

# licht.wissen 06

Shop Lighting – Attractive and Efficient



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# Editorial

Lighting plays a key role in making shopping a sensory experience. It performs a number of tasks, from facilitating orientation through accentuating displays to presenting merchandise in a suitable light. Given its capacity for dramatic effect, artificial lighting is an exceptionally effective instrument for boosting sales performance – not only for individual retail outlets but also for shopping malls and department store salesrooms. Light creates atmosphere, directs attention to merchandise, supports customer guidance systems and underlines brand image. Lighting that is harmoniously integrated into the overall design of a store actively attracts shoppers into the premises. Light also helps remove certain entry barriers, extends the shopper's length of stay in a store and stimulates consumer activity.

However, lighting is also a major operating cost for a retailer, accounting for 25 percent of total energy costs in the food trade and no less than 62 percent in the non-food trade. Hence the increased demand for (energy-)efficient lighting solutions – because energy is going to be a scarce and costly commodity in the long term. So there are two reasons to optimise energy input: to conserve available resources and minimise climate-relevant impacts, on the one hand, and to lower energy costs for a good business result, on the other.

Sustainability is developing into a core issue for our society. People are becoming increasingly aware of their social and environmental responsibility. That awareness is fostered not only by reports of natural and environmental catastrophes and rising energy prices but also by an appreciation that the Earth's natural resources are finite. The term "sustainability" comes originally from forestry, where it means managing resources so that the forest can regenerate naturally and retain its essential characteristics. Applied to business activity, it means the need for an enterprise to meet environmental challenges while also taking account of economic and social aspects. Because of the growing call for sustainable corporate management from society and consumers, its implementation ensures long-term economic success.

But a coat of green paint is not enough. To meet customer expectations of credibility and sustainable development, companies need to position themselves as prudent, resource-saving actors. Energy-efficient operation is only one facet of the drive for sustainability but it is an area where ecology and economy can be reconciled particularly well. So it is not surprising that numerous energy-efficiency, pro-environment and climate protection projects have already been launched across the wholesale and retail trade – and that minimising energy consumption for lighting figures prominently among them.

*Rakita*

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[Cover] Shop lighting presents major challenges for the lighting designer. Simulations and renderings are a big help.

[01] Light is an important tool in shop design. It helps make shopping a sensory experience.



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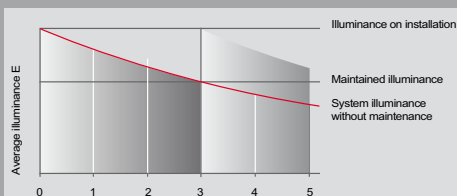


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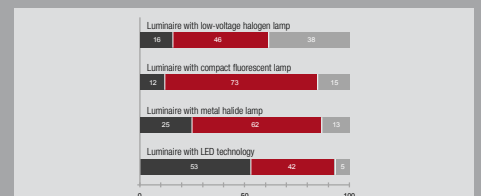
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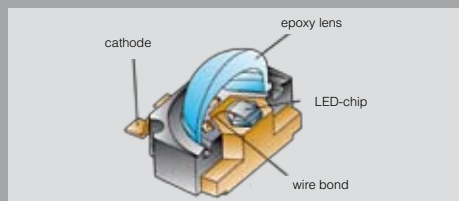
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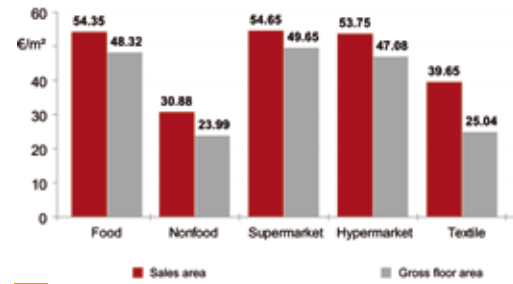
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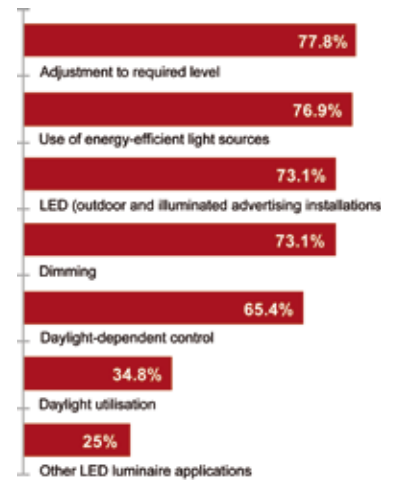


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Source: EHI Retail Institute



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Source: EHI Retail Institute

# Setting the stage and energy efficiency

Lighting dramaturgy – lighting for dramatic composition – is a major tool for sales promotion and thus an important factor to consider when selecting luminaires, light sources and lighting control facilities. Another, equally important criterion is the energy efficiency of the system as a whole – it is a vital requirement for economic efficiency and success.

The primary purpose of shop lighting design is always to enhance the sensory shopping experience. This applies as much to a full-range department store as to an upmarket boutique, an exclusive delicatessen store or a cool handy shop. One of the most important tools for addressing this task is lighting dramaturgy. Light sources, with their diverse characteristics such as light colour and colour rendering, contrast capacity and light distribution, play a particularly important role in determining how the atmosphere of the room impacts on the customer – making a cool impression in a high tech store, casting garments or leather goods in a warmer light, striking a note of sophistication with elegant white or energising the scene with dynamic colour effects.

So to develop a seductive impact, a lighting solution needs to be precisely tailored to suit the ambience and the merchandise for which the stage is set. At the same time, account needs to be taken of individual store and marketing concepts as well as any sectoral lighting requirements. These criteria influence the choice of luminaires, light sources and lighting control facilities as well as their intended purpose, which can range from swift orientation through highlighting to setting the scene.

## Energy efficiency advancing

Just as important as this "emotional" side of a lighting concept are the "rational" aspects of its design, especially energy efficient operation and low maintenance. This is because operating costs have a fundamental impact on a shop's economic performance.

Energy efficiency is the ratio of energy input to ultimate benefit, i.e. the less energy is needed to deliver the same light, the greater the energy efficiency of the system. Energy-saving lamps are propagated

as a universal remedy but switching from conventional luminaires and lamps alone does not exhaust the potential for saving energy. Consideration needs to be given to the system as a whole, comprised of luminaire, light source, operating gear and lighting control facilities.

## Experience counts

To ensure an energy-efficient lighting solution, it is advisable to select luminaires with a high light output ratio, lamps or high-quality LEDs with a low power consumption rating and an intelligent lighting management system that can not only create great scenarios but also reduce energy consumption by dimming. However, efficiency depends to a large extent on how skilfully the components are integrated into the system as a whole.

That interaction calls for intelligent design as well as the ideas and experience of lighting planners or designers. These are crucial to ensuring both maximum lighting quality and energy efficiency. Retail lighting design is a dual challenge. It entails not only creating a sales-promoting dramaturgy, i.e. deciding what kind of light is needed in which part of the store to address the various tasks presented, but also – and equally importantly – weighing up the relevant parameters to define the technical qualities of the lighting required as well as analysing the life cycle costs – the total investment and operating costs – of the lighting installation.

Only when all these tasks are accomplished can the way be paved and the economic foundations laid for a successful retail operation.

[02 - 04] To develop a seductive impact, a lighting solution needs to be precisely tailored to the ambience and the merchandise for which the stage is set.

[05] Annual energy costs for electricity, gas, heating oil, etc. by sector; figures for 2010, in euro/m<sup>2</sup>.

[06] Increasing the efficiency of lighting: most widely implemented measures in 2010.

# Corporate lighting, lighting for brand merchandise

As an intangible and versatile design element, light is an excellent vehicle for communicating brand messages. Harnessed in solutions specifically designed for the purpose, the "fourth dimension of architecture" becomes an integral part of brand identity.

Brands provide bearings in the world of merchandise. The systematic communication of brand messages paves the way for sustainable sales success. But brand perception is significantly influenced by the point of sale experience. Salesroom design – and thus lighting as the "fourth dimension" of architecture – forms an integral part of brand identity: corporate design is supplemented by a similarly distinctive lighting concept.

## Corporate lighting and scenography

Successful "corporate lighting" concepts stand on two footings. Firstly, they rely on lighting moods and lighting effects with brand associations, the crafting of which is a complex task for which it is advisable to enlist the services of a professional lighting designer. Secondly, they are based on a selection of luminaires that convey the relevant brand image through their design. Lighting tasks can generally be addressed in a number of ways, and the appearance of the solutions can contrast sharply: integrative installations with lighting tools incorporated in the ceiling on the one hand, additive solutions on the other. Favourites here – power track systems with spots and individual luminaires such as standalone or pendant luminaires – make a positive statement that is shaped by the design of the products.

Salesrooms today are designed to focus consumer attention on the shopping or brand experience. To do so, they use scenographic tools to shape shop contents and themes into a coherent dramaturgy. One of those tools is light, an intangible medium that allows space to be restructured and redesigned time and again.

## Functional versatility

Shop lighting performs a whole range of functions:

- It attracts attention to light advertising elements, shop windows and entrance areas.
- It structures the salesroom into function zones, creates perceptual hierarchies and highlights routes.
- It optimises product presentation and sets the stage for special displays.
- It ensures that the customer feels good and – especially in fashion and cosmetic stores – looks good.
- It provides a vehicle for expressing brand content and value through identity-heightening "corporate lighting" and for creating the right atmosphere to emphasise seasonal themes such as changes of collection in the fashion industry.

Both cyclical changes like that and the task of addressing consumer emotions are applications for dynamic lighting, which acts as a spatial, temporal and atmospheric design tool. Lighting control allows a sales floor, for example, to be divided into different zones by brightness levels programmed to create specific light scenes. Coloured lighting is also part of the toolbox, its applications ranging from the subtle to the dramatic – from the pastel-shaded backdrop of a shop window to vivid beams of accentuating coloured light. Thanks to its sheer versatility, light can thus literally bring brand merchandise to life.

[07] Brand perception is significantly influenced by the point-of-sale experience.

[08] Salesroom design – including lighting as the "fourth dimension" of architecture – is an integral part of brand identity.

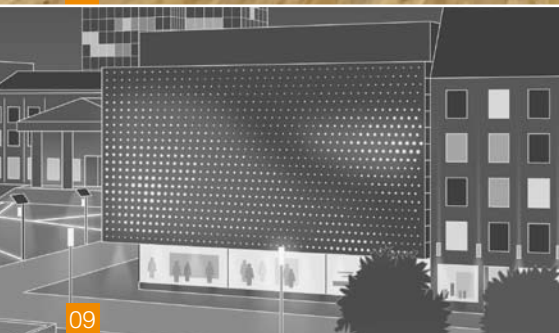
[10] The image of a shop or shopping mall is partially defined by the visual impact of the illuminated entrance.





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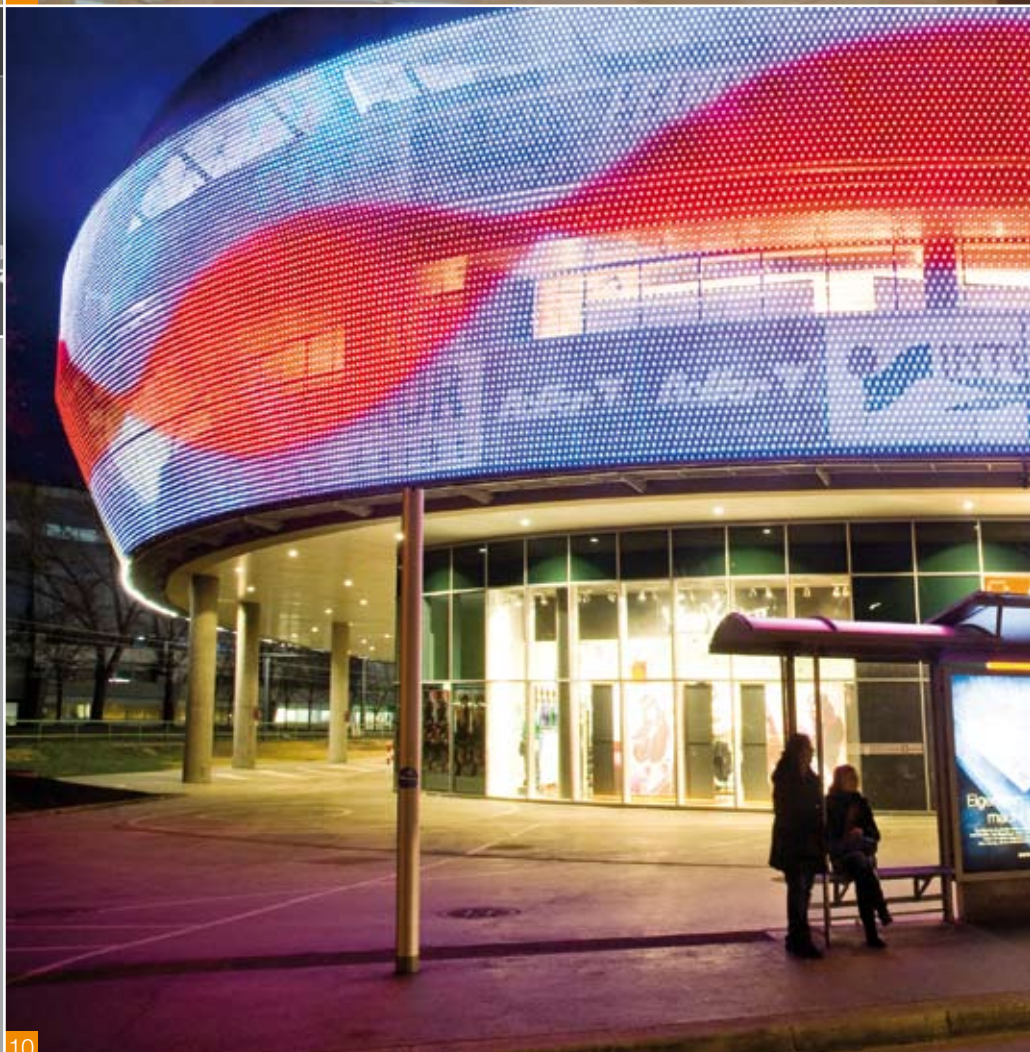
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## LED facade lighting

Visual impact at night [09]: Artificial lighting shapes the face of our cities at night – not only in back-lit messages, logos, XXL posters, etc., but also by illuminating facades. Effective facade and building lighting plays an important role in the corporate lighting concepts of the retail trade; it sends out a long-range signal and lends visual emphasis to the architecture of the building. A building may, for example, radiate light from within through a transparent shell or may be externally illuminated to highlight decorative facade elements, a building axis, window reveals, etc.. Luminaires for outdoor use need to be impervious to wind and weather and must thus be specially designed to guarantee effective protection against dust and moisture, for example, as well as UV resistance and thermal stability. Because the outer shell of a tall building generally presents access problems that make lamp replacement a costly operation, the light sources used should have a long rated life. So it is not surprising that LEDs are increasingly superseding neon lighting and other conventional lamps as the light source of choice for facade illumination.



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# Parking facility, facade and entrance lighting

At night, the appearance of the outdoor space that forms the context of a retail store or shopping mall strikes a magical note. Differentiated lighting solutions underline the character of buildings and their entrances and thus combine to create a unique lighting dramaturgy for the urban environment.

