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2 SOFT LIGHTS FOUNDATION,

3 Petitioner,

4
5 US DEPARTMENT OF ENERGY

6 Respondent

PETITION TO REPEAL FINAL RULES
EERE-2021-BT-STD-0005 AND EERE-2021-
BT-STD-0012 FOR GENERAL SERVICE
LAMPS

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9 **I. Introduction**

10 On May 9, 2022, the US Department of Energy Office of Energy Efficiency and
11 Renewable Energy published two final rules. 1) Final Rule Docket: EERE-2021-BT-STD-0005
12 - Energy Conservation Program: Energy Conservation Standards for General Service Lamps¹
13 and Final Rule Docket: EERE-2021-BT-STD-0012 - Energy Conservation Program: Definitions
14 for General Service Lamps²

15 The fundamental purpose of a General Service Lamp is to provide safe, uniform
16 illumination with light that disperses over distance following an inverse square law. Rule -0005
17 sets a 45 lumen per watt minimum luminous efficacy standard for GSLs without setting any
18 quality metrics for the light. Rule -0012 classifies LED lamps as a GSL, even though LEDs do
19 not provide uniform illumination, do not emit light that disperses following an inverse square

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22 ¹ <https://www.federalregister.gov/documents/2022/05/09/2022-09477/energy-conservation-program-energy-conservation-standards-for-general-service-lamps>

23 ² <https://www.federalregister.gov/documents/2022/05/09/2022-09480/energy-conservation-program-definitions-for-general-service-lamps>

1 law, and have no comfort, health, or safety regulations published by the Food and Drug
2 Administration. Because of the failure of these two rules to ensure uniform illumination, inverse
3 square law dispersion, and the protection of the public health and welfare, these two rules must
4 be repealed.

5 6 **II. The Law**

7 **A. Radiation Control for Health and Safety Act of 1968**

8 In 1968, Congress passed the Radiation Control of Health and Safety Act which directed
9 the Food and Drug Administration to regulate electronic products and the electromagnetic
10 radiation emitted by those products, including visible light. The FDA issued Title 21, Part I,
11 Subchapter J, Part 1040 in the Code of Federal Regulations which is titled Performance
12 Standards for Light-Emitting Products. The FDA has issued 21 CFR Part 1040.10 Laser
13 products., Part 1040.20 Sunlamp products and ultraviolet lamps intended for use in sunlamp
14 products., and Part 1040.30 High-intensity mercury vapor discharge lamps. The FDA has failed
15 to publish comfort, health, or safety regulations for the visible radiation emitted by Light
16 Emitting Diodes, despite Congress' mandate to do so.

17 The Department of Energy was given authority to regulate nuclear radiation via the
18 Atomic Energy Act of 1954, but the DOE has not been given any authority to regulate
19 electromagnetic radiation from electronic products. The FDA has sole authority to regulate the
20 visible radiation from electronic products. DOE's decision to mandate 45 lumen per watt
21 General Service Lamps was done without first ensuring that the FDA publishes comfort, health,
22 and safety regulations for Light Emitting Diode products. Since LEDs emit a directed beam of
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1 spatially non-uniform energy that has very little dispersion over distance, LEDs cannot be used
2 to replace the incandescent light bulb as like-for-like. The DOE’s rule requiring manufacturers
3 to sell only GSL’s that have at least a 45 lumen/watt luminous efficacy will force the
4 manufacturers to produce LED lamps, even though the FDA has not stated that LED visible
5 radiation is safe and has not published comfort, health, or safety regulations for LED products.
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7 **B. The Public Health and Welfare**

8 The Energy Policy and Conservation Act of 1975, the Energy Policy Act of 1992, the
9 Energy Policy Act of 2005, and the Energy Independence and Security Act of 2007 (each
10 described in more detail below) have all been codified into the federal statutes for energy
11 efficiency which are found in Title 42 of the United States Code titled The Public Health and
12 Welfare.³ It is critical to recognize that energy efficiency statutes must meet the goal of Title 42
13 which is protect the public health and welfare. An energy efficiency statute that fails to consider
14 the impacts on human health or which harms public health must be rejected as illegitimate.

15 Chapter 77 of Title 42 is titled Energy Conservation. The first section in Chapter 77 is
16 Section 6201 which is titled Congressional Statement of Purpose which states “*The purposes of*
17 *this chapter are— (5) to provide for improved energy efficiency of motor vehicles, major*
18 *appliances, and certain other consumer products;*” Congress’ explicit statement of purpose is to
19 improve energy efficiency and at the same time protect the public health and welfare under Title
20 42. If the statute fails to meet Congress’ purpose, then the statute must be vacated. LED light is

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23 ³ <https://www.govinfo.gov/content/pkg/USCODE-2011-title42/pdf/USCODE-2011-title42.pdf>

1 not an energy efficient light (explained in great detail below) because it does not provide uniform
2 illumination, does not disperse following an inverse square law, and harms the public health.
3 Any statute or rule that attempts to allow LED lamps to replace incandescent lamps fails to meet
4 Congress' energy efficiency requirements.

5 Title 42, Chapter 77, Subchapter III is titled Improving Energy Efficiency. Energy
6 efficiency means providing the same quality of service using less energy. If the statute or rule is
7 designed for using less energy but fails to ensure the same quality of service, then the statute or
8 rule must be rejected as invalid.

9 10 **C. The Energy Policy and Conservation Act of 1975**

11 Congress passed the Energy Policy and Conservation Act in 1975.⁴ This act included
12 sections on energy efficiency but did not include energy efficiency standards for lightbulbs. The
13 ECPA stated the following definition: “*The term ‘energy efficiency’ means that ratio of the*
14 *useful output of services from a consumer product to the energy use of such product, determined*
15 *in accordance with test procedures under section 323.*” In simpler language, energy efficiency
16 means providing the same quality of service (useful output) using less energy (energy use). The
17 EPCA was codified in statute in United States Code Title 42 The Public Health and Welfare.

18 19 **D. Energy Policy Act of 1992**

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23 ⁴ <https://www.govtrack.us/congress/bills/94/s622/text>

1 Congress passed the Energy Policy Act in 1992 which added energy efficiency standards
2 for lighting.⁵ Title I is titled Energy Efficiency. Subtitle C is titled Appliance and Equipment
3 Energy Efficiency Standards. Section 123 is titled Energy Conservation Requirements for
4 Certain Lamps and Plumbing Products.

5 The Energy Policy Act of 1992 amended US Code Section 6291 to contain definitions for
6 (30)(A) Fluorescent Lamp, (30)(B) General Service Fluorescent Lamp, (30)(C) Incandescent
7 Lamp, (30)(D) General Service Incandescent Lamp, (30)(F) Incandescent Reflector Lamp. Note
8 that the term General Service Lamp had yet to be defined.

9 Item (30)(E) states “*The terms ‘fluorescent lamp’ and ‘incandescent lamp’ do not include*
10 *any lamp excluded by the Secretary, by rule, as a result of a determination that standards for*
11 *such lamp would not result in significant energy savings because such lamp is designed for*
12 *special applications or has special characteristics not available in reasonably substitutable lamp*
13 *types.*” As we look forward into additional updates to US Code Title 42 Section 6291, we must
14 keep in mind that Congress is not intending for newer technologies to replace previous
15 technologies if the quality of the light is reduced. There can be no “energy savings” if the
16 service provided is changed or if the quality of the light is reduced.

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18 **E. Energy Policy Act of 2005**

19 Congress passed the Energy Policy Act of 2005 in 2005 and for the first time in the
20 history of the Energy Policy and Conservation Act timeline, introduced the Light Emitting
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23 ⁵ <https://www.govinfo.gov/content/pkg/STATUTE-106/pdf/STATUTE-106-Pg2776.pdf>
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1 Diode.⁶ Title IX is titled Research and Development. Section 912 is titled Next Generation
2 Lighting Initiative. Item (c) is titled Objectives and states, “*The objectives of the Initiative shall*
3 *be to develop advanced solid-state organic and inorganic lighting technologies based on white*
4 *light emitting diodes that, compared to incandescent and fluorescent lighting technologies, are*
5 *longer lasting, are more energy-efficient and cost-competitive, and have less environmental*
6 *impact.*”

7 We must look very, very closely at this section. This section is Title IX Research and
8 Development. Congress is not mandating anything other than investigation. Congress is not
9 mandating solid state lighting but is hopeful that LED lighting can be a more energy efficient
10 version of incandescent and fluorescent lighting. Congress is not stating that LED lighting is
11 more energy efficient than incandescent lighting but is directing public and private parties to
12 develop solid state lighting that is longer lasting, more energy-efficient and cost-competitive, and
13 have less environmental impact. Failure to develop such a technology is entirely possible, but
14 Congress is authorizing the investigation with the hope that success is possible.

15 In the following years from 2005 to 2022, the industry has certainly invested money and
16 time into developing solid state lighting using Light Emitting Diodes, but what they didn’t do is
17 develop a solid-state device that is more energy-efficient than incandescent. The reason is
18 because LEDs emit a directed beam of spatially non-uniform energy that does not follow an
19 inverse square law for dispersion. The flat surface of an LED chip produces a dangerous beam
20 that is just as intense at the destination as it is as the source and the spatial non-uniformity of this

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23 ⁶ https://www1.eere.energy.gov/femp/pdfs/epact_2005.pdf

1 beam interferes with the human nervous system and is toxic to human health. Since LEDs do not
2 provide the same uniform illumination service and follow the same inverse square law for
3 dispersion as incandescent, LEDs are not energy-efficient compared to incandescent and LEDs
4 harm the public health and welfare. **Thus, LED lamps do not meet Congress' directive to
5 develop solid-state lighting that is more energy efficient than incandescent or fluorescent.**

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7 **F. Energy Independence and Security Act of 2007**

8 Congress passed the Energy Independence and Security Act in 2007.⁷ Title III is titled
9 Energy Savings Through Improved Standards for Appliance and Lighting. Subtitle B is titled
10 Lighting Energy Efficiency. Section 321 is titled Efficient Light Bulbs. Section 6291 Item
11 (30)(BB) is titled General Service Lamp. This is the first appearance of the definition of General
12 Service Lamp and states, "The term 'general service lamp' includes -- (I) General Service
13 Incandescent Lamps; (II) Compact Fluorescent Lamps; (III) General Service Light Emitting
14 Diode (LED or OLED) Lamps; and (IV) any other lamps that the Secretary determines are used
15 to satisfy lighting applications traditionally served by general service incandescent lamps.

16 It is in this Energy Independence and Security Act of 2007 that Congress made the error
17 of including something called a "General Service Light Emitting Diode" without defining what
18 such a device is, and then including this device in the classification of GSL. As we have seen
19 earlier, LEDs do not provide uniform illumination and do not emit light that follows an inverse

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23 ⁷ <https://www.govinfo.gov/content/pkg/PLAW-110publ140/pdf/PLAW-110publ140.pdf>

1 square law for dispersion, are not more energy-efficient than incandescent, and cause harm to
2 human health and welfare.

3 The cause of this error was that Congress was misinformed about the technical nature of
4 LEDs. Even today, there is a lack of understanding within DOE, and all other federal agencies,
5 and the LED lighting industry that **LEDs emit non-uniform luminance that has little**
6 **dispersion over distance**. While certain individuals in the LED lighting industry and many
7 more individuals in the LED display industry certainly understand that LEDs emit non-uniform
8 luminance, this knowledge is not widely dispersed, and certainly did not make it to the members
9 of Congress. Congress is therefore under the false impression that LEDs emit uniform
10 luminance and visible radiation that disperses following an inverse square law just like
11 incandescent.

12 Congress' directive in 2005 to research the idea of using solid-state lighting as an energy-
13 efficiency replacement for incandescent lighting rapidly morphed into full-scale adoption of
14 LEDs without any effort to study to the health effects of such light, by focusing only on
15 luminous efficacy, and by ignoring the light quality properties. By 2007, members of Congress
16 had been led to believe that LED light was an equivalent light to incandescent, and thus
17 Congress included General Service LED in the classification of GSL even though it was invalid
18 to do so, and without waiting for the FDA to publish comfort, health, and safety regulations for
19 LED products.

20 Item (a)(6) is titled Standards for General Service Lamps. Within this section are
21 directives to the Secretary to determine if more stringent standards for luminous efficacy for
22 GSLs are needed. The problem here is that Congress was misinformed about the nature of solid-
23 state lighting and did not understand that their 2005 directive to investigate the possibility of

1 using solid-state LED lighting as an energy-efficient replacement for incandescent was not
2 successful. Members of Congress were given the impression by DOE and the industry that LED
3 lighting provided uniform illumination and inverse square law dispersion when it does not.

4 From 2007 to 2022, DOE has been attempting to determine if more stringent luminous
5 efficacy standards should be applied to GSLs. DOE was unsuccessful in making this
6 determination, most likely because LEDs cannot be classified as GSLs. In item (a)(6), Congress
7 specified a backstop luminous efficacy requirement of 45 lumens/watt if DOE failed to
8 determine if more stringent luminous efficacy standards should be applied to GSLs. However,
9 this 45 lumen/watt requirement was based on Congress' flawed understanding of how LEDs emit
10 light and the invalid assignment of LEDs to the GSL classification.

