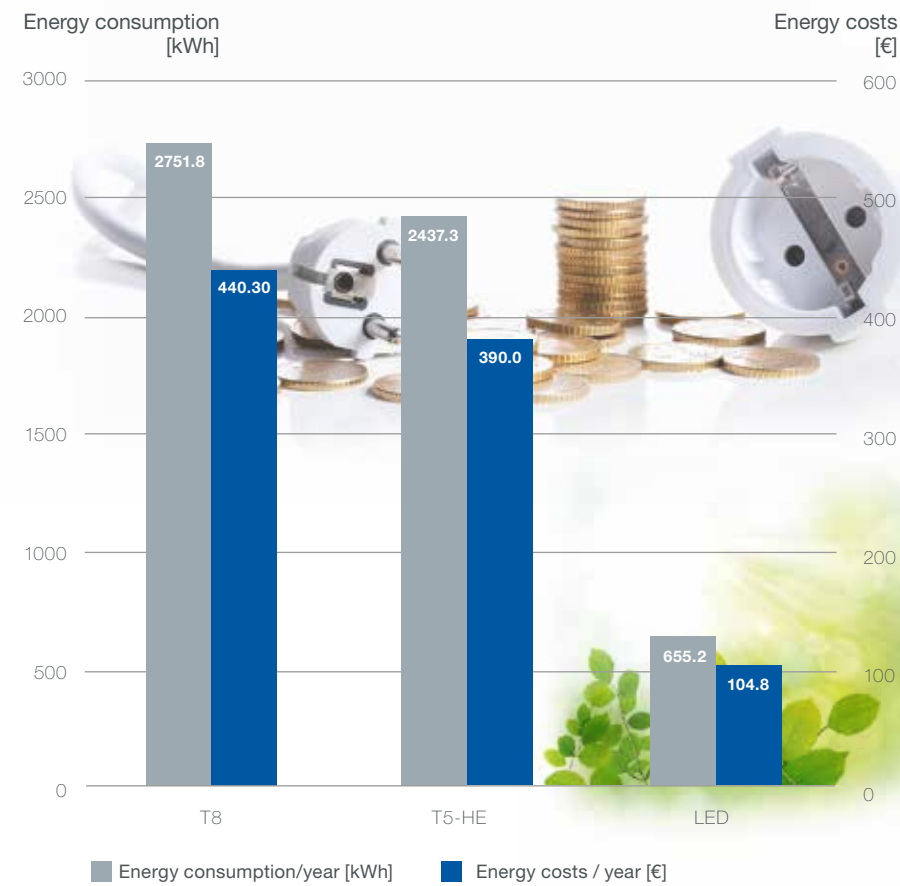


Economic benefits

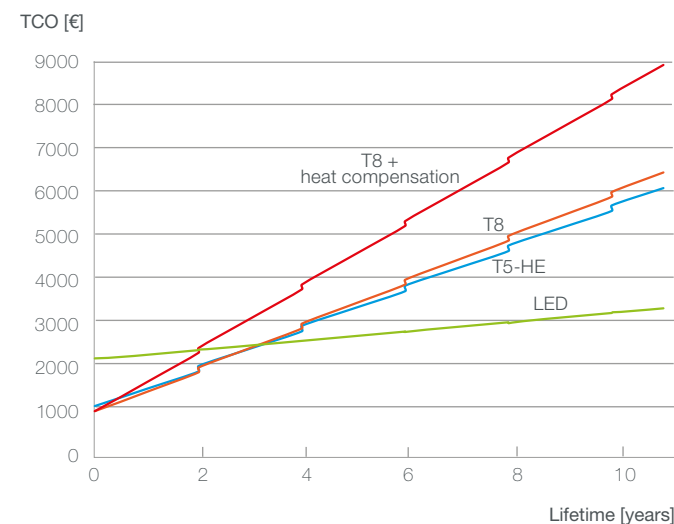
Different perspectives lead to different results: In the short term LED applications with their higher initial investment cannot compete. But in the long term, taking a total costs of ownership (TCO) approach, LED luminaires win hands down.

The TCO calculation takes into account all the factors affecting the cost-effectiveness of a device, i.e. not only the purchase price but also the lamp life (fluorescents are usually replaced approximately 4-5 times during the life of a display case, whereas the life of an LED lamp usually exceeds that of the display case), energy used (direct power input but also indirect requirement – increase in refrigeration load), etc.

