UVB technology and HCL to create a lighting solution that places people holistically at the centre.*

Dr Sylvio Schubert  
Technical Director  
Regiolux GmbH

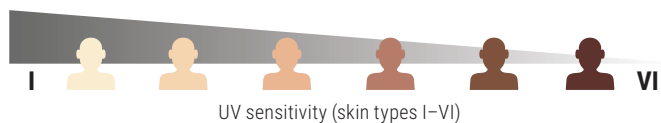
## Low UV index

Depending on the skin type (Fitzpatrick) and the UV index, spending between a few minutes and approx. 1 hour outdoors is sufficient for the body to produce vitamin D naturally (see table). **A UV index of 0.019 was determined as a benchmark for the LumiD<sup>3</sup> module.**



## Safety first – the dose and monitoring are crucial:

Skin pigmentation (melanin) protects against UV light, but generally inhibits the synthesis of vitamin D. The dose and monitoring are therefore crucial to ensure a safe and comparable effect, and the erythema-effective irradiance SED<sup>(3)</sup> is decisive here.



Light skin produces vitamin D more quickly than dark skin, but it is also more sensitive: skin type I reacts with redness and sunburn at an SPF of around 2.0. People with darker skin tones can generally tolerate higher doses.

Our **LumiD<sup>3</sup> UVB module** with a radiation output of 14 mW is designed for safe use:

- » Automatic shut-off with a distance of less than 10 cm
- » Timer control with a maximum of 8 hours of operation per day<sup>(4)</sup>
- » Daily dose of 0.14 SED, roughly equivalent to 8 minutes of summer sunshine (see planning recommendations on pages 13–14)
- » Optional winter mode for seasonal use, which can be installed on site
- » Safe to use even in summer due to the low radiation output

**The Federal Office for Radiation Protection recommends exposing your face, hands and arms to the sun briefly 2–3 times a week to ensure an adequate production of vitamin D – for example, for approx. 10 minutes if your skin would start to redden after roughly 20 minutes.**

<sup>(1)</sup>Skin type I according to the Fitzpatrick scale, <sup>(2)</sup>World Health Organization, <sup>(3)</sup>standard erythema dose, <sup>(4)</sup>DALI control (timer remains active)/ON/OFF control (timers are reset), <sup>(5)</sup>walk in the summer

## Natural endogenous synthesis of vitamin D

Guidelines on UVB-dependent vitamin D production by skin type and UV index. The times stated are for guidance only and may vary depending on individual circumstances and environmental factors.

In summer, UV indices of 8–9 are reached on average in Germany, and up to 11 in high mountain regions.

| UV Index                    | 3–5        | 6–7        | 8–10       | 11+        |
|-----------------------------|------------|------------|------------|------------|
| <b>Skin type I</b>          | 10–15 mins | 5–10 mins  | 2–8 mins   | 1–5 mins   |
| <b>Skin type II</b>         | 15–20 mins | 10–15 mins | 5–10 mins  | 2–8 mins   |
| <b>Skin type III</b>        | 20–30 mins | 15–20 mins | 10–15 mins | 5–10 mins  |
| <b>Skin type IV</b>         | 30–40 mins | 20–30 mins | 15–20 mins | 10–15 mins |
| <b>Skin type V &amp; VI</b> | 40–60 mins | 20–30 mins | 20–30 mins | 15–20 mins |

Based on international studies on UVB-induced vitamin D synthesis (including Holick 2007; NIH; WHO).

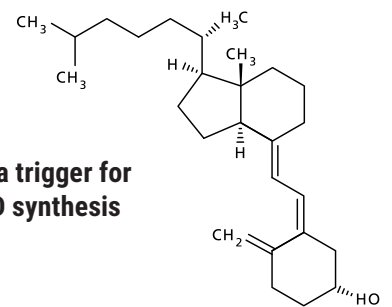
Essential for our health

# Light for the natural production of vitamin D

**Along with visible light, natural sunlight also** includes UV radiation. UVB radiation in the 280–315 nanometre range is the natural trigger for vitamin D synthesis in the epidermis. However, this effect is almost entirely absent in modern, highly glazed buildings, as window glass blocks UVB radiation.