Since the triumphant march of the neon sign at the beginning of the 20th century, illuminated advertising and lighting effects have been an integral part of the nocturnal face of the city. Apart from classical, eye-catching illuminated signs, facade and building lighting plays an increasingly important role here. Emblematic architecture is used to direct consumer attention to stores and commercial offers on busy downtown streets or to draw visitors from afar across the anonymous space of a business park. There are two options here. Firstly, architecture can be illuminated from inside through a transparent building shell – a solution popular for shop windows and interiors close to facades. Secondly, solid or opaque facades can be illuminated in a range of ways by exterior luminaires – lending subtle emphasis to architectural details or making a dramatic statement with dynamic, colourful event lighting.

## Highly differentiated

Vertical surfaces in the urban environment play a major role in shaping squares, streets and buildings. For psychological and aesthetic reasons, facade lighting is an important element of urban night-time lighting. Different types of facade require tailored lighting concepts to emphasise the qualities of their architecture. Just as

buildings look different in daylight, differentiated lighting solutions can be developed to craft a distinctive appearance at night. As a matter of principle, opaque facades need to be treated differently from transparent buildings. Apart from planar illumination of solid facades, there is also the option of accentuating the contours of the building or of individual structural components. With glass architecture, however, the impression of a gleaming core can be created by illuminating specific surfaces inside the building. During the day, the interior of such buildings is hidden from view by reflections on the glass due to the high illuminance of daylight. At night, however, transparent buildings gain depth as a result of the visible dimensions of their interior space. With lighting control, programmed scenes can be automatically created to cast facades in the desired light in response to photoelectric sensors or timers.

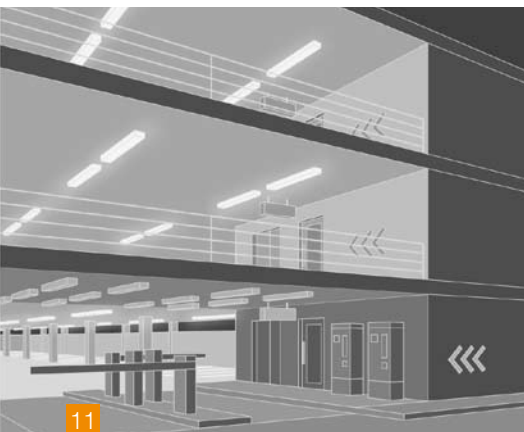
## Calling card

Entrances – which are the calling card of a building at night – also merit attention. As well as highlighting architectural elements or guidance systems, lighting can be used here as either a primary or secondary tool for creating atmosphere and facilitating orientation. The simplest way to harness

light for visitor guidance is to ensure a higher level of lighting at the entrance than in the adjoining parts of the building. A carpet of light outside an entrance extends a welcoming invitation to visitors. Additional diffuse lighting, e.g. provided by wallwashers, lightens shadows on faces and thus creates an agreeable basis for communication at the door. Glancing light can be used to set dramatic accents. Route and step lights make for safety on the approach.

[12] Windows bathed in coloured light make the store an eye-catching sight at night.

[14] The vibrancy of the interior lighting is carried outside by large floor-to-ceiling windows, lending the store a magnetic attraction.



## Outdoor and indoor parking facility lighting

Road safety first [11, 13]: Accessing shopping streets necessitates indoor and outdoor parking. Here, because moving and parking vehicles encounter both pedestrians and cyclists, road safety has priority. As traffic loads increase, so too does the risk of accidents. That rising risk is countered by tailored, dark-zone-bridging lighting, which additionally facilitates orientation and recognition of vehicles, persons, boundaries and obstacles. Lighting also gives users a greater sense of security and guards against crime. The requirements for outdoor parking facility lighting are met by column luminaires with high-precision light-controlling optics. Metal halide lamps or LED modules – with electronic operating gear – make for an economically efficient lighting installation. Adequate brightness inside indoor parking facilities is provided by T26 or T16 fluorescent lamps; electronic ballasts ensure energy-efficient operation, which can be enhanced even more in multi-storey car parks by daylight-dependent lighting regulation.



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# Showcase lighting for shop windows

A shop window establishes a link between a store and passers-by in the street. Its fascination is based to a large extent on tailored lighting that can be quickly and easily adapted to meet the needs of frequent changes of window dressing.

Eye-catching light accents, marked contrasts, calculated use of light and shade, deliberate choice of light colours – these are characteristic features of high-quality shop lighting. They are also the criteria for shop window lighting, where the challenge lies in attracting the attention of passers-by not only at night but also during the day in bright sunlight. This calls for different levels of illuminance. Shop window lighting design also needs to take account of the brightness of surrounding areas, e.g. that of the next shop window, as well as reflections of passing traffic or facing buildings that could be a source of visual interference.

## Effective and flexible

Brightness contrasts turn viewing light into display light, making merchandise stand out from its surroundings and directing the eyes of passers-by to it.

Simultaneous foreground and background lighting makes for different levels of perception and thus emphasises the depth of the shop window. For these lighting tasks, power track systems have proven a popular and flexible lighting tool. The spots can be quickly and easily mounted – usually without tools – at any point on the track and repositioned as required. They are normally swivel mounted to permit different angle settings and can be fitted with filters for special lighting effects. These luminaires – which also make a design statement – thus provide an ideal basis for the precise illumination and showcasing of any new display. Spots additionally demonstrate their strengths in "modelling" shop window dummies with light by accentuating the figures from above, from below and from the side. Today, LED media walls are used to provide a background design for large shop windows but stage technology is

also harnessed for the purpose. Coloured light and projections as well as dynamic lighting sequences open a wide range of possibilities for generating attention and atmosphere.

[15] Calculated use of light and shade brings a shop window to life.

[16] Brightly lit, the shop window stands out clearly from its surroundings.

[17, 19] Power track systems have proven a flexible lighting tool for shop windows because the spots can be quickly and easily mounted at any point on the track and repositioned as required.



## Light colour in shop windows

Daylight [18]: Daylight changes during the course of the day, from very warm tones in the morning and evening to cool tones around 6,500K at mid-day. This very high colour temperature is found perfectly agreeable as long as we are outdoors. Indoors, however, warmer colour temperatures between 2,700K and 4,250K are preferred. The choice depends ultimately on the merchandise displayed and the nature of the presentation. Cool light colours over 4,000K suggest freshness and dynamism, warm light around 3,000K makes for brilliant colours and at 2,700K creates a cosy atmosphere.



# Lighting Special: Lighting terminology

The terms 'lamp' and 'light' are often confused. Lights are what the industry today calls luminaires but they are frequently referred to in common parlance as "lamps". A lamp is actually only the light source, i.e. the fitment that emits light inside a luminaire. Other terms used in lighting are also improperly understood. The following definitions shine light into the "darkness".

## Basic lighting variables

**Luminous flux  $\Phi$**  is the total power or quantity of visible light radiated in all directions by a light source. Measured in lumen (lm), luminous flux takes account of the brightness sensitivity of the human eye.

**Luminous efficacy  $\eta$**  indicates how much luminous flux a light source generates from the electricity it consumes and is thus a measure of light source efficiency. The unit of measurement is lm/W. Any comparison of luminaires on the basis of lm/W also needs to take account of ballast losses.

**Luminous intensity I**, measured in candela (cd), is the amount of luminous flux radiating in a particular direction and is defined as luminous flux per solid angle. It is significantly influenced by optical control elements such as reflectors. The radiant characteristics of a luminaire are illustrated by an intensity distribution curve (IDC).

**Luminance L** is the brightness of a luminous or illuminated surface as perceived by the human eye. The unit of measure-

ment candela per square metre ( $\text{cd/m}^2$ ) indicates the degree of luminous intensity over a defined area of that surface. The luminance of an illuminated surface depends to a large extent on its reflectance.

**Illuminance E** indicates how much luminous flux from a light source falls on a given surface. Expressed in lux (lx), this variable is used for dimensioning interior lighting; standard values for different applications are set out in DIN EN 12464 Parts 1 and 2 "Light and lighting – Lighting for indoor and outdoor work places".

## Reflectance

Reflectance  $\rho$  – which depends on colour and surface finish – indicates how much of the luminous flux that strikes a surface is reflected. The brighter and/or smoother the surface, the greater the reflectance and the brighter the surroundings as a result. With white walls and ceilings, reflectance can be as high as 90 percent.

## Glare

Glare reduces visual performance and visual comfort and can thus impair visibility. Direct glare is caused by luminaires or by very bright daylight. Glare can also be caused indirectly by light reflecting from shiny surfaces. In luminaires, light sources are shielded along lines of sight.

## Light colours

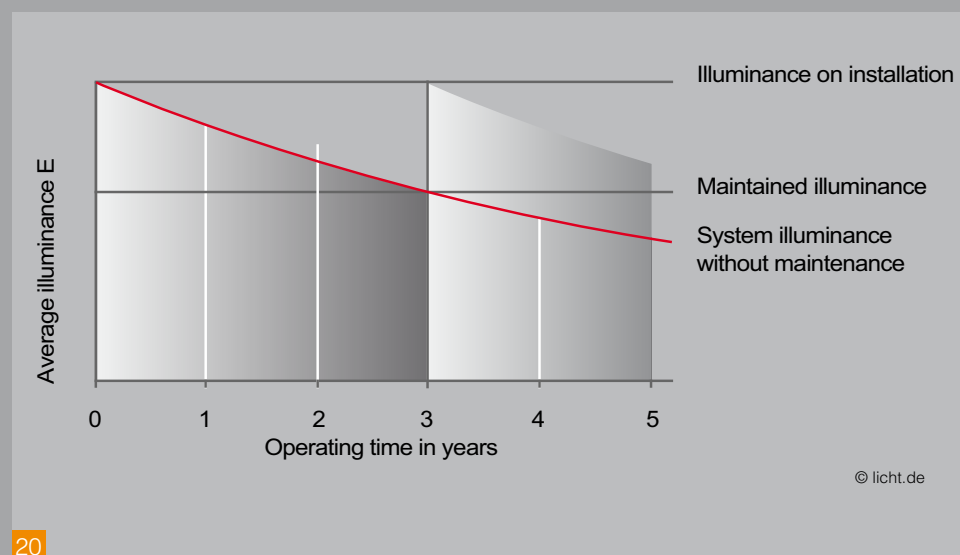
The light colour of a light source determines the atmosphere in a room. The defining variable is the colour temperature of the artificial light source, expressed in kelvin (K). Low temperatures make for warm lighting, higher ones for a cooler ambience. The most widely used light colours are warm white (below 3,300K), neutral white (3,300 to 5,300K) and daylight white (over 5,300K). Warm white light is predominantly used to emphasise reds and yellows. Blues and greens are accentuated at higher temperatures.

## Colour rendering

The colour rendering index  $R_a$  indicates how accurately colours are rendered by artificial lighting. Under the light of a lamp with a  $R_a$  rating of 100, all colours look perfectly natural. Colour rendering index depends largely on the spectral composition of the artificial light, i.e. on the type and quality of the light source. Halogen lamps have the best  $R_a$  rating of all (100); metal halide lamps, fluorescent lamps and energy-saving lamps achieve very good ratings between 80 and 90.

## Maintained illuminance

Maintained illuminance is the average illuminance that needs to be maintained as a minimum at all times. During the life of a lighting installation, illuminance



decreases due to ageing and soiling of lamps, luminaires and room surfaces. To compensate for that decrease, new lighting installations need to be designed for a higher illuminance value (value on installation). The lighting designer takes account of the decrease in illuminance by applying a maintenance factor:

$$\text{maintained illuminance} = \text{maintenance factor} \times \text{value on installation}$$

### Maintenance factor

The maintenance factor MF is defined as the ratio of maintained illuminance to the value on installation and is the product of four factors: lamp lumen maintenance factor (LLMF), lamp survival factor (LSF), luminaire maintenance factor (LMF) and room surface maintenance factor (RMF). According to CIE 97:2005, a maintenance factor of 0.7 should be applied to lighting installations in rooms subject to normal accumulation of dirt. However, the issue of maintenance factors is not relevant in a retail environment because the illuminance values found in shops are generally much higher than those required by standards. Even so, lighting system maintenance also plays an important role here.

### Light output ratio

Light output ratio is defined in DIN EN 13032-2 "Measurement and presentation of photometric data of lamps and luminaires – Part 2: Presentation of data for indoor and outdoor work places" as the ratio of the radiant luminous flux of a luminaire to the luminous flux of the fitted lamps. In the case of direct/indirect luminaires, the components "Down Light Output Ratio" (DLOR) and "Upper Light Output Ratio" (ULOR) are also specified, permitting identification of the distribution of a luminaire's radiant luminous flux in the lower and upper segments.

### CE mark

The CE mark – the acronym stands for "Communauté Européenne" (European Community) – is a condition for placing products in the single market of the European Union. It is applied by manufacturers and importers on their own responsibility

– i.e. without verification by a neutral testing agency – to certify that their products meet the "essential requirements" of relevant European directives and standards.

### ENEC/VDE test mark










The ENEC mark – EN for European Norms, EC for Electrical Certification – is the European approval mark for luminaires. In Germany, it is awarded in conjunction with the VDE symbol.

Where products display the VDE/ENEC symbols, they can be assumed to conform to the current state of the art and thus meet the requirements of the German Equipment and Product Safety Act (GPSG). The numeral following the ENEC mark is a key to the name and location of the certification institute. As well as inspecting products, VDE engineers also monitor production.

### GS mark

The GS mark shows that a product conforms to the German Equipment and Product Safety Act (GPSG) and the relevant EU directive. Awarded by authorised certification agencies, it is based on product safety testing and an assessment of whether operating instructions are clear and complete. The GS symbol may be used only in conjunction with the logo of the certifying body (e.g. VDE, TÜV). Control audits are conducted to maintain certification. These may involve monitoring production facilities or checking product modifications against the unit tested.

### Degrees of protection

Code numerals	1st code numeral: Protection against foreign bodies and contact	2nd code numeral: Protection against water
0	non-protected	non-protected 
1	protected against solid foreign bodies > 50 mm	protected against dripping water 
2	protected against solid foreign bodies > 12 mm	protected against dripping water when 15° tilted 
3	protected against solid foreign bodies > 2.5 mm	protected against spraywater 
4	protected against solid foreign bodies > 1 mm	protected against splashwater 
5	protected against dust 	protected against jets of water
6	dustproof 	protected against powerful jets of water
7	–	protected against temporary immersion 
8	–	protected against prolonged submersion 

The degree of protection assigned to items of electrical equipment such as luminaires indicates their suitability for use in different environmental conditions (see table). The IP code (Ingress Protection) consists of two numerals: the first refers to protection against solid foreign bodies and particles, the second indicates the degree of protection against water and moisture. For example: IP44 identifies a luminaire protected against solid foreign bodies larger than 1 mm and against splashwater. A capital "X" in place of one of the two numerals means the degree of protection is not specified.

### Classes of protection

Classes of protection indicate how luminaires are protected against electrical shock (short circuit). In line with DIN EN 61140 (formerly DIN VDE 0140), electrical equipment is divided into three classes of protection and identified by different symbols according to the environmental conditions in which they are used and the measures taken to protect them. In a retail context, most of the luminaires used need to meet Class I requirements, i.e. be designed for connection to a line-side PE conductor.

More information and links on standards, test marks and safety are found at [www.licht.de](http://www.licht.de).

[20] Maintained illuminance is the local average illuminance at which system maintenance is required. Example: maintenance interval 3 years.