11 The Massachusetts Institute of Technology has developed an incandescent technology
12 called "light recycling" that may be able to achieve a luminous efficacy of 45 lumens per watt.⁸
13 However, this technology is not yet mature has not been given the resources by DOE in the same
14 way that DOE supported LED development. Therefore, Congress' 45 lumen/watt backstop
15 cannot be applied simply because no technology exists that meet Congress' criteria of a GSL that
16 provides the same quality of service as an incandescent with 45 lumen/watt luminous efficacy.
17 DOE therefore is not obligated to implement the 45 lumen/watt backstop rule, and, in fact,
18 cannot implement this backstop rule. **An LED is not a GSL and does not meet Congress'**
19 **energy-efficiency and public health and welfare requirements.**

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23 ⁸ <https://jdj.mit.edu/~ilic/recycling-light>

1 **G. Executive Order 13990**

2 On January 20, 2021, President Biden issued Executive Order (“E.O.”) 13990, Protecting
3 Public Health and the Environment and Restoring Science to Tackle the Climate Crisis. 86 FR
4 7037 (Jan. 25, 2021). In the opening paragraph, President Biden stated, “**Section 1.** Policy. *Our*
5 *Nation has an abiding commitment to empower our workers and communities; promote and*
6 *protect our public health and the environment; and conserve our national treasures and*
7 *monuments, places that secure our national memory. Where the Federal Government has failed*
8 *to meet that commitment in the past, it must advance environmental justice. In carrying out this*
9 *charge, the Federal Government must be guided by the best science and be protected by*
10 *processes that ensure the integrity of Federal decision-making. It is, therefore, the policy of my*
11 *Administration to listen to the science; to improve public health and protect our environment; to*
12 *ensure access to clean air and water; to limit exposure to dangerous chemicals and pesticides;*
13 *to hold polluters accountable, including those who disproportionately harm communities of*
14 *color and low-income communities; to reduce greenhouse gas emissions; to bolster resilience to*
15 *the impacts of climate change; to restore and expand our national treasures and monuments;*
16 *and to prioritize both environmental justice and the creation of the well-paying union jobs*
17 *necessary to deliver on these goals.”*

18 The DOE Final Rules for General Service Lamps, -0005 and -0012, do not meet the
19 President’s or Congress’ goals of using the best science and protecting public health. LED lamps
20 are undeniably dangerous to public health and welfare, and therefore, these two final rules are in
21 direct opposition to Executive Order 13990 and must be repealed.

1 **H. Rule EERE-2021-BT-STD-0005**

2 In the Summary section of EERE-2021-BT-STD-0005, the DOE writes, *“In this final*
3 *rule, the U.S. Department of Energy (“DOE”) is codifying in the Code of Federal Regulations*
4 *the 45 lumens per watt (“lm/W”) backstop requirement for general service lamps (“GSLs”) that*
5 *Congress prescribed in the Energy Policy and Conservation Act, as amended. DOE has*
6 *determined this backstop requirement applies because DOE failed to complete a rulemaking*
7 *regarding GSLs in accordance with certain statutory criteria. This final rule represents a*
8 *departure from DOE’s previous determination published in 2019 that the backstop requirement*
9 *was not triggered.”*

10 As noted earlier in this document, the reason why DOE has flip-flopped on its
11 understanding of whether the 45 lumen/watt backstop requirement was triggered or not is
12 because of Congress’ error in assigning the so-called General Service Light Emitting Diode to
13 the classification of General Service Lamp. Both DOE and Congress are under the mistaken
14 belief that LEDs provide uniform illumination, follow an inverse square law for dispersion, and
15 are an energy-efficient replacement for the incandescent light bulb. Since LEDs are not energy-
16 efficient compared to incandescent, and since LEDs are a danger to public health and welfare,
17 the 45 lumen/watt backstop cannot be applied because the statute itself is based on a false
18 premise and is thus invalid.

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20 **I. Rule EERE-2021-BT-STD-0012**

21 In the Summary section of EERE-2021-BT-STD-0012, the DOE writes, *“On January 19,*
22 *2017, the U.S. Department of Energy (“DOE”) published two final rules adopting revised*
23 *definitions of general service lamp (“GSL”) and general service incandescent lamp (“GSIL”),*

1 *and other supplemental definitions, to go into effect January 1, 2020. (“January 2017 Final*
2 *Rules”). Prior to that effective date, on September 5, 2019, DOE withdrew the revised definitions*
3 *of GSL, GSIL, and the other supplemental definitions. Upon further review and consideration, on*
4 *August 19, 2021, DOE published a notice of proposed rulemaking (“NOPR”) proposing to*
5 *amend the definitions of GSL, GSIL and the other supplemental definitions as previously set*
6 *forth in the January 2017 Final Rules. DOE responds to comments received on the NOPR in this*
7 *final rule and adopts the definitions of GSL and GSIL and the associated supplemental*
8 *definitions set forth in the January 2017 Final Rules as proposed in the NOPR.”*

9 Again, and as noted earlier in this document, the reason why DOE has flip-flopped on its
10 understanding of what can be classified as a General Service Lamp is because of the error in
11 belief that an LED lamp provides uniform illumination, follows an inverse square law for
12 dispersion, and is safe for public health and welfare.

13 In EERE-2021-BT-STD-0012, the DOE falsely claims that LED light has the same
14 characteristics as incandescent light, falsely claims that DOE is unaware of any negative health
15 effects from LED light, and claims that the Americans with Disabilities Act is irrelevant. The
16 reason why these DOE claims are false is explained in great detail below.

17 DOE does not classify a laser lamp as a GSL. Similarly, DOE cannot classify an LED
18 lamp as a GSL. Classifying a Light Emitting Diode as a General Service Lamp is unsupported
19 by the physics and the health effects of LED light. The DOE must wait for the FDA to publish
20 regulations for LED products before making a decision as to whether LEDs can be classified as a
21 safe, GSL.

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23 **J. Regulation of LEDs**

1 While the Food and Drug Administration regulates laser light, the FDA has failed in its
2 duty to regulate LED light. While LED chip makers have created chips that exceed 100,000,000
3 nits of peak luminance, human comfort level is approximately 300 nits and maximum human
4 tolerance is about 50,000 nits. The radiance/luminance of LED chips far exceeds any level that
5 could be considered safe for humans, and yet there are no regulations to prohibit lamp
6 manufacturers from making unsafe products. The federal agencies that we have contacted have
7 all, or nearly all, deferred to the FDA for regulation of LEDs. This includes the FDA, NHTSA,
8 EPA, FMCSA, CPSC, CDC, FHWA, FCC, FAA, and DOE.

9 It is negligent for DOE to classify an unregulated, dangerous device such as an LED lamp
10 as a General Service Lamp whose purpose is to provide safe, uniform illumination that follows
11 an inverse square law for dispersion without first waiting for the FDA to publish comfort, health,
12 and safety regulations for LED products.

14 III. The Physics

15 K. Definition of Energy Efficiency

16 There is not a single universal definition of “energy efficiency”, but all definitions
17 include the same basic premise. **Energy efficiency is providing the same quality of service**
18 **using less energy.**

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20 United States Department of Energy – “Simply put, energy efficiency means using
21 less energy to get the same job done.”⁹

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23 ⁹ https://www.energystar.gov/about/about_energy_efficiency

1 West Virginia Department of Environmental Protection – “Energy efficiency means
2 using less energy to accomplish the same task.”¹⁰

3 Environmental and Energy Study Institute – USA – “Energy efficiency simply means
4 using less energy to perform the same task.”¹¹

5 United Kingdom Department of Energy and Climate Change – “On a technical level,
6 energy efficiency is the relationship between the energy consumed and the output
7 produced by that energy, often called ‘energy services’, for example the number of
8 miles travelled for a gallon of fuel. Increasing energy efficiency means using either
9 less energy to provide the same level of energy services, or using same level of
10 energy to provide a higher level of energy services.”¹²

11 Law Insider – Energy Efficiency means a decrease in customer consumption of
12 electricity or natural gas achieved through measures or programs that target
13 customer behavior, equipment, devices, or materials without reducing the quality of
14 energy services.¹³

15 The claim of energy efficiency relies on a comparison to a baseline energy system. The
16 following two examples demonstrate energy systems that improve energy efficiency by
17 providing the same quality of service but using less energy.

18 **Example 1:** A motor vehicle with an Internal Combustion Engine travels 15 miles on one
19 gallon of gas. Engineers redesign the combustion chamber with a hemispherical top, resulting in
20 less wasted energy and an increase to 20 miles of travel on one gallon of gas. The same job is
21 performed, but using less energy, so the new technology is energy efficient.

22 **Example 2:** The water in a hot tub is heated by burning wood in an open fire underneath
23 the hot tub and it takes 3 chords of wood to heat the water to 105 degrees Fahrenheit. The system

21 ¹⁰ <https://dep.wv.gov/daq/EnergyEfficiency/Pages/default.aspx>

22 ¹¹ <https://www.eesi.org/topics/energy-efficiency/description>

23 ¹² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/65598/6918-energy-efficiency-strategy-statistical-summary.pdf

¹³ <https://www.lawinsider.com/dictionary/energy-efficiency>

1 is redesigned to enclose the fire and direct more of the heat to the bottom of the hot tub so that it
2 only takes 2 chords of wood to heat the water to 105 degrees and yet still heat the water
3 uniformly. The same job is performed, but using less energy, so the new system is more energy
4 efficient than the old system.

5 If the new technology performs a different job or a lower quality of service, then a claim
6 of energy efficiency cannot be made. The following three examples demonstrate systems that
7 reduce energy usage, but which are not energy efficient because the quality of the service is
8 reduced.

9 **Example 3:** A water purification machine uses 100 watt-hours of energy to produce 75
10 gallons of water that is 99.9% free of bacteria. A new technology machine uses 50 watt-hours of
11 energy to produce 75 gallons of water, but the water produced is only 30% free of bacteria. The
12 new technology did not perform the same job, so the new technology is not more energy efficient
13 than the previous technology.

14 **Example 4:** An elevator uses 1,000 joules to carry 5 passengers to the 4th floor and open
15 the door to let the passengers out. A new elevator design uses 600 joules to carry 5 passengers to
16 the 4th floor, but the new design does not allow the doors to open, and the passengers remain
17 stuck inside. The new technology is not more energy efficient than the previous technology
18 because it doesn't have the same functionality.

19 **Example 5:** A light bulb uses 60 watts to illuminate a room with 700 lumens of uniform
20 light that disperses gently following an inverse square law for dispersion. A new technology uses
21 10 watts to provide 700 lumens of light, but the light is not uniform, and is a directed energy
22 beam with little dispersion, making it difficult to see and making people sick. Thus, the new
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1 technology is not more energy efficient than the previous technology because it does not provide
2 the same service and results in less quality illumination than the previous technology.

3 The baseline service in the case of General Service Lamps is that provided by the
4 incandescent light bulb. An incandescent has the following light qualities: a) uniform
5 illumination, b) disperses following an inverse square law, c) a spectral power distribution with a
6 smooth transition from low blue to high red and high infrared, and d) low analog flicker. A new
7 technology such as LED that does not provide those same characteristics cannot be considered to
8 be energy efficient because it isn't getting the same job done or providing the same service.

9 10 **L. Light Quality**

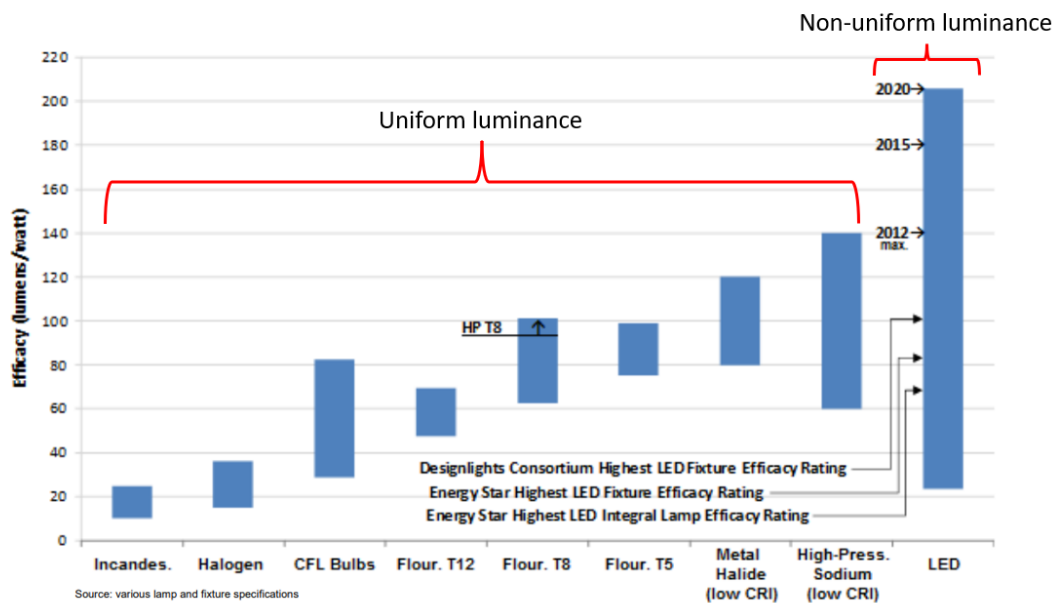
11 The incandescent light bulb provides the baseline quality metrics for electric lamps. The
12 incandescent light bulb provides the following:

- 13 a) Uniform illumination.
- 14 b) An inverse square law for dispersion.
- 15 c) Smooth, continuous increase from low blue to high red spectral power
16 distribution.
- 17 d) Analog sine wave flicker characteristics.

18 To set energy efficiency standards, DOE must include light quality metrics paired with
19 luminous efficacy requirements. A new technology would need to provide uniform illumination,
20 inverse square law dispersion, a smooth, continuous spectral distribution from low blue to high
21 red, and analog flicker characteristics, with a luminous efficacy greater than the luminous
22 efficacy of an incandescent light bulb to be able to claim greater energy efficiency.

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2 **M. Luminous Efficacy**

3 Figure 1 shows a comparison of the luminous efficacy of various lamp types. Each lamp
4 type has different characteristics compared to incandescent. All the lamp types emit uniform
5 luminance with dispersion following an inverse square law, except LED which emits non-
6 uniform luminance that remains a tightly focused beam over distance. Even though LED has the
7 highest potential luminous efficacy, LED cannot be used or classified as a GSL because LED
8 does not provide the service of uniform illumination and inverse square law dispersion.
9 Luminous efficacy alone does not equate to energy efficiency and LEDs are not energy efficient
10 compared to incandescent.



Source: Centerpoint Energy - <https://www.centerpointenergy.com/en-us/Documents/Commercial-Industrial-Docs/Lighting-Guide.pdf>

Figure 1 - Luminous Efficacy Comparison

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23 **N. Spatial Uniformity**

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1 Figure 2 shows the flat surface of a solid-state LED light source.¹⁴ The false colors
2 indicate the changing luminance, with the peak luminance, in red, being in the center of the LED
3 chip. An LED chip is called a *flat surface source* and brightness is measured with luminance in
4 nits (candela per square meter). The human nervous system is not biologically adapted to
5 receiving this type of non-uniform energy. Therefore, the non-uniformity of surface source light
6 creates a spatially low-quality light.

