

# The Science of Colour Rendering

**Colour Rendering Index (a.k.a. CRI or Ra) is a lighting metric that is often forgotten about, assumed or frankly deceiving. It is a numerical measure of a light sources ability to accurately represent, or render colours, with reference as to how they would appear under the sun.**



**CRI 60**

**CRI 70**

**CRI 80**

**CRI 90**

**In basic terms, this means that a low CRI light source can make colours appear different from how they were intended, and as a result of this, they can look flat and dull. On the other hand, High CRI light sources can represent colours much truer to how they were intended, but ( and there is always a but), this technology can sometimes come at a premium or traded off against luminaire efficiency.**

## Why is CRI important?

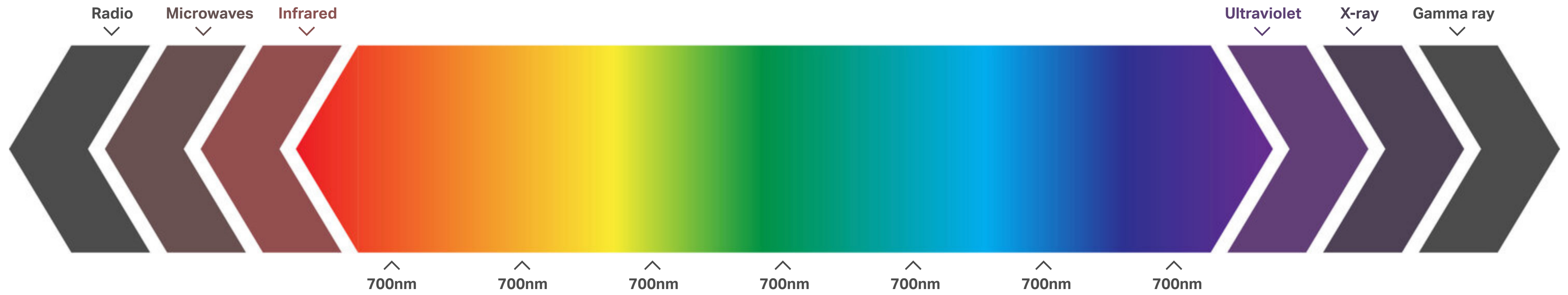
As designers, we want our spaces to feel natural, to feel familiar. Luminaires with a poor Colour Rendering Index can make our spaces disorientating, even down to how we see each other! A low CRI can make spaces feel dull, and make people look unhealthy with very washed-out skin tones. And why do we allow an interior designer to make bold choices with texture, pattern and colour if the lighting will undo all of this hard work?

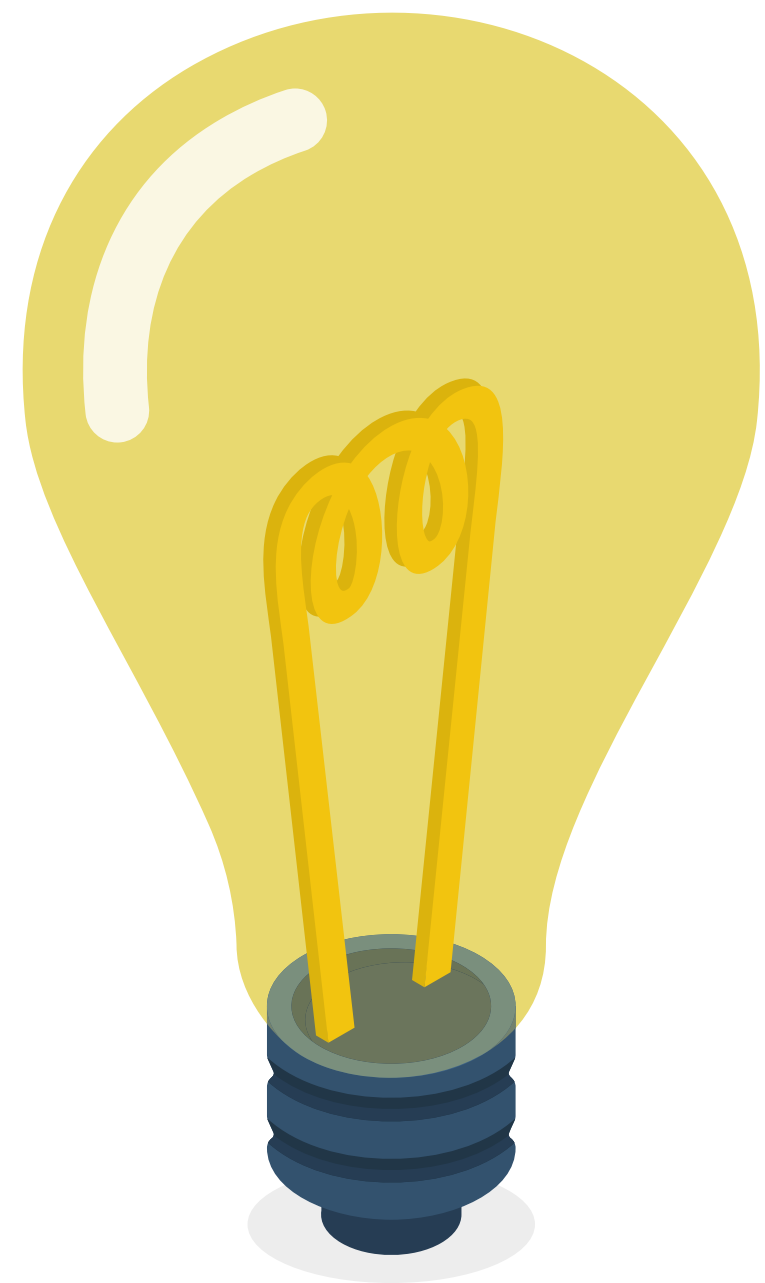
**CRI is especially important in colour-critical & human-centric applications. Think clothes shops, fruit and veg shops or meat counters (a dull steak isn't very appealing!) Think retail and showrooms all the way to restaurants, offices and meeting rooms.**

## Why do we reference the sun?

The sun is our perfect light source. The sun emits all radiation on the electromagnetic spectrum (think radio waves, microwaves, X Rays etc.) including visible light. It emits the entire visible light spectrum, which means that every wavelength that represents a different colour is emitted from the sun. When this light hits an object, some of these wavelengths are absorbed, and some are reflected. This reflected light is what we perceive as colour. A green wall looks green because it absorbs all wavelengths of light except for the green ones, which are reflected, and our eye detects these reflections.