Vitamin D (cholecalciferol)



## Light as a trigger for vitamin D synthesis

UVB triggers the skin's natural process of vitamin D synthesis. If this light stimulus is missing, the body has less raw material available to produce the biologically active forms of vitamin D in the liver and kidneys.

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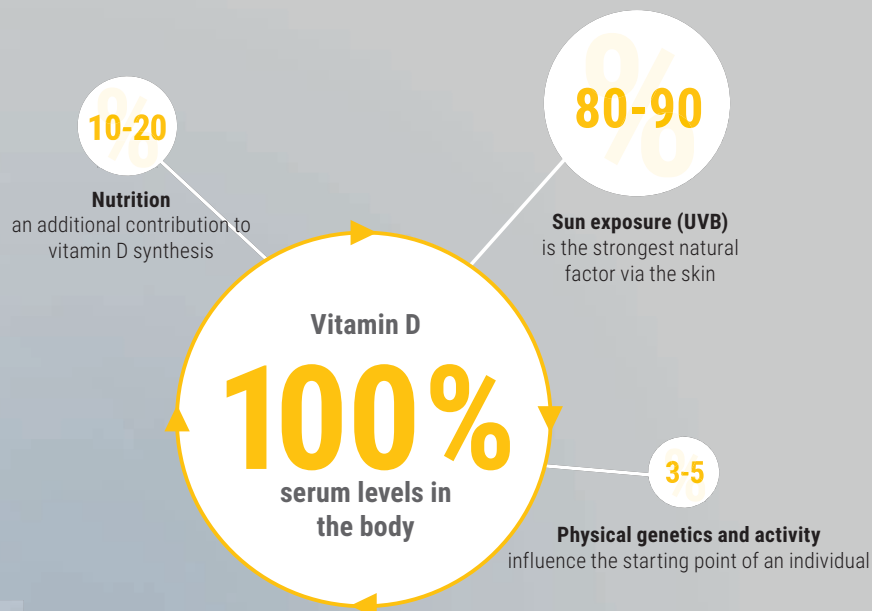
*Vitamin D is essential for bones, muscles and the immune system. UVB is its natural trigger – in practice, this is a combination of controlled dose, safe operating conditions and a meticulous balance.*

Dr Martin Schnaubelt, MD  
Internal medicine specialist,  
gastroenterologist,  
diabetologist and emergency physician

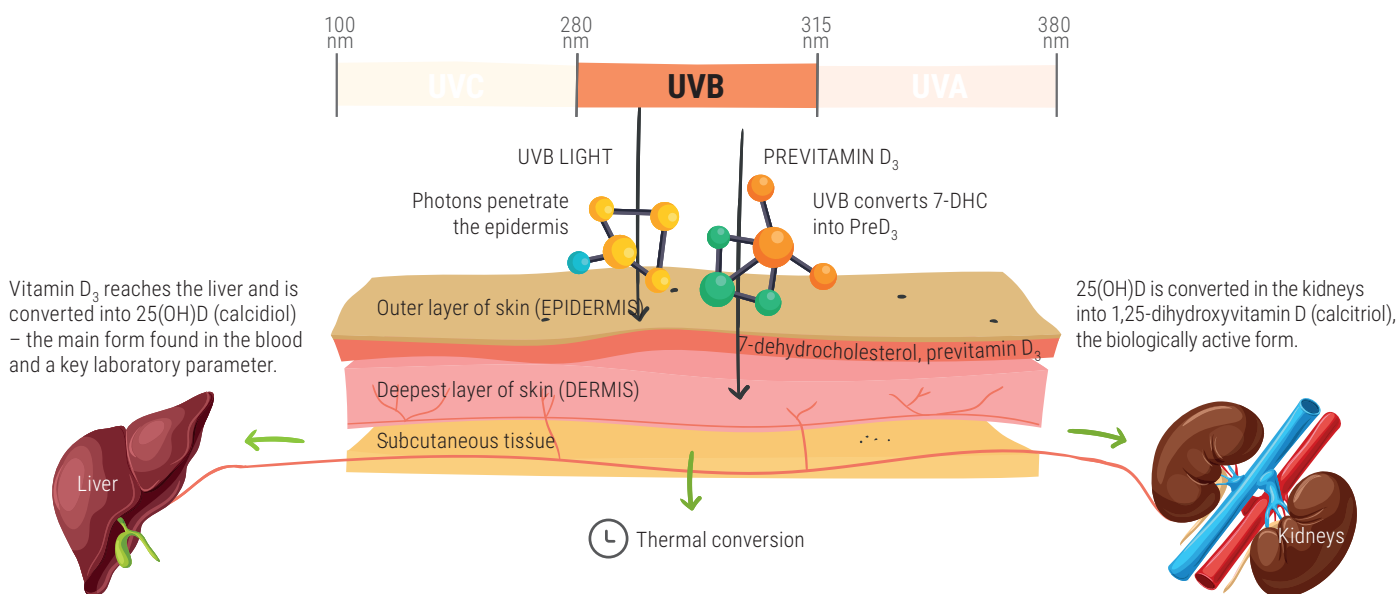
**Serum vitamin D levels depend on several factors – primarily UVB light, which is the most significant natural factor.**