Pure Energy and Costs Comparison*



Total Costs of Ownership*



*Calculations are based on:

- Multideck length 3.75m
- Illuminated canopy and 5 rows of shelves
- Lights on 14 h/day, 6 days/week, 52 weeks/year
- Energy costs €0.16 per kWh
- Relamping fluorescents every 2 years, €6 per tube (price + work)
- T8+ costs including additional refrigeration load to compensate extra heat emitted by fluorescent tubes
- Year 0 – initial investment

Source: Carrier Mz-RDC

LED - economic benefits

Brief lighting glossary

An **LED lamp** is a solid-state lamp that uses light-emitting diodes (LEDs) as its source of light.

Light (visible light) is a range of electro-magnetic radiation that can be detected by the human eye and is thus responsible for the sense of sight. The wavelengths in this range are approx. 380 nm (nanometers) to approx. 740 nm – between invisible ultra-violet light with shorter wavelengths and invisible infrared light with longer wavelengths.

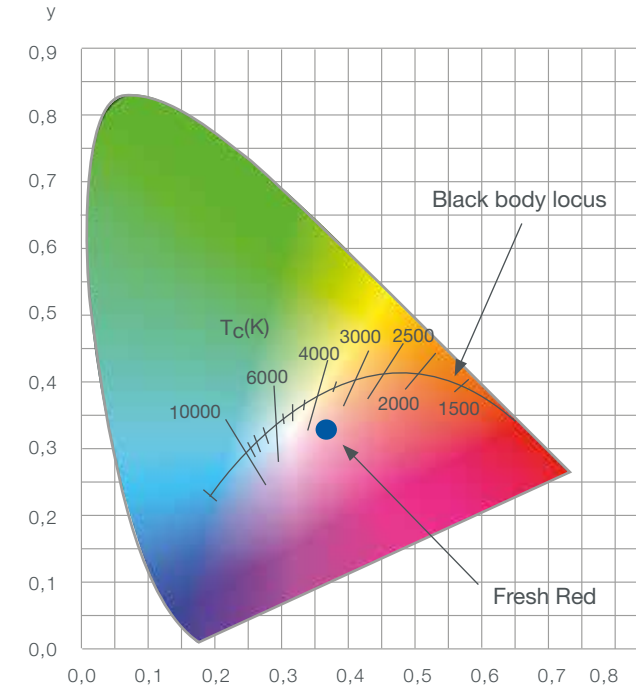
The **color temperature** describes the hue of a light source by comparing it to the radiated light of an ideal black body radiator (basically a piece of metal) which is heated up to a certain temperature in Kelvin (K). It goes from deep red at low temperatures through orange, yellowish white (warm colors), white, and finally bluish white (cool colors) at very high temperatures.

Many light sources, such as fluorescent lamps or LEDs, emit light primarily by processes other than thermal radiation. This means the emitted radiation does not follow the form of a black body spectrum. These sources are assigned what is known as a **correlated color temperature (CCT)**. CCT is the color temperature of a black body radiator which to human color perception most closely matches the light from the light source.

A further attribute of the light sources is the evenness of the radiation emitted (light). Some sources may suppress some wavelengths (colors). For example the lack of a red component in the emitted light spectrum will make the red color of the specified object indistinguishable.

The **color rendering index (CRI)** is a quantitative measure of the ability of a light source to faithfully reproduce colors of various objects in comparison with an ideal or natural light source. The higher the CRI, the richer the colors appear. An incandescent lamp has a CRI of 100 (which is the possible maximum). CRI rating comparison of different (monochromatic!) light sources is possible only when their color temperatures are close to each other.

The **CIE 1931 xy chromaticity diagram** describes every hue distinguishable by the human eye with xy coordinates.



The CIE 1931 xy chromaticity diagram including the black body locus and the crossing lines of constant CCT.

The **black body locus** is the path showing the color coordinates of a black body radiator depending on its temperature. The crossing lines define the color coordinates for one CCT of a light source. This description however isn't unambiguous. Therefore, the xy-coordinates are more precise definition of a light color.

A piece of advice...

Combined together, the CRI and CCT can give a numerical estimate of what reference (ideal) light source best approximates a particular artificial light, and what the difference is.