The 299 team attended several site meetings with the design team, provided product samples and technical support for the project. We produced detailed lighting design and calculations including emergency lighting design.

**Over 172 hours of lighting design in total were used to secure and support this complex project.**

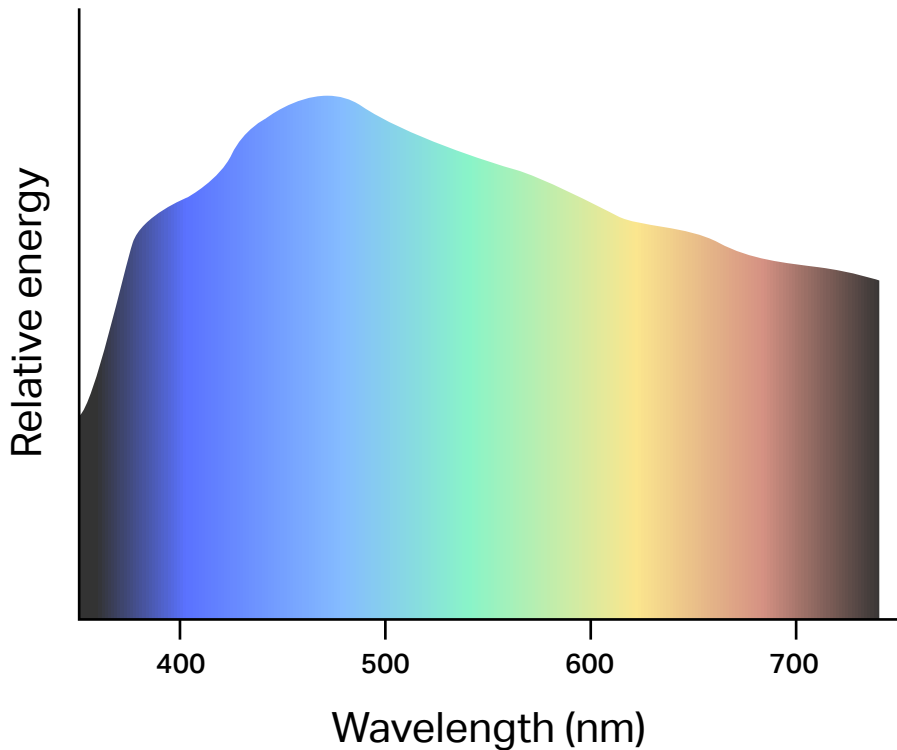


What LED manufacturers are trying to achieve is a spectral output, an output of as many wavelengths of visible light as possible, as similar to the sun's output as possible. This is quite difficult with an artificial light source.

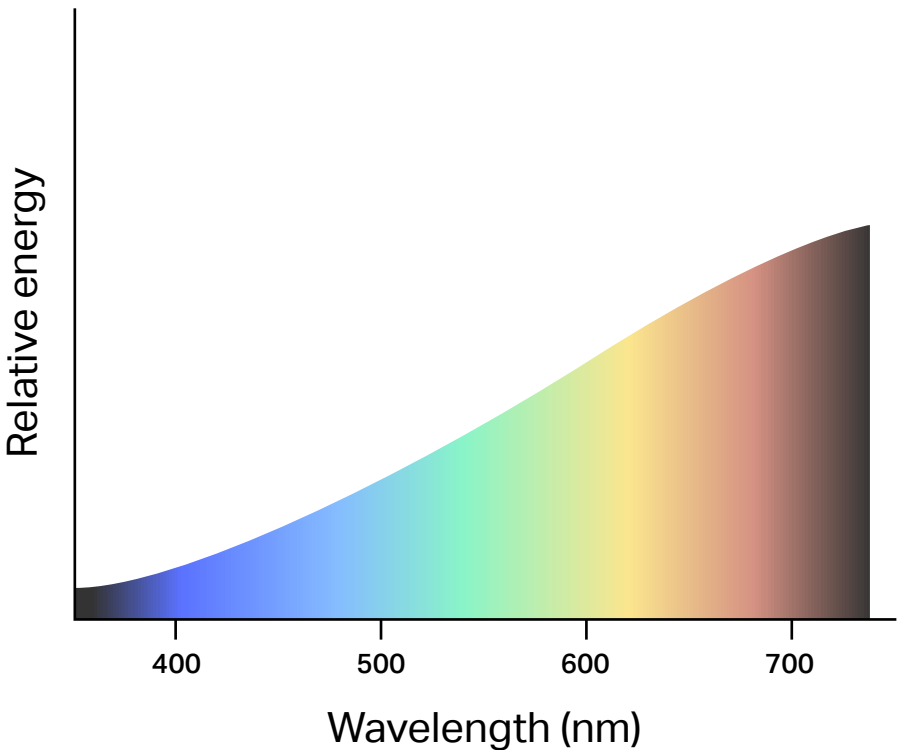
As you can see in the graphs to on the next page, although our light sources may appear 'white' their spectral outputs are all significantly different, with peaks and troughs in different wavelengths.

The peaks show the colours that the light outputs, whereas the troughs show the colours that the source is lacking. This image is just a typical example – different manufacturers and models will have different spectral outputs.

