September 5, 2025

DLC Team
DesignLights Consortium
10 High Street
Medford, MA 02155

Dear DLC Team:

Re: Comments on proposed DLC technical requirements for LED lighting: Solid State Lighting Version 6.0 (SSL v6.0) and LUNA Version 2.0 (LUNA V2.0), and the requirement for a General Wellness Light Fixtures and Lamps category

The undersigned consortium of healthy lighting research scientists, LED and lighting manufacturers and lighting specifiers and health-conscious lighting users have reviewed the Design Lights Consortium (DLC) proposed technical requirements for LED lighting: Solid State Lighting Version 6.0 (SSL v6.0) and LUNA Version 2.0 (LUNA V2.0), with particular attention to the proposed Efficacy Requirements measured in lumens/watt.

We commend the DLC for providing separate lower Efficacy Requirements for "LUNA" lighting products that seek to minimize outdoor light pollution that impacts the health and well-being of non-human species, including turtles ("**turtle lighting**")

However, protecting the health of humans from indoor light pollution is just as important, if not more important, than protecting the health of non-human species from outdoor light pollution.

Our comments below will summarize the evidence that the DLC should equally recognize the need to reduce the lumens per watt requirements for indoor lighting products that are spectrally engineered to improve the health and well-being of humans while also providing visible

illumination to support normal human activities. These lighting products fall within the general wellness category established by the FDA[1], and are referred to as **General Wellness Lighting Fixtures & Lamps.**

General Wellness Lighting Fixtures & Lamps cannot meet the proposed DLC v6.0 standards for light fixtures and lamps because they are not designed to maximize the green and yellow wavelengths that determine visual brightness (i.e. maximize lumens). Rather they are spectrally-engineered with the primary purpose of providing light with spectral compositions that support and optimize human health and wellness depending on the time of day or night.

There are a significant and growing number of General Wellness Lighting Fixtures & Lamps of the following types:

- Full spectrum lights that mimic the natural visible daylight spectrum
- Circadian-friendly daytime lights with enhanced 440-495nm blue content with peak emissions between 470-490 nm.
- Circadian-friendly evening and night lights with near zero 440-495 nm blue content with or without violet light emission to whiten the light
- Orange-red or red lights for nocturnal use
- White lights with added red and/or near infrared \ to boost mitochondrial health

Appendix 1 defines the characteristics of these General Wellness Lighting Products and Appendix 2 provides data on the lumens per watt efficacy of these lighting fixtures, and Appendix 3 provides data on the lumens per watt efficacy of these E26 base light bulbs. Based on this data we propose a **45 lumens per watt** minimum requirement for these products.

Recently we have petitioned the US Department of Energy (DOE) to begin a new rulemaking process to define a new product class, pursuant to 42 U.S.C. §6295(q), for general wellness light bulbs. Consumers need a new product class for general wellness light bulbs that can produce circadian-friendly light, near-infrared light, and other forms of healthy lighting. The proposed new product class we requested would not be subject to the 2024-04-19 Energy Conservation Program: Energy Conservation Standards for General Service Lamps (GSL); final rule (125 lumens per watt rule or 125 L/W rule[2]). but would still be subject to the energy efficiency standards in the 45 lumens per watt ('L/W') backstop requirement for general service lamps [GSL] that Congress prescribed in the 2007 Energy Policy and Conservation Act.

In summary, we propose the DLC create a protected product class of General Wellness Lighting Fixtures & Lamps, with a comparable 45 lumens per watt minimum requirement, that would allow for the design, manufacture, and sale of lighting fixtures and lamps that provide both illumination and essential human health benefits. These health benefits are obtained by emitting or excluding specific visible or non-visible wavelengths that are not largely confined to the

[1] https://www.fda.gov/regulatory-information/search-fda-guidance-documents/general-wellness-policy-low-risk-devices

[2] We use the 125 lumens per watt ("125 L/W rule") as an abbreviation. The actual minimum requirements for GSLs under this rule vary between 83.3 to 195.4 lumens per watt depending on the lightbulb type, with the most common lightbulbs having a 124.6 lumens per watt minimum.

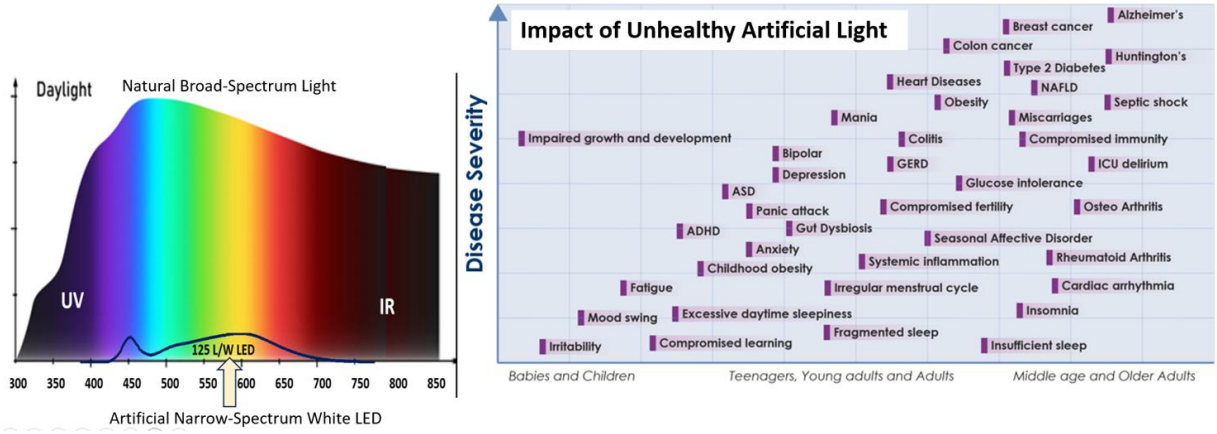
narrow range of green and yellow wavelengths that predominate in calculating the lumens value of a light source under DLC proposed SSL v.6.0 requirements for LED lighting.