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### Lamps recommended for fresh food lighting



	Fresh and processed meats	Fish	Cheese	Fruit and vegetables	Bakery and confectionery products
<b>LED</b>					
Economy	● ● ●	● ● ●	● ● ●	● ●	● ● ●
Lighting quality	● ● ● ●	● ● ● ●	● ● ●	● ● ●	● ● ●
Product protection	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●
<b>Metal halide lamps</b>					
Economy	● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●
Lighting quality	● ●	● ● ● ●	● ● ●	● ● ●	● ● ●
Product protection	● ●	● ●	● ●	● ●	● ● ●
<b>High-pressure sodium vapour lamps</b>					
Economy	● ●	● ●	● ● ●	● ● ●	● ● ●
Lighting quality	● ● ● ●	● ● ●	● ● ● ●	● ● ● ●	● ● ● ●
Product protection	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●

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### Recommended light colours

Food lighting [21, 22, 23]: Food lighting needs to take account of more than just product sensitivity to heat or infrared (IR) and ultraviolet (UV) radiation; care must also be taken to ensure "appropriate" light colours. Fruit and vegetables come in a wide range of colours and call for a warm light colour and very good colour rendering. The freshness of red and white fish varieties is emphasised by warm-tone and cool lighting respectively. With meat and sausages, which have a high red content, the white of the fat content needs to remain visible. Filters perform this selective task. A warm light colour is right for yellow cheese, a cooler colour for white varieties, while a gold filter or reflector casts bakery products in a perfect light. Only cream cakes are an exception; they require a white light environment. LEDs are available in light colours precisely tailored to the lighting task – as well as being UV- and IR-free.



# Lighting for fresh foods

With food lighting, it is particularly important to emphasise the quality and freshness of the produce on display. The right lighting, carefully designed to render intrinsic colours accurately, ensures that the items on show look appetising. This is "honest" use of light, not "embellishment".

Product presentation in a food store is mainly about stressing the freshness of the products on sale. Their characteristic colours can be excellently emphasised by light, which is thus an important sales promotion tool. Light sources with a high colour rendering index and "appropriate" light colours ensure that the colours of products on display are rendered accurately and not distorted. At the same time, it is vital to take account of the specific characteristics of the foods themselves, e.g. their sensitivity to heat or to infrared (IR) and ultraviolet (UV) rays. Light sources with a high blue content, for example, deliver more high-energy radiation than those with more red in their spectrum. Apart from the use of filters, adjusting illuminance and exposure time can provide the safeguards needed for careful food management.

Consumers expect "honest" lighting and gladly return to shops where not only the quality and freshness of the food but also the atmosphere is right. A lighting scheme that makes food look better than it is, however, produces only short-lived profits. Because different product groups feature different ingredients, a differentiated approach to lighting is always required. The most widely used light sources are metal halide lamps, high-pressure sodium vapour lamps and LEDs, with fluorescent lamps used for additional lighting in counters and display cabinets.

## High requirements

But LED technology is making appreciable headway as a source of solutions for food store lighting. The advantages it offers – such as directional light in a virtually IR- and UV-free beam and light colours specially created for the different product groups – are rapidly driving semiconductor lighting forward in the fresh food sector. It particularly scores points for outstanding operational characteristics

in a cool environment, longevity with low loss of luminous flux and the sheer range of LED lighting design options. What is more, switching frequency has no impact on an LED's lifespan and luminous flux is delivered instantly on activation – so LED solutions can also be used for emergency lighting.

Thanks to these characteristics, LEDs are increasingly winning a place in the food sector. Apart from being used in refrigerated cabinets, e.g. for dairy products, packaged meats or cheese, they are literally predestined for the task of casting fruit, vegetables and bakery products in an appetising light. Here, particular light colours are showing their potential. The red tones of meat and sausages are emphasised but the white of the fat content still remains visible. Bread and bread rolls look great in oven-fresh gold light and fresh fish on a bed of glittering ice becomes the star of the show in deep-freeze cold white.

## Potential of LED light

High-pressure sodium vapour lamps are the light source of choice today for bakery as well as fresh and processed meat lighting. But the future belongs to LED modules specifically designed to cater for the different foods.

Thanks to new salesroom lighting solutions with tailored brightness distribution curves, the illuminance in counters and on rear wall shelves can be reduced by 15 to 20 percent. In such cases, light is efficiently directed onto vertical product space, leaving a need for only low-level lighting on horizontal surfaces. Higher contrasts give presented products a considerably more attractive appearance, so the accentuated shelf lighting perfectly partners the efficient LED lighting in counters. The resulting high-contrast lighting solution can cut energy consumption by around 40 percent.

Because of the greater distance between luminaire and product, the LED solutions available at present cannot yet replace the high-pressure sodium vapour lamps used to illuminate meat freezers. However, there is an alternative that is almost 50 percent more energy-efficient: the metal halide lamp with ceramic burner, spectral colour correction filter and UV/IR protection.

## Promising route

LED solutions for fresh food counters not only take account of the heat and light sensitivity of the different products; they also prevent processed meats from turning grey and cheese from sweating – so they minimise product loss. What is more, because LED luminaires generate less heat than conventional lamps, the energy required for closed-system cooling can be significantly reduced. This lowers operating costs and makes a contribution to climate protection and sustainability. LED systems thus offer all-round benefits, so the higher initial outlay is fairly quickly recouped.



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# Supermarket lighting

Foodstuffs are not the only everyday products that need to be attractively presented in a supermarket. In the drive for energy efficiency and sustainability, "energy-reduced" lighting concepts and LED solutions are increasingly making a mark.

Supermarkets play a key role in meeting local demand for food and beverages, most of them also carrying drugstore articles and other everyday commodities. Factors of competition are not just range, product quality and service but also a welcoming atmosphere for shoppers. Special accents are set here by fresh food sections displaying fruit and vegetables as well as service counters for cheese, fresh and processed meats, fish and delicatessen products. But self-service cold shelves stocked with milk, dairy products and pre-packed fresh foods as well as freezer cabinets and islands should also be attractively presented. The aim, therefore, is to cast all these different shop areas in an appetising light.

However, instead of raising lighting levels ever higher and making stores brighter than their competitors, many supermarket operators are currently doing the opposite. Sustainability programmes have been launched at many stores, focusing on responsible product range management as well as economical use of energy and resources. And with more energy efficient lighting solutions, connected loads can actually be reduced by half.

The way to lower energy consumption is paved by switching from general lighting

to accentuating product presentation and by the advent of LED systems for freezer cabinet and product counter lighting. The pre-wired systems with coordinated components – i.e. LED modules, mounting plates, lenses and converters – are specially designed to cater to the needs of food stores and supermarkets.

## Effective showcasing

The "shop in shop" principle is increasingly being adopted for wine, drugstore, fruit and vegetable, household, textile and footwear sections as well as for freezer cabinets and islands, self-service processed meat cases and even service counters. This calls for lighting that is always specifically tailored to the relevant store arrangement.

For accentuated product presentation, the continuous rows of luminaires are positioned parallel to shelves. Light is thus cast only where it is really needed: merchandise is brightly illuminated, aisles and circulation areas retreat into the background. Light distribution tailored to the geometry of shelves ensures attractive product presentation and makes it easy for shoppers to survey the range. This lighting task is addressed, for example, by continuous rows

of linear fluorescent luminaires combined with easily adjustable spots with metal halide lamps.

Shelf-oriented lighting also makes for more economical lighting. Compared to a planar lighting solution, it requires considerably fewer luminaires, so the connected load is minimised. In so-called "green shops", loads of less than 12 W/m<sup>2</sup> have actually been achieved. The result is a substantial reduction in energy consumption and operating costs.

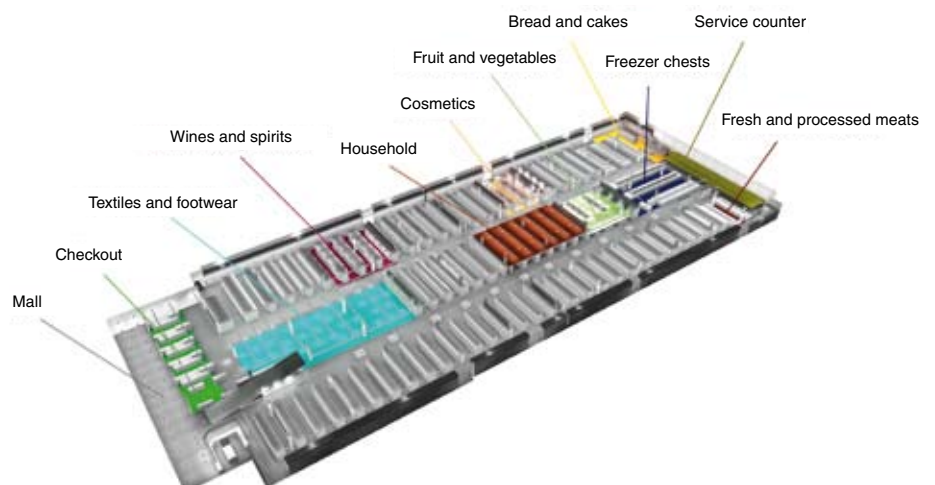
## Freshness as a distinguishing feature

Fresh food sections play a particularly important role in shaping a supermarket's commercial success. Although the perishable nature of the products they accommodate presents a risk, the margin on them is an interesting one for the operator. So what the operator wants is to emphasise the colours of fruit and vegetables, the appetising appearance of meat in the counter display and the crispness of bread on the shelves and thus "seduce" shoppers into making sales-boosting spontaneous purchases.

[24, 25] Shelf-oriented lighting for accentuated product presentation makes do with less lux than a room-related luminaire arrangement – which has a positive impact on shop operating costs.

[26] Strategically positioned spots make for an impressive product presentation.

[27] Supermarkets play a key role in meeting local demand for food and beverages, drugstore articles and other everyday items.



The requirements that need to be met by lighting are diverse. As well as addressing the task referred to above, lighting needs to be highly cost effective and must not shorten the shelf life of the products. Shopper attention is generated not by accentuating high illuminance but by the right lamp or LED light source and a light colour that underlines the intrinsic colour of the relevant products: light with very good red rendering characteristics for fresh and processed meats, a gold tone for bakery products and cool white for fish.

#### Deep freeze lighting

LED lighting for freezer and refrigerated cabinets makes product presentation a delight for the eye. Lighting characteristics can be precisely attuned to the product by strategic positioning and the use of lenses with different beam angles.

Value added is produced by outstanding operating performance at low and sub-zero temperatures in terms of higher luminous efficacy and full luminous flux on activation. In contrast to fluorescent lamps, a cool "climate" lengthens the lifespan of LED modules, so no maintenance is required during a freezer cabinet's life. LED solutions have very low energy consumption ratings. They also radiate very little heat, so refrigerating and air-conditioning requirements are lower and an even better energy balance is achieved.

Under certain circumstances, it may be an option to replace existing T26 fluorescent lamps with so-called LED light tubes. Anyone considering such an exchange, however, should check whether the new light source is a retrofit lamp or a so-called conversion lamp, which requires the luminaire to be re-wired. In any event, the replacement must always be carried out by a professional. The existing luminaires are optically and electrically tuned for use with fluorescent lamps. Replacing them with LED light tubes changes the way the luminaire distributes light and may also affect electrical reliability. The test mark assigned to the luminaire is not valid for this combination.

#### Boosting sales at the checkout

Checkout area lighting needs to meet two requirements. On the one hand, it should attract customers' eyes to interesting products, thus providing a "distraction" that helps make queuing an agreeable experience and also encourages impulse buying; on the other, the checkout is a workplace and has ergonomic requirements that need to be met to enable staff to focus on their assigned tasks and work without making mistakes. The choice of luminaire for the task area needs to take account of both reflected glare from shiny surfaces and direct glare caused by lamps.

[28] On the one hand, checkout area lighting should direct shoppers' eyes to interesting products; on the other – because the checkout is a workplace – it also needs to meet ergonomic requirements.

[32] LED-based refrigerated cabinet lighting reduces the amount of heat to be dissipated.



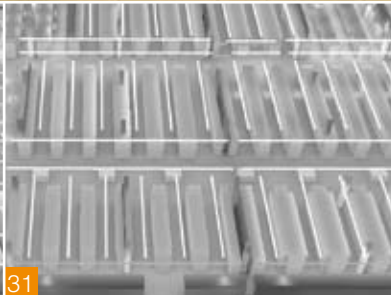
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### Emergency and safety lighting

Emergency lighting systems [29] are required in many public buildings, commercial premises with salesrooms and places of assembly to permit orientation in the rare event of a power failure rendering the general lighting inoperational. Persons who are not familiar with the layout of the building can thus vacate the premises safely. Safety and escape sign luminaires enable escape routes to be located and ensure swift access to fire extinguishers and safety equipment. This reduces the risks for people in the building, prevents panic and saves lives. DIN EN 1838 stipulates the need for at least 1 lx horizontal illuminance along the central axis of an escape route at least 2 m wide.



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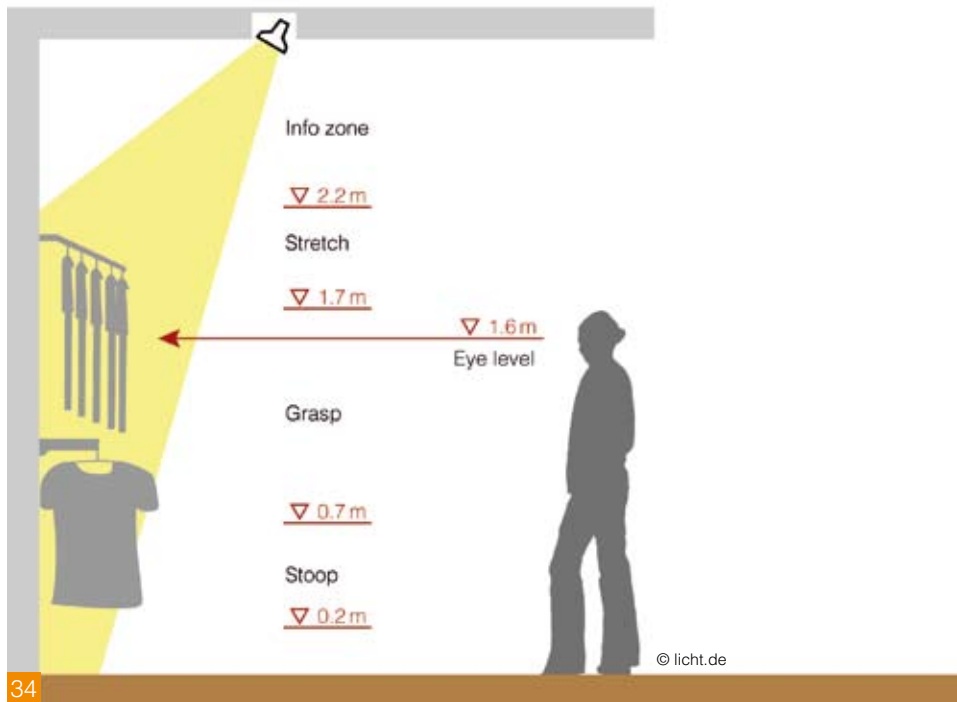
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## Saving energy with aisle-oriented lighting

Room-related or aisle-oriented lighting [30, 31, 33]: Continuous rows with special specular optics arranged parallel to shelves increase the amount of light falling on merchandise and improve energy efficiency. Figure 30 shows continuous rows of luminaires running at right angles to shelves, illuminating them from above and thus consuming energy to produce light that is not needed. If luminaires are suspended along the centre of the aisle (Fig. 31), the light is cast onto the merchandise and into the aisle. No light falls unused on the top of the shelves. With a 1.80 m wide aisle running between 40 cm deep shelves, this improves energy efficiency by around 40 percent. The lighting can be optimised by reflectors which – tailored to the geometry of the aisle – direct twice as much light onto the lower shelves as onto the upper ones. The light distribution curves show maximum emittance at angles between 15° and 50°, which ensures that shelves are uniformly illuminated from top to bottom and aisles are shielded from glare.