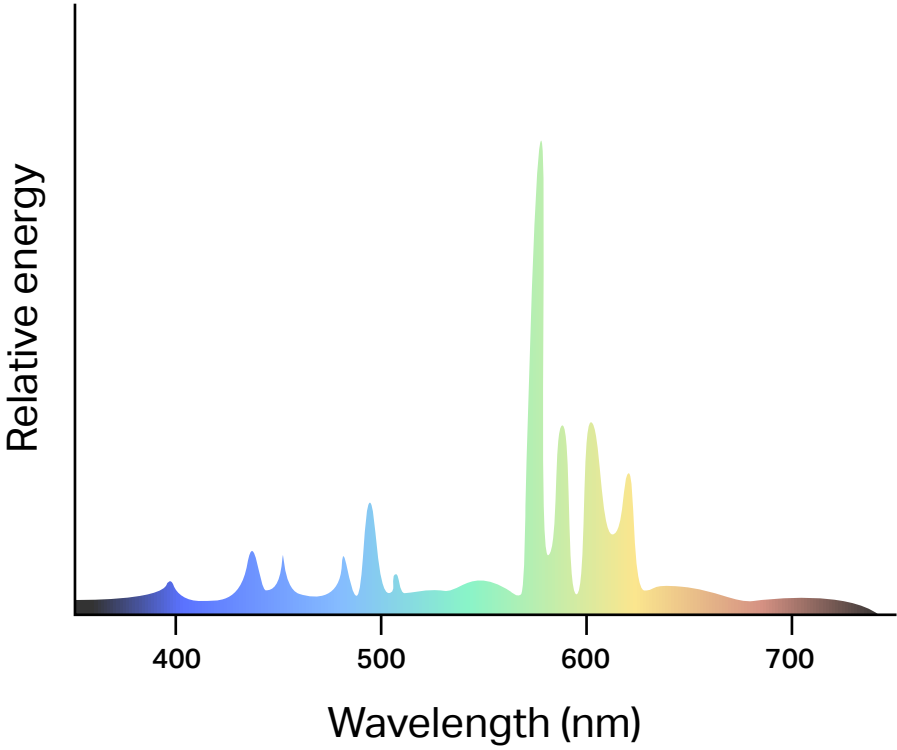
**Sunlight**



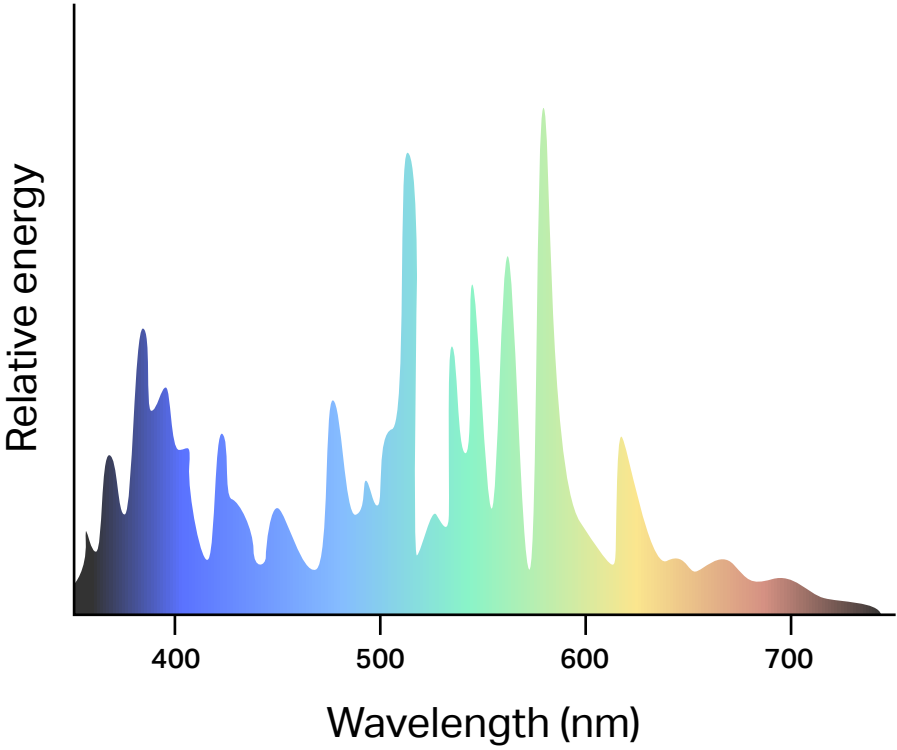
**Incandescent lamp**



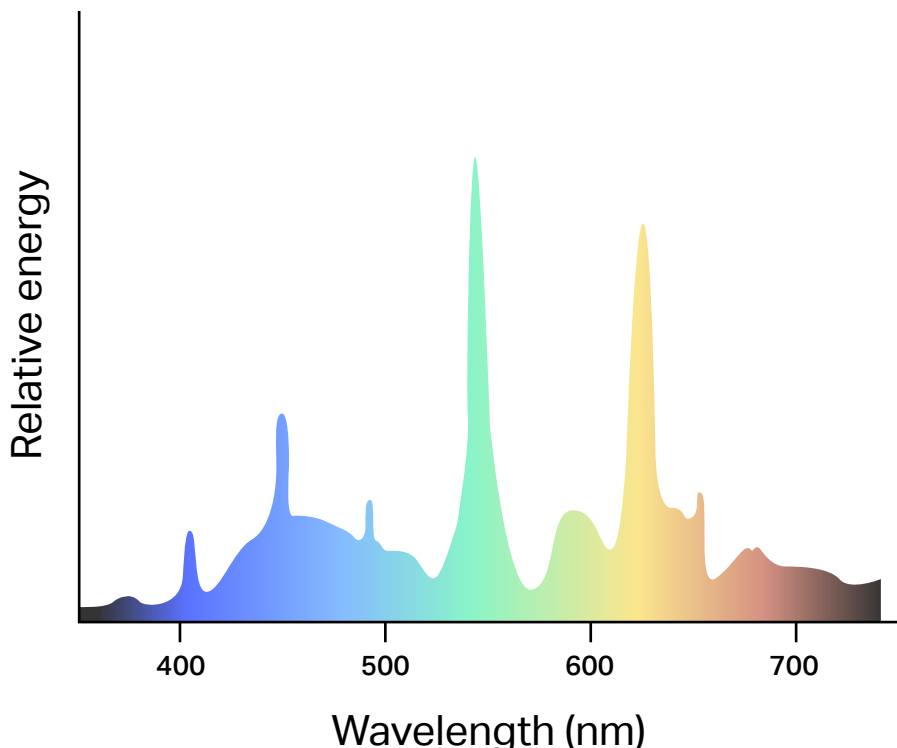
**High pressure sodium lamp**



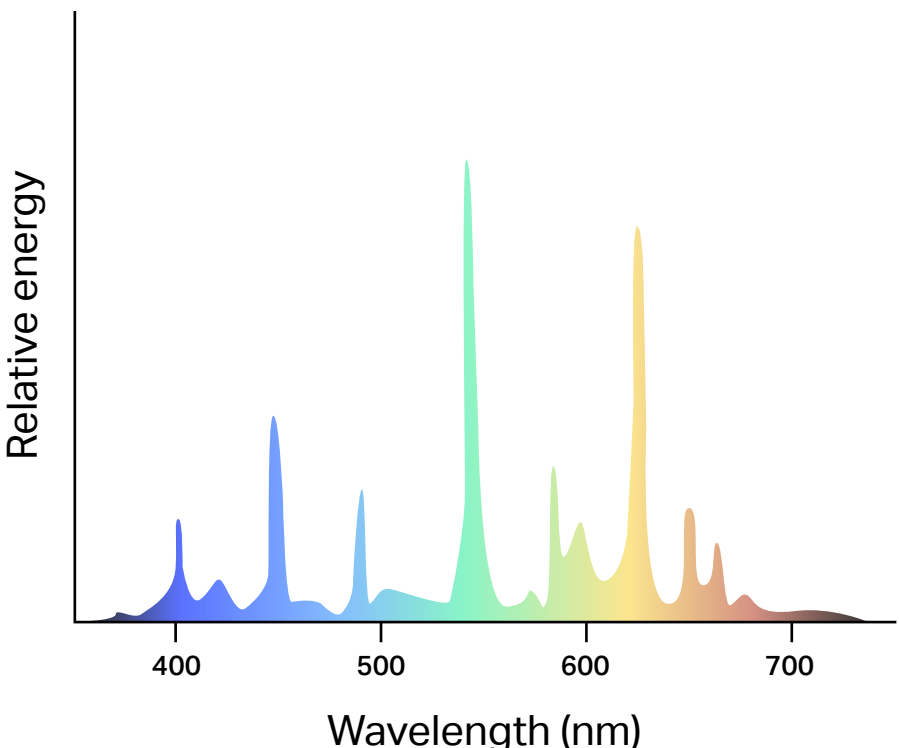
**Metal halide**



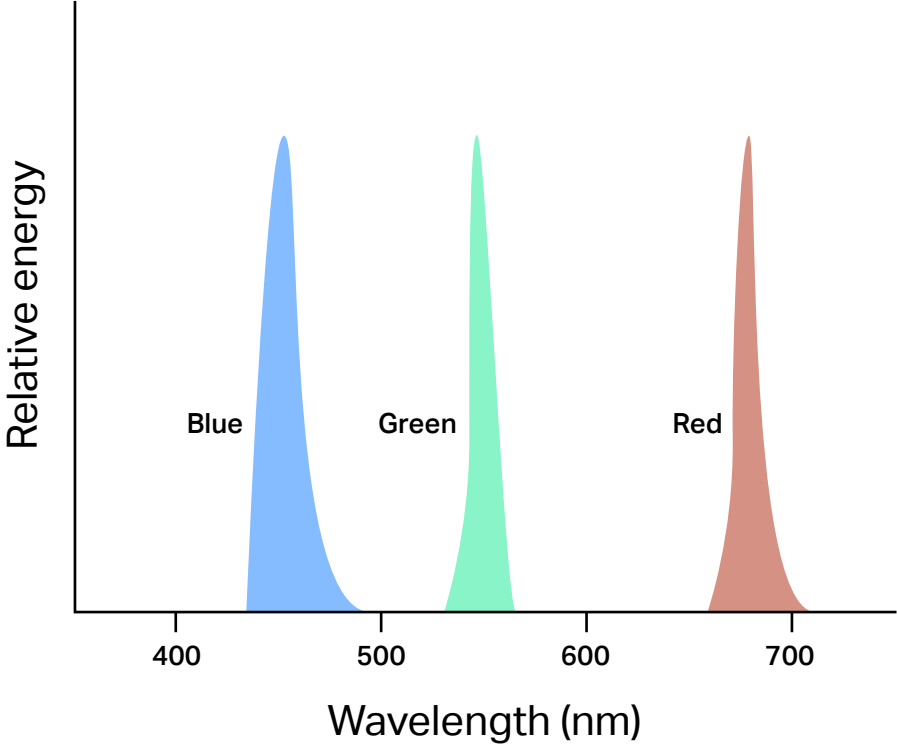