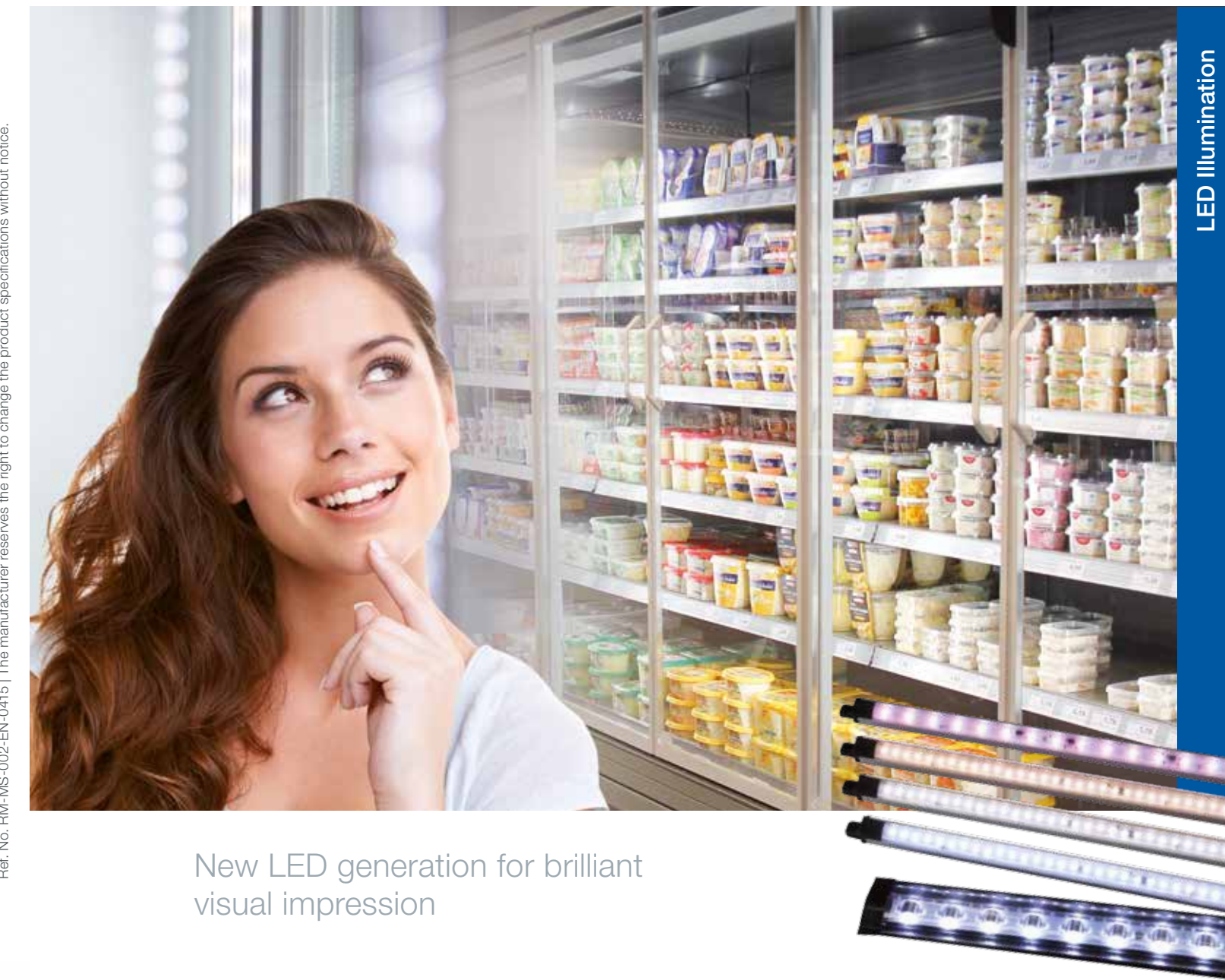
However, it should be noted that CCT and CRI are only two objective values of many used to describe the light source and do not bear full information about the light quality (luminosity, distribution, uniformity etc.) or color perception to the human eye.

Likewise, it can be said that a higher CRI rating is more important for fresh fresh food (ie. meat, fruit & vegetables, etc.) to highlight its natural look, while for packaged food (with a printed exterior) this is not the case.

Ref. No. RM-MS-002-EN-0415 | The manufacturer reserves the right to change the product specifications without notice.