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[34] For shelf zone lighting, the distance between light source and shelving system should be around a third of the room height.

[35] Continuous rows of luminaires with selected reflectors are particularly good at accentuating shelves and merchandise.

[36] In peripheral zones, swivel-mounted downlights are excellent for casting products in a promotional light.



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# Shelf, aisle and wall lighting

In any shop, lighting needs to address a number of tasks. Basically, it should create an agreeable and interesting ambience and direct shoppers' eyes to the merchandise on sale. The dramaturgy for this is based on different brightness levels and selective accentuation.

Shop lighting solutions need to perform a variety of tasks – from general lighting to highlighting products and marking routes. Ultimately, the factors that determine the layout of a store and the arrangement of lighting fittings are cost and energy efficiency. With planar lighting, luminaires are distributed evenly throughout the room and are not directly assigned to specific sales area furnishings. This facilitates rearrangement and re-zoning of the room but provides no accentuating light for merchandise. Rotatable and swivel mounted luminaires trained on shelves or display fittings are used to direct shoppers' eyes.

Because of the uniform spacing between luminaires, planar lighting makes for a neat, uncluttered ceiling but because part of the light falls on the shelves from above and is not available for product presentation, it requires a large number of luminaires and lots of lux. This results in high energy consumption.

The energy efficient alternative consists of continuous rows, swivel mounted downlights or spots arranged parallel to shelves. The merchandise on show is brightly highlighted, aisles and circulation areas retreat into the background. This dramatic product presentation not only enables the customer to survey the range swiftly; because there are only a small number of luminaires, it also makes for particularly economical lighting. Light falls only where it is needed.

Special attention needs to be paid to the ends of shelves. Where light sets the right accents, gondola heads become valuable orientation points and locations for special promotions.

## Enhancing appeal

Highlighting merchandise adds variety and generates more customer attention. The best results are achieved with precisely angled spots with beams tailored to the size of the illuminated objects. At the same time, care should be taken to select a light colour that suits the products on display. High-tech equipment, for example, requires a cooler atmosphere, leather goods call for a warmer light. Thus emphasised, colours make an effective vehicle for conveying (brand) messages.

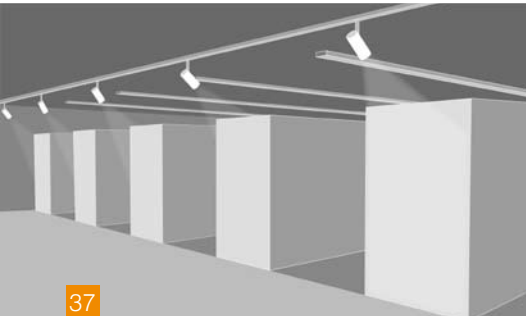
Special promotions require a special dramaturgy. Whether the items on offer are textiles, mobile phones or white goods, shoppers' eyes can be directed and their perception and assessment of the offer

crucially shaped by supplementary accent lighting. Linear luminaires integrated in shelving – a solution mostly found in drugstore and cosmetic sections – are a very good choice for generating attention. However, they can present a high heat load. LED solutions are the answer here.

High luminous efficacy, colour constancy and excellent colour rendering make metal halide lamps with ceramic burners a convincing tool for shop lighting. LEDs now also bring a much better performance profile to the task, making them a suitable substitute for low-voltage halogen lamps in particular. Because product displays are often rearranged, continuous rows featuring a combination of linear fluorescent luminaires and easily adjustable metal halide spots show their potential here. The brilliant light accents they set alleviates the monotony of the otherwise uniform illumination.

## Spatial perception

Sense of space can be enhanced by light flooding through walls. It facilitates orientation and at the same time conveys a sense of distance. However, it can also make a shop interior seem dark. One option here is to highlight logos, emotion images and focal points evenly with wallwashers or wide-angle spots. This solution also makes for better orientation over large distances. The type of lighting required depends on how aisle zones are used. e.g. whether special promotions are staged there or not.



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## Gondola head lighting

Ends of shelves [37]: The ends of shelves are eminently suitable for presenting special offers. Known as gondola heads, they facilitate the location of certain product groups and help shoppers' get their bearings. Furnished with accentuated lighting, gondola heads also become eye-catchers, directing attention to "highlights" and contributing to the shopping experience. Spots or downlights with metal halide lamps are recommended for this task. A more economical solution is provided by linear luminaires with fluorescent lamps and special reflectors that illuminate both the main aisle and the vertical surfaces of the gondola heads.

# Lighting Special: Basics of lighting design

Crafting lighting concepts for shops is a complex task. It involves selecting from a huge range of products and brands and developing the right lighting dramaturgy for them. Other factors that need to be considered include functionality and energy consumption optimisation.

Developing a lighting concept for a shop or brand environment is always a challenge for the lighting or interior designer because there are no standard recipes. This is due, for one thing, to the sheer range of applications: lighting solutions are required for discounters, boutiques, Michelin star restaurants, exclusive hi fi shops, shopping malls and department stores. In each case, what is needed is a distinctive (lighting) identity reflecting the commercial focus of the retail environment or the brand message presented. For retail chains, in particular, individual store and marketing concepts need to be considered and combined with other elements to make a new coherent statement.

Considering that our brain receives 80 percent of all information about our environment from our eyes and that the percentage would be zero without light, it is hard to overestimate the importance of a thought-through lighting solution. But it is not just quantity that matters; quality of lighting plays an absolutely key role. The earlier a lighting designer is involved in a shop lighting project, the better the result

will be. Technical aspects are an important consideration – but so are aesthetics, efficiency, ergonomics, corporate identity and, last but not least, sales psychology.

## Stagecraft for success

Lighting solutions are a fundamental part of an interior design concept and should fit seamlessly into it. Apart from the physical environment, two key aspects require attention: the target group and the product and its history. This is because the aim, in effect, is to set a stage – for a drama in which the (potential) customers themselves are protagonists.

The "script" contains scenes crafted by light – scenes of delight, rapture and seduction. Light sends an invitation to come closer, to enjoy a pleasurable experience, and it can direct our eyes. So lighting performs a number of tasks – from route-marking and orientation to accentuation and presentation. And the lighting dramaturgy is correspondingly complex.







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### Focusing on human needs

It is becoming increasingly popular to harness daylight for retail premises – not only because of daylight's stimulating impact and guarantee of excellent colour rendering but also because incorporating it into an artificial lighting scheme helps minimise energy consumption, heat load and air-conditioning costs. Natural lighting is dynamic, i.e. it changes during the course of the day. In a shopping mall with low daylight incidence, this circadian rhythm and its invigorating effect can be restored by artificial lighting.

Lighting concepts are as diverse as the architecture of the retail premises for which they are developed. Brightness levels are zoned for different functions. However, consideration needs to be given to human perception. Light directed exclusively onto the floor, for example, is "wasted" – at least where floor coverings are dark – because people predominantly pay attention to vertical surfaces. Generally finished in light colours, these surfaces instantly convey a different sense of brightness and space when illuminated. This is because the human eye does not perceive illuminance; it registers only luminance, which is mainly determined by the light reflected by surfaces.

Brightening peripheral areas gives them a certain "pull" and makes for swift orientation in a room. Room surfaces with a high reflectance improve the overall efficiency of the lighting installation.

Indirect lighting systems, luminous ceilings or cove lighting – such as are often found in boutiques or shopping malls –

offer sufficient luminance for the eye and at the same time create a bright, cheerful atmosphere.

### Variety for more attention

Unlike in other applications, such as office lighting, it is not advisable to work with a uniform lighting level in a salesroom. On the contrary, what is required here is dramatic and theatrical design.

Lighting effects with an element of surprise help make shopping a sensory experience. The range of options is extensive: light from below, glancing light, monochrome light or light that changes colour, light trails, starry skies and the use of gobos make for both variety and a product/brand-specific atmosphere. They are found to extend the time a shopper spends in a store and to encourage consumer spending.

But the atmosphere generated by general (viewing) and accent (decorative) lighting is not the only vehicle for communicating the corporate identity of a shop. Equally important are the luminaires themselves. Used as a deliberate stylistic device, their design and materials also impact on the ambience.

There are many ways to cast merchandise in the right light: in a discount store, the solution may lie in uniformly bright, almost monotonous lighting. Dramatic product lighting with differentiated brightness levels, on the other hand, signals exclusivity. Warm white light colours convey a sense of intimacy, neutral white light strikes a business-like note.

### Functionality

Emotional aspects are one consideration but functionality also plays an important role in lighting design. Every salesroom is a workplace, so lighting needs to guarantee focused, fatigue-free work and boost the motivation of employees. This means that the illuminance values stipulated in standards need to be observed – indeed exceeded to achieve a sales-promoting effect – and both direct and reflected glare must be avoided.

Energy consumption minimisation is another increasingly important topic, one with implications for the choice of light sources and lighting control systems for shop lighting.

[38, 39] The sheer range of retail operations – from discount warehouses through exclusive boutiques to department stores – means that developing lighting concepts for shops and brand environments is always a challenge. There is no such thing as a standard solution.



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# DIY centre lighting

The success of DIY and garden centres is due largely to their broad product range, which appeals not only to private customers but also to tradesmen, property caretakers and house builders. Clarity is promoted by lighting specifically designed to provide guidance.

The success of the DIY and garden centre concept owes as much to breadth of range and clear product presentation as to competitive pricing and competent advice. The result is a store that appeals not only to the private consumer but also to tradesmen of all descriptions, property caretakers and house builders. The diversity of the product range calls for shelves of different designs and heights, because small items such as screws and wall plugs cannot be displayed in the same way as sanitary ware or doors. Lighting needs to cater for those differentiated displays in order to generate a sales-promoting atmosphere. Access to the product displays is normally via a central aisle up to 6 m wide, uniformly illuminated by high bay reflector luminaires. Rounding off the visual experience are gondola heads, which can be accentuated by spots.

## Extremely differentiated

Because product presentations frequently change, the lighting solution for the salesroom needs to be flexible. What is more,

luminaire mounting heights of 5–6 m are needed to cater for pallet racks or heavy load shelves filled by hand or fork lift. A uniform background brightness is provided by continuous rows of luminaires with narrow-angle or double asymmetrical reflectors for highlighting products on all shelves at the same time. Product lighting needs to ensure adequate vertical illuminance to generate attention. Additional lighting in the shelving system itself enhances the appeal of the products on display.

The initial outlay for continuous rows of luminaires is greater than that for the planar illumination achieved with high bay reflector lights. However, the shelf-oriented, accentuating concept cuts energy costs by as much as 30 percent.

Bathroom displays call for high-quality lighting that is both brilliant and flexible. So do displays of small furniture items, carpets and wallpapers. Such lighting can be adjusted to cater for changing presentation concepts and, at the same time, is visually distinct from the shelf lighting.

Spots with a warmer light colour and good colour rendering characteristics are suitable for this purpose.

To meet the special requirements of the timber cutting station, luminaires need to be specifically designed for damp interiors and must also be dustproof.

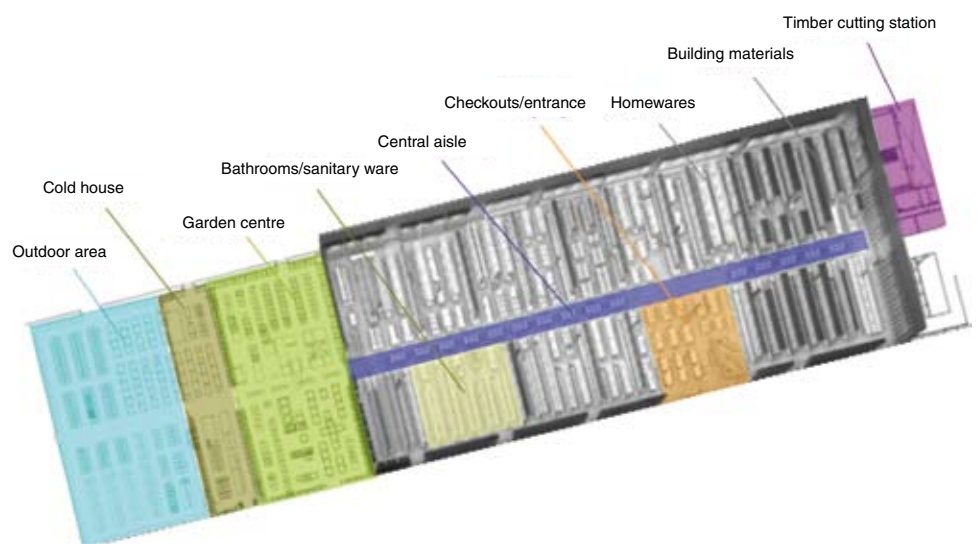
## Plants have special needs

Plants thrive best in daylight, so garden sections consist of an open, non-roofed sales area as well as a kind of greenhouse with a large glass roof. For energy-efficient general lighting, continuous rows of dimmable linear luminaires with narrow-angle reflectors – mounted at a height of more than 6 m – are therefore preferable to high-bay reflector luminaires. A daylight-dependent control system adds artificial lighting as required. Spots above plant tables show off blooms to their best advantage.

[40, 41] Continuous rows are suitable for most lighting tasks in DIY and garden centres.

[42] Spots with metal halide lamps bring out the colours and textures of wood.

[43] The wide range of products sold in DIY and garden centres appeals not only to the private consumer but also to tradesmen of all descriptions, property caretakers and house-builders and is thus a guarantee of success.



# Furniture store lighting

In furniture stores, it is particularly important to use light to create a feel-good atmosphere and make the visit to the shop an experience. This extends the length of time shoppers spend in the store and makes them more likely to make a purchase. So the lighting needs to appeal to emotions.

The furnishings market is a crowded place nowadays; furniture houses face tough competition. At the heart of every successful strategy is the need to motivate customers, who are wooed by large stores with anniversary offers, discount campaigns, etc., and by exclusive furnishing houses with special quality of service. However, to lengthen the time visitors stay in the store and increase their willingness to buy, it is even more important to provide a stimulating atmosphere. An inviting ambience that is both energy-efficient and tailored to appeal to the relevant target group is the primary operational requirement for a furniture store today. Optimised luminaires and carefully selected lamps meet that requirement.

For large display areas, the number of luminaires required means that the focus is mainly on economy, i.e. luminaires are generally simple models fitted with energy-efficient light sources. Stores targeting customers for modern designer furniture, however, require a more sophisticated and versatile lighting concept – one in which the luminaires used underline the emphasis on quality.

Generally speaking, the higher the quality of the furniture, the more customised and differentiated the lighting concept needs to be.

## Enhancing the experience with display light

The luminaires that provide the background brightness need to be supplemented by rotatable and swivel mounted spots for lighting accents. Positioned on power track or installed as recessed or surface-mounted models, they provide the high flexibility needed for changing collections and displays. With wallwashers, attention can be directed to product presentations in peripheral

zones. Cove lighting and indirect lighting bounced off ceilings offer more options for creating a bright, welcoming room atmosphere.

But luminaires are also among the exhibits in a furnishing store display. Perfectly embedded in the domestic scenes presented, the pendant luminaire over the dining table, the reading light flanking the sofa and the table luminaire on the sideboard help customers make their decisions.