**Fluorescent lamp**



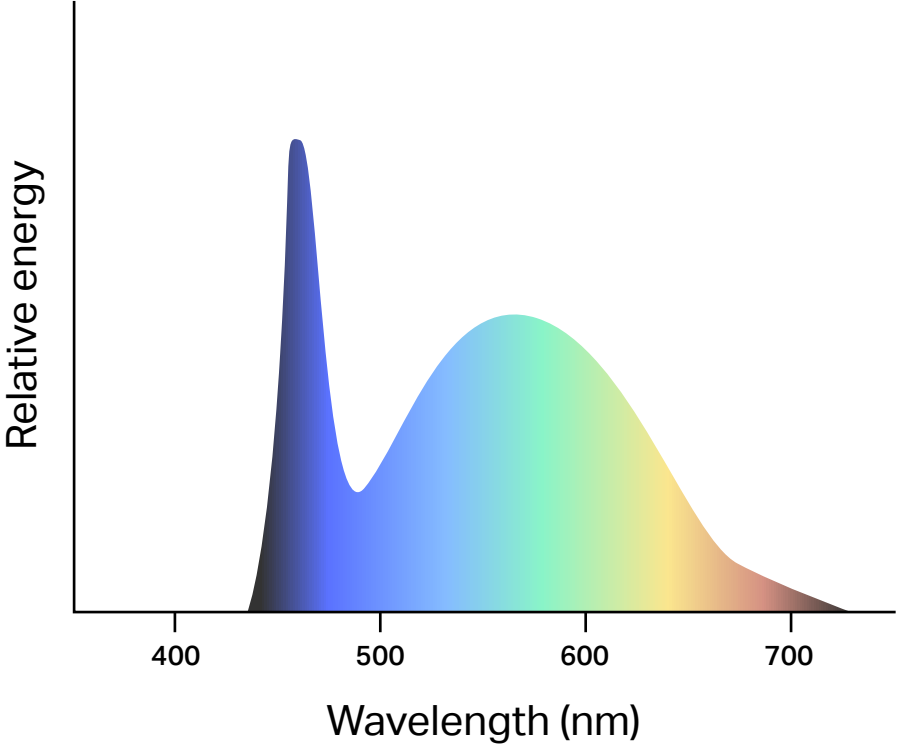
**High pressure mercury lamp**



**Monochromatic LEDs**



**White LED (Blue LED with phosphor)**

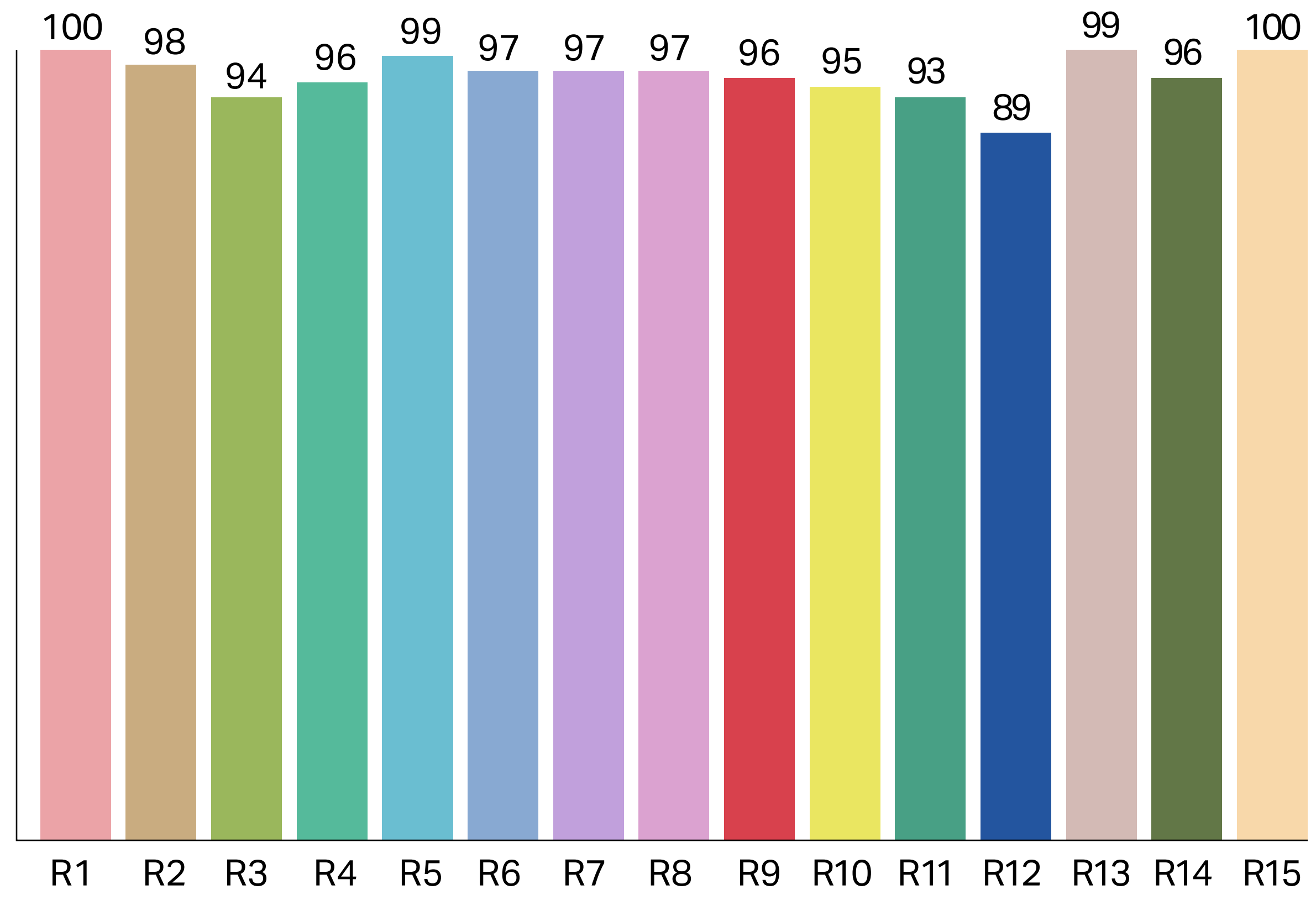


## So how do we really know if our luminaire has a good CRI?

A reputable luminaire manufacturer should have an array of test data available for their luminaire. Ask the manufacturer for the R9 value – this is the strong red measurement that is taken, but not included in the CRI calculation. This can work in conjunction with your CRI number – a high Ra and a high R9 would make for a good light source. A high Ra but a low R9 would give you a poor red representation.

