

DRAFT

(NOTE: There may be final adjustments as we gather signatures)

DATE TBD, 2025

Via e-mail: The.Secretary@hq.doe.gov

The Honorable Chris Wright
Office of the Secretary of Energy
U.S. Department of Energy
1000 Independence Ave. SW
Washington, DC 20585

RE: Petition for Rulemaking for a New Product Class of General Wellness Light Bulbs

Pursuant to the Administrative Procedure Act, 5 U.S.C. § 553(e), the undersigned persons and organizations respectfully submit this petition for rulemaking. We request that the Department of Energy (DOE or Department) 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 requested proposed new product class 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 rule¹) 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 Energy Policy and Conservation Act, as amended.”²

This product class would allow for the design, manufacture, and sale of GSLs that provide both illumination and essential human health benefits. These health benefits would be obtained by emitting or excluding specific visible or non-visible wavelengths that are not largely confined to the narrow range of green and yellow wavelengths that predominate in calculating the lumens value of a GSL under current regulations.

DOE must establish this product class of general wellness light bulbs because in promulgating the 125 L/W rule it failed to comply with 42 U.S.C. § 6295(o). The 125 L/W rule effectively eliminates the range of available wavelengths or the proportion of wavelengths in the spectrum of many existing types of light bulbs. That rule not only lessened “the utility and performance” of these types of GSLs we propose to protect in the new product class, but it also eliminated them. The previous Secretary of Energy also failed to consider, as required by that law, that the 125 L/W “standard is likely to result in the unavailability” of the performance characteristics and features of many current GSLs that produce wavelengths essential for human health or omit wavelengths necessary to prevent harm to human health.

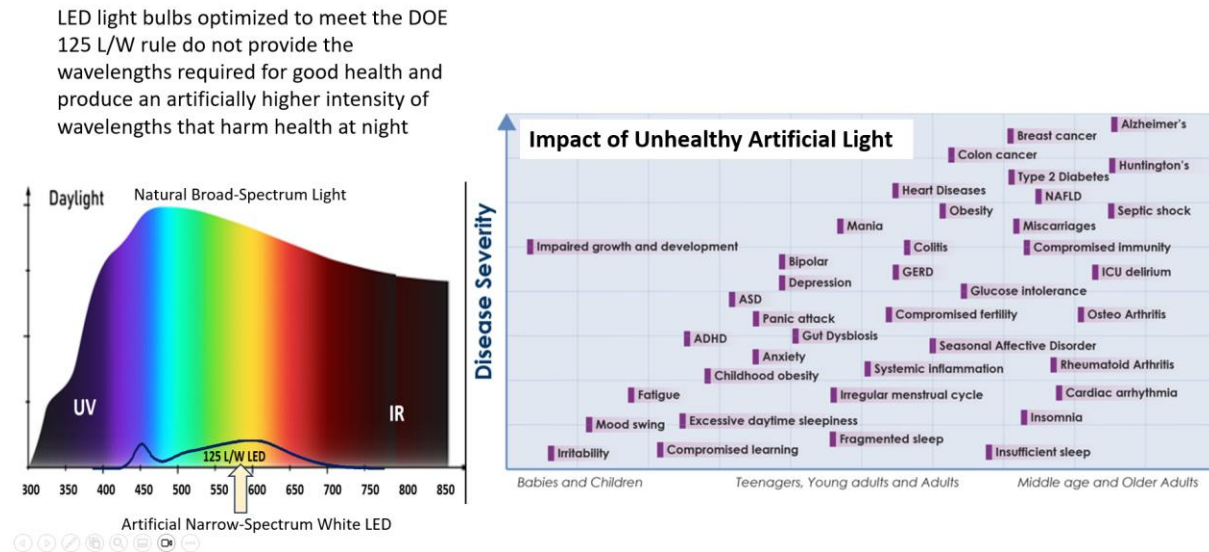
¹ We use the 125 lumens per watt (“125 L/W rule”) as an abbreviation. The actual minimum requirements for GSLs under this rule vary between 83.3 to 195.4 lumens per watt depending on the lightbulb type, with the most common lightbulbs having a 124.6 lumens per watt minimum.

² Energy Conservation Program: Energy Conservation Standards for General Service Lamps, 87 FR 27439, available at <https://www.federalregister.gov/d/2022-09477>.

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 93% of their time indoors under highly processed artificial light that fails to provide the health benefits of natural sunlight.⁴

Fig 1: Many of the chronic diseases of our time are caused or exacerbated by unhealthy artificial light



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 people⁵. 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

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 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.

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.