Light colours attuned to the product presentation set off the colours of the items on display to good effect. Neutral white or cooler light colours create a gleaming business-like atmosphere for timeless designer furniture featuring glass, chrome and other high gloss or reflective materials. Warm light colours with a higher red content, on the other hand, lend themselves to creating a homely atmosphere for classical furniture with lots of wood and for oriental carpets. Dynamic lighting with changing light colours offers two advantages: it can arouse special interest and it can realise a mood change, e.g. for a new presentation.

For home textiles and carpets, which need to be rendered as naturally as possible, colour rendering characteristics play a crucial role. UV and IR filters ensure that materials such as leather, fabrics and veneers are not exposed to harmful rays that could cause them to fade or crack.

Carefully orchestrated by appropriately angled spots, light and shade can be harnessed to emphasise and draw attention to surface structures. At the same time, however, care must be taken to avoid dazzling the customer by ensuring that spots are not aligned with main lines of sight. However, reflected glare on

shiny surfaces can be deliberately used as a stylistic device to accentuate certain items.

## Energy efficiency and economy

In the case of large sales areas – which generally have to make do without daylight – the energy efficiency of the lighting solution is a particularly important consideration. (Compact) fluorescent lamps and metal halide lamps are economical options here. But cost effectiveness is also influenced by other factors: dark colours absorb light while light colours reflect it, so a room with light-coloured surfaces requires considerably less light than a room with dark ones.

Energy can also be saved by regulating lighting, e.g. with a daylight-dependent control system in (usually glass-panelled) entrance areas or with presence detectors that enable lighting to be activated only when it is required. An accentuated light guidance system may be a more efficient solution than uniform, monotonous-looking brightness. In lowering the connected load, it also reduces the heat that needs to be dissipated by the air conditioning system.

[44, 45] In areas with incident natural light, energy can be saved by daylight-dependent regulation and by using presence detectors to activate lighting only when it is required.

[46] Rotatable and swivel-mounted spots – mounted directly on the ceiling or attached to power track – not only furnish accentuating light but also provide the high flexibility needed for changes of collection or decor.



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## Textile store lighting

The success of a new boutique depends crucially on a combination of things – shop concept, interior design and lighting solution. As well as targeted use of general, accent and effect lighting, energy efficiency and economy are increasingly important topics.

Light can be used to structure interiors and create atmosphere. But it takes more than light to lend a distinctive character to a boutique – it takes a combination of shop concept, interior design and lighting solutions. And there is no "right" or "wrong" way to go about it; the key to success lies in image and impact. Chain and brand stores consciously exploit this fact by developing "corporate lighting". Basically all the general shop lighting rules, such as prioritisation, zoning, etc., need to be observed to take account of the different applications. Shop windows, entrance, decoration zones, vertical and horizontal product presentations,

checkout areas, rest zones, stairs, lifts, changing cubicles and the large central sales area are structured with light. The high-contrast, accentuated presentation lighting in the shop windows, for example, creates an atmosphere of suspense in combination with relaxing, uniform salesroom lighting. Decoration points always require intense directional light. This produces an interplay between low and high illuminance, between light and shadow. The human eye perceives the switch between light and dark and is stimulated by it. Nothing is more fatiguing for our eyes than monotonous uniform light.



### Pay point lighting

Shopping experience [47, 48]: Every shopping experience ends at the payment counter. And that last impression is almost as important as the first one because it sticks in the customer's memory. So special attention should be paid to the design of the pay point and the lighting plan for it. A single decorative luminaire of striking dimensions and design or a group of daintier models catch the eye and make a pay point easier to locate. Light distribution characteristics should be selected to meet the workplace requirements of a cashier. The luminaires above the payment counter also act as a stylish addition to the salesroom lighting, which is fully geared to the product presentation and rounds off the feel-good atmosphere.

Accentuated lighting appeals to our emotions and makes shopping an experience. The higher the contrasts of an illuminated area, the more arresting the space and merchandise. A key factor here is the appeal of modelling – a vital device that makes light visible and contrast possible. If background brightness is lowered – thus reducing energy consumption – clear accents can be set even with very little light; in such an environment, a spot with a 20 W metal halide lamp seems very intense. The presentation is further emphasised – and consumer appetites aroused – by coloured, dynamic light.

### Specifically selected

Selecting the right light distribution, beam angle and light colours and choosing a luminaire design appropriate for the store underline the statement that a salesroom makes. In the fashion sector,

excellent colour rendering is especially important to ensure easy recognition of colours and textures.

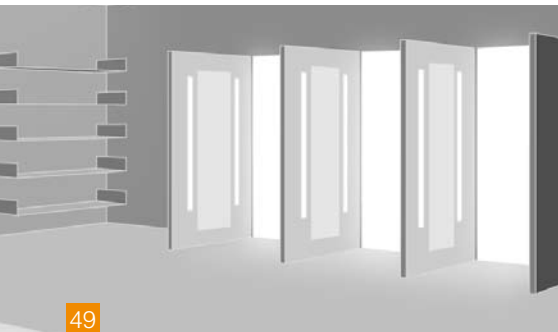
Light colours, in particular, are a simple dramaturgical tool for presenting garments to specific target groups. Warm light with colour temperatures – depending on light source – between 2,500 K and 3,500 K have a spectrum with a higher red content, so all merchandise featuring shades of red is emphasised and a more "homely" atmosphere is produced.

Cold light, on the other hand, has a more pronounced blue spectrum and has a colour temperature of around 4,000 K as neutral white and between 5,400 K and 6,500 K as daylight white. Cool light makes colours look more neutral, especially blues and greens, and a room radiates a crisp, fresh dynamism.

Awareness of the impact of light colours enables a salesroom to be structured with light. With a lighting control system, there is also the possibility of modifying colour temperatures to cater for a change of collection or seasonal theme. Hence the growing investment in lighting control across the retail sector; it offers the chance to programme light scenes or scenographic effects – even in time sequence – for retrieval as required. Standardised protocols such as DALI or DMX make for simple management.

### Designing with light

Because collections change, lighting solutions for the fashion and textile industry need to be flexible and offer scope for scenographic design.



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## Changing room lighting

Changing cubicles have special lighting requirements [49, 50]: Customers feel particularly good in a changing room if luminaires are positioned to the left and right of the mirror and emit even, diffuse light. The light sources should have first-class colour rendering characteristics. The same requirements apply to all room situations with mirrors in a salesroom: adequately diffuse brightness with good colour rendering quality makes everyone "look good" in an outfit. Directional spot lighting from above, on the other hand, emphasises "every little wrinkle".



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Power track systems with swivel-mounted and rotatable spots are particularly suitable for this purpose. However, ceiling integrated systems such as lighting channels or coffers can be supplemented by (focusable) recessed or directional spots.

In an exclusive fashion boutique, as in any store, merchandise, presentation and lighting need to be carefully coordinated. Wallwashers can be used to set the scene for product shelves or vertical displays. Spots with different beam angles – depending on the size of the display fittings and presentation areas as well as room height and distance from the merchandise – can be angled to provide perfect accentuating light. Accessories such as sculptural and Fresnel lenses or special reflectors – e.g. which broaden the beam along an axis to create an elliptical pool of light – set specific formal accents on figures, display islands, product tables, etc.. And they do so with only a few luminaires. Light sources delivering a brilliant light are eminently suitable for presenting shiny materials or accessories. The general rule is: the better a luminaire is designed for the task, the fewer luminaires are needed overall, so investment and operating costs are minimised.

### Reflectors for effect

Reflectors are important components for formal lighting design, i.e. for directing light onto walls, ceiling, floor or merchandise. The range includes symmetrical, asymmetrical and axially symmetrical reflectors (round) as well as reflector trays (angular), narrow-angle and wide flood reflectors, focusable reflectors and interchangeable reflectors. Depending on requirements, light can be focused to accentuate a detail or spread wide to provide uniform illumination. It can create rhythmically visible pools of light on walls or provide perfectly homogeneous illumination for a particular area. Here, luminaires with interchangeable reflectors have the advantage that they can be easily adapted to cater for changing scenarios at any time – even after installation.

### Efficiency and economy

Energy efficiency and sustainability – i.e. also cost-effectiveness – are increasingly important topics in fashion store lighting. Illuminances are still very high in the fashion retailing sector today and could be reduced by more accentuated product lighting for greater energy efficiency. The target for product lighting is set at less than 20W/m<sup>2</sup> for large areas and under 35W/m<sup>2</sup> for small areas.

The number of luminaires required depends crucially on the lighting technology used, especially on the light output ratio of the luminaires. This depends, in turn, on a number of factors such as light source, reflector, heat dissipation, lampholder tolerance and ballast. Basically speaking, the better the quality of the components, the higher the luminaire efficiency and the greater the amount of light made available. Today, however, account needs to be taken of not just the individual luminaire but the lighting solution as a whole – because lighting control enables energy to be saved e.g. by adjusting the light to ambient brightness or programming it for different scenarios at different times.

Provided in the right place and the right light colour, in the required quantity and with a light distribution curve appropriate for the task, lighting turns a sales area into an exciting space. Good lighting concepts also make optimal use of energy for lighting atmosphere. Professional lighting design is the key.

High-performance LED modules with up to 3,000lm luminous flux and a lighting effect comparable to a 35W metal halide lamp are now showing their potential. Marked improvements are also being noted in light colours and colour rendering. What is more, because the infrared (IR) and ultra-violet (UV) content of LED light is minimal, LED light sources are safe for illuminating even the most sensitive merchandise on display and open up new dimensions in product lighting with their wide range of designs.

Miniaturisation is also naturally a topic with 20W and 35W metal halide lamps, which make smaller spot and luminaire designs possible. The combination of efficient reflectors, good light output ratios exceeding 80 percent and adjustable lamp focus capability results in low-energy lighting with outstanding modelling characteristics for high-impact presentation.

However, establishing economic viability involves looking at more than just energy costs; installation costs, maintenance costs and lamp replacement costs over the entire life of an lighting installation also need to be considered. Which is why it matters whether luminaires are easy to install, whether reflectors and lamps can be replaced without tools and how long the lamps' life is expected to be.

### Light as a key to success

Interest in lighting has increased in recent years. Light is no longer just a necessary accessory; it has become a fully fledged element of interior design. Accent and effect lighting combine with general lighting to create a customised, holistic lighting solution – which forms an excellent basis for choreographic dramaturgy for the perfect showcasing of the fascinating world of fashion.

[51] Light is a tool for designing interiors and creating atmosphere – large, project-specific luminaires set additional accents.

[52] Wallwashers effectively set the stage for product shelves or vertical displays.

[53] Metal halide lamps have carved a niche in retail lighting as a result of their brilliant light and excellent colour rendering.





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# Lighting Special: Efficiency and cost economy

Energy efficiency and sustainability are important objectives promoted by the German government. But measures that can improve the energy balance of a lighting installation also reduce operating costs and thus contribute to commercial success.

In the case of a new lighting installation or when an old installation is refurbished, only the investment costs are normally considered – not the operating costs. This approach is catastrophic because operating costs are crucial to the overall economy of an installation over the full course of its life. Given that the average economic life of a lighting installation spans eight to ten years, energy costs add up to around €240 - 300 per 50W connected load – assuming an operating time of 4,000 hours a year and an electricity price of 0.15€/kWh. Where the economic life of an installation is indeed this long, its operating costs are generally considerably more than the investment costs.

Where installations are over-dimensioned or components ineffective, there is every likelihood that considerable potential for economies exists. That potential can be established by a precise analysis of costs. Energy costs and maintenance costs, in particular, mount up. The latter include the costs of replacing lamps, spare parts, cleaning soiled reflectors, louvers and enclosures as well as disposal costs. All the costs presented by a lighting installation – i.e. investment and installation costs plus energy and maintenance costs – are

summed under the heading "Total Cost of Ownership" (TCO). To establish the most energy-efficient and economical lighting solution, every investment decision should be based on this life cycle cost view.

At the same time, it should be remembered that both energy consumption and maintenance costs are influenced by user behaviour.

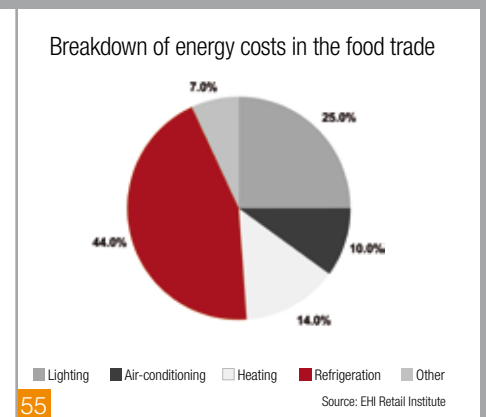
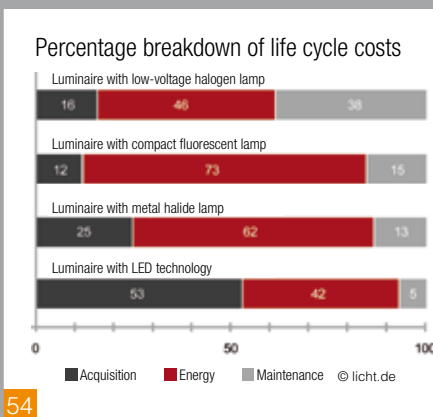
## Complete refurbishment vs. retrofitting

In view of the high cost of investing in a new lighting installation, many decision-makers wonder whether it might not be cheaper and therefore more sensible to exchange only the components that affect energy efficiency, such as ballasts and reflectors, or even to replace only the lamps. At first glance, this seems a tempting idea. However, a luminaire is a system, and the components of that system are both electrically and physically tuned to work together.

What is more, when individual components are exchanged, the luminaire loses its VDE certification; responsibility for its reliability reverts to the operator. Where reflectors are exchanged – except using kits offered by the manufacturer of the existing instal-

[54] Percentage breakdown of life cycle costs for luminaires with different lamps assuming an operating life of eight years, a burning time of 4000 h/a and an electricity price of 0.15€/kWh.

[55-58] Breakdown of energy costs by consumer in the food, textile, DIY and furniture trades.



lation – luminaire light distribution is often affected, so the original lighting design values are no longer valid. The changes in lighting parameters may even result in certain values, e.g. for illuminance or glare limitation, falling below the minimum stipulated in standards, thus undermining the standard compliance of the lighting installation.

Adapters for T16 lamps or voltage reduction systems for reducing the energy consumption of existing installations should also be viewed in a critical light. Such solutions are rarely advisable because they primarily lower the lighting level. What is more, the lamp adapters do not always properly guarantee electrical reliability.

Expertise is required here to ensure that replacing individual components is not ultimately more expensive than complete refurbishment.

#### Renewal as opportunity

When modernising lighting installations, it is advisable to adopt a standardised method. Crafting a successful solution involves proceeding chronologically through a sequence of steps – from a quick scan and stock-take through a full scan and comparison of refurbishment options to benchmarking.

A **quick scan** permits a superficial estimate of savings potential to be made on the basis of the existing installation, i.e. light sources, reflectors and electrical gear, operating time and operating costs. It also

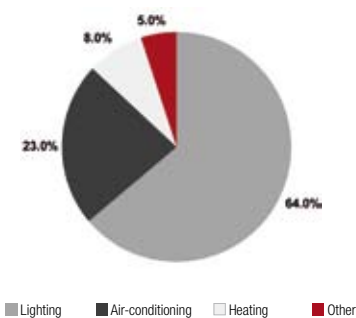
permits assessment of the feasibility of control options where adequate daylight incidence is present and provides pointers to the "correct" level of illuminance, which has a significant bearing on energy consumption. Even if the motto "light lures" is a major consideration in shop design, background illumination should be kept to a reasonable level and extravagant light accents should not be too numerous.