Age, body fat, genetics, diet and dietary supplements are also factors here. UVB activates the body's own vitamin D synthesis directly in the skin and is therefore triggered with no active intervention. Contrary to dietary supplements, UVB is unlikely to exceed the dose of vitamin D, as the body naturally limits its production.

**Controlled, moderate exposure to UV light remains crucial.**

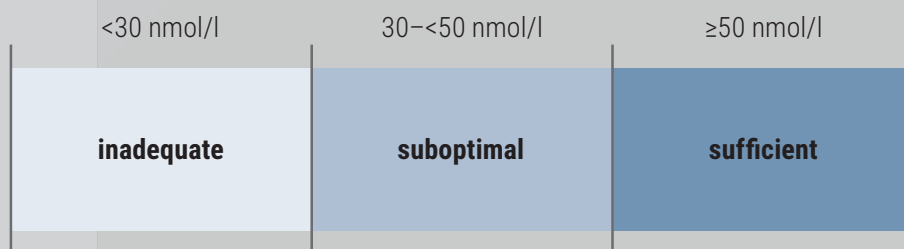


Our own illustration based on scientific literature on vitamin D synthesis and its influencing factors (including the NIH Office of Dietary Supplements and Holick 2007)



Based on insights into the natural cycle of activity and rest.

**Vitamin D status is determined by the 25-OH-D serum level.** Levels of approx. 30–50 ng/ml (75–125 nmol/l) are considered optimal. Globally, however, a large proportion of the population falls below this level – often below 20 ng/ml (50 nmol/l).



Based on recommendations from international professional bodies regarding vitamin D status (including the Endocrine Society, the Institute of Medicine and the Robert Koch Institute)



Dynamic lighting and controlled UVB pulses.

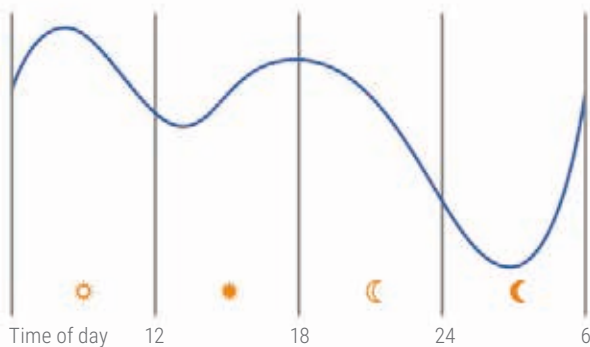
# A holistic approach An intelligent combination

**Light operates on multiple levels.** Light not only affects how we see. It also affects how we feel, the structure of our day and how we perceive indoor spaces.