LED Illumination



New LED generation for brilliant visual impression



Carrier Commercial Refrigeration is a leading supplier of high-efficiency turnkey refrigeration systems and services in the food retail industry.

www.carrier-refrigeration.com
www.carrier.com



LED luminaires – unbeatable performance with low energy consumption

Illumination benefits

- Elaborated light distribution of each application
- Range of colors to highlight the appeal of different food categories
- No UV or IR radiation produced having a harmful effect on merchandise

Economic benefits

- Low energy consumption
- Fast payback
- Long lifetime, no maintenance or relamping costs

Safety benefits

- Enhanced safety with 24 V supply (Safety Extra Low Voltage – SELV)
- Shock resistant

Environmental benefits

- Environmentally sustainable (no mercury, less waste)
- Lower CO₂ footprint

The appropriate illumination can dramatically enhance the visual impact of any product category. Depending on the merchandise displayed or cabinet type, the new Carrier LED lamps meet your requirements with flying colors.



Carrier LED family (from top left): canopy HO module, vertical center module, horizontal module and integrated module for High Efficiency Frame in vertical freezers.

The new Carrier vertical LED in MonaxEco cabinets assure perfect light uniformity along the merchandise.



Lighting merchandise to its best advantage

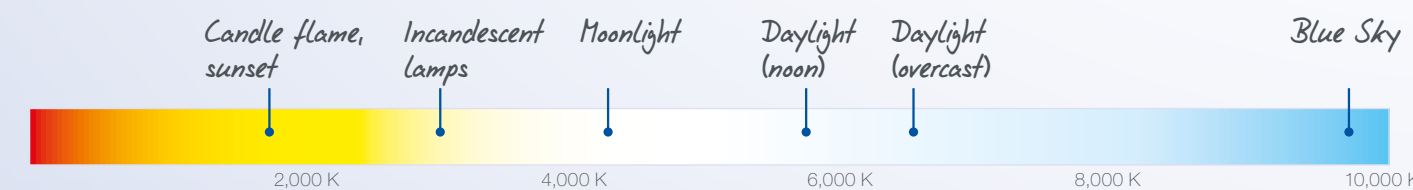
Available LED light colors for Carrier remote cabinets



Cool white: A common term to describe a color temperature above 5000K (Carrier LED lamps are 5700K). It has a slight bluish tint. For the vivid colors of frozen food packaging.

Neutral white: A common term to describe a color temperature of around 4000 K. A natural and soft light for realistic color rendering of fresh or packaged food.

Examples of common color temperatures



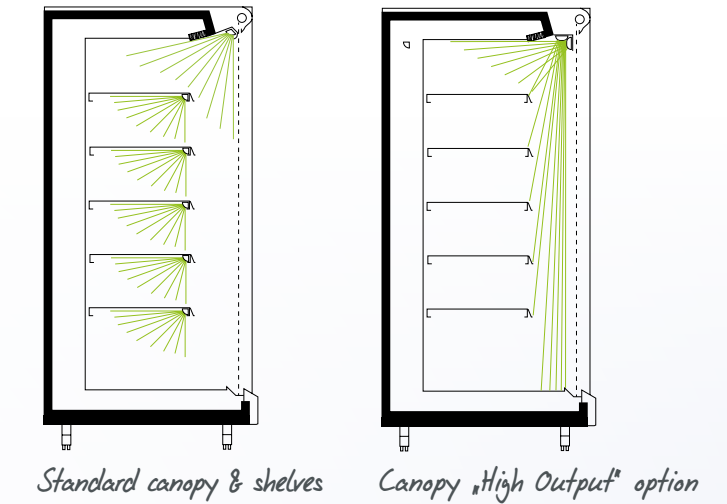
Warm white: A common term to describe a color temperature of around 3000 K. It has a slight yellowish tint. A typical choice for natural colors of fresh food, e.g. produce, cut salads, sandwiches etc.

Fresh red: An exclusive color mixture to underline the natural look and quality of fresh meat and sausages. A harmonious light with excellent illumination results (see color coordinates on the last page: x=0,39, y=0,33).

Outstanding results do not fall from the sky...