The **stock-take** establishes how many luminaires are installed, how much power is consumed, how high the maintenance costs are and whether the installation meets present-day requirements, including standard stipulations. The scan calls for a detailed tally of all luminaires as well as figures for variables such as operating hours, cost of electricity, maintenance requirements, etc.. The result presents an accurate picture of the current state of affairs, especially as regards connected load, surface area, illuminance and operating time.

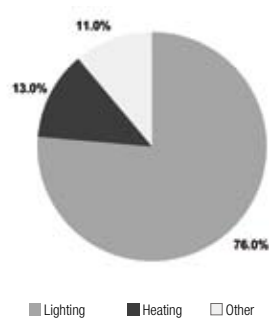
For the **design and comparison of energy efficient alternatives**, high priority needs to be given to the systematic assessment of selected products on the basis of efficiency criteria. Light output ratios are particularly important. Once the design work is done, every component of the lighting solution is defined. The next step is to establish the project-specific operating conditions, so that the life cycle costs of the old installation can be compared to those of the new one and any variants that may be considered. This indicates the energy-saving potential and the payback time of the investment.

**Benchmarking** – comparison with best practices – provides an opportunity to identify the scope for increasing efficiency. It is best here to engage the services of an energy consultant.

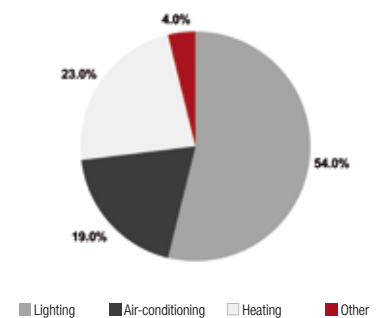
Breakdown of energy costs in the textile trade



Breakdown of energy costs in the DIY trade



Breakdown of energy costs in the furniture trade



## Upmarket specialist store lighting

The overall impression made by architecture, furnishings and lighting significantly shapes the shopping experience and thus also the buying mood of the shopper. So lighting that is finely tuned to the merchandise on display plays an extremely important role in retail design.

In the world of retail design, there is a strengthening trend towards individualism. That is to say, the focus is not on some perceived trend in design but on the relevant brand message. The identifying aspects of the brand, including corporate identity, need to be brought to life in the shop and experienced by the customer. The overall impression made by architecture, furnishings, merchandise and lighting significantly shapes the shopping experience and thus the buying mood of the shopper. Interior design needs to be attuned to the range on display. Select jewellery, designer spectacles, high-end audio equipment and fine leather goods all require a different ambience. The primary task is to create an atmosphere that appeals

to all the senses: unique and distinctive. And lighting is one of the most important and effective tools for the job.

Materials such as leather and selected fabrics have demanding lighting requirements. Very good colour rendering and warm white light colours with a colour temperature up to 3,000K are a must for an environment designed to stimulate consumption. What is more, sensitive product surfaces need to be protected from cracking and fading due to infrared (IR) and ultraviolet (UV) rays, excessive illuminance and over-long exposure times. For hi tech items such as mobile phones, TV sets or hi fi equipment, however, daylight white is more appropriate

for a cooler atmosphere. Additional accent lighting sets off the texture and suppleness of leather to good effect and seduces the shopping into touching the merchandise or enhances the "cold" aura of metal or the sparkle of jewels. Thus attuned to the products on display, lighting helps make shopping a sensory experience.

But dramaturgical elements also make a varied contribution: products on shelves, for example, can be attractively and vigorously highlighted by gently changing colours.

[59] The overall impression made by architecture, furnishings, merchandise and lighting significantly shapes the shopping experience and thus also the buying mood of the shopper.

[60] In retail design, the primary focus is not some perceived uniform design trend but the particular brand message that needs to be put across.

[61] The pay point has a special status in the design environment of a retail outlet.

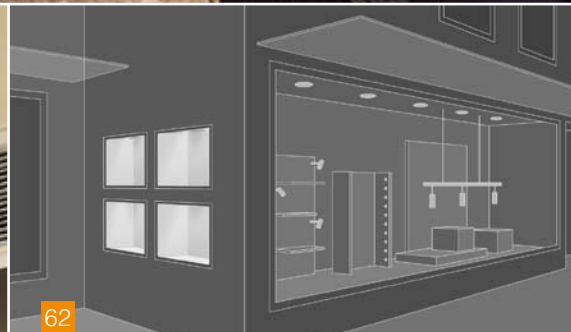




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## Display cabinet lighting

Select jewellery [62]: In display cabinets, items such as select jewellery or fine leather goods are protagonists bathed in accentuating light. In the past, the task of highlighting them – while taking account of their sensitivity to heat – was generally performed by low-voltage halogen lamps with cool-beam reflectors or by fibre-optic systems. Today, that role has been taken over by LED solutions. Being UV- and IR-free, LED light is gentle on exhibits. What is more, the minimal dimensions of an LED light source permit extremely petite luminaire design – 360° rotatable linear luminaires, for example, with a head that can be swivelled through 40° to direct light perfectly onto the items displayed. LEDs with different colour temperatures and very good colour rendering thus set brilliant accents in display cabinets.

Display cabinets can also be used as eye-catchers. Items inside them are protected from dust and unauthorised access and can be effectively presented as a "star of the show". Because of their minimal dimensions, LED lighting systems show their potential here. Discreet but effective in the showcase context, they also score points for generating very little heat in the direction of the beam.

#### Setting the stage for spectacles

Light is also an important design element for an optician's shop. Apart from ensuring agreeably bright, neutral-white background lighting, the lighting design task here is to divide the room into zones. This makes for maximum clarity, atmosphere and security for the customer.

To ensure there is no inhibition threshold, the illuminance at the entrance should be geared to that in the shop window. This is effectively a stage, showcasing items to attract (potential) customers into the shop, and

the stage can be set by marked contrasts in brightness. Three-phase power track with rotatable and swivel-mounted spots offers the flexibility needed for regularly changing window displays.

For the walls, which are the main surfaces on which merchandise is presented, care must be taken to ensure sufficiently high vertical illuminance. This task can be performed by wallwashers, supplemented by narrow-angle spots for highlighting individual exhibits.

Presenting spectacle frames against a bright background has proven an effective practice. The fluorescent backlighting needs to create a uniform, diffuse backdrop with no sign of the lamps. The requirements are a minimum distance of 20 cm from the diffuser and less than 20 cm between lamps. White-finished side and back panels ensure a high diffuse reflection. This also needs to be considered where walls are backlit by LEDs, although the depth of the unit can be reduced.

Minimalist luminaires or fibre-optic or LED systems can be integrated in shelves and display cabinets. This avoids annoying reflected glare and reflections.

For mirror lighting, a warm-white light colour and very good colour rendering ensures the most flattering conditions for customers trying on new spectacles. Luminaires to the left and right of the mirror make for a soft and glare-free atmosphere. Directional light is definitely undesirable here because of the hard-edged shadows it produces.

#### Sales-promoting ambience

Thus shaped by light, an emotionally stimulating atmosphere is created: shopping becomes an experience. With the right lighting, exhibits gleam and sparkle, colours become rich and vibrant. Customers become players on a retail stage, enjoying a perfect part with a touch of luxury. And the retailer profits from increased sales.





[63] LED lighting systems show their potential in display cabinet lighting.

[64] A zoned shop landscape with different brightness levels generates more attention than uniform lighting.

[65, 66] Dynamic coloured light makes for emotional appeal and variety in a purist environment.







# Shopping mall lighting

Lighting is the largest energy consumer in a shopping mall. Consumption is minimised by conscious use of light – which calls for early planning and consultation between architects and lighting designers – and high-quality components.

A shopping mall combines the worlds of retailing and entertainment, providing the roof under which all the tenants are assembled. One major challenge for its designers is to ensure harmony between tenants' brands and the brand of the mall. All such consumer temples project an image of more than just a "shopping factory"; they present themselves as stages for the wonders of the retail world, as brands that promise an emotional experience for the consumer. So as well as architecture, which uses shapes, materials and colour to bring the mall to life, lighting design plays an important role.

Energy efficiency is an increasingly relevant topic in shopping malls because, according to the calculations of shopping centre specialist ECE, lighting accounts for around 60 percent of total energy requirements. The average energy requirement of a shopping centre – air conditioning and ventilation are also significant consumers – is estimated to be as much as 400 kWh/m<sup>2</sup> a year.

So light is not only one of the "most visible" but also the biggest energy consumer. Consequently, there is a design challenge in minimising energy requirements while at the same time creating agreeable lighting conditions for shoppers and tenants. Individual measures such as using energy-saving lamps are not enough to address this complex issue. Architects and lighting designers need to tackle it at an early stage, developing lighting concepts that take account of every aspect, from architecture through daylight utilisation to stimulating dramaturgy. Light – including eye catching coloured accent light – needs to be consciously harnessed in a system crafted by experts. During the day, for example, light needs to be brighter and whiter than in the evening, when a warmer light is found more agreeable. For less is often more.

## Daylight for a feel-good atmosphere

No shopping gallery should be without natural light. Its stimulating effect is important. But how much daylight is used in a project should always be considered in the light of its impact on energy consumption. Environments differ, affected by factors such as the orientation of the building. Too much incident sunlight increases the need for cooling. The optimum situation is where diffuse light is captured from a northerly direction because it brightens the interior without significantly heating the building. Incidence can be influenced by the design of the roof, e.g. by partially closed roof areas.

Artificial lighting is "dosed" in response to daylight. Contrary to popular belief, it needs to be raised as the incoming natural lighting increases. Because the level of incident daylight is not the same everywhere, marked contrasts occur and need to be eliminated by artificial lighting to prevent them impacting on visitors' sense of wellbeing. What is more, the human eye adapts to the brightest areas it perceives, so it fails to register as much detail in darker patches.

Artificial lighting ensures that all areas are adequately perceived. Crucial energy-saving factors include optimised daylight utilisation, high-quality luminaires, innovative light sources that generate little heat, electronic ballasts and intelligent lighting control. Fluorescent lamps for back-lighting luminous ceilings and coving, metal halide lamps for downlights and nowadays even LEDs provide an optimal basis for energy efficient lighting. Because of their low heat loss, they also help reduce shopping mall air-conditioning requirements.

[67] Shopping malls present themselves as worlds of wonder – lighting plays a major role in shaping that image.

[68] Daylight stimulates and is thus increasingly used in shopping malls to create a feel-good atmosphere.

[69, 70] Different light colours at different times of day bring the dynamism of daylight indoors.

# Lighting Special: Daylight and lighting control

The primary purpose of shop lighting is to create an atmosphere in which customers feel good and to highlight certain products. A combination of daylight and artificial lighting – controlled by an intelligent lighting management system – offers considerable added value for that task.

Natural light, with its seasonal and diurnal fluctuations, has always had a stimulating effect on human beings. Light colour, spectral composition, direction of light and quantity of light vary and influence our circadian rhythm. What is more, daylight is the ultimate benchmark for colour rendering.

Both colour rendering and stimulation are important criteria for sales area lighting. This is a widely appreciated fact and explains the increased use of daylight in retail environments. Natural light is brought into a car dealership or department store through large windows – which double as a visual link with the outside world – and enters a shopping mall through glass roof panels. It is then supplemented by artificial lighting to maintain an agreeable brightness level after dark and to set accents.

ing as required in response to changes in ambient brightness. Intelligent lighting control systems – based on the DALI protocol or incorporated into a KNX building management system – open up lots of opportunities to design a lighting installation for more energy-efficient operation or to simplify maintenance. Emergency lighting systems can also be integrated.

To make use of the full bandwidth of automation options, it is essential to ensure an operating system designed for maximum convenience and user-friendliness. Manual intervention naturally also needs to be allowed to enable automatic settings to be altered, e.g. for extended opening hours or Sunday trading. And it goes without saying that light scenes need to be easy to modify and re-programme without an outside expert.

## Cost almost zero

Where daylight enters through windows or skylights, measures also need to be taken to protect merchandise from UV radiation, e.g. by limiting the sunlight exposure times of shop windows, or to avoid an

[71, 72] Daylight entering through the glass facades makes the supermarket interior bright and cheerful – daylight dependent regulation here ensures that artificial lighting is added as required.

[73] In multi-storey shopping malls, daylight entering through skylights creates a positive atmosphere right down to the lowest level.



excessive heat load for the building's air-conditioning. The needs-based operation of shading or sunscreen systems can also be integrated into the lighting management scenes.

Because they harness zenith light, skylights and glass roof areas basically direct a great deal more natural light into a room than windows. Depending on the position, size and number of roof openings, the incident daylight also creates a different ambience. Daylighting can thus be used to influence the atmosphere of an interior.

With a daylight-dependent control system, as much incident daylight as possible is harnessed and the artificial lighting component minimised, i.e. luminaires are dimmed for low-light operation or even deactivated. This not only lowers energy consumption but also extends the life of lamps. The initial outlay required for lighting installations with a lighting management system is somewhat higher than for static installations but the extra investment is quickly recouped through lower operating costs.

#### Endless possibilities

Depending on functionality, lighting control and lighting management systems offer almost unlimited possibilities for the user. For example, controlled use of two light colours – neutral white during the day and warm white in the evening – enables an

almost natural and thus stimulating room atmosphere to be created. Alternatively, accentuating coloured light can be programmed for special attention-grabbing effects.

But the focus does not need to be on lighting moods for ambience; light scenes can also be designed to enhance energy efficiency. Where outdoor brightness exceeds 10,000lx, a "sun" scene could be relevant, programmed to dim or even deactivate luminaires in all areas benefiting from incident daylight. Complementary scenes include "overcast sky", "twilight" – triggered by threshold values below 2,000lx – and "night", "all on" and "all off" as well as a timer controlled scene for "cleaning light".

The information required for intelligent lighting control can be provided by a weather station on the roof. The data transmitted include outdoor brightness, twilight, time and date, type of sky with position of the sun, and precipitation. Calendar- and weather dependent light scenes are then automatically activated to suit the relevant conditions. Lighting in less frequented areas such as stairwells can naturally also be controlled by presence detectors.

#### Added value

The prerequisite for lighting control and lighting management is that luminaires should be equipped with dimmable electronic operating gear. Via appropriate

interfaces and – where required – gateways such as DALI interfaces and DALI/KNX gateways, all status information can be retrieved from ballasts and visualised on the relevant user interface. The information collected includes, amongst other things, burning time and lamp or LED failure, current dimming levels of individual luminaires and details of any hardware component failure. These operating data, which are available for each individual luminaire or for luminaire groups, depending on the system, can be used for anticipatory maintenance, lamp replacement and other operations. This considerably simplifies facility management.

Each on their own, daylight utilisation and lighting control offer a great deal of added value. As a team, however, they are unbeatable – both in terms of the possibilities they offer for generating atmosphere and for the energy and maintenance costs they save.



# Pharmacy lighting

To stay successful in a changed environment, pharmacies are reinventing themselves. Contemporary sales concepts call for different lighting solutions that present products in a promotional light.