The shift in lifestyles makes healthy indoor lighting more important

In 1900, 41% of American jobs worked outdoors on farms; now, it's only 1%[3]. In today's world, the average person spends approximately 95% of their time indoors under "ultra-processed" artificial light that fails to provide the health benefits of natural sunlight.[4]

People who spend the most time outdoors daily are far healthier and live longer than those mostly confined indoors. This has now been repeatedly shown in large-scale studies tracking daily light exposure and the health of tens of thousands of people[5]. Furthermore, most chronic disease deaths at higher latitudes occur during winter when solar exposure levels are at their lowest, and the public spends more time indoors.[6]

Figure 1: Lights engineered to met the proposed DLC 125 – 145 lumens per watt requirement do not provide the optimal wavelength distribution required for good health, and produce a higher intensity of wavelengths that can harm human health at night



People who are exposed to healthy natural sunlight are less likely to suffer from chronic diseases. Science has established that artificial light that does not reproduce non-visible wavelengths

[3] US Bureau of Labor Statistics

[4] 87% of time in enclosed buildings and 6% of time in enclosed vehicles with filtered glass...Klepeis NE, et al. (2001) The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants. J Expo Anal Environ Epidemiol 11:231-252. Over the past 25 years the percent time indoors has increased. In 2024 the average time indoors varied seasonally from 97.9% in January to 92.9% in July. https://appleheartandmovementstudy.bwh.harvard.edu/summer-daylight-2024/

[5] Lindqvist et al. (2014) Avoidance of sun exposure is a risk factor for all-cause mortality: results from the Melanoma in Southern Sweden cohort. J Intern Med 276:77–86, and Windred DP et al (2024) Brighter nights and darker days predict higher mortality risk. A prospective analysis of personal life exposure in >88,000 individuals. PNAS. 121 (43) e2405924121

[6] Grant WB and Boucher BJ (2022) An Exploration of How Solar Radiation Affects the Seasonal Variation of Human Mortality Rates and the Seasonal Variation in Some Other Common Disorders. Nutrients 14, 2519. https://doi.org/10.3390/nu14122519

important to health and/or delivers the wrong type of light at night are important factors that exacerbate and may create chronic diseases (Fig 1)[7].

Unfortunately, the ultra-processed visible light that will be produced by lighting fixtures and lamps designed to meet the proposed DLC technical requirements for LED lighting: Solid State Lighting Version 6.0 (SSL v6.0) will substantially harm human health. Thus, a new product class with lower lumens per watt requirements is essential to provide consumers with a choice in lighting that provides health benefits for their families. It will also allow schools to provide lighting to optimize the health of their students and faculty and businesses to provide similar benefits for their employees and customers. The healthy lighting enabled by the product class is especially important for children and those unable to venture outdoors, such as the ill, the injured, or the elderly.

The artificial light mandated by proposed DLC technical requirements for LED lighting: Solid State Lighting Version 6.0 (SSL v6.0) is creating two key problems for optimal human health. **First**, the type of light at night produced by the vast majority of LED fixtures and lamps emits excessive amounts of specific wavelengths of blue light that disrupt our circadian rhythms at night. **Second,** the lack of exposure of the body to near-infrared light is an important factor in mitochondrial malfunction that contributes to many chronic diseases. The proposed v6.0 DLC requirements make it impossible to provide lights that avoid these two problems inherent in most LED light fixtures and lamps, thus greatly increasing the need for this new product class.

Blue-Rich Light at Night Causes Major Health Disorders

Blue light in the 440-495 nm waveband synchronizes circadian clocks during the day. However, exposure to the same 440-495 nm blue-rich light during evening and nighttime hours causes medically significant circadian disruption[8]. Such circadian disruption contributes to a wide range of neurologic, psychiatric, carcinogenic, metabolic, cardiovascular, allergic, and immunologic disorders.[9]

By 2007, there was sufficient evidence for the World Health Organization (WHO) International Agency for Research on Cancer (IARC)[10] to classify light exposure during night shift work causing circadian disruption as a probable (group 2A) human carcinogen based on human epidemiological studies and research with animal models. Since 2008, there have been over 10,000 peer-reviewed scientific publications on the interaction of light and circadian clocks[11],

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[7] [7] Sulli G et al (2018) Training the Circadian Clock, Clocking the Drugs, and Drugging the Clock to Prevent, Manage, and Treat Chronic Diseases. Trends Pharmacol Sci. 39:812-827. doi: 10.1016/j.tips.2018.07.003

[8] Moore-Ede M, Blask DE, Cain SW, Heitmann A & Nelson RJ (2023) Lights should support circadian rhythms: evidence-based scientific consensus. Front. Photon 4:1272934 https://doi.org/10.3389/fphot.2023.1272934

[9] Fishbein AB, Knutson KL & Zee, PC (2021) Circadian disruption and human health. J Clin Invest. 2021;131(19):e148286. https://doi.org/10.1172/JCI148286.

[10] International Agency for Research on Cancer (2010) Working Group on the Evaluation of Carcinogenic Risks to Humans: Shift work. Painting, Firefighting, and Shiftwork 98:563-764 https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Painting-Firefighting-And-Shiftwork-2010.

[11] PubMed search of "circadian" + "light" identified 10,002 peer-reviewed scientific articles published between April 1, 2008 and April 1, 2022

which shows the widespread effects of light-induced circadian disruption in the genesis and exacerbation of the risk of multiple health disorders, including obesity, diabetes, cardiovascular disease, breast cancer, and prostate cancer.

Near-Infrared Light Is Essential for Human Health

The conversion to LED lighting and displays, NIR and UV blocking window glazings, and spending approximately 95% of our time indoors represents the largest decrease in solar exposure in human history. Combined with the increased use of artificial light at night the ill-effects impact much more than turtles and outdoor wildlife.

There is growing evidence that conventional LED light fixtures and lamps are a causal factor in increasing levels of metabolic diseases in the human population and other lifeforms. Recent human studies comparing current LED lighting and incandescent lighting reveal that LED lighting degrades human eye color contrast in hours compared to incandescent,[12] and 670 nm red increases life spans in aged flies by over 50%.[13] Mitochondria damage has been identified in extended stay astronauts at the International Space Station. Similar problems among submariners and stealth vessels have been reported.