Alongside the R9 value, you could also request the RE value. This is an extended CRI test, which does take into account the fidelity of the pallets R1-R15 i.e. the RE value has considered the red content of the light source, or ask for the colour rendering chart to see just how well each R-value is rendered.

Whilst CIBSE recommends a minimum of CRI80 for all front of house spaces in office projects, you should always consider the appropriate CRI value for your project – you may decide that you need higher.



CCT	CRI	CRI R9	TM30 Rf	TM30 Rg	CQS
3000 K	97.0	96.2	95.0	103.3	95.1

**CRI CASE STUDY:  
Eagle House, Bristol**



Eagle House is a property that was recently tenanted by Immediate Media, a large publishing company that run many of the nations favourite magazines. 299 Lighting designed and supplied the lighting for the full refurbishment of the building in 2018.

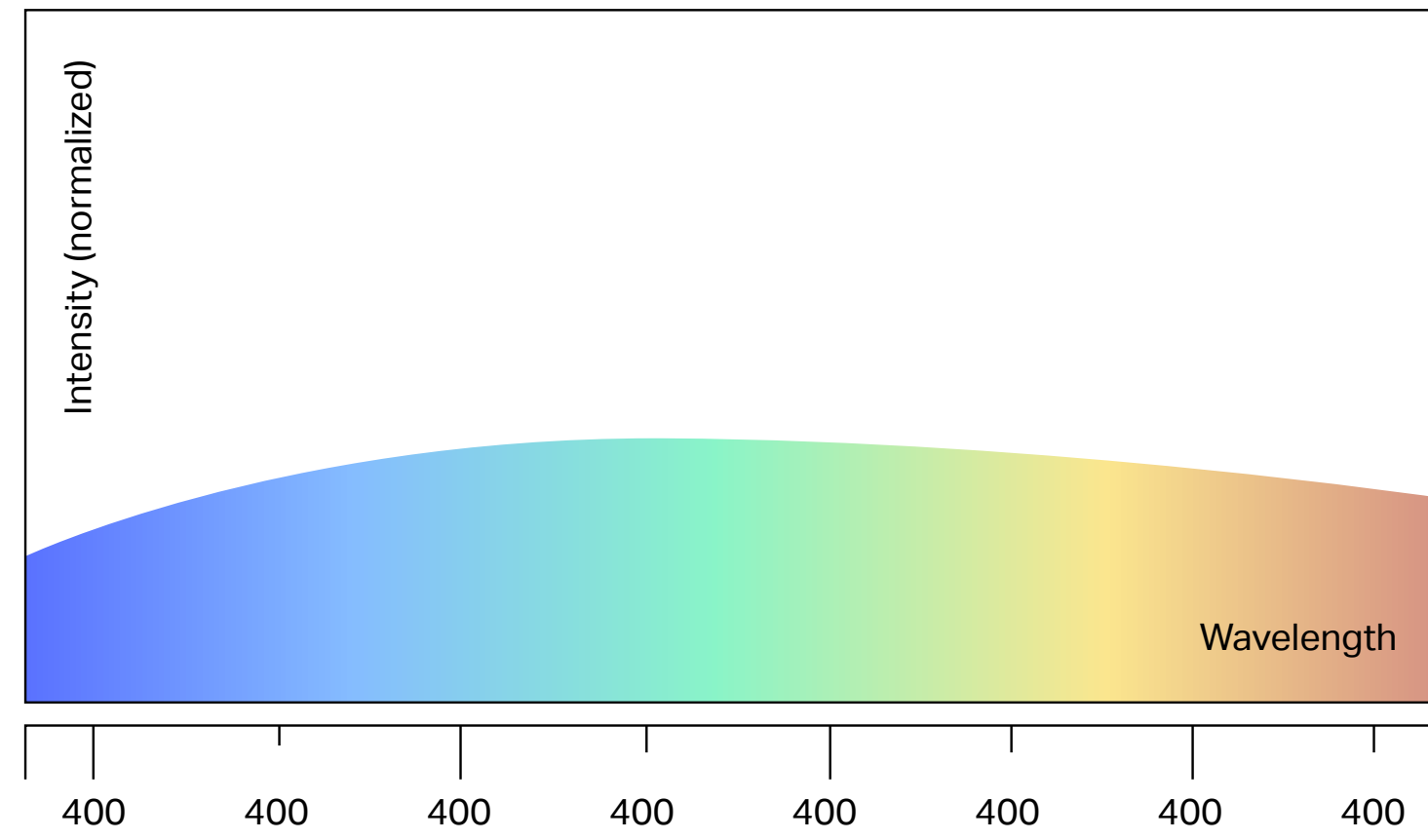




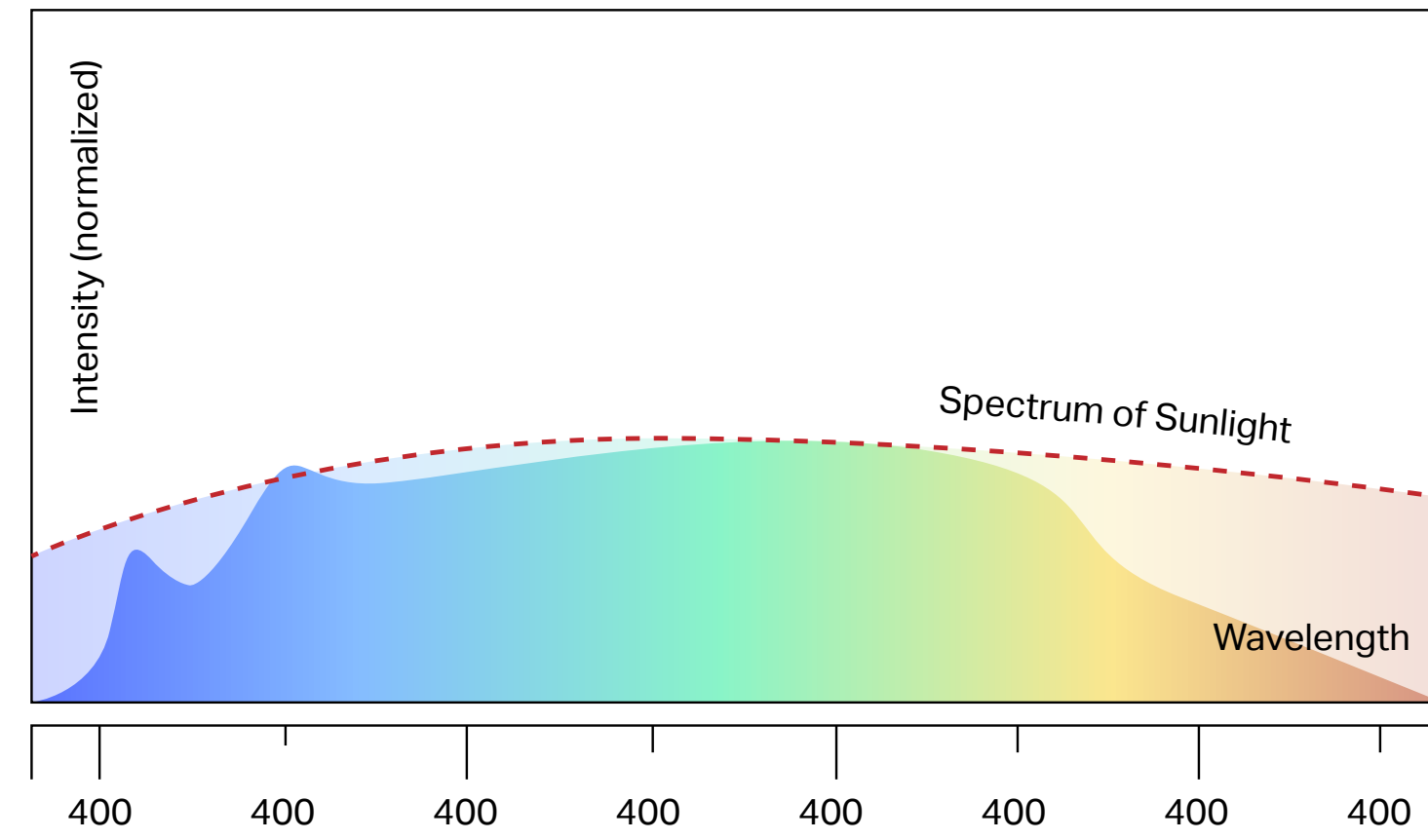
Whilst CRI80 was suitable for the office spaces, we had to consider some of the specialist areas. One of these areas, the reprographics room, was used to print material and test pages etc. For this space, we specified a special 'sunlike' LED chip – this is a high CRI (97+) LED with a spectral output that has been specifically engineered to match the spectral output of sunlight (or get as close as possible!). This meant that the printed material could be viewed under the artificial lights as true as it would look under natural light.