The old-style pharmacy where most transactions involved exchanging prescriptions for medication is now part of history. Pharmacies today face a new mega-trend driven by wellness, anti-aging and active health promotion. A key role in any contemporary concept for active sales promotion – i.e. classical retail strategy – is played by the behind-the-counter display. Instead of headache tablets and cold remedies that customers buy anyway, the shelves at the pharmacist's back need to present elaborate themed product arrangements. Common topics include "vitamins" in spring, "skin" in summer, "colds" in autumn or "dieting" after Christmas. This transformation of pharmacy business also

presents different lighting requirements. Just providing sufficient brightness for visual tasks is no longer enough; sales-room lighting is required – lighting that draws attention, directs the customer's eye and at the same time creates a feel-good atmosphere.

For the general lighting, variable design luminous ceilings or large panel luminaires are a suitable option. Their uniform light distribution makes for a bright and cheerful salesroom and a comfortable room height.

For a product presentation with emotional appeal, accentuating display fittings is key. Today, brilliant light accents are set by

swivel-mounted downlights or by power track spot systems. However, the future here belongs to LEDs – e.g. for back-lighting individual shelves. Their minimal dimensions open up new applications and their cool, IR/UV free light makes them particularly gentle on items on display. And above all, LEDs offer the modern pharmacy a range of monochromatic or changing coloured light options that can be tailored to the needs of the current sales campaign.



[74] The combination of indirect lighting, multi-directional downlights and decorative pendant luminaires creates a feel-good atmosphere for clientele, while at the same time showcasing products.

[75] Well-lit shelves behind the counter are increasingly important for the success of a modern pharmacy.

[77] Downlights pour accentuating light onto the shelves behind the service counter, highlighting changing displays and promoting sales.



## Service counter lighting

Pharmacies are embracing modern sales concepts [76]: The shelving system behind the pharmacist is presented as an eye catcher. Swivel or gimbal-mounted downlights or power track spot systems with metal halide lamps accentuate "campaign" products with brilliant light from above. Shelves with LED backlights create new effects for the retail environment. RGB colour mixing enables medicines, food supplements and care products to be cast in a suitable promotional light – either coloured or conventional white. The dramaturgy makes service counter and shelves stand out clearly against the bright and cheerful backdrop of the rest of the salesroom. Lighting installations that arouse and direct customers' attention while at the same generating a feel-good atmosphere are the solutions of the future.



# Car dealership lighting

Car dealerships present themselves as a stage for the wonders of automotive engineering. High-quality detailed lighting creates an environment in which vehicles are showcased to best advantage. Only then are successful sales figures guaranteed.

[78] Because of their highly reflective paintwork, cars present a special challenge for the showroom lighting designer.

[79] Projector-reflector lighting systems set the stage to good effect, emphasising the colours and contours of the vehicles.

[81] Generally high-ceilinged and with large glass facades, car dealerships are places where light and lighting design need to meet high requirements.

Generally high-ceilinged and with large glass facades, car dealerships are places where light and lighting design need to meet high requirements. This is because different room uses are found here under the same roof. Display area, workplaces and communication routes lie side by side and each has its own specific needs. Vehicles require special attention because of their high-gloss paintwork. As a general rule, daylight entering through large glass facades is the best possible light here because it brings out the colours of the vehicles perfectly. On sunny days, however, the high illuminance and luminance outdoors makes the showroom seem dark. The glass facades look black

and reflect the surroundings; the observer gets the impression that the dealership is closed. That impression can be countered by low-reflection glass, which makes for a better result than massively raising the illuminance indoors.

## Open and inviting

At night, a sense of quality can also be conveyed in a car showroom by setting only a few light accents. Using just a few groups of luminaires to highlight specific presentation islands makes a big visual impact while at the same time saving energy. Additionally illuminating walls delimits the space. The brightness selected should be geared



to conditions outdoors: on a busy street, the lighting level needs to be higher than in a sparsely illuminated landscaped setting.

As a matter of principle, a salesroom should have an open and inviting appearance. Because surroundings are reflected in vehicle paintwork, a tranquil ceiling is preferred. Illuminating parts of the ceiling with floods makes the room look higher and the reflected light contributes to the general lighting. The light sources most widely used are metal halide lamps, which combine the advantages of high luminous flux and a long life. They also have the very good colour rendering properties needed to ensure that the colours of car paintwork are not distorted. In future, such tasks will be performed by LED luminaires; their system efficiency is steadily improving and they are virtually maintenance-free.

As an alternative to floodlighting, automobile showrooms can be illuminated by luminous ceilings, which combine a homogeneous

appearance with very uniform light distribution. Whether the backlighting is provided by fluorescent lamps or LED systems, luminous ceilings can also be fitted with lighting controls to simulate the dynamism and changing colour temperatures of daylight – with a motivating impact on (potential) customers. Standardised protocols such as DALI or DMX make for simple management.

#### Accents as icing on the cake

Spots with different beam angles – mounted above presentation islands on suspended three-phase power track – can be easily adjusted and angled to highlight vehicles on show. Metal halide lamps with low watt ratings are sufficient for this task, which significantly reduces energy consumption. In the future, LED spots will also be an option here, although certain lighting quality issues will need to be overcome. Luminaires with lots of dots of LED light considerably disrupt the overall visual picture; they can also cause intense glare and reflections on

paintwork. Moreover, not all LED solutions on the market today live up to their promise in terms of colour rendering – and colour appearance can make the difference between a sale and no sale.

Dynamic colour effects attract attention and can underline brand image. The possibilities seem endless: indoors and out, areas can be highlighted, lines drawn, even structures stretched over parts of the building. Especially here, however, the design maxim should be "Less is more!" LEDs are the solution of choice for this purpose and have overtaken nearly all conventional light sources.



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## Communication routes and stairs

Red thread [80]: Communication routes and stairs at a car dealership are not just for orientation and security. They are the red thread that leads the customer through the salesroom to the vehicles. Luminances should be synchronized to avoid unnecessarily lengthening the time it takes the eye to adapt. The reflectance of floor coverings also plays a role: a dark floor absorbs a lot of brightness, a light-coloured floor reflects the light back into the room. A customer's sense of wellbeing is also affected by reflections on floors, glare or – especially on stairs – shadows. LED solutions are available here. Integrated in handrails or steps, they help dispel insecurity.



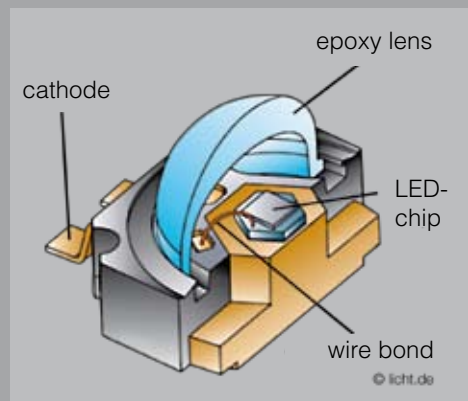
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# Lighting Special: LED – The light source of the future

LEDs are making great strides towards the bright future forecast for them in the lighting market – helped along by advances in luminous efficacy, lighting quality and lifespan. Whether they are marketed as modules, retrofit lamps or LED luminaires, only high-quality products achieve the performance levels reported in the press.

LEDs (Light Emitting Diodes) produce light – but that is just about all they have in common with conventional lamps. Traditional light sources are either thermal radiators with a filament, such as incandescent and halogen lamps, or they work on the principle of gas discharge. Low-pressure models here include fluorescent lamps, compact fluorescent lamps and energy-saving lamps; among the high-pressure discharge lamps are mercury vapour, sodium vapour and metal halide lamps. LEDs, however, are electronic semiconductor elements.

## How LEDs work



An LED is essentially a p-n semiconductor diode and thus has the same basic characteristics. When an electrical current is passed through the solid crystal, the crystal starts to glow, i.e. it "emits" light. This process, known as electroluminescence, is the reason for the "cold" beam of light that an LED projects. In contrast to incandescent lamps, LEDs do not radiate heat in the direction of light emittance but they still give off heat, which needs to be dissipated by heat sinks to ensure the operating conditions needed for energy efficiency and longevity. LEDs always produce narrow-band (=monochromatic) radiation. Spectral

range and efficiency can be influenced by careful selection of semiconductor materials – gallium arsenide and indium gallium nitride are the most widely used – as well as by doping. Apart from the "standard" light colours red, green, yellow or blue, there are now a whole range of application-specific nuances, e.g. for food lighting or corporate livery.

To simplify electrical contacts and protect the LED from environmental influences, the chip is encased in a transparent plastic housing. Integrated reflectors ensure that light radiates upwards at angles up to 180°. The light is directed by lenses.

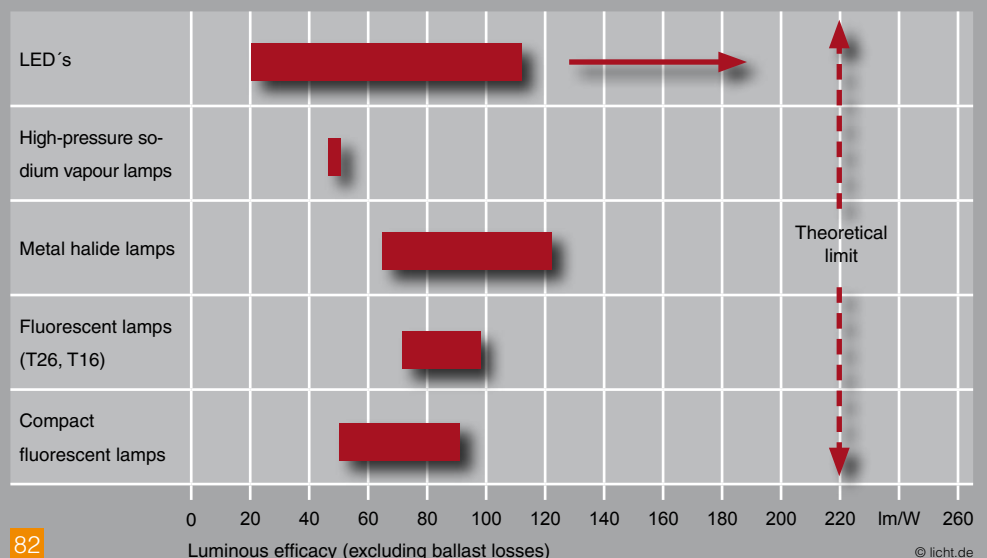
## Efficiency and luminous efficacy

Provided that the specified operating parameters are observed, LEDs are extremely efficient light sources. The first LED, produced in 1962, achieved a luminous efficacy of 0.1 lumen/watt (lm/W). Today, ratings in the region of 70 lm/W are standard for the most efficient light colour,

daylight white. High-performance LEDs already reach 100 to 120 lm/W – which is in the same range as the 100 lm/W efficacy achieved by fluorescent and metal halide lamps. Under laboratory conditions, 150 lm/W has been achieved at 700 mA constant current. Incandescent lamps are poor performers by comparison, delivering only around 10 lm/W, while halogen lamps do moderately better at roughly 20 lm/W, albeit in warm white.

## Long life

LEDs have a very long service life. While a fluorescent lamp burns for around 18,000 hours and an incandescent lamp fails after just 1,000 hours, LEDs have a rated life of about 50,000 hours. And in actual fact, they burn longer. The end of an LED's life is defined as the point at which luminous flux drops to 70 percent of the original rating – it still produces light beyond that. In practice, LED longevity makes for a virtually maintenance-free system because there is no need for lamp





replacement. However, LED luminaires still require cleaning. An LED luminaire in operation for 11 hours a day, 250 days a year, will last for around 18 years.

However, the length of an LED's life hinges crucially on operating and ambient temperatures. The colder the location, the more efficiently LEDs work. Conversely, their performance is impaired by high ambient temperatures; their luminous flux diminishes and their life can be significantly shortened. So effective heat dissipation is a major issue in the development of high-performance LED systems.

### LED modules

LED modules are a versatile light source permitting totally new design solutions. As encapsulated modules, they require no housing and can be directly recessed, for instance, in floor or ceiling ducts. As individual modules, they are integrated in minimalist LED luminaires and, with an appropriate base, serve as replacements for many conventional lamps.

**Linear LED** modules are useful for both wallwashing effects and for architectural lighting, where they give depth to facades and arches or can be placed end to end to realise seamless lines of light.

**Flexible LED modules** are particularly good at highlighting curves, corners and arcing

surfaces, so they lend themselves well, for example, to illuminating or back-lighting lettering or handrails.

**Planar LED** modules are normally available as ready-to-use LED panels with diffuse glass or plastic surfaces for use as light tiles or in complete luminous ceilings. With an appropriate control system, modules can be connected together to realise large-area displays.

**LED chains** are used for backlighting surfaces, e.g. in light advertising.

### Retrofit lamps: LEDs with base









LEDs with a pin or screw base are a special module variant. Models are available in classical "light bulb" design with a E14 or E27 screw base to replace conventional incandescent lamps; others feature a variety of pin bases to replace halogen lamps. Simply inserted into existing luminaires and delivering warm white or coloured light, retrofit LED lamps are an energy-saving alternative for home or small office use. However, they do not match the luminous efficacy of a specially designed LED luminaire. Even so, they are a good choice: an 8 W warm white LED light bulb, for example, has a life of around 25,000 operating hours – which is almost 25 years at nearly three hours a day.

### Quality features

LEDs are in vogue. However, only quality products offer the promised lighting quality, luminous efficacy and longevity – not to mention electrical reliability. Inferior systems tend not to reveal their weaknesses until they are in operation. The moderate extra investment at the outset definitely pays off.

[82] Comparison of the efficiency of different light sources.

[83] Growth potential of LED technology for various applications.

								
	Shelf lighting	Cornice lighting	Refrigeration cabinets	Emergency lighting	Shop window lighting	Parking facility lighting	Building illumination	Outdoor advertising
Today	••	••••	••••	••••	•	••	••••	••••
In two years	•••••	•••••	•••••	•••••	••	••••	•••••	•••••
In five years or more	••••••	••••••	••••••	••••••	•••••	••••••	••••••	••••••

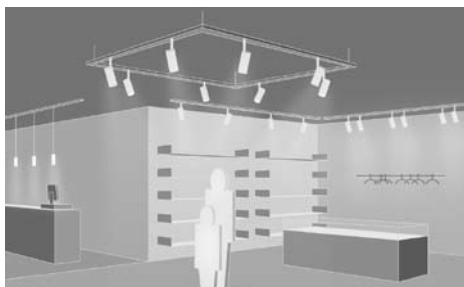
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## Luminaire applications

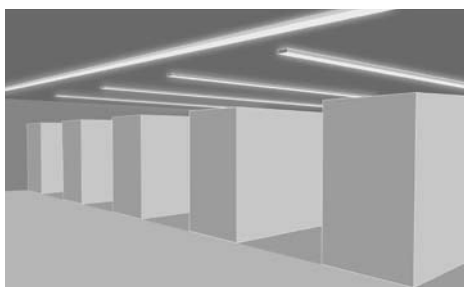
The range of luminaires and light sources for shop lighting is extremely diverse. To facilitate the search for the optimal luminaire and lighting effect, all the most important luminaire types are listed below together with their principal applications.

The term "luminaire" refers to the entire light fitting in which the lamp is mounted, operated and protected. The luminaire distributes and directs the lamp light and prevents it causing glare. Special attachments mounted on luminaires can alter light colour and colour rendering characteristics as required.

**Power track systems** provide flexibility: luminaires and spots can be mounted on adapters at any point on the track. The adapter also establishes the electrical connection: the conductor is enclosed inside the track. Power track systems come in three electrical designs – for low-voltage, single-phase and three-phase connection – and are suitable for surface mounting on ceilings, recessing in ceilings, pendant mounting on ceilings and mounting on walls.