The enemy of longevity is chronic disease, such as heart disease, diabetes, obesity, and many more. These diseases are all emblematic of mitochondrial dysfunction.[14] Most metabolic processes rely on activation energies between 1.2 eV and 0.2 eV to minimize reactive oxygen species generation and to reduce electron transfer time scales to milliseconds. As such near and mid-infrared solar photons have just the right amount of energy to assist in the basic processes of life (ATP production, hormone changes, immune response, and neurological health).

The electron transport chain (ETC), is just one example of how near and shortwave infrared assists in the survival of all lifeforms. Inside most of our cells, there are organelles called mitochondria. They burn fuel in the form of glucose, fats, and proteins to make energy and carbon dioxide by transferring electrons down a cascade of energy barriers.

As shown by Jeffery, exposure to deep red and near infrared on less than 10% of the body (28 KJ) in minutes reduces glucose levels in the blood and increases carbon dioxide in the breath. Given that up to 60% of the food we eat exits the body through our breathing, it is reasonable to argue that longer wavelengths in sunlight increase ETC efficiency by assisting in the transfer of electrons. It is also clear that localized exposure can lead to systemic response on the time scale of minutes. We know that the near infrared in sunlight penetrates inches into the body providing assistive energy to overcome the energy barriers that control electrons movement. It is also becoming clear that it is not just the ETC that sunlight enhances but a wide range of metabolic, hormonal, and neurological processes.

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[12] Jeffrey G. (2025) LED lighting undermines human performance www.researchgate.net/publication/392009672

[13] Begum R, et al (2015) Near infrared light increases ATP, extends lifespan, and improves mobility in aged Drosophila melanogaster. Biol. Lett. 11: 20150073

[14] This paragraph and the following three paragraphs were adapted from "Roger Seheult, MD, COVID 2024 Surge: The Most Accessible Defense," posted August 29, 2024, by MedCram, YouTube, 25 min., 17 sec., https://youtu.be/SXfOtQkHlig.

In general, the body is best described as a multijunction solar collector taking maximum advantage of each portion of the solar spectrum. UV (4 to 3 eV) forms the 2nd highest density of photons using these high energy photons to assist in Vitamin D production, formation of most sex hormones, and production of a wide range of steroids. In the visible (3 to 2eV) our eyes are highly specialized to respond to a narrow range of photon energies so that we can differentiate colors (good snake - bad snake). In the near infrared (2 to 1eV) the body is translucent, allowing penetration deep into the body. This distributes these photons to a wide range of absorbers in our muscles, blood, and organs. In the shortwave infrared (1 to 0.2eV) water absorption localizes photon density in the outer skin with 50% of photons being absorbed in the epidermis and dermis forming the highest photon density in the body. This region also appears based on work by Hudson to generate high levels of hydrogen peroxide in the outer 50 microns of the skin forming a protective barrier to pathogens and improving efficiency of UV oxidation of cholesterol.

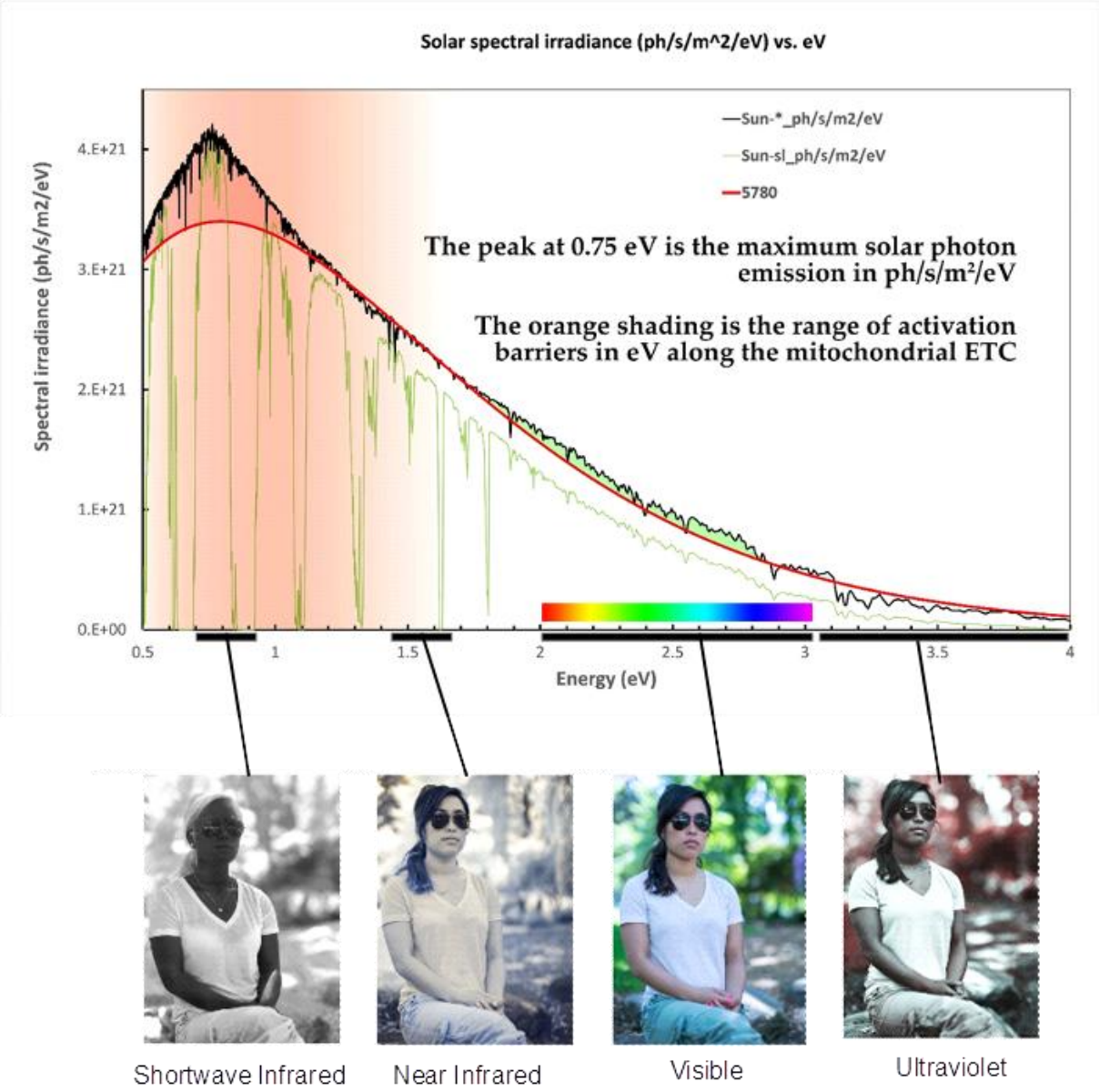

Figure 2: Components of the solar spectrum that reach the earth's surface.