**A viable lighting design takes two dimensions into account in a combined HCL and UVB solution:**

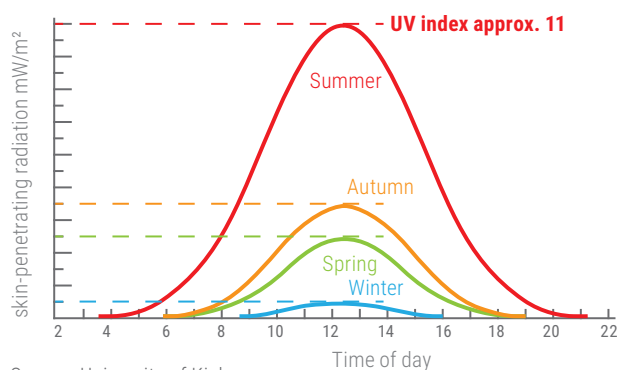
- » Temporal dynamics of light
- » Spectral supplementation of light

## Human performance levels



**Human centric lighting (HCL)** brings the natural rhythm of the day into indoor spaces, thereby boosting the *natural energy levels at different times of day* – from feeling energised in the morning to relaxing in the evening.

## Intensity of UV radiation in Germany



Source: University of Kiel

However, **UVB radiation** – a prerequisite for the body's own vitamin D synthesis – is highly dependent on the season and time of day in Germany and is virtually unavailable in winter; furthermore, this component is almost entirely filtered out behind glass.

Schematic representation based on chronobiological findings

## A new level of interior lighting

The quality of the light is increasingly becoming a differentiating factor. The combination of human centric lighting and controlled UVB technology represents:

- » Visual quality
- » Biological efficacy
- » Technical safety
- » Planning integration
- » Spectral supplementation of light

## Both follow the same principle:

Interior spaces should not only be functional but should also create tangible added value for humans. The combination of HCL and UVB enables us to plan holistic, future-proof light quality – particularly where indoor spaces shape everyday life.

### Daily structure



Promotes a clear circadian rhythm through dynamic light progressions and carefully timed pulses.

### Ability to concentrate



Promotes alertness and attentiveness through stimulating light components in the morning and pleasant lighting conditions throughout the day.

### Sleep quality



Boosts temporal orientation through adapted lighting dynamics and improves natural resting phases in the evening.

### Well-being



Naturally structured lighting conditions enhance the quality of the space and improve the subjective perception of the room.

### Muscle function



A balanced vitamin D status is linked to vital muscle strength and physical stability.

### Immune system



Vitamin D plays a key role in the function of the immune system.

### Bone metabolism



UVB impulses stimulate the body's own vitamin D production – an important factor for calcium absorption and bone mineralisation.

### Performance



A clear daily progression of light can reduce phases of fatigue and ensure a balanced working atmosphere.

### Cardiovascular system



Positive effects on blood pressure and inflammatory markers. Boosts vascular function.

### Prevention that is suitable for everyday life



The effects happen "in passing". Even short periods can enhance well-being.

### Added value for users



Enhances new and existing buildings. Creates a unique selling point and employer attractiveness.

### Future-proof planning



Expands traditional lighting concepts to include biological aspects, while adding no complexity to building operations.

Based on scientific findings on the effects of light and vitamin D synthesis.

## Architecture assumes responsibility.

Buildings today are highly optimised – energetically, technically and economically. A combined HCL and UVB solution results in:

- » A scheduled daily structure within the room
- » A supplementation of absent natural light components
- » A modern, future-oriented positioning
- » Added value for users and operators
- » A natural lighting approach to support the modern human lifestyle

Holistic lighting solution integrated or supplemented in a modular design.

# The system solution

**Everything in one luminaire.** The combination of efficient LED technology, human centric lighting and an integrated lumiD<sup>3</sup> UVB module results in a highly effective luminaire. Ideal for new-build projects or comprehensive modernisations.