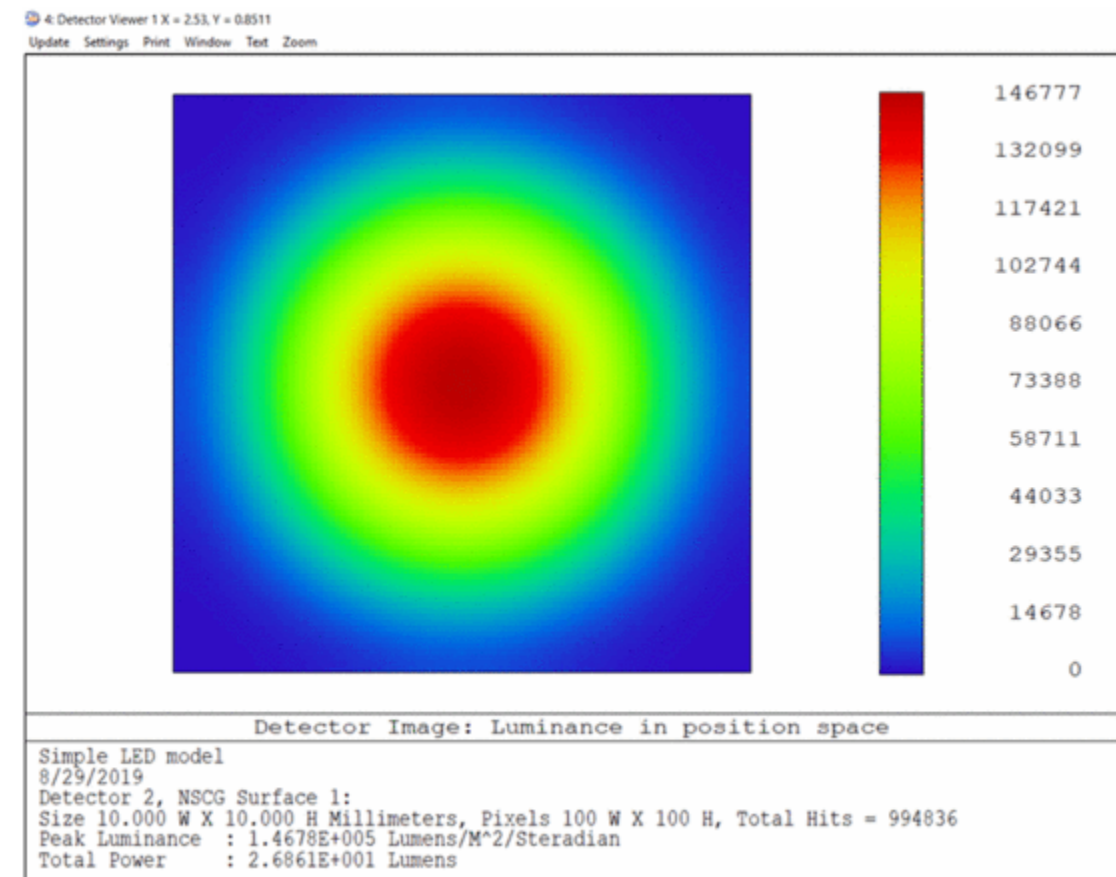


Figure 2 - Non-uniform Luminance

¹⁴ <https://ieeexplore.ieee.org/document/8879542>
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1
2 On the other hand, Figure 3 shows the uniformity at a given distance of a **curved surface**
3 **source** such as incandescent. The brightness of a point source is measured with luminous
4 intensity in candela. This uniform energy is biologically compatible with the human nervous
5 system and thus a curved surface source creates a spatially high-quality light.



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11 *Figure 3 - Uniform Luminance*

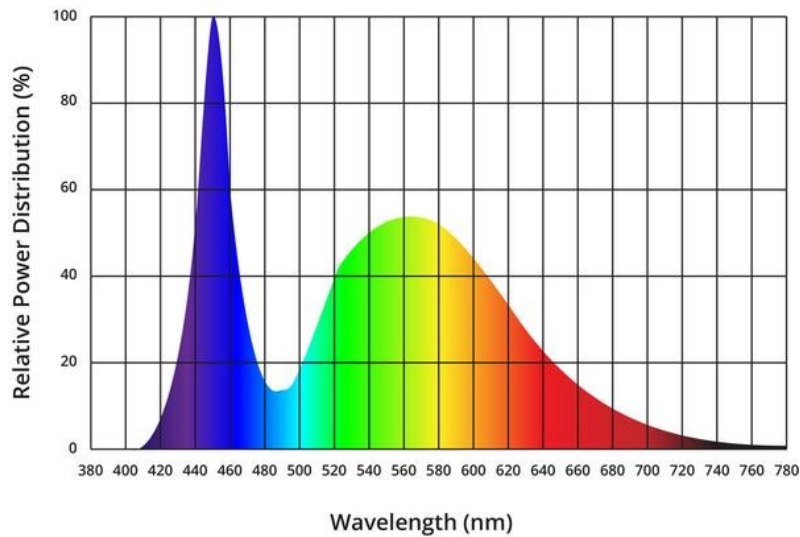
12
13 This difference in spatial distribution between the uniform luminance from a curved
14 surface source incandescent and the non-uniform luminance from a flat surface source LED is in
15 direct contrast to DOE's statement in EERE-2021-BT-STD-0012 that "*DOE has confirmed that*
16 *all lamp types included in the GSL definition have the same characteristics in the non-*
17 *incandescent versions as offered in the incandescent versions.*" DOE has incorrectly placed LED
18 lamps into the category of General Service Lamps by falsely claiming that LED light has the
19 same characteristics as incandescent light. **DOE is wrong to state that incandescent light and**
20 **LED light have the same characteristics.**

21 As a comparison example, consider a laser light source. DOE is not claiming that laser
22 light and incandescent light have the same characteristics. DOE would not attempt to claim that
23 a laser light source is more energy efficient than an incandescent light source because the light

1 output has different characteristics between the two types of emitters. In the same way, DOE
2 cannot claim that an LED light source is more energy efficient than an incandescent light source
3 since the light output has different spatial properties between the two source types.

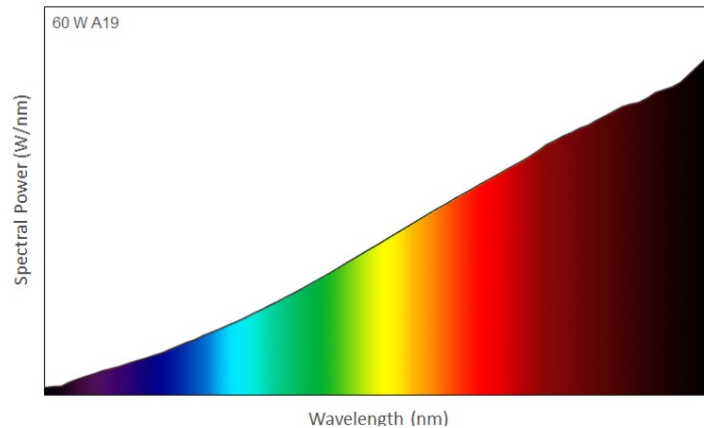
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5
6 **O. Spectral Power Distribution**

7 Figure 4 shows the spectral power distribution of a 5500K LED lamp. Notice the sharp
8 spike of blue wavelength at 450nm which is the same wavelength that is toxic for humans and
9 damaging to the eye. In addition, notice the trough at 490nm-cyan and lack of red and infrared
10 light. This distribution of energies in the visible spectrum is low quality because of the toxicity
11 of blue wavelength light, the piecewise spectral distribution, and lack of red wavelength.



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18 *Figure 4 - LED Spectral Power Distribution - 5500K*

1 On the other hand, Figure 5 shows the spectral power distribution for an incandescent
2 lamp. This is a high-quality light because of the lack of blue wavelength light, the strictly
3 increasing spectral distribution, and the large amount of red wavelength.



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Figure 5 - Incandescent Spectral Power Distribution¹⁵

We refer again to DOE’s statement in EERE-2021-BT-STD-0012 that “*DOE has confirmed that all lamp types included in the GSL definition have the same characteristics in the non-incandescent versions as offered in the incandescent versions.*” As shown in the two images above, LED light and incandescent light do not have the same characteristics and LED light, by virtue of the excessive amount of toxic blue wavelength light, is a low-quality light.

It should be noted that the reason that the manufacturers use blue wavelength light in LEDs is because this is how they increase luminous efficacy and reduce costs. The industry claims that LEDs are energy efficient are false because LEDs don’t provide the same high-quality spectral distribution as incandescent. If the manufacturers were to make LEDs with the

¹⁵ https://www.energy.gov/sites/prod/files/2016/11/f34/royer_spectral-power-dist_denver2016.pdf
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1 same quality of spectral power distribution as incandescent, the luminous efficacy would be no
2 better than incandescent.

3
4 **P. Flicker**

5 The article 1789-2015 - IEEE Recommended Practices for Modulating Current in High-
6 Brightness LEDs for Mitigating Health Risks to Viewers shows the difference between the
7 analog sine wave flicker from an incandescent, and the digital square wave flicker of an LED.¹⁶
8 As noted by IEEE, “*Presently, there are no standards on safe modulating frequencies for high-*
9 *brightness LEDs.*” This lack of safety standards for LEDs makes LEDs very dangerous because
10 chip makers and lamp manufacturers have no restrictions on the flicker emitted by the LED.

11 Figure 6 shows the flicker characteristics of an incandescent. The sine wave is
12 continuous and smooth and the light output changes by 6.6% as the alternating current cycles.

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23 ¹⁶ <https://ieeexplore.ieee.org/document/7118618>

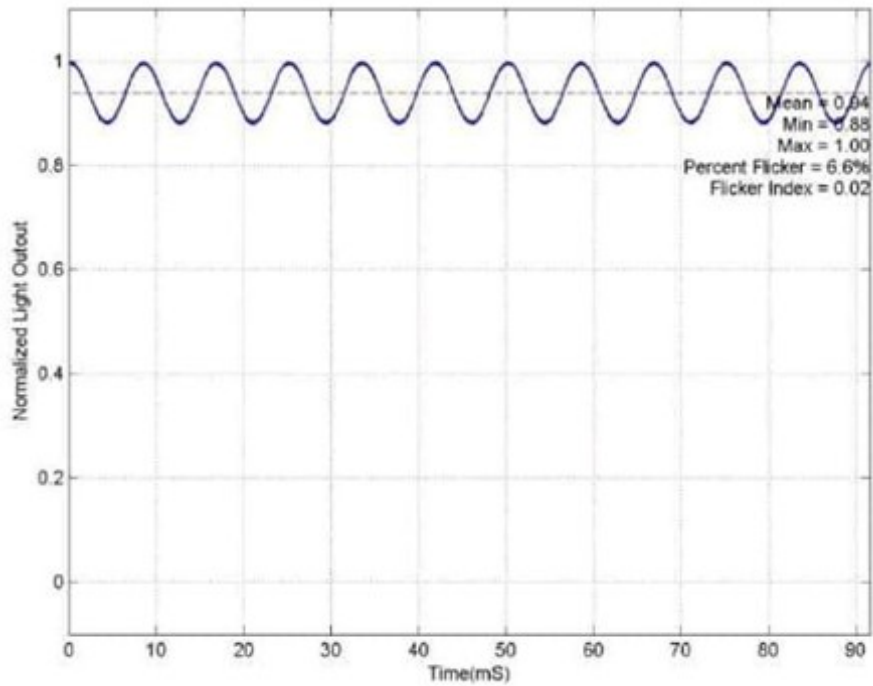


Figure 6 - Incandescent Flicker – 6.6%

On the other hand, Figure 7 shows the essentially discontinuous function of the square wave flicker of an LED. The light output drops from 100% to 0% and then back to 100% as the alternating current cycles. The discontinuous function and the extreme change between states produces flicker that is incompatible with the human nervous system.

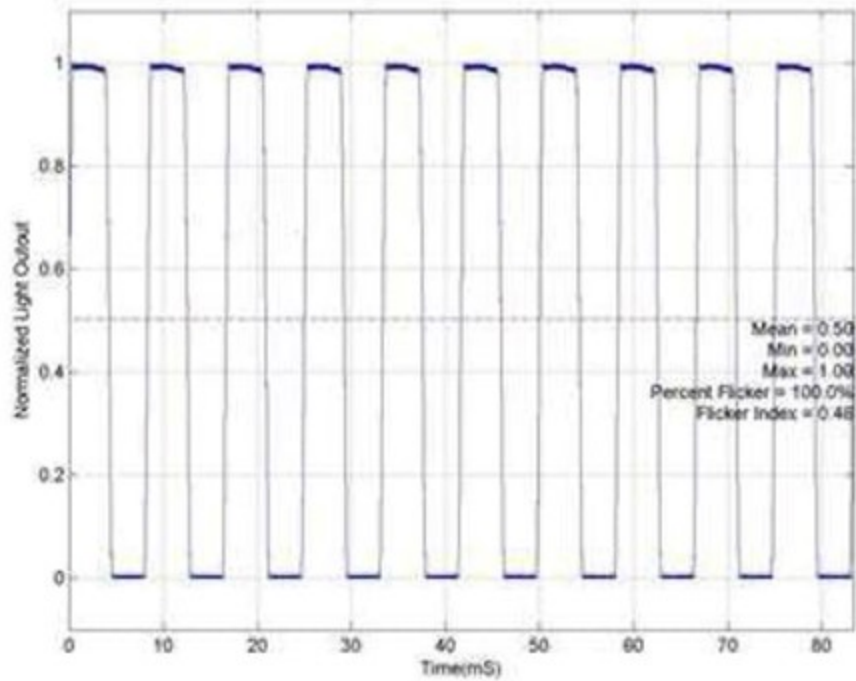


Figure 7 - Solid State Flicker - 100%

The square wave flicker is neurologically dangerous for many people and this makes LED light a low-quality light. For some people, this flicker is not consciously noticeable, but for others the flicker is consciously noticeable. However, even if the square wave flicker is not consciously noticeable, it is still having a negative effect on human health and is to be avoided. Since square wave flicker is lower in quality than analog sine wave flicker, the LED light is a lower quality light than incandescent, and DOE cannot claim that LEDs have the same characteristics as incandescent and cannot claim that LEDs are energy efficient.