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>

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

Unfortunately, the ultra-processed visible light that will be produced by GSLs under 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 rule⁸) will substantially harm human health. Thus, a new product class 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 the GSL energy regulations that become effective in 2028 is creating two key problems for optimal human health. First, the type of light at night produced by the vast majority of LED GSLs 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 125 L/W rule makes it impossible to provide GSLs that avoid these two problems inherent in most LED GSLs, 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 disruption⁹. Such circadian disruption contributes to a wide range of neurologic, psychiatric, carcinogenic, metabolic, cardiovascular, allergic, and immunologic disorders.¹⁰ Practically, LED lighting, under the 2028 rule change, often has no dimming or limited dimming. The inability to mimic day/night dimming range compared to incandescent and hybrid approaches further aggravates circadian disruption.

By 2007, there was sufficient evidence for the World Health Organization (WHO) International Agency for Research on Cancer (IARC)¹¹ 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 clocks¹², which shows the widespread effects of light-induced circadian disruption in the genesis

⁸ 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.

⁹ 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>

¹⁰ 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>.

¹¹ 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>.

¹² PubMed search of “circadian” + “light” identified 10,002 peer-reviewed scientific articles published between April 1, 2008 and April 1, 2022

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

There is growing evidence that the current LED GSLs are a factor in increasing levels of metabolic diseases in the population and have other harmful effects on health.

The enemy of longevity is chronic disease, such as heart disease, diabetes, obesity, and many more. These diseases are all emblematic of mitochondrial dysfunction.¹³

Inside most of your cells, there are organelles called mitochondria. They burn fuel in the form of glucose, fats, and proteins to make energy and carbon dioxide. Like a car's engine, it needs a sound cooling system; otherwise, the engine will become inefficient and even shut down. Similarly, in the process of making energy, mitochondria also generate oxidative stress, which can make the mitochondria less efficient and reduce energy output, leading to mitochondrial dysfunction and chronic disease.

However, numerous studies have found that melatonin is made inside the mitochondria to mitigate oxidative stress. It functions as a kind of cooling system. The higher the level of melatonin, the less oxidative stress, which allows your mitochondria to work more efficiently.¹⁴
15 16

Recent research shows that you can improve melatonin in your cells by exposing your body to the Sun, specifically red light and near-infrared light. Near-infrared light (NIR) is invisible to the human eye but can penetrate deep inside the body. Such light likely produces melatonin, the most potent antioxidant in the human body, in mitochondria.

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.¹⁷

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 to exacerbate many chronic diseases because we have removed a key source of NIR from the indoor environment.

¹³ This paragraph and the following three paragraphs were adapted from "Roger Scheult, MD, COVID 2024 Surge: The Most Accessible Defense," posted August 29, 2024, by MedCram, YouTube, 25 min., 17 sec., <https://youtu.be/SXfOtQkHlig>.

¹⁴ *Int J Mol Sci.* 2016 Dec 16;17(12):2124. <https://pmc.ncbi.nlm.nih.gov/articles/PMC5187924/>

¹⁵ *Life Sciences*, Volume 301,2022, 120612 <https://doi.org/10.1016/j.lfs.2022.120612>

¹⁶ *Ageing Research Reviews*, Volume 101,2024, <https://doi.org/10.1016/j.arr.2024.102480>

¹⁷ PubMed search of "Near infrared light" + health

A New Product Class Is Necessary

Besides the physiological impact, creating a new product class will increase innovation and investment in U.S. companies to design and manufacture this new class of products.

The DOE is apparently unaware of this science showing the link between light and health and thus has failed to propose a rule on its own for such a product class, leading us to submit this petition.

A broad range of different types of lighting used to be allowed by law and regulation, such as incandescent, halogen, and LED. The law and regulations inadvertently eliminated bulbs that can provide light 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 $V(\lambda)$ luminosity function), predominantly measures the green and yellow wavelengths in a light, and not its blue or red wavelengths. Since it only measures visible light, it also omits invisible ultraviolet (UV) and near-infrared (NIR) wavelengths essential for health.