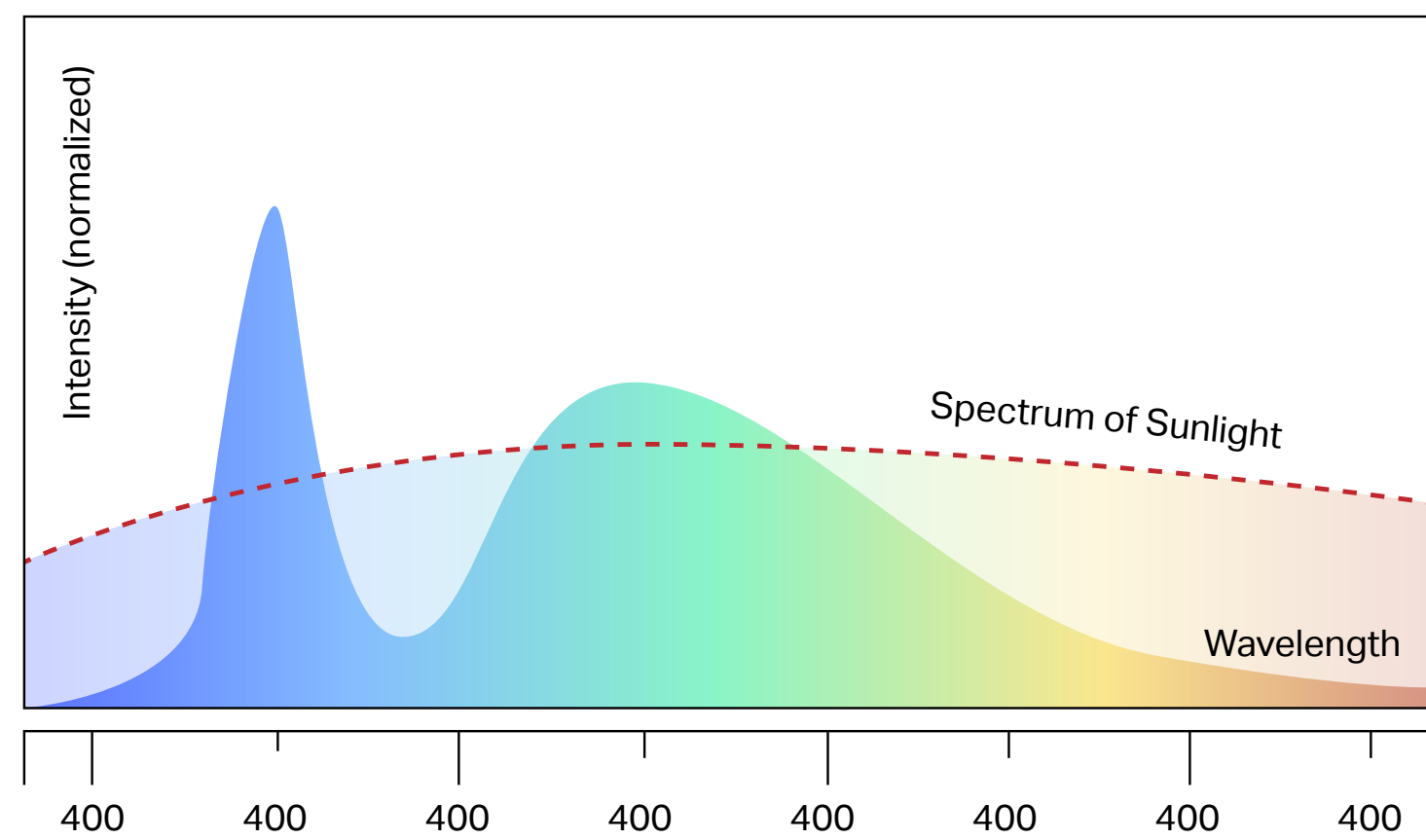
Sunlight



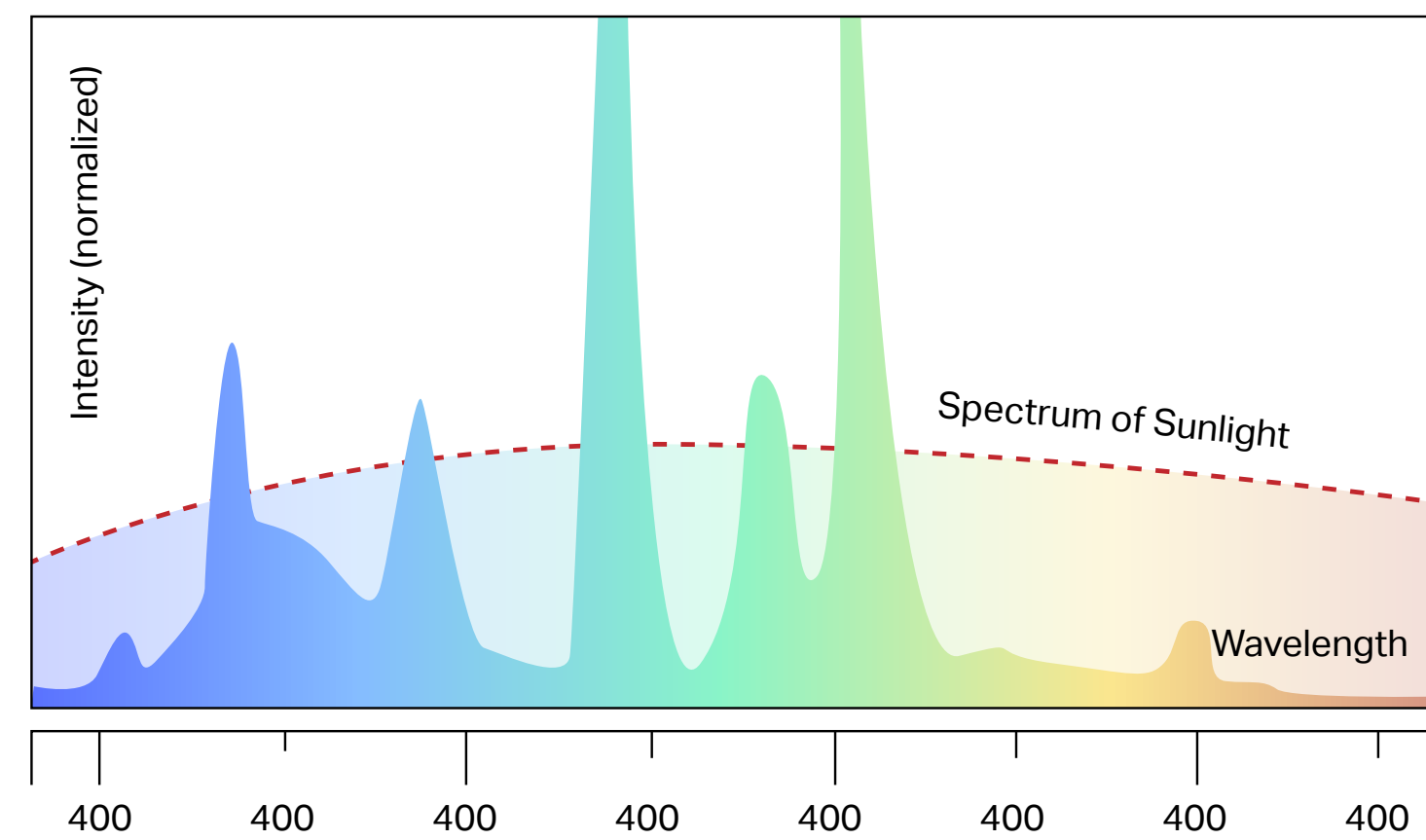
TRI-R



Commercial LED



Fluorescent lamp



## CRI Top Tips

Re (extended CRI value) will give you a much better idea of how the LED will perform over Ra (which just tests the first 8 colours)

Look at the R9 (Saturated Red) value – if reds are important in your project, make sure this is high

Look for specialist LEDs for your application – some luminaires can be specified with specially engineered chips to light specific items, for example, denim, meat, cheese etc.



**Talk to our light  
engineers to learn  
more about how to  
make your project  
more efficient and  
meet the current  
regulations**