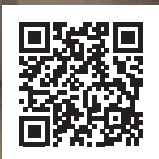
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*The tirabo combines a clean, architectural design with precise lighting technology, HCL and integrated UVB technology. The result is a lighting solution that shapes spaces and provides optimum support for people.*

Axel Lüdtké, Product Manager  
“tirabo” luminaire range  
Regiolux GmbH

## The tirabo combines all the advantages as an integrated solution:

- » Energy-efficient LED basic illumination
- » Dynamic HCL lighting control
- » Integrated UVB technology
- » Coordinated safety mechanisms
- » Maximum planning freedom
- » Targeted retrofitting
- » Project-specific customisation
- » Integration into the existing lighting architecture
- » Flexible control using existing systems



[www.regiolux.de/de/tirabo](http://www.regiolux.de/de/tirabo)

\* AI-generated image (for illustrative purposes only; actual product may vary)

## Planning recommendations for single or double workstations:



Individual workstation



Dual workstation

**The tirabo combines all the benefits of an integrated lighting solution and, at an installation height of 2.0 m, achieves equivalent illuminance levels of approximately 2 lx for a single or double workstation.**

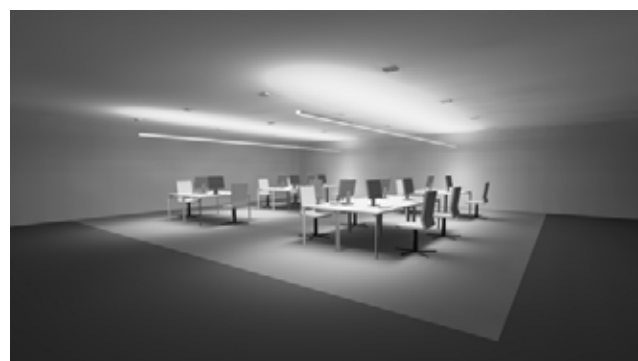
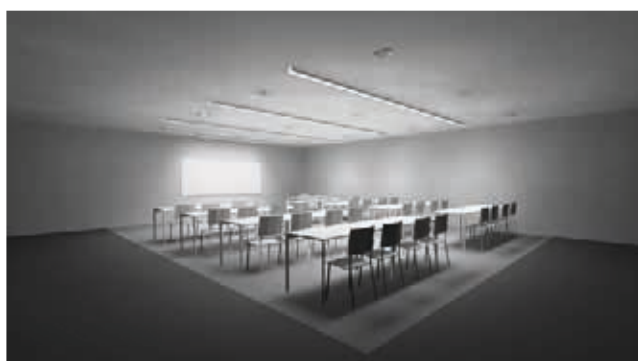
» **Em ≈ 2 lx** corresponds roughly to exposure to sunlight for approx. 8 minutes, 2–3 times a week in the midday summer sun of Central Europe.

Em approx. 4 lx: Maximum recommended average illuminance at the working plane





### Planning recommendations for large-scale lighting:



**Depending on the intensity of the light, the UVB exposure is roughly equivalent to brief periods spent in the midday summer sun in Central Europe.**

- » **Em ≈ 4 lx** is equivalent to approx. 16 minutes, 2–3 times a week (maximum recommendation)
- » **Em ≈ 2 lx** is equivalent to approx. 8 minutes, 2–3 times a week
- » **Em ≈ 1 lx** is equivalent to approx. 4 minutes, 2–3 times a week

Reference: A walk in the midday sun in summer (Central Europe)  
Em = average illuminance at the working plane



Not every project starts from scratch.

# LumiD<sup>3</sup> as a supplement

UVB supplementation can be implemented independently of the basic illumination. The UVB module LumiD<sup>3</sup> is therefore also available as a standalone emitter.

As an optimal supplement to your lighting, the LumiD<sup>3</sup> UVB module may be:

- » Used as a recessed or surface-mounted version
- » Used in combination with existing HCL luminaires
- » Flexibly integrated into various spatial concepts
- » Coordinated and optionally controlled on a seasonal basis
- » Controllable lighting profiles
- » The surface-mounted housing is also suitable for installation in a rough-cast ceiling – cut-out openings are provided on the front of the housing.