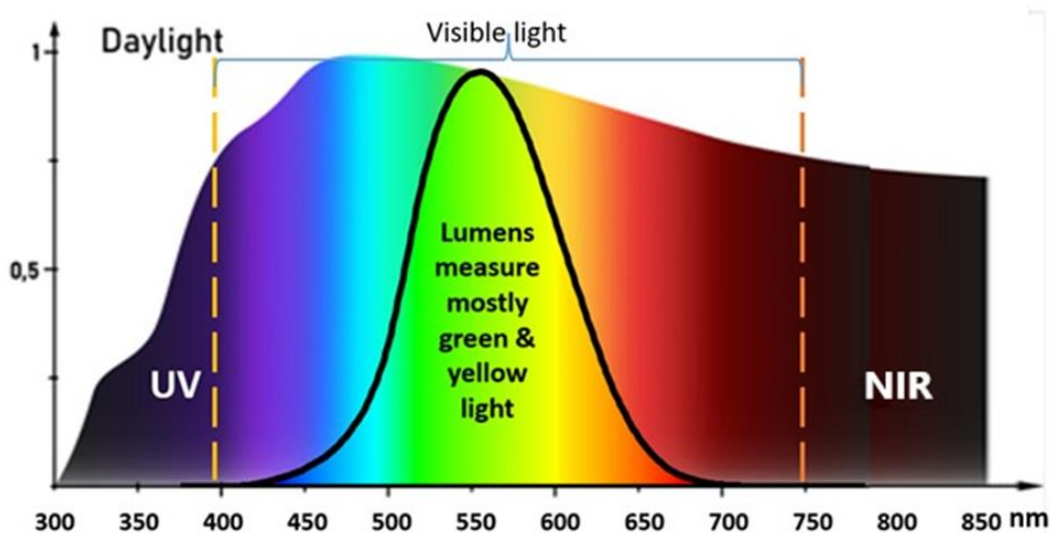


Fig 2: The sun delivers a broad range of light wavelengths at the earth's surface, including invisible ultraviolet, visible colors from violet to blue to green to yellow to red, and invisible infrared, each of which provides specific health benefits. In contrast, the lumens value used in DOE regulations is determined by the 1924 $V(\lambda)$ 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 red¹⁸.

As illustrated in Figure 2 above, the perceived visual brightness of a light source for the average human is measured in lumens based on the 1924 $V(\lambda)$ luminosity function, which is

¹⁸ From Moore-Ede (2025) <https://lightdoctormartinmooreede.substack.com/p/why-most-artificial-led-light-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.

In 2023, a 45 lumens per watt minimum standard regulation 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.

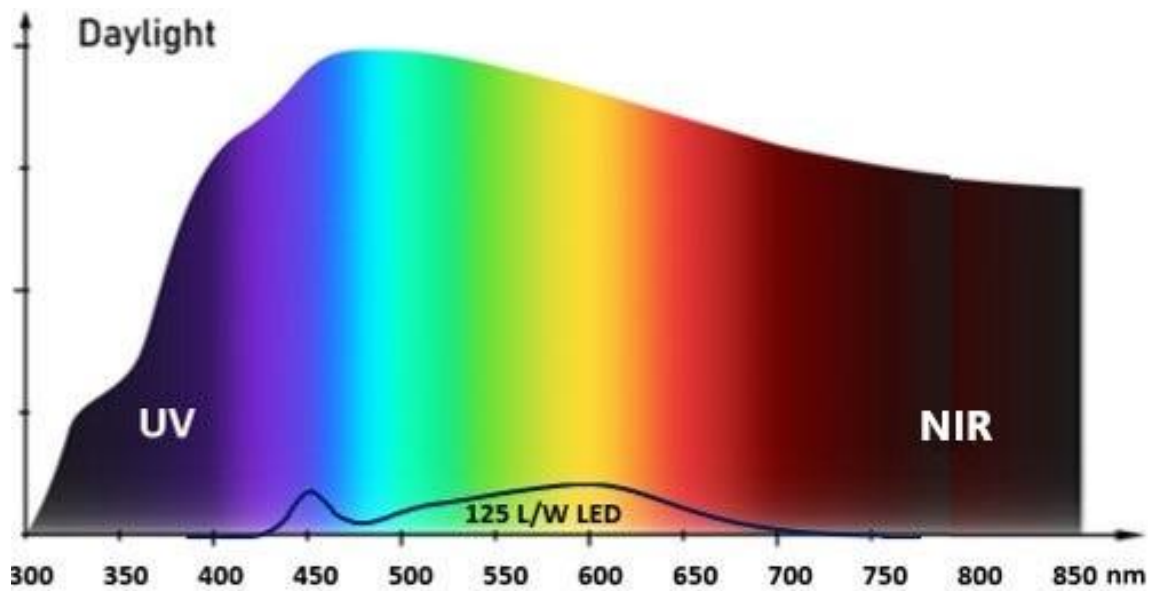


Fig 3: Comparison of spectral wavelength composition of natural outdoor daylight on a very dark cloudy day (5000 lux) with an indoor room brightly lit (500 lux) by LED lights that can meet the new DOE 125 lumens per watt rule.