**Continuous row systems** (linear fluorescent lamps) are end-to-end through-wired luminaires that can be fitted with a wide range of reflectors and louvers as well as spots. Because of their flexibility and efficiency, these systems are a good and variable solution for supermarkets, DIY centres and discount stores.



**Lighting channel / recessed lighting systems** offer a high degree of flexibility for adapting lighting to changing product presentations. Combinations of elongated luminaires and high-performance spots are possible. Operating gear can be easily integrated.



With **recessed ceiling luminaires**, the luminaire housing is set into the ceiling, so the luminaire enclosure is flush with the surrounding surface. The only part of a recessed luminaire that impacts on interior design is thus its light, which is one of the reasons why recessed spots are so popular with architects and interior designers.



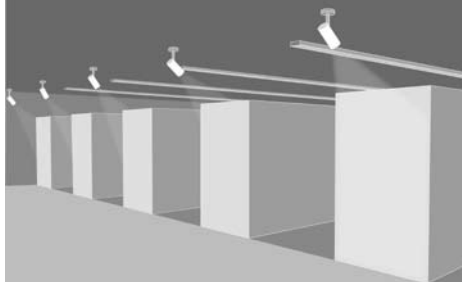
**Rotatable/swivel-mounted recessed luminaires** enable spots to be set at any angle – e.g. in showrooms. They can be set and focused by servomotors.



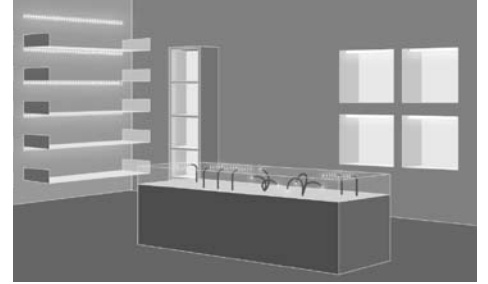
**Recessed panel luminaires, light walls and luminous ceilings** produce diffuse to moderately directional light and are particularly suitable for indirect lighting.



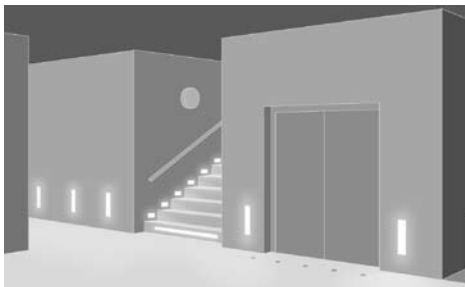
**Rotating/swivel-mounted surface luminaires** are generally mounted on the ceiling; the luminaire housing is fully visible.



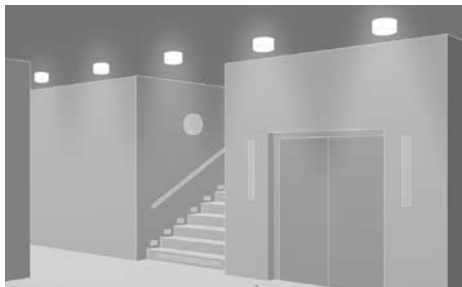
**Showcase luminaires:** small dimensions make fibre-optic lighting systems and LEDs particularly good for illuminating items in display cabinets.



Flush mounted and low key, **recessed wall luminaires** submit to the architecture. They are often used for step lighting.



With **fixed surface luminaires**, the visible luminaire housing forms part of the interior and is thus an element of architectural design.



**Standalone/table luminaires** are generally used in shops for decorative lighting; they create a homely atmosphere.



**Recessed floor luminaires** radiate light upwards. They are available with narrow- or wide-angle, symmetrical or asymmetrical intensity distribution curves.



**Wall luminaires** are suitable for decorative lighting and are often installed as part of the general lighting or as an additional source of accentuating light.



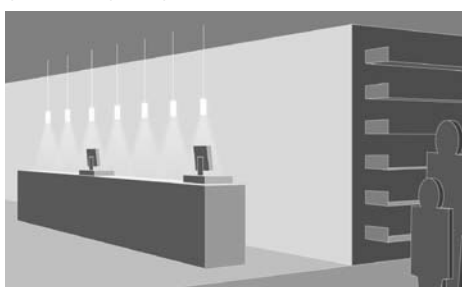
**Projector-reflector lighting systems** deliver high illuminances. They are used to ensure optimal visual conditions in high enclosed spaces, especially shopping malls.



**Cove luminaires** are installed for indirect lighting in the curving, often moulded plaster transition between walls and ceiling. The light sources used are fluorescent lamps or LEDs.

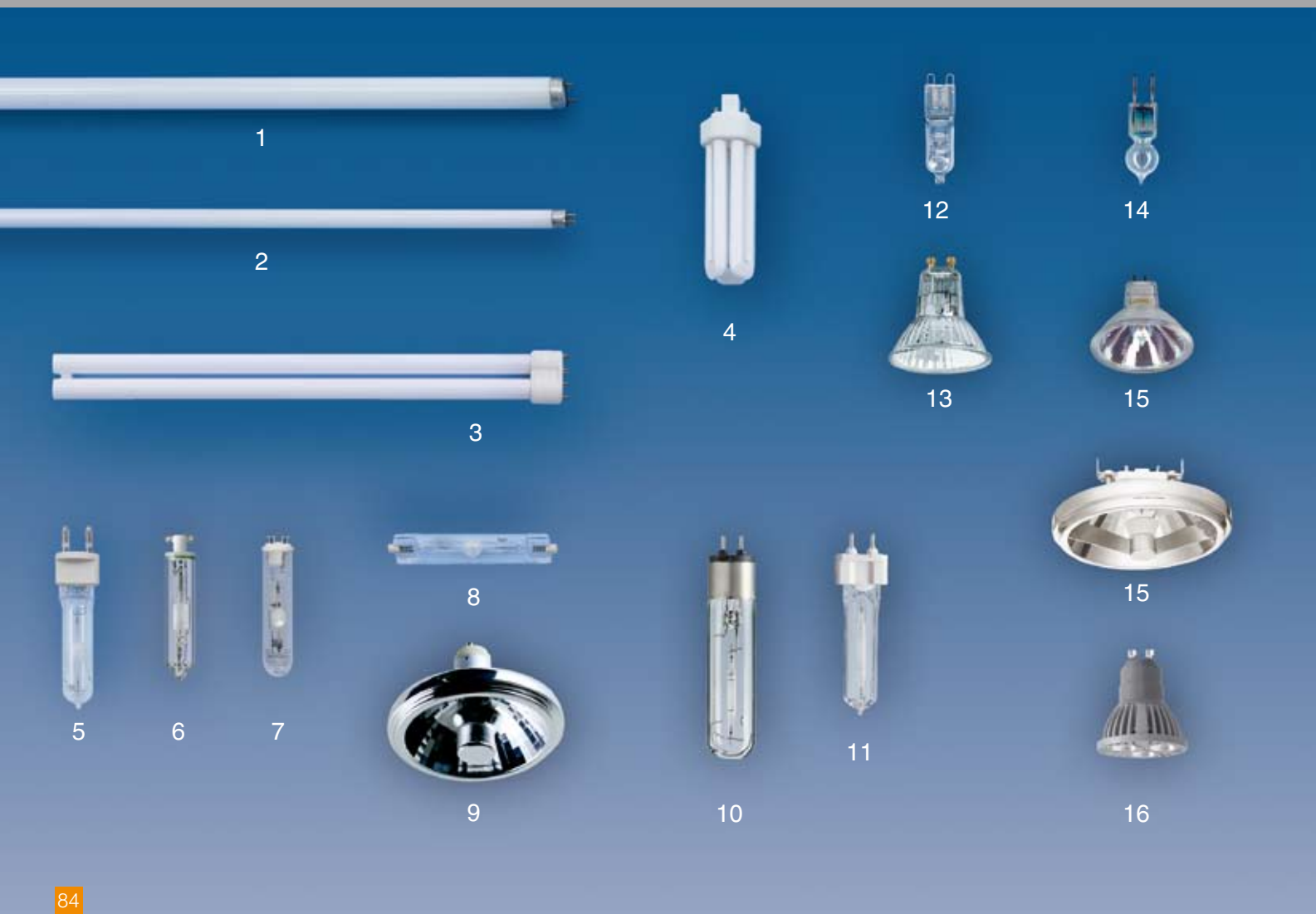


**Pendant luminaires** are suspended from the ceiling and are particularly popular in shops for counter or product presentation lighting. Reflector models also used for general lighting.



The low lighting provided by **emergency and safety luminaires** is enough to facilitate orientation and allow the building to be vacated safely.

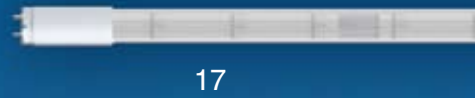




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Lamp type		Fluorescent lamp Ø 26 mm	Fluorescent lamp Ø 16 mm	2-tube lamp elongated design	3-or 4-tube lamps compact design	Single capped with ceramic technology	Single capped with ceramic technology	Single capped with ceramic technology	Double capped with ceramic technology	Reflector shape with ceramic technology	Tube shape	Tube shape
		1	2	3	4	5	6	7	8	9	10	11
		Linear fluorescent lamps		Compact fluorescent lamps		Metal halide lamps					High-pressure sodium lamps	
Power rating (W)	from to	14 58	14 80	7 80	10 42	20 150	20 35	35 70	70 150	20 70	35 100	50 100
Lichtstrom (lm)	from to	750 4,600	1,100 7,000	250 6,500	600 3,200	1,700 15,000	1,650 3,000	3,300 7,300	6,800 14,500	2,200* 55,000*	1,300 5,000	2,400 4,900
Luminous flux (lm/W)	from to	50 81	67 104	46 90	60 75	71 106	75-79	85 100	88 104	- -	40 50	48 50
Light colour		ww, nw, dw	ww, nw, dw	ww, nw, dw	ww, nw, dw	ww, nw	ww	ww, nw,	ww, nw,	ww, nw	extra WW	extra WW
Colour rendering index $R_a$ (in some cases as range)		80-98	80-93	80-90	80-90	80-95	85-90	93-96	88-95	82-90	80-83	80-83
Base		G13	G5	2G11 2G7	GX24q G24q	G12	PGJ5	GU8.5	RX7s	GX8.5	PG12-1	GX12-1

# Lighting Special: Light sources



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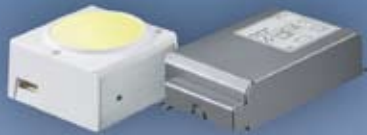
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19



20



21

## Fluorescent lamps [1, 2]

The distinguishing features of fluorescent lamps include high luminous efficacy, good colour rendering and longevity. Electronic ballast (EB) operation – a must for 16 mm diameter lamps – improves their energy efficiency and quality of lighting.

## Compact fluorescent lamps [3, 4]

Compact fluorescent lamps offer the same qualities as regular fluorescent lamps but because of their compact form, can be integrated into different luminaire designs.

## Metal halide lamps [5-9]

Metal halide lamps have always been popular for their brilliant light and are proving the light source of choice for attractive shop lighting, even in exclusive boutiques. Lamps with ceramic burner technology offer even higher luminous efficacy – up to 100 lm/W – which makes them significantly more energy-efficient.

## High-pressure sodium vapour lamps [10, 11]

High-pressure sodium vapour lamps with ceramic burners are often used in supermarkets, largely because they have the wavelength spectrum required for both bakery product and fresh and processed meat lighting.

## Low-voltage halogen lamps [12, 13]

Low-voltage halogen lamps deliver a brilliant light with very good colour rendering properties. They need to be operated by a transformer that reduces the voltage to 12 V. With appropriate transformers, they can also be dimmed.

## High-voltage halogen lamps [14, 15]

High-voltage halogen lamps are widely used in shops – also as reflector models – because of their brilliant and agreeable light. They also have a very good colour rendering index ( $R_a$  100) and are fully dimmable.

## LED lamps [16, 17]

LED lamps are available today in many shapes and base designs. With a lifespan up to 30,000 hours, they are an extremely long-life, energy-efficient substitute for conventional halogen lamps (type 16). Used to replace fluorescent lamps, they change the way the light is distributed. Electrical reliability needs to be guaranteed by a professional.

## LED modules [18-21]

LED modules – comprising LEDs, wide-angle lens and reflector – are the future solution for technical and decorative shop lighting, not least because of the high luminous efficacy they now achieve. LED systems specifically designed for refrigerated cabinets and freezers make the most of LEDs' special characteristics at low and sub-zero temperatures.

Tube shape	Reflector shape	Tube shape	Reflector shape	Reflector shape	Tube shape Ø 26 mm	LED module	LED module	LED module	LED module
12	13	14	15	16	17	18	19	20	21
High-voltage halogen lamps		Low-voltage halogen lamps		LED lamps		LED modules			
18	20	5	10	4,5	24	11	8	9	17
140	75	100	100	10		30	12	39	44
200	380*	60	350*	450*	1,200	750**	600*	800	1,100
2,800	950*	2,200	33,000*	1,200*	1,550		1,350*	3,000	3,000
11	-	12	-	-	51	-	-	55	55
20	-	30	-	-	66	-	-	75	75
ww	ww	ww	ww	ww, nw, dw	ww,nw, dw	ww, nw	ww, nw, dw	ww, nw	ww, nw
100	100	100	100	80-90	70-90	75-80	80-90	80-95	80-90
G9	GZ10 GU10	G4 GY6,35	GU5,3 GU4 G53	GU10	G13	-	-	-	-

\* = in candela  
 \*\* = in lux  
 ww = warm white colour temperature below 3,300 K  
 nw = neutral white colour temperature 3,300 K to 5,300 K  
 dw = daylight white colour temperature over 5,300 K

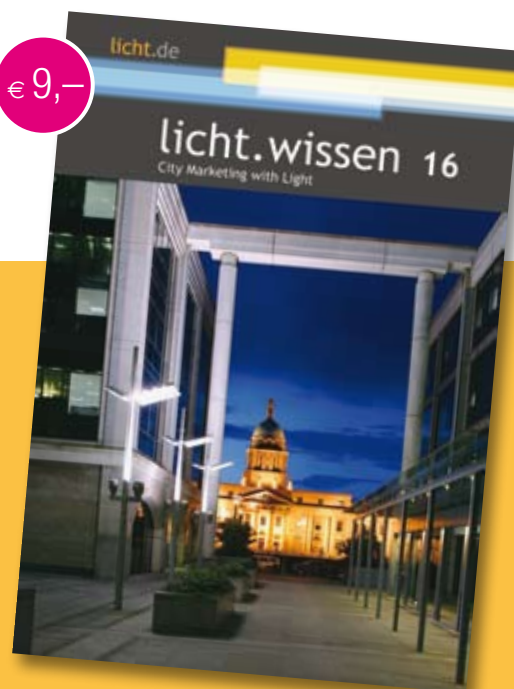
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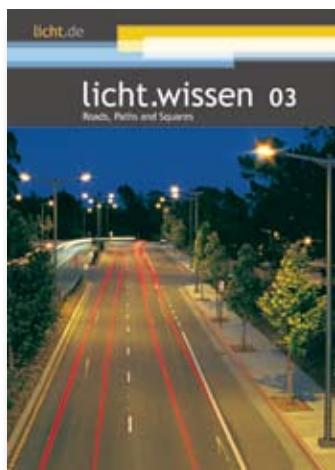
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