Q. Characteristics of Incandescent and Non-Incandescent General Service Lamps

1 In EERE-2021-BT-STD-0012 Energy Conservation Program: Definitions for General
2 Service Lamps, the DOE states, “*Hence, in this final rule, incandescent lamps that are included*
3 *as GSLs have or can have more efficient, non-incandescent replacements with the same form*
4 *factor and light output. DOE has confirmed that all lamp types included in the GSL definition*
5 *have the same characteristics in the non-incandescent versions as offered in the incandescent*
6 *versions.*”

7 To be “more efficient”, the non-incandescent replacement must provide the same light
8 quality as incandescent. A non-incandescent cannot simply achieve a higher luminous efficacy
9 than incandescent by having different or lower light quality metrics and be considered “more
10 efficient”. The DOE incorrectly concludes that all non-incandescent lamp types, including
11 LEDs, included in the GSL have the same characteristics as incandescent. LEDs have non-
12 uniform luminance compared to the uniform luminance of incandescent, and LED light remains
13 a tightly focused beam over distance, as compared to the inverse square law dispersion of
14 incandescent light. Most LEDs have a large peak of blue wavelength light compared to almost
15 no blue for an incandescent. LEDs have square wave flicker compared to sine wave flicker for
16 an incandescent. The so-called General Service Light Emitting Diode Lamp cannot be classified
17 as a General Service Lamp because it has different light output characteristics than an
18 incandescent.

19 In EERE-2021-BT-STD-0012, DOE states, “*General service lamps include, but are not*
20 *limited to, general service incandescent lamps, compact fluorescent lamps, general service light-*
21 *emitting diode lamps, and general service organic light emitting diode lamps.*” This
22 classification appears to be wholly arbitrary, as incandescent lamps and LED lamps provide
23 entirely different services. DOE further states that, “*General service lamps do not include:*

1 *General service fluorescent lamps; High intensity discharge lamps.*” DOE also does not include
2 laser lamps in the definition of GSL. DOE has incorrectly used only the screw base type and the
3 lumen output criteria to classify a lamp as GSL. This cannot be done because the definition of
4 energy efficiency requires a comparison of the light quality and the service provided and because
5 the purpose of a GSL is to provide uniform illumination. If fluorescent lamps, high intensity
6 discharge lamps, and laser lamps are all excluded from the classification of GSL, then so too
7 must LED lamps be excluded from classification of GSL.

8 Placing any type of light source into a medium screw base with a luminous flux between
9 310 and 2600 lumens does not automatically qualify that light source as a General Service Lamp.
10 Using the incandescent as a baseline, to qualify for GSL classification the light output of the
11 lamp GSL must produce uniform illumination, the light must disperse following an inverse
12 square law, have low-blue to high-red spectral distribution, and have analog flicker
13 characteristics. These requirements automatically exclude laser light and LED light from the
14 GSL classification. **All GSLs must provide the same service and same quality of service, but
15 incandescent and LED provide different services, and therefore an LED lamp cannot be
16 classified as a GSL.** DOE’s decision to include LEDs in the category of GSL is arbitrary and
17 not legally justifiable.

19 IV. Public Health and Welfare

20 R. Harm to Human Health

21 In 2005, when Congress directed DOE to study the feasibility of using solid-state lighting
22 to create a lamp that was more energy-efficient than an incandescent, DOE failed to study the
23

1 impacts of the non-uniform luminance, non-inverse square law dispersion, blue wavelength light,
2 and square wave flicker from LEDs on the public health and welfare. This is a major oversight,
3 and this failure has led to serious negative health effects, loss of ability to work, exclusion from
4 society, and an entirely new class of disabled persons who become disabled in the presence of
5 LED visible radiation. Again, we must remember that US Code Title 42 is titled The Public
6 Health and Welfare and that Congress' goals are for DOE to develop energy-efficient lighting
7 that does not harm public health or welfare. DOE's analysis of the health effects of LED light
8 fails to meet Congress' directive for developing a solid-state energy efficient light that does not
9 harm public health and welfare.

10 In EERE-2021-BT-STD-0005, DOE states, "*Though the public comments do not include*
11 *quantitative evidence of specific lighting technology characteristics relevant to health, DOE has*
12 *considered these public comments. DOE researched studies and other publications to ascertain*
13 *any known impacts of LED lamps on human health and has not found any evidence concluding*
14 *that LED lighting used for general lighting applications directly results in adverse health*
15 *effects.*" and then lists the following three references as supposed proof that LEDs do not result
16 in adverse health effects.

- 17 1) European Commission, "Scientific Committee on Health, Environmental and
18 Emerging Risks (SCHEER) Report," June 2018. Available at [https://ec.europa.eu/
19 health/system/files/2019-02/scheer_o_011_0.pdf](https://ec.europa.eu/health/system/files/2019-02/scheer_o_011_0.pdf);
- 20 2) Cleveland Clinic, "Are LED Lights Damaging Your Retina?" August 9, 2019.
21 Available at [https://health.clevelandclinic.org/are-led-lights-damaging-your-retina/;](https://health.clevelandclinic.org/are-led-lights-damaging-your-retina/)
22
23

1 3) Light Europe, “Frequently Asked Questions on alleged LED health related issues,”
2 December 2016. Available at [https://www.lightingeurope.org/images/publications/
3 general/FAQ_on_alleged_LED_related_health_issues_-_December_2016.pdf](https://www.lightingeurope.org/images/publications/general/FAQ_on_alleged_LED_related_health_issues_-_December_2016.pdf).

4
5 **The listing of just these three links, only one of which is a study, is inexcusably**
6 **negligent.** Immediately obvious is the omission of the American Medical Association report of
7 2016 showing that blue wavelength light is dangerous.¹⁷ Also missing are the studies of how
8 LED light impacts those who are most sensitive to the non-uniform luminance of LED light such
9 as those with epilepsy, autism, and migraines.

10 The SCHEER report referenced by the DOE is a severely flawed document that cannot be
11 relied on. Yet, the SCHEER report is full of warnings of the dangers of LED light. The
12 language used in the report attempts to water down the risk, but many dangers of LED light are
13 listed. Here are some quotes from the SCHEER report.

- 14 1. Page 2 – *“Since the use of LED technology is still evolving, the Committee considers*
15 *that it is important to closely monitor the risk of adverse health effects from long-term*
16 *LED use by the general population.”* – The SCHEER report was published in 2018.
17 Since that time, even more research has come out showing that LED light is
18 dangerous and toxic. DOE has failed to “closely monitor” the adverse health effects
19 of LED light.

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23 ¹⁷ [Human and Environmental Effects of Light Emitting Diode \(LED\) Community Lighting](#)
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- 1 2. Page 22 – “*point source light (light emitted from an LED chip)*” – This is incorrect.
2 LED light is a flat surface source (Lambertian), not a curved surface point source.
- 3 3. Page 8 – “*The SCHEER is concerned about the high-luminance exterior sources used*
4 *on some vehicles.*” – High luminance LED light with excessive amounts of blue
5 wavelength light is dangerous, and yet these LED lights are being used as vehicle
6 headlights, floodlights, streetlights, and indoor lights.
- 7 4. Page 8 – “*People who suffer from photosensitive conditions have been considered.*” –
8 This “have been considered” phrase is the same meaningless phrased used by DOE.
9 What does it mean to “have considered” something? Where are the details? How
10 was it considered? What were the positives and negatives? Where is the discussion
11 of those who have suffered seizures, migraines, panic attacks, blurred vision, loss of
12 balance, skin rashes, and nausea from LED light? The “have been considered” phrase
13 is simply a way to ignore the truth about the negative effects of LED light.
- 14 5. Page 12 – “*The optical radiation incident on a target tissue is expressed in terms of*
15 *irradiance (W/m²) or illuminance (lm/m² or lux).*” – The SCHEER report is
16 misunderstanding that LEDs are a flat surface source light and that the proper metrics
17 are radiance (W/m²-steradian) and luminance (nits or candela/m² or lumen/m²-
18 steradian)
- 19 6. Seizures – Even though LED light is known to trigger epileptic seizures, there is no
20 discussion of this in the SCHEER report.

21 Examining all the flaws of the SCHEER report would be an exhaustive exercise that
22 deserves its own paper.

1 The link to the Cleveland Clinic is not a study, just a simple article and certainly not
2 worthy of reference. Similarly, the link to Light Europe (“The Voice of the Lighting Industry”)
3 is not worthy of consideration. DOE’s failure to provide serious, detailed analysis of the
4 hundreds of reports of harm caused by LED light is wholly inadequate and does not meet
5 Congress’ directives to ensure that LED lighting technology does not harm public health and
6 welfare. DOE must diligently review and provide detailed analysis of the LED research studies.

7 The overwhelming and inescapable conclusion of hundreds of studies, many of which are
8 linked to below, is that LED light is toxic, hazardous, unsafe, and is not fit for the purpose of
9 general illumination.

11 S. Health Research

12 DOEs only comment on the research that LED light harms human health is the following,
13 “DOE has considered these public comments.” **This singular comment about the health**
14 **effects of LED visible radiation constitutes negligence by DOE officials.** The scope of how
15 LED light impacts human health and ecosystem system health is so vast that the statement “DOE
16 has considered these public comments” constitutes a dereliction of duty.

17 Below is a list of some of the research studies on the effects of artificial light and LED
18 light that DOE has ignored.

19 **March 14, 2022** – [Light Exposure During Sleep Impairs Cardiometabolic Function](#) – Blue
20 light is bad. Any light is bad. Tiny amounts of light at night is bad.

21 **March 10, 2022** – [Outdoor Light at Night and Autism Spectrum Disorder](#) – Artificial Light
at Night significantly increases the risk of developing autism.

22 **December, 2021** – [Is Street Lighting Damaging Our Health?](#) – Cree Lighting is the first
23 company in the industry to admit that the industry has been measuring LED light incorrectly.

1 **November, 2021** – [One Third of Us are At Risk](#) – Compiled links to medical research on the
effects of LEDs.

2
3 **May 13, 2021** – [Should We Re-think Regulations and Standards for Lighting at
Workplaces? A Practice Review on Existing Lighting Recommendations](#) – Quote: the quality
4 of light should not be reduced for lower energy consumption.

5 **April, 2021** – [What is Photobiological Safety Standard?](#) – Discussion of IEC 62471 and
concern about eye damage from LEDs and the classification groups Risk Group 0, 1, 2 and 3.

6 **March, 2021** – [Do no harm: the beginning of the age of healthy hospital lighting](#) –
7 Reduction of blue wavelength light improves sleep.

8 **February 8, 2021** – [Associations between Artificial Light and Risk for Thyroid Cancer](#) –
Artificial light increases thyroid cancer risk by 55%.

9 **February, 2021** – [Insights into blue light accelerated tooth whitening](#) – At a radiance of
10 190 mW/cm², LEDs will bleach teeth.

11 **January 27, 2021** – [Moonstruck sleep: Synchronization of human sleep with the moon
cycle under field conditions](#) – Sleep timing is synchronized under the moon cycle. Artificial
12 light disrupts this cycle.

13 **January 7, 2021** – [Light Pollution, Sleep Deprivation, and Infant Health at Birth](#) – This
study confirms that light pollution can lead to premature births.

14 **November 5, 2020** – [Evening home lighting adversely impacts the circadian system and
sleep](#) – This article makes the case that the economic benefits of energy efficient LED
15 lighting are outweighed by the substantial disease burden they produce.

16 **July 14, 2020** – [Comparison of ophthalmic toxicity of light-emitting diode and organic
light-emitting diode light sources](#) – LEDs are toxic to the eye, OLEDs less so.

17
18 **May 24, 2020** – [20% to 30% Have Heightened Sensitivity](#) – This article articulates how the
19 20% to 30% of the population who are sensitive receptors have been so far snubbed by the
the psychology profession.

20 **February 29, 2020** – [LED Street Lights – Major Health Concerns](#) This presentation by Dr.
21 Wojcik summarizes the research about the dangers of blue wavelength light.

22 **February 27, 2020** – [Blue Light Suppresses Melatonin in Dairy Calves](#) This study shows
that melatonin is suppressed by blue wavelength light, thus affecting eating, drinking, etc.

1 **February, 2020** – [Light-induced Retinal Ganglion Cell Damage and the Relevant](#)
2 [Mechanisms](#) – Retinal Ganglion Cells in the eye are damaged by excessive visible radiation.

3 **October 17, 2019** – [Daily blue-light exposure shortens lifespan and causes brain](#)
4 [neurodegeneration in Drosophila.](#) – LED blue wavelength light causes serious injury to
5 flies.

6 **December, 2018** – [Exposure to excessive blue LED light damages retinal pigment](#)
7 [epithelium and photoreceptors of pigmented mice.](#)

8 **October 2, 2018** – [Melatonin: An Anti-Tumor Agent](#) This study shows that light at night
9 increases risk of breast and prostate cancer.

10 **June 25, 2018** – [Current Understanding of Photophobia, Visual Networks, and Headaches](#) –
11 How light triggers pain.

12 **June 5, 2018** – [SCHEER Final Opinion on Light Emitting Diodes](#) – An overly positive
13 opinion of LEDs, choosing to ignore the downsides and missing studies.

14 **February, 2018** – [Including an index measuring the weighted content of blue light in lamp](#)
15 [labelling](#) – A proposal for G-Index in place of Correlated Color Temperature.

16 **August 8, 2017** – [Harvard University – Outdoor Light at Night and Breast Cancer Incidence](#)
17 [in the Nurses’ Health Study II](#) This study shows the link between artificial light at night and
18 breast cancer.

19 **June 29, 2017** – [Effects of white light-emitting diode \(LED\) exposure on retinal](#)
20 [pigment epithelium in vivo](#)

21 **February 18, 2017** – [Light-emitting-diode induced retinal damage and its wavelength](#)
22 [dependency in vivo](#)

23 **February, 2017** – [Blue Light Paradox](#) – Blue wavelength controls circadian rhythms, but
also damages the eye.

January 31, 2017 – [National Institutes of Health – Timing of Light Exposure Affects](#)
[Mood and Brain Circuits](#) This scientific research article covers how circadian
rhythms are being disrupted by artificial light at night.