What you can see in Figure 3 above is that the type of blue-chip LED light that can meet the 125 L/W rule for light bulbs 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.

Wavelength	Color	Function	Source
293 nm	Ultraviolet (UVB)	Vitamin D synthesis	19
380 nm	Deep Violet (UVA)	Eye blood flow - prevents myopia	20
405 nm	Violet	Bacterial decontamination	21
420 nm	Violet	Alertness / Cognitive Performance	22
460 nm	Royal blue	Reduce jaundice in babies	23
480 nm	Sky blue	Circadian Sync (Day) Disrupt (Night)	24
525 nm	Green	Reduction of migraine & fibromyalgia pain	25
555 nm	Green	Visual perception of brightness (Lumens)	26
650 nm	Red	Hair growth	27
670 nm	Red	Improved vision in eyes (age > 40 years)	28
700-3000 nm	Near Infrared	Multiple health functions	29

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 source³⁰.

Under current regulations, consumers would not have access to GSLs that provide the parts of the natural light spectrum that are essential for health. Table 1 above 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.

¹⁹ 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

²⁰ 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>

²¹ 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>

²² 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.

²³ Maisels MJ and McDonagh AF (2008) Phototherapy for Neonatal Jaundice. *N Engl J Med* 358: 920-928

²⁴ 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).

²⁵ 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.

²⁶ 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>

²⁷ 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>

²⁸ Shinhmar H et al (2020) Optically Improved Mitochondrial Function Redeems Aged Human Visual Decline. *Gerontol A Biol Sci Med Sci*, 2020, 75: e49–e52 doi:10.1093/gerona/glaa155

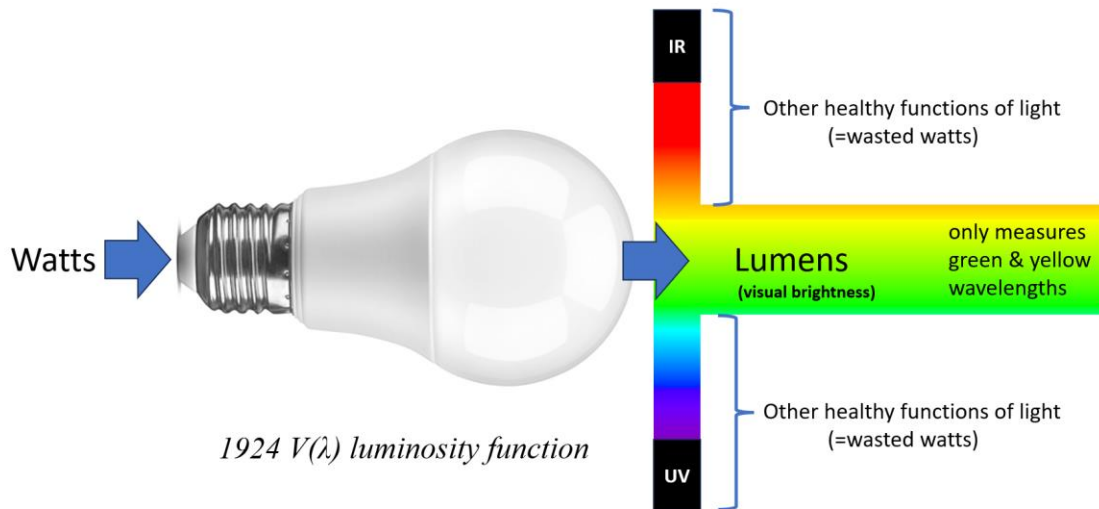
²⁹ See Scott Zimmerman and Russel J. Reiter (2019) “Melatonin and the Optics of the Human Body,” *Melatonin Res.* 2 (1) 138-160; doi: 10.32794/mr11250016 and Fosbury R and Jeffrey G (2024) Life-life interactions beyond photosynthesis. https://herschelsociety.org.uk/wp-content/uploads/2024/02/The-Astrophysics-of-Earth_v3.3.pdf

³⁰ From Moore-Ede (2025) <https://lightdoctormartinmooreede.substack.com/p/why-most-artificial-led-light-is>

Table 1 shows an example of the peak effective light wavelengths for different biological functions of light. None of these color wavelengths other than 555 nm green is accurately represented by the lumens value of the light source, or by the lumens per watt electrical efficiency metric used in the current standards. The 125 L/W rule regulates lamps based on their “lumens per watt,” or luminous efficacy, which ignores the healthy (or unhealthy) properties of a light source. However, this rule only regulates the energy efficiency of providing the green and yellow wavelengths that determine the visual brightness of light measured in lumens (Fig 4). The rule does not reflect the energy efficiency of delivering most of the light wavelengths that promote human health.