Label for  
rocker switch



|                         |                                                                                                                                                                                                                                                                          |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RG0 at 50 cm            | The UVB emitters operate in the RG0 range in a typical recessed ceiling installation (2.8 m ceiling height, 0.75 m working level).                                                                                                                                       |
| Planning objective RG 1 | All UV-B solutions are designed so that risk group 1 is not exceeded even in the event of an undesirable proximity to within 30 cm.                                                                                                                                      |
| Safety features         | 8-hour timer: Automatic switch-off after daily dose<br>Proximity sensor: Deactivated at <10 cm<br>Overheating protection<br>DALI control (timer remains active)<br>ON/OFF control (timers are reset)<br>Seasonal usage profiles (optional or as indicated by the client) |



Built-in module

PRACTICAL  
DETAILS

# Light quality redefined.

**Regiolux combines** visual excellence, energy efficiency and health-boosting light pulses in a holistic system approach.



## EPD for tirabo-TRHINB/1800 UVB LED:

- ✓ All the environmental data at a glance
- ✓ All product data available digitally
- ✓ Planning reliability for BIM, PIM and tendering

### What distinguishes human centric lighting from conventional LED lighting?

- » Conventional lighting is primarily focused on brightness and energy efficiency. Human centric lighting also takes into account the spectrum, light levels over the day and the vertical luminance at the eye. The aim is to achieve an effective combination of the visual and biological effects of light.

### For which applications is the combination of HCL and UVB particularly suitable?

- » Wherever people spend long periods indoors during the day, e.g. in office and administrative buildings, educational institutions and care and nursing facilities, particularly where there are low levels of daylight.

### Is the user required to actively intervene?

- » No. The lighting profiles and UVB pulses are controlled automatically and designed for efficient daily operation.

### How is HCL planned professionally?

- » Vertical luminance, spectrum and temporal lighting profiles are crucial. International recommendations also take melanopic luminance into account when evaluating non-visual light effects.

### What is the role of the EN 12464-1 standard?

- » The standard contains guidance on non-visual lighting effects. HCL concepts expand traditional visual light planning to include these aspects.

### Can the solution be integrated into Relux or DIALux?

- » Yes. IES and LDT files are available for the luminaires and modules. This facilitates standard-compliant design work in Relux or Dialux.

The following equivalence approach applies to your planning:  
Lumen/m<sup>2</sup> Ev (illuminance in lux) is equivalent to mW/m<sup>2</sup> Ee (irradiance in mW/m<sup>2</sup>) for UVB planning, which makes it simple and reliable to use.

### Can I produce too much vitamin D?

- » No. The skin itself regulates vitamin D production, therefore an oversupply via UVB light is not possible. This distinguishes the UVB approach from dietary supplements, where it is possible to exceed the recommended dose.

### Is exposure to UVB safe?

- » Yes. The daily UVB dose is limited by defined operating times; an integrated distance sensor additionally ensures controlled application.

### How is UVB evaluated technically?

- » The standard erythema dose (SED) is used to classify radiation that affects the skin. It serves as a reference value for a comprehensible technical design.

### Is this a medical device?

- » No. It is a lighting solution for work and leisure areas. It does not replace medical treatment and serves no therapeutic purpose.

### What is the scientific basis for UVB and vitamin D?

- » UVB radiation in the range of approximately 280–315 nm triggers the production of vitamin D in the skin. This mechanism has been scientifically proven for decades.

### Why does human centric lighting have a biological effect?

- » Specialised ipRGCs (intrinsic photoreceptor ganglion cells) in the eye respond to specific spectral components of light. These influence alertness and circadian synchronisation, among others.

### When are effects measurable?

- » Studies show that regular, low-dose exposure to UVB over several weeks can produce positive changes in vitamin D levels. This does not constitute an individual guarantee of efficacy.



PDF

Regiolux @ Social Media



### Image index

|                |                                                                                        |
|----------------|----------------------------------------------------------------------------------------|
| pages 3–5      | .....Freepik                                                                           |
| pages 6, 7, 12 | .....Regiolux GmbH                                                                     |
| pages 13–14    | .....* AI-generated image<br>(for illustrative purposes only; actual product may vary) |

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