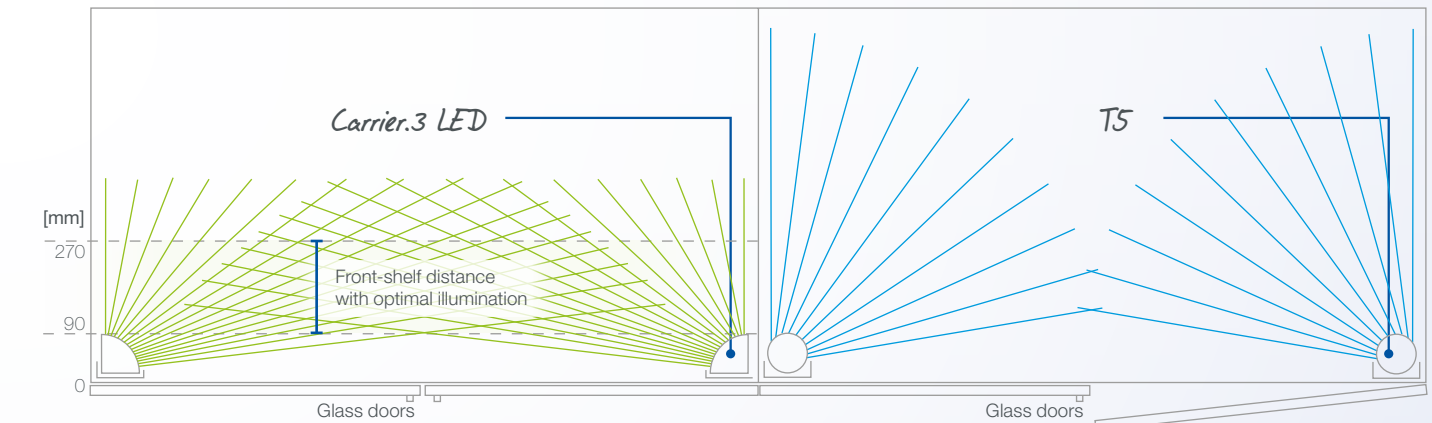
Carrier has endeavored to stay at the forefront of the rapid development of LED lamps. Our LED lighting technology meets exacting requirements for displaying merchandise to offer the highest quality presentation. The result is illumination without compromise, designed exclusively for Carrier cabinets to fulfill the highest expectations. Featuring integrated LED lighting in the new Velando® vertical freezer High Efficiency Frame, or as shown here, innovative lighting solutions for refrigerated multidecks.

Light distribution of horizontal lights

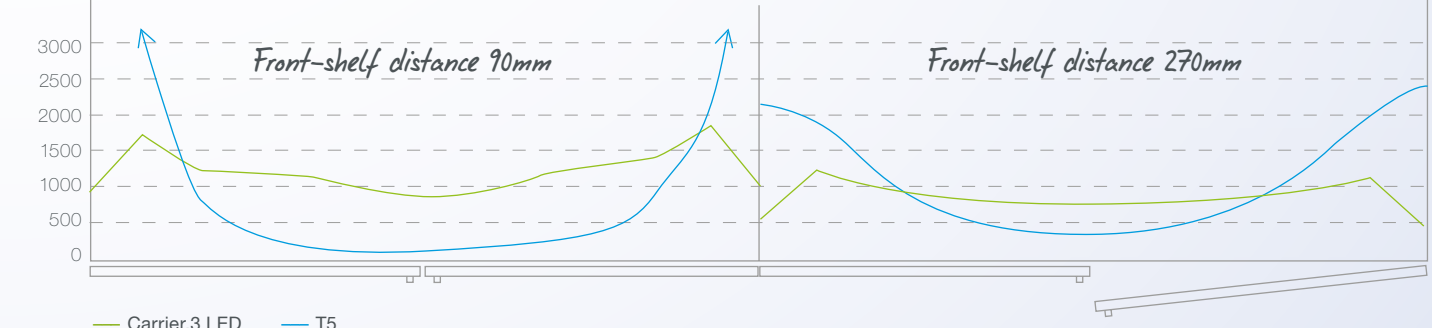


Comparison of light distribution of a standard canopy LED light together with shelf lighting and the new innovative „High Output“ (LED HO) luminaire. With only one fixture with stronger power and improved optics a similar illumination is achieved.

Light distribution within glass door multidecks (in door mullions, top view)



Illumination level (light uniformity) at front-shelf distance 90mm and 270mm



A common T5 vertical light solution shows a big amplitude of the luminous flux over the cabinet length and would need the support of a canopy lighting to unify illumination. By way of contrast, Carrier's new vertical LED luminaires brighten even the closest

distances evenly reaching the very middle area between the mullions. And all this with much lower energy consumption and greater reliability than fluorescents.

Source: Carrier Mz-RDC