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 125 L/W rule. Thus, GSLs that are circadian-friendly (480 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 125 L/W rule.

Fig 4: DOE GSL energy regulations use a 100-year-old metric Lumens per Watt that only measures visual brightness



The petition for a new class of general wellness GSLs 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 regulations.

The only lights available under the current 125 L/W rule 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.

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 done³¹. Our proposed product class would do just that, use less energy to get the job of providing healthy light done.

Permitting the production and sale of GSL bulbs that provide healthy lighting would provide enormous health benefits for all Americans. We reiterate that under our proposed product class GSLs would still meet the statutory requirements for energy efficiency of 45 lumens per watt, providing a 75% or more energy use reduction compared to incandescent GSLs.

If DOE fails to provide the proposed new product class, it will set in motion an unprecedented public health experiment on over 330 million unwilling Americans who would have no way to opt out by purchasing general wellness light bulbs. As consumers become increasingly aware of the lack of availability of healthy light bulbs, they will likely buy exempted products, such as rough service or appliance light bulbs, or a black market will develop. Creating a new product class that provides healthy energy-efficient lighting is likely to save energy and improve health.

The Department 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 GSLs. We propose that DOE consider a definition for the General Wellness Lamp product class that appears in Appendix I.

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 bulbs will greatly encourage the lighting industry to invest in research to determine the most energy-efficient ways to provide healthy lighting.

The Trump Administration and the Secretary of Energy have called for action that is relevant to this petition

In his Inaugural Address, President Donald J. Trump declared, “Together, we will end the chronic disease epidemic.” On February 3, in his proclamation of “February 2025 as American Heart Month,” he reiterated that point when he wrote, “My Administration is also steadfastly committed to ... ending the chronic disease epidemic. And we will fulfill our pledge to investigate what has caused the decades-long increase in health problems.” As explained in this petition, the lack of natural outdoor light is a significant factor in chronic diseases, and the creation of this new product class would be an essential tool in the fight to reduce chronic diseases.

On January 20, President Trump issued an executive order titled “Unleashing American Energy.” Section 2 of that order said in part, “It is the policy of the United States ... to safeguard

³¹ 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>

the American people’s freedom to choose from a variety of goods and appliances, including but not limited to lightbulbs ... and to promote market competition and innovation within the manufacturing and appliance industries....”

Section 3 of the order declared in part that the “heads of all agencies shall review all existing regulations ... to identify those agency actions ... that are otherwise inconsistent with the policy set forth in section 2 of this order.”

On February 5, 2025, Secretary of Energy Chris Wright signed his first Secretarial Order. It declared in part that “The Department will pursue a commonsense approach that does not regulate products that consumers value out of the market; instead, affordability and consumer choice will be our guiding light.”

The proposed product class would expand consumer freedom of choice, spur U.S. manufacturing, and encourage investment and innovation in light bulbs.

Conclusion

As noted by one expert, current regulations do not consider “beneficial uses of light beyond the elimination of darkness, which is the equivalent of creating a diet plan that only considers necessarily 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 regulatory consideration.”³²

Because product development and marketing of GSL light bulbs that produce healthy light is a multi-year process, the 2028 rule is already having a major dampening effect on investment in and innovation for healthy lighting.

Therefore, a new 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.

By this petition, we respectfully request your attention and consideration.

Respectfully submitted,

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Director
Circadian Light Research Center
Stoneham, MA

³² Paul Pickard, Comment EERE-2022-BT-STD-0022-0188, available at <https://www.regulations.gov/comment/EERE-2022-BT-STD-0022-0188>

Appendix I

General Wellness Lamps are GSLs (General Service Lamps) that, in addition to providing visible illumination, also have one or more of the following characteristics:

- a) Less than 2% of total spectral irradiance between 380 and 780 nm falls in the 440 - 495 nm irradiance band (**Circadian night GSL**)
- b) More than 20% of total spectral irradiance between 380 and 780 nm falls in the 440 - 495 nm irradiance band (**Circadian day GSL**)
- c) Less than 40% of total spectral irradiance falls in the 500 - 600 nm band (**Spectrally targeted GSL**)
- d) 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 GSL**)
- e) CCT of less than 2700K (**Low blue evening/night GSL**)
- 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) Dynamic lamps that change the spectral power distribution between two or more of these (a-f) conditions by time of day (**Dynamic circadian GSL**)
- h) More than 50% of total optical watts distributed across the 600nm - 3000 nm band (**Near and shortwave infrared enhanced GSL**)
- i) More than 100,000 to 1 dimming range (**Artificial light at night GSL**)