Numerous studies have found that melatonin is made inside the mitochondria to mitigate oxidative stress. It functions as a kind of cooling system suppressing reactive oxygen species locally and modulates cortisol, sex hormones, and a wide range of antioxidants. The higher the level of melatonin, the less oxidative stress, which allows your mitochondria to work more efficiently.[15] [16] [17] The development of sweat biosensors with sampling frequency of 3 minutes that simultaneously measure melatonin, cortisol, IL-6 and TNF (alpha) are now revealing that on top of the daily circadian response to sunlight discussed above there is a transient hormonal response to environmental stressors on a time scale of minutes independent of time of day. The data supports that melatonin spikes suppress cortisol levels on the scale of minutes during eating, exercise, and sunlight exposure. In nature, we are never exposed to higher energy UV or visible photons both during the day or at night without an excess of near and shortwave infrared photons. The transient response data supports that visible only LED lighting and displays are creating a harmful environment that exposes our children to elevated cortisol levels both during the day and night. Cortisol is our fight or flight response that suppresses immune response, elevates glucose levels, tanks testosterone levels, and increases blood pressure. There is also growing evidence that elevated cortisol impacts likelihood of relapses in drug users. It is reasonable to argue that our indoor spaces increase cortisol relative to outdoor spaces. Elevated cortisol relative to melatonin has been shown in schizophrenic and clinically depressed patients.

Figure 3: Near infrared light in the 800-850 nm range penetrates through the human body

Near and shortwave infrared are invisible to the human eye. This combined with lack of adequate measurement equipment across the (4eV to 0.2 eV) solar spectral range has led to the false impression that we could eliminate 90% of sunlight from our lives. All lifeforms are highly

[15] *Int J Mol Sci.* 2016 Dec 16;17(12):2124. https://pmc.ncbi.nlm.nih.gov/articles/PMC5187924/
[16] *Life Sciences*, Volume 301,2022, 120612 https://doi.org/10.1016/j.lfs.2022.120612
[17] *Ageing Research Reviews*, Volume 101,2024, https://doi.org/10.1016/j.arr.2024.102480

adapted to a single predominately infrared emitter the sun. As shown, the body scatters near infrared photons throughout the body.

An explosion of research has appeared in peer-reviewed scientific publications on the importance of NIR to health. In the last ten years, at least 455 papers were published on this subject, up from just 25 in the previous ten-year period.[18] While mainly focused on narrowband emitters, they provide further evidence that near infrared through mid-infrared needs to be restored to our indoor spaces.

Incandescent bulbs generate large amounts of NIR, while consumer LEDs generate none (by design). Significant portions of the population spend nearly all their time indoors, and the indoor lighting available in recent years, combined with modern glass reflecting NIR, provides little or no NIR light in many, if not most, buildings today. The phase-out of incandescent bulbs is likely exacerbating many chronic diseases because we have removed a key source of NIR from the indoor environment. To our knowledge, no studies to date have shown visible only conventional LED lighting to improve any biological marker relative to incandescent or sunlight. Instead, there is growing data that supports the need for warning labels on conventional visible only LED lighting.

A New Protected Product Class Is Necessary

Besides the physiological impact, creating a new General Wellness Lighting product class with lower lumens per watt requirements will increase innovation and investment in U.S. companies to design and manufacture this new class of products.

A broad range of different types of light bulbs used to be allowed by law and regulation, such as incandescent, halogen, and LED. The law and regulations inadvertently eliminated incandescent light bulbs that can provide light that is beneficial to health. This is because the minimum lumens per watt standards only look at the visual brightness of a light and not its health-giving properties.

The problem is that our visual sensation of brightness measured in lumens comes from a standard written over 100 years ago. That standard (1924 V(λ) luminosity function), predominantly measures the green and yellow wavelengths in a light, and not its blue or red wavelengths. Since it only measures a narrow range of visible light wavelengths, it omits visible, invisible ultraviolet (UV) and near-infrared (NIR) wavelengths essential for health.

As illustrated in Figure 4 below, the perceived visual brightness of a light source for the average human is measured in lumens based on the 1924 V(λ) luminosity function, which is heavily weighted by green and yellow wavelengths with very little input from blue and red (and none from UV or NIR). In contrast, natural light from the sun contains a much broader range of visible and invisible wavelengths from ~300 nm to ~3000 nm, each of which provides specific health benefits.