October, 2016 – [Blue Light: What are the Risks to Our Eyes?](#) – International Review of
Ophthalmic Optics – Quote: *We cannot seriously deny the potential ocular risks from
overexposure to blue light. It is important not to forget that it is the cumulative effect over
time that is dangerous and must be fought.*

1 **June 14, 2016** – [Human and Environmental Effects of Light Emitting Diode \(LED\) Community Lighting](#) – The American Medical Association reports that blue wavelength
2 light from LEDs is toxic.

3 **April, 2016** – [Exposure of Fluid Milk to LED Light](#) – LED light has a strong negative impact
4 on the taste of milk.

5 **January 24, 2016** – [NIH – Effects of Blue Light on the Circadian System and Eye Physiology](#) This scientific research paper concludes that blue light causes photoreceptor
6 damage.

7 **April 8, 2015** – [Retinal damage induced by commercial light emitting diodes \(LEDs\).](#)

8 **March, 2014** – [White light-emitting diodes \(LEDs\) at domestic lighting levels and retinal injury in a rat model.](#)

9 **January 2013** – [Health Effects of Large LED Screens on Local Residents](#) – Luminance above
10 10,000 nits is dangerous and this article mentions the need to further study the impacts of
LEDs on those with epilepsy.

11 **November 8, 2012** – [Ensuring Safety in LED Lighting](#) – Significant coverage of the dangers
12 of LED radiation. Blue light hazard, excessive luminance, macular degeneration, sleep
disruption, and LEDs classified as lasers for use in toys.

13 **December, 2010** – [Light Pollution: Light at Night and Breast Cancer Risk Worldwide](#) This
14 study shows that cancer risk increased by as high as 50% for countries with high Artificial
Light at Night.

15 **November 22, 1996** – [Effect of bright light exposure on muscle sympathetic nerve activity in human](#) – 5000 lux light triggers nerve activity, even after the light is shut off.

17 DOE must address these studies with in-depth analysis prior to adopting any rule that
18 would allow the use of LED lamps.

19
20 **T. Personal Stories of Harm**

21 The DOE has failed to conduct studies of the effects of LED light on human health but
22 has allowed LEDs to proliferate across the US without regulatory oversight. Thus, we have all

1 become unwitting participants in a real-time experiment. We can use the responses generated by
2 the public as evidence that LED light is harmful.

3 Ms. MarieAnn Cherry testified to the New York State Public Service Commission that
4 LED light triggers life-threatening epileptic seizures. Ms. Cherry opened her testimony with the
5 following statement, *“I have epilepsy and migralepsy. I cannot neurologically tolerate any LED*
6 *exposure, and I am thrown instantly into violent seizures from the briefest strike of LED light.”*¹⁸

7 Ms. Elaine Dennehy testified to the Irish Parliament that LEDs have excluded her from
8 society. Ms. Dennehy opened her testimony with the following statement, *“I thank the*
9 *committee very much for this opportunity. I also hope that this can help, in many ways, the*
10 *others who are suffering around the world from light emitting diode, LED, sensitivity and*
11 *artificial light sensitivity. I have been made ill from LEDs since 2007. It is more than a*
12 *sensitivity; it is a disability. I am disabled by my environment, like so many others, and excluded*
13 *from society. This is also an accessibility issue.”*¹⁹

14 Below is a list of confirmed stories of personal injury from LED light.

- 15 1. [Testimony to NYSPSC](#)
- 16 2. [NY Times Opinion](#)
- 17 3. [Personal letter from a person with epilepsy](#)
- 18 4. [Personal letter from a person with epilepsy](#)
- 19 5. [Testimony to Irish Joint Committee on Disability Matters](#)
- 20 6. [Personal letter from a person with migraines](#)

21 _____
22
23 ¹⁸ <https://www.softlights.org/wp-content/uploads/2022/05/To-the-Hon-Letter-to-NYSPSC.pdf>

¹⁹ https://www.oireachtas.ie/en/debates/debate/joint_committee_on_disability_matters/2022-02-03/2/

- 1 7. [Personal letter from a person with migraines](#)
- 2 8. [Personal letter from a person with autism](#)
- 3 9. [Personal letter from a person with autism](#)
- 4 10. [Personal story in the New York Times](#)
- 5 11. [Personal story of eye damage](#)
- 6 12. [Personal story of neurological trauma](#)
- 7 13. [Personal story from a person with lupus](#)
- 8 14. [Personal story from a person who gets headaches](#)
- 9 15. [Personal story from a person with nystagmus](#)
- 10 16. [Personal story from a teacher](#)
- 11 17. [Personal story from a person with lupus](#)
- 12 18. [Light sensitivity causing social isolation](#)
- 13 19. [Personal story from a person with electromagnetic sensitivity](#)

14
15 The following are the results of an informal survey conducted in New York.²⁰

- 16 1. *“I have not found a medication that stops seizures that are triggered by the (LED)*
- 17 *lights.”*
- 18 2. *“I have epilepsy as well and know the damage the lights can cause.”*

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22
23 ²⁰ <http://www.softlights.org/wp-content/uploads/2022/01/Quotes-from-adversely-affected-individuals.pdf>
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- 1 3. *“Daily I am bombarded with seizure triggers (strobes on bicycles, dog collars, police*
2 *and fire engines, and LEDs in stores, restaurants, and even in doctors' offices...which*
3 *I find unforgivable!) ...They also make my muscles twitch and I feel nauseous.*
- 4 4. *“When exposed to LED light sources I experience nausea, vertigo, anomia and*
5 *sometimes migraine-like, pounding headaches combined with a feeling of reality*
6 *loss...certain street lights or LED panels induce very fierce symptoms after only a*
7 *short exposure.”.*
- 8 5. *“Currently I am not employed or doing any volunteer work because of lighting in*
9 *buildings...and other road lighting. I hate going out in public because of light*
10 *sensitivity.”*
- 11 6. *“I had no previous health conditions, optical sensitivity, or problems with*
12 *headaches...Bright blueish LEDs also make me feel agitated and nauseous. I'm*
13 *perfectly well if I stay away from these lights, but that means staying away from my*
14 *children's school, the health center and hospital, most churches and meeting houses,*
15 *libraries...much of life as I knew it. The times the symptoms last depend on the length*
16 *of exposure to the lighting, but for ages afterwards I feel incredibly drained and down*
17 *and 'wrong' all over.”*
- 18 7. *“This situation has recently gotten a lot worse with the introduction of LED street*
19 *lighting...which causes the worst pain yet.”*
- 20 8. *“... no longer able to cycle, walk or drive wherever LED streetlights are installed as*
21 *they instantaneously trigger bad headaches...which quickly develop into disabling*
22 *migraines, including dizziness, not being able to think straight, some loss of*
23

1 *coordination, and a general inability to function... symptoms lasting more than a*
2 *day.”*

3 9. *“I have seizures when I glimpse an LED light...Anyone else experiencing the*
4 *same???”*

5 10. *“I cannot be around any LEDs...incandescent works perfectly well, but the lighting*
6 *industry is desperate to phase them out...It's getting to be where many of us are*
7 *prisoners in our own homes.”*

8 11. *“The LED streetlights I have encountered have been pure and utter hell for me. Being*
9 *around them, I just feel burning right on my eyes...the pain is almost unbearable.”*

10 12. *“Blue light is recognized by photo-dermatologists to be much more penetrating and*
11 *therefore much more aggravating for people with light sensitive skin conditions. The*
12 *high blue content of the proposed street lighting...I would become totally*
13 *housebound...”*

14 13. *“I was bathed in a very bright LED street light from a new housing estate...I felt ...a*
15 *severe headache, the pain lasted for a month and was accompanied by general light*
16 *sensitivity to all bright light.”*

17 14. *“It is well-known that light can affect the brain in negative ways. Sometimes I think:*
18 *how has this happened? How is this the kind of environment we want to live in?”*

19 15. *“...the impact is far worse from LED lights...(I wear) special tinted glasses to try and*
20 *mitigate the effects, but they only help to a limited degree. I'm concerned about when*
21 *the relaxing orange street light outside my bedroom window will be changed to LED,*
22 *because others have been converted in our road already. If the one outside my*
23 *window gets changed to LED, that would be a disaster for me.”*

- 1 16. *“I have special glasses I wear when going out that seem to help with bright lights.*
2 *With the LEDs it can be tricky. If I notice any place I went to has LED lights, then I*
3 *make it (a point to) remember. It helps me avoid them (LEDs).*
- 4 17. *“All new street lights including LEDs make me feel disoriented, lose my balance and*
5 *be unable to sense my feet... I have to hold onto another person to stop myself falling.*
6 *After being exposed, I suffer a migraine.”*
- 7 18. *“Most LED street lights make me feel awful and unable to function well, with*
8 *migraines, dizziness, pain, extreme discomfort, being on edge, and a substantial*
9 *feeling of general malaise. NonLED street lights are totally fine for me!”*
- 10 19. *“Street lights in my area were changed over four years ago from sodium... effect on*
11 *me so devastating (that I have) barely left the house or even opened my front door in*
12 *the evening since they were installed. I can also be affected during the day as many*
13 *LEDs are actually on permanently...”*
- 14 20. *“I was already unable to work due to LED lighting in the offices but losing the*
15 *freedom to be outside or even look outside at dawn or after dusk is a further*
16 *disability, I am having inflicted upon me. The winter months are a particularly*
17 *difficult time as I have to draw the blinds and curtains in the middle of the day to*
18 *avoid feeling ill.”*
- 19 21. *“a devastating change...excluded from work and leisure outside the house...(no)*
20 *classes or meetings, even just walking through the town is impossible (since LED*
21 *street lighting arrived)...very upsetting, but better than living in constant pain...”*

1 22. *“The parking garage (now) has LED lighting. The second (I am in the garage) I get a*
2 *lightheaded feeling and nausea...I cannot use LED light bulbs without feeling quite*
3 *ill. My time in public stores, these days, has to be very short.”*

4 23. *“I’ve never had migraines...but recently I was in Walmart, and it felt like the lights*
5 *were flashing, it seemed exceedingly bright...I am experiencing the same thing now at*
6 *work. They’ve changed the lighting to LEDs in our warehouse and now this is*
7 *happening.”*

8 The informal study above was conducted in New York, but those quotes likely represent
9 the population as a whole. Here are some statistics of classes of people in the USA whose health
10 may be harmed by LED light.

11 3,400,000 people with epilepsy.

12 5,400,000 adults with autism.

13 35,000,000 people with migraines.

14 73,000,000 children.

15 There are hundreds of documented stories of harm to human health caused by LED light
16 and likely millions of undocumented stories. Some of these stories are documented by the Soft
17 Lights Foundation²¹ and other stories documented by LightAware Charity.²² Ongoing reports of
18 harm are posted daily on numerous social media groups such as Ban Blinding LEDs.

19
20
21
22
23 ²¹ <http://www.softlights.org/stories/>

²² <https://lightaware.org/about/individual-stories/>

1 Based on these reports of the personal adverse effects of LED visible radiation, it is likely
2 that millions of Americans are being harmed by LED visible radiation. All of these reports
3 contradict DOE's assertion that LED light does not cause harm. These reports of harm from LED
4 light must be taken seriously by DOE and cannot be ignored.

5
6 **U. Americans with Disabilities Act**

7 The ADA is a federal law originally adopted in 1990, and then further strengthened in
8 2008. The ADA prohibits discrimination. LEDs have created a new class of disabled citizens
9 who become disabled in the presence of LED visible radiation. If LEDs remain classified as
10 GSLs and incandescent light bulbs are eliminated from the market, then businesses and
11 government agencies will be placed into the impossible position of having to provide light that
12 discriminates due to unavailability of non-discriminatory incandescent lighting.

13 For example, let's say that a small town has one US Post Office that was previously using
14 incandescent light bulbs that are safe for people who become disabled in the presence of LED
15 visible radiation. If an incandescent light bulb burns out and needs replacement, but
16 incandescent light bulbs are no longer available, then the USPO will have three choices: 1)
17 Replace the incandescent with an LED lamp that produces low-quality light that causes epileptic
18 seizures, migraines, and panic attacks, thus preventing those who are disabled by LED visible
19 radiation from accessing the USPO, or 2) Use candles or oil lamps, or 3) Leave the USPO dark.
20 This is a dilemma that the DOE must not force the Post Office into.

21 DOE has not collaborated with the US Access Board during this process. DOE must
22 begin the conversation with the US Access Board to ensure that guidelines are developed to
23 protect LED light-disabled people from discrimination.

1
2 **V. RELIEF**

3 In this appeal, we have proved all the following:

- 4
- 5 1. In the same way that laser lamps are not classified as a GSL, LED lamps cannot be
6 classified as a GSL because LED lamps do not provide the fundamental service of
7 safe, uniform illumination that disperses following an inverse square law. LED lamps
8 pose a danger to public health.
 - 9 2. Congress' 45 lumen/watt luminous efficacy backstop requirement was made on the
10 false premise that an LED lamp can be classified as a GSL, and therefore the 45
11 lumen/watt requirement cannot be adopted.
 - 12 3. Energy efficiency requires both light quality and luminous efficacy requirements.
 - 13 4. Setting luminous efficacy requirements without corresponding light quality metrics
14 results in lower quality light that can harm human health and a fail to achieve energy-
15 efficiency.
 - 16 5. LED visible radiation causes serious adverse health effects and creates discriminatory
17 barriers.
 - 18 6. The FDA has not approved any LED products and has not set comfort, health, or
19 safety standards for LED products.

20 Therefore, DOE must do the following:

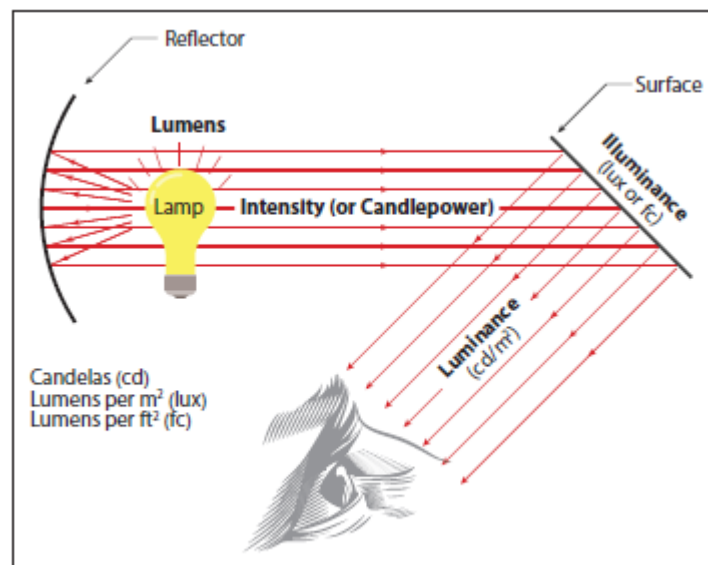
- 21
- 22 1. Repeal Rule EERE-2021-BT-STD-0012 and remove LEDs from the GSL
23 classification.