[18] PubMed search of "Near infrared light" + health

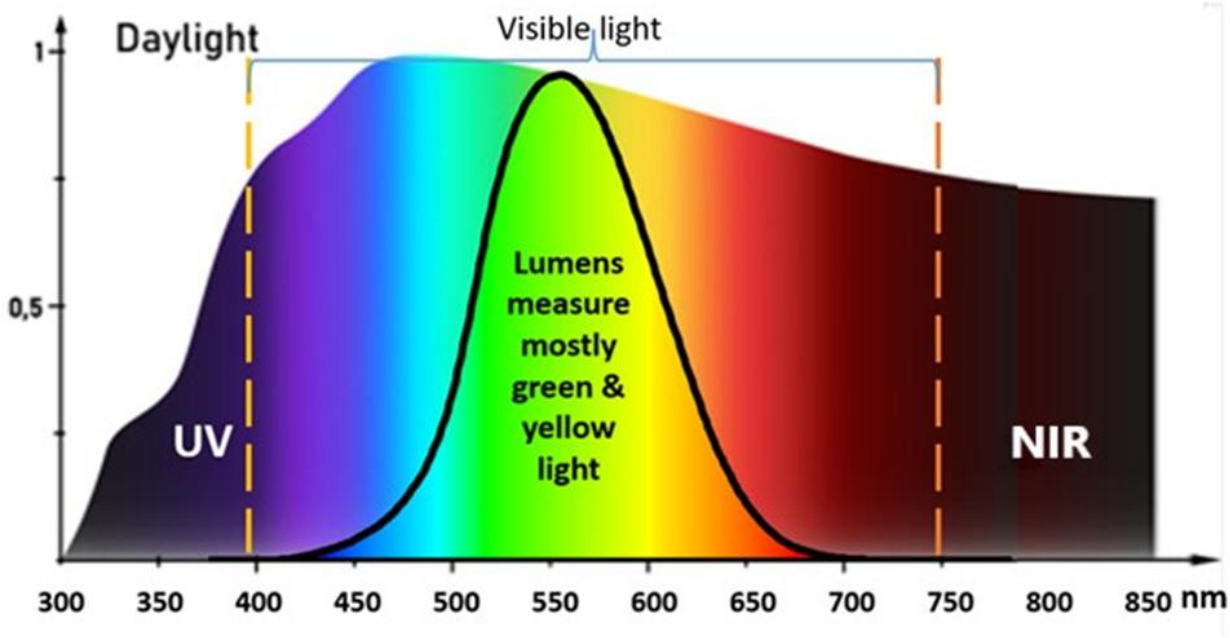

Fig 4: The sun delivers a broad range of light wavelengths at the earth's surface, including invisible ultraviolet, visible colors from violet to blue to green to yellow to red, and invisible infrared, each of which provides specific health benefits. In contrast, the lumens value used in the proposed DLC SSL v.6.0 requirements is determined by the 1924 V(λ) luminosity function, which measures the intensity of a much narrower range of color wavelengths, with 555 nm green having the greatest contribution, and with minimal input from blue or red[19].

In 2023, a 45 lumens per watt minimum standard regulation for General Service Lamps (light bulbs) took effect, as mandated by a law passed by Congress in 2007, which effectively banned all incandescent and halogen light bulbs. While these bulbs are relatively inefficient at providing visible light, they are an excellent source of near-infrared light.

Unfortunately, in 2024, DOE went even further by adopting the 125 L/W rule. As a result, virtually all light bulbs available in 2028 will become narrow-spectrum blue pump LEDs. That rule will effectively make unavailable the manufacture and sale of light bulbs in 2028 that can provide healthy lighting in an energy-efficient way. American consumers desperately need access to a class of general wellness light bulb products. This is why we have petitioned the DOE to create a new product class of General Wellness Lights.

What you can see in Figure 5 below is that the type of blue-chip LED light that can meet the proposed DLC 125-145 L/W requirement for LED lights has a very artificial and limited light spectrum. It has no ultraviolet or violet light, relatively little sky-blue light, very little red, and no near-infrared. It does have relatively more green and yellow wavelengths because those are required for human vision, but they are at much lower levels than we see outdoors.

[19] From Moore-Ede (2025) https://lightdoctormartinmooreede.substack.com/p/why-most-artificial-led-light-is

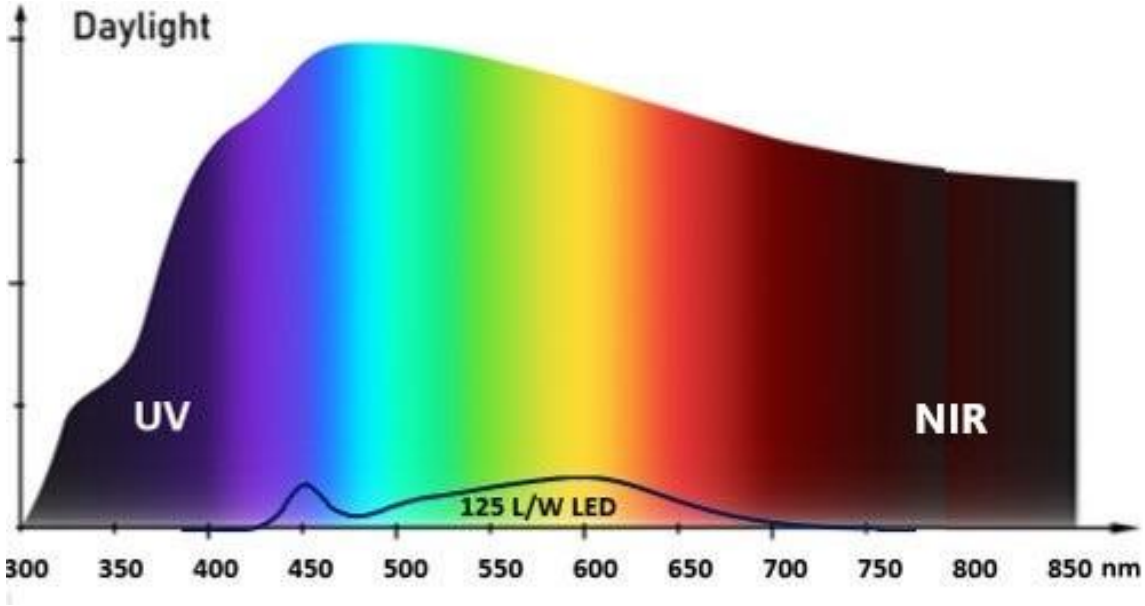

Fig 5: Comparison of spectral wavelength composition of natural outdoor daylight on a very dark cloudy day (5000 lux) with an indoor room brightly lit (500 lux) by LED lights that can meet the proposed DLC 125-145 lumens per watt requirements.

Table 1 below shows the vital health-promoting functions of natural sunlight's different visible and invisible wavelengths.

A wide range of wavelengths across the natural solar light spectrum deliver specific types of non-visual health benefits in addition to the value they may have in enabling color vision. Table 1 shows an example of the peak effective light wavelengths for different biological functions of light. Most of these color wavelengths are not accurately represented by the lumens value of the light source, or by the lumens per watt electrical efficiency metric used in the proposed DLC standards. The 125 -145 L/W proposed DLC requirement assesses fixtures and lamps based on their "lumens per watt," or luminous efficacy, which ignores the healthy (or unhealthy) properties of a light source. However, these proposed requirements only regulates the energy efficiency of providing the green and yellow wavelengths that determine the visual brightness of light measured in lumens. These requirements do not reflect the energy efficiency of delivering most of the light wavelengths that promote human health.

As shown in Fig 6 below, **the watts of electricity required to generate healthy wavelengths of light outside the 500 - 600 nm green-yellow range are treated as wasted watts by the proposed DLC 125-145 L/W requirements.** Thus, light sources that are circadian-friendly (470 - 490 nm blue-rich day and 480 nm blue-depleted night) or have a broader spectrum of healthy wavelengths outside the narrow 500 – 600 nm wavelength band that determines lumens cannot meet the proposed DLC 125-145 L/W requirements.

Wavelength	Color	Function	Source
293 nm	Ultraviolet (UVB)	Vitamin D synthesis	[20]
380 nm	Deep Violet (UVA)	Eye blood flow - prevents myopia	[21]
405 nm	Violet	Bacterial decontamination	[22]
420 nm	Violet	Alertness / Cognitive Performance	[23]
460 nm	Royal blue	Reduce jaundice in babies	[24]
480 nm	Sky blue	Circadian Sync (Day) Disrupt (Night)	[25]
525 nm	Green	Reduction of migraine & fibromyalgia pain	[26]
555 nm	**Green**	**Visual perception of brightness (Lumens)**	[27]
650 nm	Red	Hair growth	[28]
670 nm	Red	Improved vision in eyes (age > 40 years)	[29]
700-3000 nm	Near Infrared	Multiple health functions	[30]

Table 1: The most biologically effective light wavelengths for different health benefits. Note that the only function reliably measured by Lumens is the visual perception of brightness. Thus, the Lumens metric does not indicate the healthiness of a light source[31].

Our request that DLC provide a General Wellness Lighting Category with its own lower lumens per watt minimum requirements would provide healthy light in an energy-efficient manner. It is truly a different product class because it would produce essential health-giving wavelengths not accommodated by the current proposed v6.0 requirements.

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[20] Kalajian TA, Aldoukhi A, Veronikis AJ, Persons K & Holick MF (2017) Ultraviolet B Light Emitting Diodes (LEDs) Are More Efficient and Effective in Producing Vitamin D3 in Human Skin Compared to Natural Sunlight. Scientific Reports 7: 11489 | DOI:10.1038/s41598-017-11362-2

[21] Torii H et al (2016) Violet Light Exposure Can Be a Preventive Strategy Against Myopia Progression. http://dx.doi.org/10.1016/j.ebiom.2016.12.007

[22] Bache SE et al (2018) Universal decontamination of hospital surfaces in an occupied inpatient room with a continuous 405 nm light source. Journal of Hospital Infection 98: 67-73 https://doi.org/10.1016/j.jhin.2017.07.010

[23] Revell VL, Arendt J, Fogg LF, and Skene DJ (2006) Alerting effects of light are sensitive to very short wavelengths. Neuroscience Letters 399: 96–100.

[24] Maisels MJ and McDonagh AF (2008) Phototherapy for Neonatal Jaundice. N Engl J Med 358: 920-928

[25] Moore-Ede M., Heitmann A and Guttkuhn R. (2020) Circadian Potency Spectrum with Extended Exposure to Polychromatic White LED Light Under Workplace Conditions *J Biol Rhythms 35(4): 405–415 (2020).*

[26] Martin LF et al (2021) Evaluation of Green Light Exposure on Headache Frequency and Quality of Life in Migraine Patients: A Preliminary One-way Cross-over Clinical Trial. Cephalalgia 41: 135–147. doi:10.1177/0333102420956711.

[27] Illuminating Engineering Society. CIE photopic luminous efficiency function https://www.ies.org/definitions/cie-photopic-luminous-efficiency-function/ Archived at https://perma.cc/5PEN-ZZ7B

[28] Yang K (2021) Hair Growth Promoting Effects of 650 nm Red Light Stimulation on Human Hair Follicles and Study of Its Mechanisms via RNA Sequencing Transcriptome Analysis. Annals of Dermatology 33: 553-561 https://doi.org/10.5021/ad.2021.33.6.553

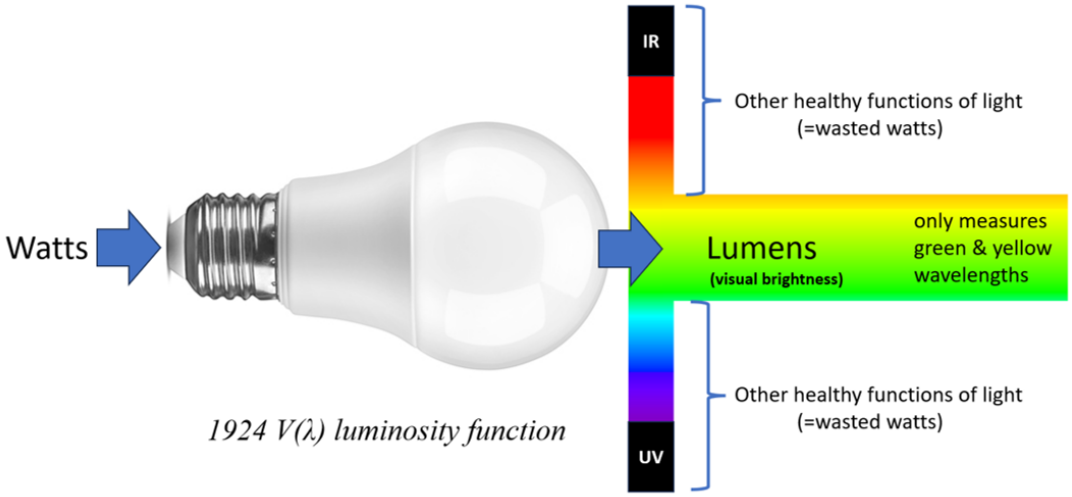
[29] Shinhmar H et al (2020) Optically Improved Mitochondrial Function RedeemsAged Human Visual Decline. Gerontol A Biol Sci Med Sci, 2020, 75: e49–e52 doi:10.1093/gerona/glaa155

[30] See Scott Zimmerman and Russel J. Reiter (2019) "Melatonin and the Optics of the Human Body," Melatonin Res. 2 (1) 138-160; doi: 10.32794/mr11250016) and Fosbury R and Jeffrey G (2024) Life-life interactions beyond photosynthesis. https://herschelsociety.org.uk/wp-content/uploads/2024/02/The-Astrophysics-of-Earth_v3.3.pdf

[31] From Moore-Ede (2025) https://lightdoctormartinmooreede.substack.com/p/why-most-artificial-led-light-is

The only lights that would be approved under the proposed 125-145 L/W DLC requirements are blue-chip LEDs with a narrow artificial spectrum that is associated with ill health when used at night and do not provide adequately healthy light during the day.