Curved vs. Flat Source Emitter

The invention of a flat surface device that emits visible radiation has created a new class of light source that requires a different set of metrics from curved surface light sources.

Curved Surface Emitter

Figure 1 is a diagram of basic lighting terms from the Illuminating Engineering Society. As can be seen in the diagram, the lamp emits uniform energy in all spatial directions, eventually entering the eye with spatially uniform (isotropic) energy. The metrics for the light entering the eye from the flat surface is called luminance and is measured in candela per square meter, also known as nits.



Relationship of basic lighting terms.

Figure 1

The brightness of the lamp is measured by the metric called luminous intensity, measured in candela. Because the energy emitted by the lamp is spatially uniform, the light will spread out following an inverse square law and will become less dense and less bright as the distance increases. Also, because of the uniform spatial energy, a single value can be used to measure the luminous intensity, and a single value can be used to measure the reflected luminance from a flat surface which was originally emitted by a curved surface. Mathematically, the light can be modeled as a single, infinitely small point and the light source can be considered a point source.

Flat Surface Emitter

The invention of solid-state lighting, which uses a flat surface chip to generate light, dramatically changes the properties of the light that's emitted. The photons emitted by the chip randomly escape at different angles, but because of the flat geometry of the chip, some of the light rays will overlap. The center of the chip is where the most overlap occurs, with the least amount of overlap occurring near the edges. There is almost no light emitted from behind the chip. These important differences are not considered with current metrics.

M. Nisa Khan has a Ph.D. in electrical engineering, and B.S. in physics and mathematics and is the author of *Understanding LED Illumination*. Dr. Khan mathematically proves¹ why LEDs emit a directed beam of spatially non-uniform visible radiation that does not follow an inverse square law for dispersion. The cause of these effects is due to LEDs emitting light from a flat surface. Figure 2 shows the fundamental difference between a flat surface emitter and curved surface emitter.

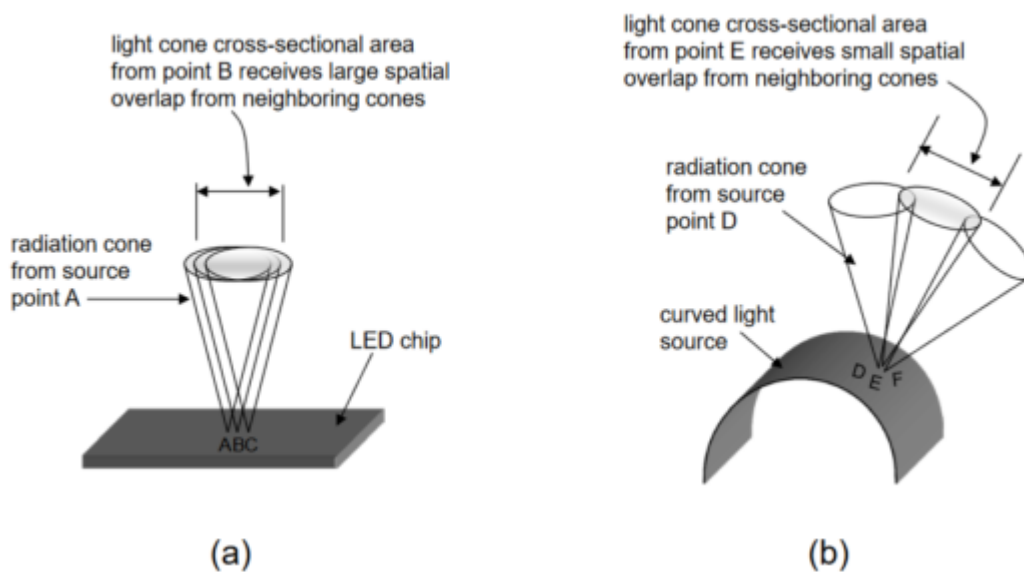


Figure 2 - Flat vs. Curved Surface Emissions²

(a) Neighboring points A, B, and C on an LED chip producing light cones in the same orthonormal directions. Very high luminance levels are produced because the neighboring light cones representing luminous intensities have large spatial overlaps as shown here, resulting in highly concentrated light within small angular ranges; (b) neighboring points D, E, and F on a curved-surface light source produce light cones in different orthonormal directions and thus spread the source LID over broader angles. Significantly less luminance is produced in curved-surface light sources compared to that of part (a) because the neighboring points produce very small, spatially overlapped light cones.²

Figure 3 shows a flat surface as the source of the light. The overlapping light rays from a flat surface source create a spatially non-uniform (anisotropic) directed energy beam, as each point in space has a different amount of energy. The mathematical profile of light from a flat surface generally follows Lambert's Cosine Law, which describes the amount of energy at each point in space.³

¹ <https://ieeexplore.ieee.org/document/8879542>

² *Understanding LED Illumination*, CRC Press, 2013, pg. 170

³ <http://www.softlights.org/wp-content/uploads/2022/03/Lambertian-2013.pdf>

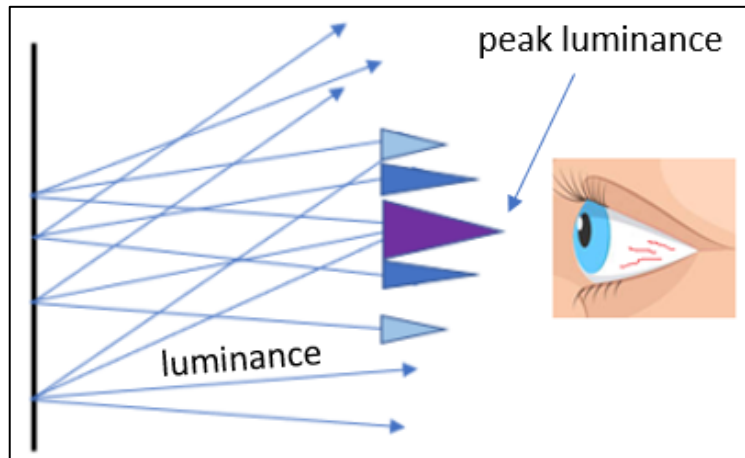


Figure 3

Because the light is emitted from a flat surface, the brightness is measured in nits (candela per square meter), and not luminous intensity as with a curved surface emitter.⁴ This is why LED electronic displays advertise brightness with the number of nits. (LED headlights and LED streetlights should also specify their brightness in nits). A single value for luminance cannot be used for a flat surface emitter; however, we can state a “peak luminance” that quantifies the maximum luminance emitted by the chip. An LED light source cannot be modeled as an infinitely small mathematical point (point source) because the emitter geometry is flat, not curved, and the resulting radiation will always retain the Lambertian spatial energy shape, no matter how far away the viewer is from the source.

An LED emits visible radiation in a tight beam and this beam does not disperse following an inverse square law. Within that beam, the energy is spatially non-uniform, which creates an inherent strobe effect due to the non-uniform energies landing at the destination at each moment in time. Even at a distance, for example many kilometers away, the light will remain dense, with little dispersion and little scattering, depending on environmental conditions. For LEDs, the luminance metric is used to measure brightness at the source of the light in near field, and there will be a different luminance value for each point in space. Generally, these measured near-field luminance values will be unchanged at the destination, such as at the eye. For example, a peak luminance of 1,000,000 nits measured at the chip will still be 1,000,000 nits at an observer’s eye 30 meters from the LED light source.

Comparison of Curved Surface and Flat Surface Emitter

A curved surface emitter such as a tungsten filament will emit essentially spatially uniform isotropic radiation as shown in (a) and (c) of Figure 4. A flat surface emitter such as an LED will emit spatially non-uniform anisotropic radiation, as shown in (b) and (d).

⁴ <https://ocw.snu.ac.kr/sites/default/files/NOTE/791.pdf>


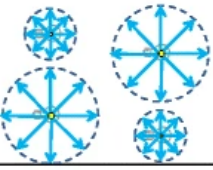
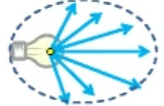
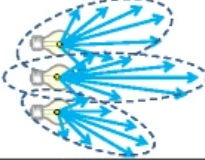
		Spatial Distribution	
		Single	Multiple
Angular Distribution	Isotropic	a 	c 
	Anisotropic	b 	d 

Figure 4 - Isotropic vs. Anisotropic⁵

Figure 5 shows a cross section of the radiation emitted from a light source as it lands on a surface. Isotropic radiation such as from a tungsten filament or gas-discharge light source will create a uniform distribution of light, whereas the anisotropic radiation emitted from a flat surface LED will create non-uniform light distribution, with much of the radiation concentrated in the center. The precision needed to measure the distribution of LED radiation is on the femtometer or picometer scale.

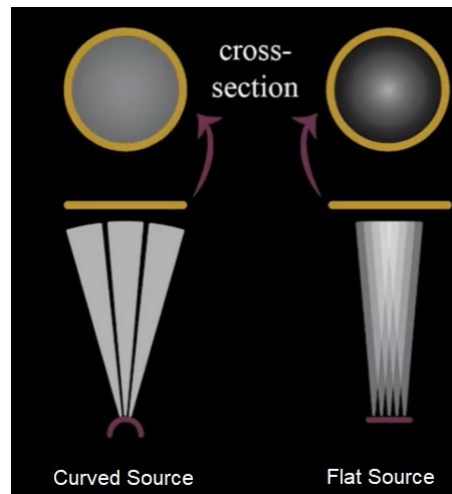


Figure 5 - Spatial Distribution Comparison

Summary

In summary, metrics previously used for curved surface emitters such as tungsten filament and gas-discharge lamps cannot be used for flat surface emitters. The brightness of a flat surface emitter is measured via peak luminance in nits (candela per square meter). LED visible radiation is spatially non-uniform. LED light does not follow an inverse square law for dispersion.

⁵ <https://ipsjcv.a.springeropen.com/articles/10.1186/s41074-016-0014-z>

December 12, 2022

Mark Baker
Bachelor of Science, Electrical Engineering
University of California, Santa Barbara
President, Soft Lights Foundation
mbaker@softlights.org

Simon Nicholas
Bachelor of Science, Master of Science, Chartered Engineer
Institution of Mechanical Engineers, Member
Lighting Advisor

Peter Veto
Ph.D., Psychophysics
Philipps-Universität Marburg, Germany
Researcher

Dr. Janine Manuel
BSc BHB MBChB FRNZCGP
University of Auckland, New Zealand
Clinical Analyst / Medical Translator

Kyra Xavia
Researcher / Lighting Advisor / Dark & Quiet Skies Advocate
Founder of Lightwise Guild

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4. Is Street Lighting Damaging Our Health? - <https://online.flippingbook.com/view/702884488/> - Cree Lighting acknowledges that LEDs emit non-uniform luminance.
5. Light Emitting Diodes, Chapter 16, Human Eye Sensitivity and Photometric Quantities - <https://ocw.snu.ac.kr/sites/default/files/NOTE/791.pdf> - States that point source brightness is measured with luminous intensity in candela, and surface source brightness is measured with luminance in nits (candela per square meter).
6. The Influence of LED Emission Characteristics on the Efficiency of Lighting Systems by Osram Opto Semiconductor - <https://www.led-professional.com/resources-1/articles/the-influence-of-led-emission-characteristics-on-the-efficiency-of-lighting-systems-by-osram-opto-semiconductor-1> - Describes the difference between volume and surface LED emitters and describes the spatial emissions as a Lambertian or near-Lambertian.
7. Angular Distribution of the Averaged Luminous Intensity of Low Power LEDs Transfer Standards - <http://www.softlights.org/wp-content/uploads/2022/03/Lambertian-2013.pdf> - LEDs emit non-uniform energy in a Lambertian shape, sometimes off-center.
8. Healthier and Environmentally Responsible Sustainable Cities and Communities. A New Design Framework and Planning Approach for Urban Illumination - <https://www.mdpi.com/2071-1050/14/21/14525/htm> - Artificial light is having significant negative consequences on human and biological health. Over 100 references to research studies.

SVMC Neurology

140 Hospital Drive, Suite 307 | Bennington, VT 05201 [REDACTED]

October 28, 2020

re [REDACTED]

To Whom it May Concern:

[REDACTED] is a patient who I have seen in consultation for her stated diagnosis of photosensitive epilepsy. She reports as do several family members who have witnessed her seizures that they are triggered by LED lights. Specifically, her seizures seemed under control prior to January when LED lights were installed in her village. Since that time, the frequency of her seizures has increased. Her daughter and husband state that they have witnessed her having seizures in response to these LED lights. She reports that she has had to move from her village in order to avoid having seizures triggered by the LED lights installed there.

Please consider making adjustments to the LED lights in order to accommodate this patient's ability to live in her village.

Sincerely,



Emma Weiskopf, MD

November 28, 2022

Re: [REDACTED]

DOB: [REDACTED]

To Whom It May Concern:

I have been providing psychotherapy, stress management, and cognitive rehabilitation to [REDACTED] for several years. She has also undergone neuropsychological testing and functional brain imaging. Her care is coordinated with her primary treating physician Dr. Michael Gray. [REDACTED] suffers from chemical hyperactivity (ICD-9, 349.82). She was declared disabled in 2007 by the Social Security Disability Administration.

Recently, her disabled status was exacerbated by exposure to a type of LED lights that are known to be toxic. She now has "another disability", that is hyper- sensitivity to light pollution (ICD-10, L59.8).

[REDACTED] should not be considered or labeled as psychosomatic or hysterical but taken seriously regarding her underlying medical condition. In fact, in many ways she is the "Miners Canary." That is chemical and light pollution affects all of us adversely.

Currently, [REDACTED] is suffering significant health problems from photo toxicity due to excessive exposure to high-intensity artificial light, often produced by light-emitting diodes in the blue spectrum. Recently, there have been several published studies providing increasing evidence of health problems related to exposure to these kinds of lights. Health problems include disruption of circadian rhythms and thus sleep, metabolic dysregulation, cancer risk, damage to the eyes, and behavioral and cognitive dysfunction. Attached to this letter is a list of references to recent research documents the problem of photo toxicity.

[REDACTED] tells me that bright lights have been put up near her home causing her to experience a number of health problems. She has experienced eye pain, swelling around her eye, blurred vision, nausea and vomiting, and

anxiety. The effects of these bright lights on her brain are demonstrated by changes in her brain electrical functioning as measured by a quantitative EEG with neurometric analysis. After exposure, health problems can continue for days.

I am strongly recommending that these bright lights around [REDACTED] house be removed. This accommodation should meet ADA guidelines for the disability.

If you have any other questions, please feel free to contact me.



B. Robert Crago Ph. D
Licensed Psychologist, State of Arizona, Certificate #866
National Registry of Health Care Service, Providers in Psychology,
Certificate #30209
ASPPB Certificate of Professional Qualification Psychology, CPQ #2058
American Board of Disability Analysts, Senior Disability Analyst/Diplomate
#2478-96
International QEEG Certification Board – Diplomate #13
Biofeedback Institute of America - EEG, Fellow: Certificate # 1022
Board Certified Diplomate Fellow in Geriatric Psychology (GCICPP)

Light Emitting Diode Health Impacts

Visual radiation from LEDs has the potential to induce seizure, migraine, headache, and exacerbation of other certain neurological disorders and autoimmune disorders (e.g., autism, lupus). These adverse outcomes have been noted from the collected data and are supported by medical reports from specialist medical practitioners and clinical PhD specialists from the United States of America and Great Britain. These adverse outcomes were initially heralded in part by the SCHEER Report of the European Commission in 2018, stating that certain individuals may experience eye and head pain. Further data collection since 2018 has elucidated that illness is in fact being experienced in the population secondary to LED visual radiation exposure.

Case History Excerpts

1. The patient had a history of occasional migraine with left retroorbital pain and left occipital pain secondary to flickering artificial light such as fluorescent lighting or computer screen. Pain was mild to moderate in nature and of three day duration. The patient was informed by a neurologist in her twenties to avoid strobe and other flickering light as she might experience seizure due to this type of migraine. Now upon exposure to LED light, the patient frequently experiences left retroorbital pain, a burning sensation at the occiput ensues coupled with nausea. The left side of the head is as if in a vice and pain becomes intense. The left side of the face becomes numb with some sensation of dysaesthesia and the left arm likewise. The patient becomes pale, mildly dis-coordinated and speech can become slightly slurred. Resolution of the entire symptomatology can be of three-day duration. Blurred vision in the left eye is initially present. There have been two syncopal episodes post exposure to an LED source with brief loss of consciousness.
2. The patient suffers from photosensitive epilepsy and suffers violent seizures from any exposure to LED lighting making the patient's own home and community dangerous for her. Light-reactive epilepsy often intensifies with repeat exposure, so each seizure needs less provocation. She has been subjected to pain, illness and injury including multiple concussions and fractures and is at risk of brain damage and sudden death as an LED-reactive seizure could cause cardiac arrest.
3. The patient has a diagnosis of systemic lupus erythematosus. The condition was under good control with medication allowing her to participate fully in life and carry out fulltime employment. With the introduction of LED lighting the patient became forced out of employment. She experiences exacerbation of her medical condition including marked formication and itch, malaise, nausea, fatigue, tachycardia, joint pain and sleep deprivation. While daylight to excess must be avoided, LED light induces the most marked symptomatology.

LED visual radiation has the potential to cause significant health impacts and is emerging as a public health risk.

Dr. Janine Manuel.
BSc BHB MBChB FRNZCGP
Clinical Analyst / Medical Translator

1 UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES
2 FOOD AND DRUG ADMINISTRATION

3
4 In the Matter of:

5 Request for Comments on Petition
6 for the regulation of Light Emitting
7 Diode Products

Docket No. FDA-2022-P-1151

8
9 **The Case for Regulation of Light Emitting Diode Products**

10 The Soft Lights Foundation; MarieAnn Cherry; Kristina Townsend; Heidi
11 O’Leary; Kristin Campisi (collectively, hereinafter called “**Advocates**”) submits
12 these comments in response to the request for public comments relating to the
13 above-captioned matter.

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1 **1. Introduction**

2 When LEDs were first invented in the early 1960s, the light was barely
3 visible to the human eye and not considered a hazard. Today, LEDs have become
4 as powerful, or more powerful, than lasers. While the FDA developed regulations
5 for lasers in the late 1960s, there are no FDA regulations for LED products. Here
6 we make the case for regulating the spatially non-uniform, directed energy, visible
7 electromagnetic radiation emitted by Light Emitting Diodes.

8 **2. Laser Regulation**

9 The first laser product was invented in 1960. In 1968, Congress created the
10 Radiation Control for Health and Safety Act and directed the US Food and Drug
11 Administration to regulate electromagnetic radiation from electronic products. The
12 FDA quickly published regulations for laser products, as even the first laser was
13 recognized as being potentially dangerous.¹

14 **3. LED Regulation**

15 The Light Emitting Diode was invented in 1962, prior to the passing of the
16 Radiation Control for Health and Safety Act in 1968. However, the FDA did not
17 publish any regulations for LED products. The likely reason that the FDA did not
18 publish comfort, health, or safety regulations for LEDs is because LED light was
19 initially so dim that it was difficult to see, which likely led the FDA to conclude
20 that LED visible radiation was safe.

21 However, since 1962, the intensity of LED light has increased dramatically,
22 with LED light being at least as dangerous as laser light. In fact, LED light is
23 likely more dangerous than laser light because of the non-uniform radiance of LED
visible radiation, its spectral characteristics, often including toxic blue wavelength
light, and its flicker characteristics. Pulsed LED visible radiation is even more
dangerous. Manufacturers continue to increase the intensity of their LED chips,

¹ <https://en.wikipedia.org/wiki/Laser>

1 with LEDs reaching 100,000,000 nits as of 2018.² There is no theoretical
2 maximum that would limit this power.

3 Even though the FDA has never regulated LEDs, international standards
4 bodies have published guidelines for LED products. The International Standard
5 IEC 60825-1 published as recently as 2001 states, “*Throughout this part 1 light
6 emitting diodes (LED) are included whenever the word "laser" is used.*”³ This
7 statement is significant because it shows that the International Electrotechnical
8 Commission understood that LEDs are similar to lasers and also have the potential
9 to be harmful. The IEC grouped the safety guidelines for lasers and LEDs into the
10 same technical document.

11 A 2005 article in LEDs magazine discusses the safety regulation of LEDs.⁴
12 The article quotes Andrew Dennington of Carclo Technical Plastics, cautioning,
13 “*The latest generation of LEDs is not safe, and someone will have their eyes
14 damaged by a high-power LED product.*” However, despite the warnings,
15 somewhere between 2005 and 2012 the safety standards for LEDs were removed
16 from IEC 60825 due to industry pressure. In 2008, IEC 62471 Photobiological
17 Safety of Lamps and Lamp Systems was published which had very little to say
18 about LED lamps. In 2009, IEC 62471-2 was published which contained specific
19 references to LED lamps.

20 Light Emitting Diodes emit electromagnetic radiation in the human-visible
21 portion of the electromagnetic spectrum. Since non-organic LEDs have a flat
22 surface, the energy emitted is a tightly focused beam of non-uniform radiance.
23 Since LEDs emit visible light, the photometric quantity luminance is often used
24 instead of the radiometric term radiance. As of 2018, LED chips have reached
25 100,000,000 nits of peak luminance, whereas human comfort is 300 nits and
26 maximum human tolerance is 50,000 nits.⁵

27 A special characteristic of flat surface radiation is that the radiation is non-
28 uniform. This has significant implications for signal processing, which includes
29 the signal processing by the human nervous system. While most regulations for
30

31
32 ² <https://www.laserfocusworld.com/test-measurement/research/article/16555223/nonlaser-light-sources-highluminance-leds-target-emerging-automotive-lighting-applications>

33 ³ https://shop.texttalk.se/shop/ws26/40626/files/full_size_-_for_start_page_banner/iec60825-1%7Bed1.2%7Den.pdf

⁴ <https://www.ledsmagazine.com/smart-lighting-iot/smart-cities/article/16696386/leds-are-safe-fact-or-fiction>

⁵ https://www.atecorp.com/atecorp/media/pdfs/data-sheets/tektronix-j16_application.pdf

1 lasers relate to eye safety, the non-uniform energy of LEDs dictates that LED
2 regulations must provide robust protections for **neurological safety, psychological**
3 **safety, circadian rhythm safety, and eye safety.**

4 The release of LED products into the environment in the USA has been
5 unconstrained, without the necessary government protections for public comfort,
6 health, and safety. Without FDA regulations for spatial non-uniformity, peak
7 luminance/radiance, spectral power distribution, square wave flicker, and flash
8 patterns, there is a high probability of psychological trauma, neurological
9 interference, circadian rhythm disruption, and eye injury.

10 **4. Neurological Safety**

11 LED visible radiation has been shown to trigger epileptic seizures. While it
12 is common knowledge that strobing lights will trigger these seizures, that common
13 knowledge is based on curved surface radiation devices. The introduction of flat
14 surface LED radiation products has created a new threat for people with epilepsy,
15 even when the LED light is supposedly static. The reasons for the LED seizure
16 trigger are not entirely known; however, it is postulated that these reasons are a
17 combination of the non-uniform radiance, the spectral power distribution, and the
18 square wave flicker. Because LED radiation is spatially non-uniform, the impacts
19 of the square wave flicker are likely intensified because each energy point in space
20 will be pulsing with a different energy.

21 LEDs also trigger migraines, anxiety, and panic attacks. Due to lack of
22 research in this area, the exact mechanics are not known, but the documented
23 observations suggest a combination of exceedingly high peak luminance, non-
uniform luminance, excessively high blue wavelength content, and the digital
on/off nature of the flicker. Flashing/strobing LEDs increase the potential to elicit
these phenomena.

Because of the severe impacts of LED visible radiation on those who are
sensitive and those who have qualified neurological disabilities under the
Americans with Disabilities Act, the use of LED visible radiation can be
discriminatory, especially when used in public settings such as vehicle headlights,
streetlights, floodlights, and electronic signs. To prevent discrimination, LED
visible radiation must be regulated.

5. Psychological Safety

Humans have evolved with uniform energy light from the sun, the reflected light from the moon, and star light. The invention of artificial light and light from electronic products and their introduction into the environment has created a psychological safety hazard.

Figure 1 shows a typical city scene with hundreds of light sources such as from windows, street signals, vehicle headlights, floodlights, and a defective purple LED street light.⁶ Figure 2 shows a parking lot with numerous sources directly impacting the eye, causing glare and psychological disturbance.

The connection between the human psyche and the natural night has evolved over millions of years and the introduction of billions of artificial light sources emitting artificial light directly into the eye is causing significant psychological trauma.



Figure 1 - LED City Lights

⁶ <https://www.cbc.ca/news/canada/british-columbia/purple-street-lights-vancouver-1.6604599>



Figure 2 - LED Parking Lot Lights

As the light sources have switched to directed energy LEDs, the intensity and radiation power have increased dramatically. This radiation from tiny LED sources has non-uniform, but highly dense radiance which is affecting human psychological wellbeing. Approximately 2,000 people in the Ban Blinding LEDs Facebook group regularly describe their distress, feelings of agitation, anger, fear, depression, and suicidal ideation due to the psychological impact of so many different high intensity visible radiation sources.

To protect psychological safety, there is an urgent need for regulations to limit the quantity and intensity of LED visible radiation.

6. Circadian Rhythm Safety

Researcher Christophe Martinsons writes in his 2017 paper titled *Photobiological Safety*, “*Light happens to be the most powerful agent to perform the daily synchronization of the biological circadian clock.*”⁷ Given that light is

⁷ https://www.researchgate.net/publication/327606703_Photobiological_safety

1 such a powerful and critical force for human health, it is then just as critical for
2 regulation of artificial light to ensure that these important biological circadian
rhythms are not interfered with.

3 Martinsons states, “*A small number of ganglion cells were found to have a*
4 *photoreception capacity that does not contribute to vision. It has been*
5 *demonstrated that the optical excitation of these cells is responsible for*
6 *suppressing the production of melatonin, the sleep hormone, and is also*
7 *responsible for many other non-visual effects such as pupil constriction, increase*
8 *of the heart rate and body temperature, etc.” The significance of this statement is
9 that great care must be taken to protect these ganglion cells and set restrictions on
10 the artificial light reaching these cells.*

11 Already, studies have shown that the use of LED outdoor lighting is
12 dramatically affecting circadian rhythms, which in turn is leading to serious
13 adverse health effects. A September 14, 2022, study confirmed that the switch to
14 LED lighting has created more blue wavelength light in the outdoors environment
15 and atmosphere which is negatively impacting circadian rhythms.⁸ Regulation of
16 LED visible radiation to prevent the radiation from impacting human health is
17 urgently needed.

13 **7. Eye Safety**

14 Figure 3 shows unregulated high intensity LED strip lights in a flower
15 display located near the entrance of a grocery store. It was reported by a store
16 visitor that these LED strip lights caused a sharp pain in the eye just as the visitor
17 opened the door to the store. Pain is a risk indicator of damage to the eye, and thus
18 it is possible that these LED strip lights cause some measurable damage to the eye.
19 Repeated exposures to these lights could incur more damage and this damage
20 could be cumulative and irreversible. Injury to the eyes of a young child could
21 likely be higher.

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⁸ <https://www.science.org/doi/10.1126/sciadv.abl6891>

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Figure 3 - LED Strip Lights

An LED strip light that causes pain simply by walking past the LED is unacceptable in a place of public business. There are currently no safeguards in this situation to protect the comfort, health, and safety of the public. The public has the right to expect a safe, comfortable experience when shopping, and therefore there must be regulatory protections to ensure that LED products such as this LED strip light pose no risk to young children, adults, the elderly, or those with sensitivities.