Figure 6: DLC proposed requirements for LEDs use a 100-year old metric (Lumens per Watt) that only measures visual brightness



According to the U.S. Environmental Protection Agency, in its own words, "Simply put, energy efficiency means using less energy to get the same job done[32]. Our proposed General Wellness Lighting product class would do just that, use less energy to get the job of providing healthy light done.

Permitting the production and sale of DLC-approved fixtures and lamps that provide healthy lighting would provide enormous health benefits for all Americans.

If DLC fails to provide this proposed new product class with its own lower lumens per watt standards , it will set in motion an unprecedented public health experiment on over 330 million unwilling Americans who would be deprived of healthy lighting fixtures and lamps. As consumers become increasingly aware of the lack of availability of healthy lights they will not see the DLC as a valid arbitrator of lighting products. Creating a new product class that provides healthy energy-efficient lighting is likely to save energy and improve health.

DLC needs to quickly establish the proposed new product class to enable, or at least allow, the restoration of a minimum level of near-infrared light essential for human health and the production of circadian-friendly LED lights. We propose that DLC consider a definition for the General Wellness Lighting product class that appears in Appendix I.

[32] EnergyStar. Energy Efficiency https://www.energystar.gov/about/how_energy_star_protects_environment/energy_efficiency Archived at https://perma.cc/A32Q-RMQF And US Environmental Protection Agency. Reduce the Environmental Impact of Your Energy Use https://www.epa.gov/energy/reduce-environmental-impact-your-energy-use Archived at https://perma.cc/X59Z-3MWQ

These products are already in the lighting market and are producing clear measurable benefits to human health. For example, Figure 7 shows a direct comparison of health efficacy of a conventional LED light that could meet the SSL v.6.0 DLC proposed requirements with a General Wellness Circadian-Friendly LED light that could not meet these DLC requirements both operating with the **same CCT** and **same desktop lux**. The General Wellness LED light enables the production of 68% more nocturnal melatonin than the DLC compliant LED.

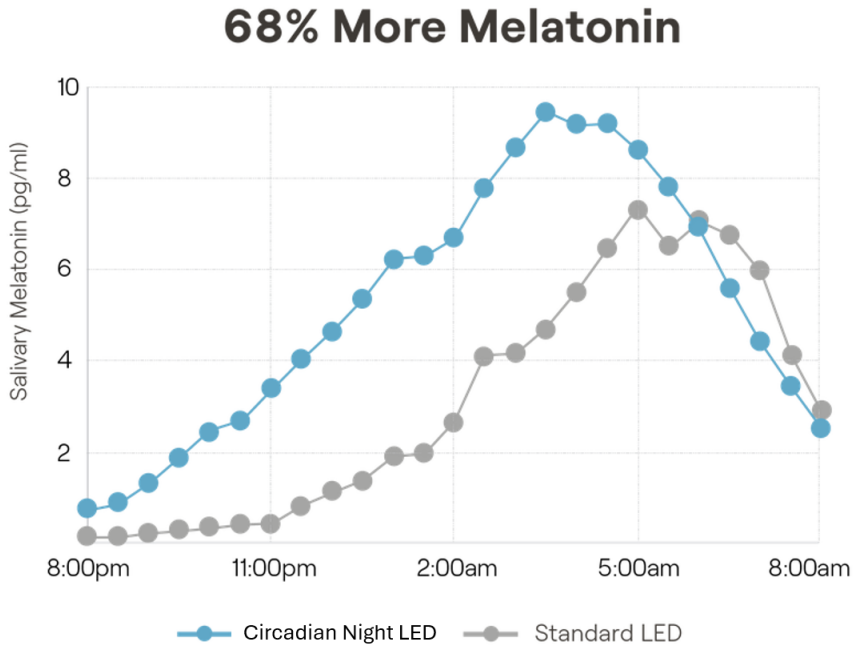


Figure 7: Improved nocturnal melatonin levels in people illuminated at ~~the~~ same lux and CCT levels with a circadian friendly night LED with <2% 440-495 nm blue as compared to a conventional LED of a type supported by DLC v. 6.0 recommendations.

Similar statistically and medically significant health benefits have been shown in glucose metabolism, insulin resistance, appetite, sleep duration and quality, and in cognitive performance in direct comparisons of DLC non-compliant General Wellness LED lights with conventional LEDs that can be compliant with DLC SSL v.6.0[33].

Proposed Minimum Efficacy Requirements for General Wellness LED Lights

Just like the carve out of a separate LUNA v.2.0 product class for "turtle lighting" with 30 (de-Amber) – 70 (pc-Amber) lumens per watt minimum requirements, we need wellness function-appropriate minimum requirements for General Wellness Lighting.

In response to DLC Team concerns that there might not be a sufficient number of General Wellness lighting products to justify a separate set of efficacy requirements we have prepared

[33] Moore-Ede M (2024) The Light Doctor: Using Light to Boost Health, Improve Sleep and Live Longer, Circadian Books, https://www.amazon.com/Light-Doctor-Martin-Moore-Ede/dp/B0D54SHWS4

Appendix 2 and 3. These provide a sample of General Wellness lighting fixtures (Appendix 2) and E26 light bulbs (Appendix 3) as defined by the criteria in Appendix 1.

These lists are not intended to be comprehensive. It should be noted that some of the largest LED chip manufacturers in the world (e.g. Seoul Semiconductor and Lumileds) produce and heavily promote LED chips like SunLike for the General Wellness market which are in manufactured and sold in many lighting SKUs. Bios has 39 partners which offer its General Wellness light engines in a wide range of lighting SKUs.

Based on the health imperative of protecting General Wellness LED lights as a distinct meritorious product class we propose a **minimum requirement of 45 lumens per watt.**

The science examining the impact of light on human health is continuously growing in often surprising ways. A flexible and relatively simple rule for general wellness light fixtures and lamps will greatly encourage the lighting industry to invest in research to determine the most energy-efficient ways to provide healthy lighting.

Conclusion

As noted by one expert, the proposed DLC v6.0 requirements, other than with turtle lighting, do not consider "beneficial uses of light beyond the elimination of darkness, which is the equivalent of creating a diet plan that only considers the necessary calories to survive without understanding the nutrients that are delivered with those calories. Just like a balanced food diet, the light diet that people consume deserves attention and .. consideration."[34]

Because product development and marketing of light fixtures and lamps that produce healthy light is a multi-year process, the proposed DLC v.6.0 2026 requirements are already having a major dampening effect on investment in and innovation for healthy lighting.

Therefore, a new General Wellness LED product class to increase consumer choice and lighting innovation is needed as soon as possible to ensure all Americans will have access to healthy lighting.

Respectfully submitted,

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[34] Paul Pickard, Comment EERE-2022-BT-STD-0022-0188, available at https://www.regulations.gov/comment/EERE-2022-BT-STD-0022-0188

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Appendix I

General Wellness Light Fixtures and Light Bulbs, that, in addition to providing visible illumination, also have one or more of the following characteristics:

a) Less than 2% of total visible spectral irradiance between 380 and 780 nm falls in the 440 - 495 nm irradiance band (**Circadian night light**).

b) More than 20% of total visible spectral irradiance between 380 and 780 nm falls in the 440 - 495 nm irradiance band, and with a peak emission between 470 – 490 nm (**Circadian day light**).

c) Provides wavelengths across the entire 400-700 nm spectrum with more than 60% of visible (380 – 780 nm) spectral irradiance falling outside the 500 – 600 nm window **(Broad visible solar spectrum day light).**

d) Dynamic light fixtures and light bulbs that change the spectral power distribution between night (a) and day (b or c) conditions by time of day (**Dynamic circadian light).**

e) Less than 40% of total spectral irradiance falls in the 500 - 600 nm band (**Spectrally targeted light**).

f) More than 80% of total spectral irradiance between 380 and 780 nm falls within a 100 nm irradiance band (**e.g., Monochromatic green or red light**).

g) More than 50% of total optical watts distributed across the 600nm - 3000 nm band (**Near and shortwave infrared enhanced light)**

Appendix 2: EXAMPLES OF GENERAL WELLNESS LIGHT FIXTURES

Product	Health Feature	Lumens	Watts	Lumens per Watt
Ecosense Lumium Circadian Blue Nitrogen 1 Linear	Max blue day and zero blue night lighting to boost circadian health, performance and sleep	1440	32	46
Ecosense Lumium Circadian Blue Nitrogen 2 Linear	Max blue day and zero blue night lighting to boost circadian health, performance and sleep	1440	32	46
Ecosense Lumium Circadian Blue Oxygen 1 Linear	Max blue day and zero blue night lighting to boost circadian health, performance and sleep	1600	32	51
Ecosense Lumium Circadian Blue Oxygen 2 Linear	Max blue day and zero blue night lighting to boost circadian health, performance and sleep	1601	32	51
Ecosense CAERA 2x2 Troffer	Max blue day and zero blue night lighting to boost circadian health, performance and sleep	3780	50	89
Ecosense CAERA 2x4 Troffer	Max blue day and zero blue night lighting to boost circadian health, performance and sleep	5773	50	89
Spectrum 4” Bios downlight	Dynamic circadian fixture	543	15	36
USG Barz Bios Linear	Dynamic circadian fixture	419	5.9	71
Meteor Atria 4 Bios	Dynamic circadian fixture	880	15	59
Meteor Atria 4 Bios	Dynamic circadian fixture	1300	25	52
ALW LightPlane +2 Bios	Dynamic circadian fixture	1044	14	74

Appendix 3: EXAMPLES OF GENERAL WELLNESS LIGHT BULBS

Product	Health Feature	Lumens	Watts	Lumens per Watt
Soraa ZeroBlue A19	Removes blue light that disrupts circadian clocks and sleep	600	11.5	55
Soraa ZeroBlue BR30	Removes blue light that disrupts circadian clocks and sleep	700	15	47
Korrus OIO A19	Dynamic day and night lighting to boost circadian health and sleep	800	9	88
Korrus OIO BR30	Dynamic day and night lighting to boost circadian health and sleep	800	9	88
GE Sunfilled Daylight A21	Full visible daylight spectrum	850	10.5	81
GE Sunfilled Daylight BR30	Full visible daylight spectrum	680	8.5	80
NIRA A19	White light + invisible infrared to promote mitochondrial health	485	9.7	50
NorbSMILE A19	Full sunlike spectrum for daytime	800	11	73
NorbSLEEP A19	Reduced blue light for evening use	520	9	58
NorbRELIEF A19	Green light for migraine relief	800	9	89
NorbFOCUS A19	High blue light to boost cognitive function & focus	780	9	87
BlockBlueLight BioLight E26	Full sunlike spectrum for daytime switchable to zero blue night	700	8	88
BlockBlueLight BioLight BR30	Full sunlike spectrum for daytime switchable to zero blue night	900	12	75
BlockBlueLight BioLight GU10	Full sunlike spectrum for daytime switchable to zero blue night	600	7	86

BlockBlueLight SweetDreams Sleep E26	Amber light with zero blue for evening use to protect melatonin	700	7	100
BlockBlueLight SweetDreams Sleep GU10	Amber light bulbs with zero blue for evening use to prevent melatonin suppression	700	7	100
BlockBlueLight Twilight E26	Red light with zero blue or green for promoting sleep	400	5	80
Neporal 1800K Amber A19	Amber light with zero blue for evening use to protect melatonin	800	9	89
Neporal Magic Glow A19	Full spectrum light for daytime use	800	9	89
Neporal 3Color Magic Glow A19	Switch between high blue 6000K day to 4000K to 1800k evening zero blue by remote control	800	9	89