For the eye, blue light (400nm – 500nm) is the most dangerous. Figure 4 from IEC 62471:2008 shows that the limit for constant exposure to blue wavelength light at 1,000,000,000 W/sr/m² is 1/1000 of second, whereas the exposure limit to 100 W/sr/m² is 10,000 seconds which is 2.78 hours.

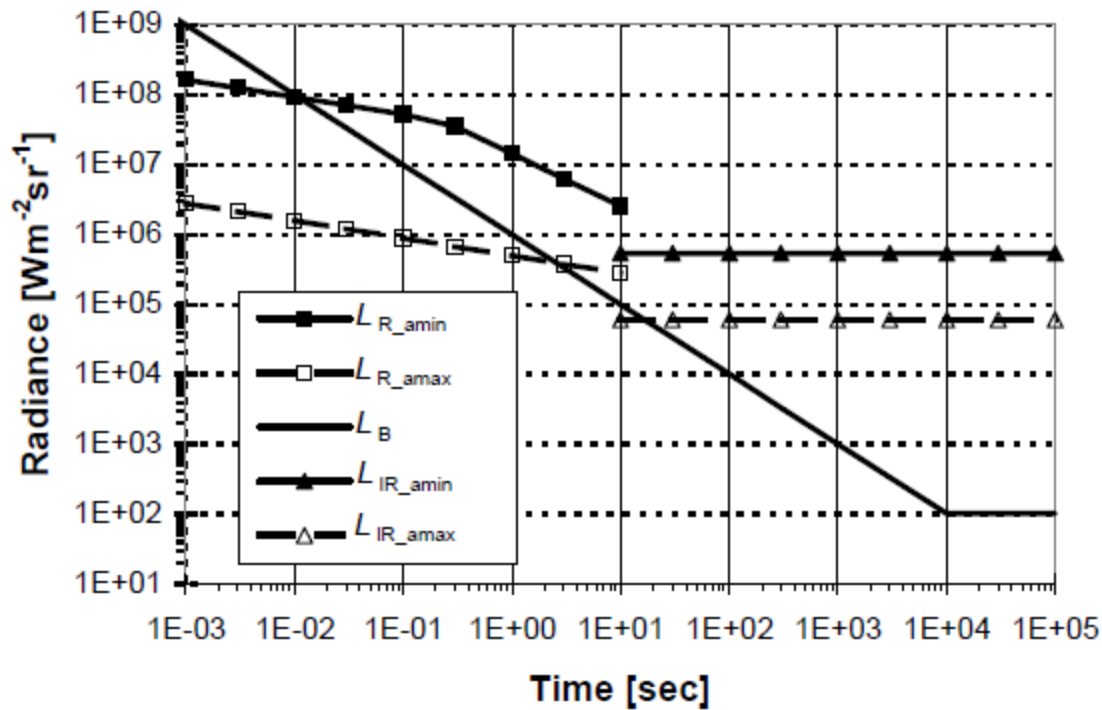


Figure 5.5 Weighted radiance exposure limits vs. time for constant exposure.

Figure 4 - Blue Light Exposure Limits

Martinsons states, “In a typical LED, the chip that emits light is so small that although the total emitted flux may be moderate, the radiance and luminance levels may be extremely high. For example, luminance values greater than 10,000,000 cd/m^2 and radiance values greater than 50,000 $W/m^2/sr$ are common figures for white LED components used in lighting products (ANSES 2010).” – At these levels, according to Figure 4, the exposure limit is only 10 seconds. We also know that LED chip makers have increased intensity by tenfold to 100,000,000 cd/m^2 as of 2018, thus reducing the exposure limit to 1 second.

Consider a professional truck driver who works night shift and is subjected to blue wavelength light from vehicle headlights and LED streetlights, such as shown in Figure 5.



Figure 5 - Blue Wavelength LED Streetlights⁹

As the driver moves from streetlight to streetlight, cumulative effects may occur. Considering that the blue light limit at $50,000 \text{ W/m}^2/\text{sr}$ is 10 seconds, then the many hours of exposure over many nights over many years to the blue light hazard from LED streetlights, LED floodlights, and LED vehicle headlights may lead to irreversible macular degeneration.

For 400-500nm light from LED sources, there must be regulations to limit total exposure over an hour, a day, and a human lifetime. For example, each exposure to an LED streetlight, LED car headlight, and LED floodlight adds to the cumulative exposure totals. To ensure protection of our eyes, especially in public spaces where the individual cannot control the exposure, there must be a regulatory mechanism that limits the total hourly, daily, and lifetime exposure.

Martinsons writes, “*The exposure levels needed to produce thermal damage on the retina cannot be met with light emitted by LEDs of current technologies.*” This statement does not state that LEDs will never reach the level of power needed to cause thermal damage to the retina, and therefore the time to develop such safety regulations is now, before the technology is created and sold. Martinsons also writes, “*Photochemical damage (photochemical retinopathy) appears after a short-time intense exposure or after a prolonged exposure to lower*

⁹ <https://www.readingglassesetc.com/blog/blue-light-from-led-street-lights-the-american-medical-associations-new-policy-guidelines/>

1 *light levels.*” This photochemical damage may already occurring in the real world
2 due to lack of regulation. To prevent additional eye damage, regulations are
3 needed and necessary.

4 In his article Photobiological Safety, Martinsons writes, “*The maximum*
5 *exposure limits defined by the ICNIRP and used to define the risk groups in IEC*
6 *62471 are not appropriate for repeated exposures to blue light as they were*
7 *calculated for a maximum exposure of one eight-hour day.*” and “*The first*
8 *published results show that retinal damage induced by chronic exposure*
9 *to white LEDs can be detected at much lower levels than the ICNIRP exposure*
10 *limits.*” We now know that the retinal damage caused by chronic exposure to LED
11 streetlights, vehicle headlights, and floodlights is cumulative and detectible at low
12 levels.

13 It is thus imperative that regulations be established that prevent these
14 cumulative effects. This would include restricting the blue wavelength light in
15 streetlights, vehicle headlights, floodlights and other sources that could be
16 encountered by the public in a night time environment.

17 Martinsons writes, “*The ICNIRP exposure limit values do not take into*
18 *account the possibility of an exposure over an entire lifetime.*” Regulations to set
19 lifetime exposure limits must be developed. Martinsons also writes, “*IEC 62471*
20 *does not take into account the sensitivity of certain specific population groups.*”
21 The impact of this statement is that those who are most likely to be harmed by
22 exposure to blue light are ignored in the standard. This is unacceptable and must
23 be addressed via strong regulations.

17 **8. Health Data and Documentation**

18 Reports of significant health risks and impacts have emerged in the
19 population as a result of exposure to LED visible radiation sources in their
20 multitude of forms. The Soft Lights Foundation has accumulated data from
21 approximately 2,000 people who have reported their adverse health experiences
22 from LED light. An additional 30,000+ people have signed the Ban Blinding
23 Headlights petition on change.org and many have submitted comments.¹⁰ Many

¹⁰ <https://www.change.org/p/u-s-dot-ban-blinding-headlights-and-save-lives>

1 people have reported eye strain/pain and headache, while a substantial number of
2 people have also reported profound illness including seizure, migraine,
3 exacerbation of auto-immune disease such as lupus, and other neurological
4 reaction.

4 **Diagnosed Medical Conditions**

5 The gravity of the impacts of LED visible radiation on people with a
6 diagnosed medical condition is documented as follows, listing a selection of cases
7 which depict the health consequences that have emerged due to exposure to LED
8 sources. When possible, medical letters from the treating clinicians are included.

8 **Epilepsy**

9 Patient 1 – April 27, 2021

10 I live in a small, appealing village of about twelve hundred residents,
11 surrounded by farms and forests. My family has been very content living here for
12 many years.

13 I have life-long epilepsy and migralepsy. Medications don't control my
14 condition, so I learned to manage my epilepsy by adapting my life habits and
15 adjusting to carefully avoid anything known to cause my seizures. Over time it
16 became second nature, and I was healthy, happy, employed, independent, and
17 nearly seizure-free for decades.

18 Seven or so years ago, however, I had my first encounter with an LED light.
19 It triggered one of the worst, most violent seizures I'd ever experienced. I didn't
20 even know what LEDs were back then. Since then, I've found that almost every
21 version of LED provokes that kind of instantaneous reflex seizure, and other LEDs
22 cause migraines which lead to seizures. It's a matter of minutes or a split second,
23 but one or the other happens every time I am exposed to LED lights. In the brief
moment where I see the LED light, but before my brain reacts, the worst LEDs
look like a spray of strobing needles.

Suddenly LEDs were turning up everywhere, impossible to avoid. It was
getting harder and harder to manage or go about my normal life. Then in late
December 2019, streetlights throughout our village were converted to LEDs. I'd
alerted our mayor and trustees several times by then to my disability and the
inescapable danger that LEDs are for me. Over eighteen months the mayor
reassured me that they wouldn't vote for any public lighting that they knew would
harm me. False reassurance, as it turned out. They went ahead and did exactly that,
saying afterwards that yes, they knew LEDs would hurt me, but I was just one

1 person and they'd decided that financial advantage for the village was more
2 important. The village got lower utility bills and a cash incentive, and in exchange
3 I was thrust into the very crisis I'd tried to prevent.

4 From that night on, I suffered hundreds of breakthrough seizures, constant
5 blinding headaches and migraines, repeated physical injuries and a whole array of
6 after and side effects. I couldn't set foot out the door or even look out the windows
7 when the lights were on. Sometimes I had seizures inside our house if LED light
8 got around cracks in the shades. I was increasingly incapacitated, and after four
9 months the threat was so severe, I was forced to flee our home and community. I've
10 been in temporary quarters on a dear friend's farm ever since. I'm deeply grateful to
11 have a safe spot to sleep on, but I'm separated from my family and heartsick from
12 wanting to go home.

13 Neither the Village Trustees nor the utility company will make any effective
14 accommodations for me, despite their actions being directly responsible for this
15 devastation of my health and home life. We've been shut out of their discussions at
16 every turn, and they won't communicate with us. They ignore everything we, my
17 doctors, other village residents or The Epilepsy Foundation sends them. The mayor
18 and trustees say they are "done" with the issue and have "zero desire" to help us.
19 Our utility company, National Grid, just keeps referring us back to the mayor and
20 trustees. It's as if my previous happy, healthy, free, contributory life never existed.
21 I'm exhausted, terrified, and traumatized, and it seems that no one who could help
22 rectify this injustice cares to get involved

23 My family and I are desperately trying to be heard. Not even the local police
chief cares, calling it a matter for the mayor to address. I'm cut off from
everything. I've lost thousands of dollars in wages and incurred thousands more in
medical bills. Awful incidents keep happening; I broke a tooth during an epileptic
seizure that first terrible month. (An angry dentist, when asked to use different
lighting, threw down her tools and stormed off announcing "I can't work like this!"
Her office called me later, said I was a "difficult" patient and told me to go
somewhere else.) The tooth is still broken, and I have an abscess now, but I can't
find a dentist who will repair it without using LEDs. Then three months ago I had a
nasty accident, after dusk, out where I go to stay each night. I couldn't get to
emergency treatment because the urgent care center and nearest hospital are
surrounded by LEDs. Badly injured and in severe pain, I couldn't even try to
recover at home because of the LED street lights. I can't go shopping, can't get to
or from work, can't use thruway rest rooms, can't walk up to take-out windows,
can't be home for Hannukah candles, and can't take an evening stroll. I nearly had a
seizure getting a COVID vaccine because the tent in the parking lot had LEDs on,

1 in a tent, in the daytime! LEDs make a barrier I can't cross. Encountering one -
2 inside or out - is like being cracked on the head with a brick.

3 This has been my life for sixteen months and counting. Ten days ago,
4 National Grid finally swapped five LED bulbs back to the previous HPS bulbs in
5 streetlights beside our home. We're on a corner in the middle of the village and the
6 very next ring of LED streetlights reaches our house. It's useless. As a friend from
7 the synagogue said, "Oh great! Now you can stand up and turn around in your
8 cage!" I might be marginally safer in the house. Maybe I could peek out of a
9 window now, but a solution it's not. The mayor and trustees make it clear that five
10 swapped lights are all I'll ever get, and the HPS bulbs will go straight back to LED
11 after they burn out. Two of the five trustees (the mayor and deputy mayor) actually
12 voted against even making even that tiny change. It did, however, demonstrate that
13 LEDs can indeed be taken out and replaced, and the streets won't descend into
14 darkness and chaos.

15 I think of the other people with LED-light-sensitivity around the country,
16 living their own version of this nightmare with the same staggering stress and fear
17 for the future. Lately it's an effort for me to think about any topic other than LEDs
18 for any length of time. I read the paper, but good news seems to have nothing to do
19 with me; bad news just compounds the misery. Either way, I'm not the engaged,
20 productive person I was and no help now to anyone anyway, not even my own
21 family. I'm trapped in a state of shock and don't recognize myself anymore. And all
22 because of a light bulb. A light bulb!

23 October 28, 2020

To Whom it May Concern:

[Patient] is a patient who I have seen in her consultation for her stated
diagnosis of photosensitive epilepsy. She reports, as do several members of her
family that have witnessed her seizures and that they were triggered by LED lights.
Specifically, her seizures seemed under control prior to January, when LED lights
were installed in her village. Since that time, the frequency of her seizures has
increased. Her daughter and her husband state that they have witnessed her having
seizures in response to these LED lights. She reports that she has had to move
from her village in order to avoid having seizures triggered by the LED lights
installed there.

Please consider making adjustments to the LED lights in order to
accommodate this patient's ability to live in her village.

Emma Weiskopf, MD

1
2 Patient 2 - March 17, 2022

3 I have photosensitive epilepsy and experience epileptic auras. One day I
4 was driving home from work and I encountered an RRFB (Rectangular Rapid
5 Flashing Beacon). A pedestrian pushed the button on the RRFB and the strobing
6 RRFB was so distracting and blinding that I almost drove into the pedestrian. My
7 epileptic auras began and I was immediately nauseous, my left leg started to
8 twitch, and I felt pain in my eyes. My legs were wobbly, and I felt physically
9 unstable. I drove to my apartment, stepped inside, and then felt like I was losing
10 control of my bladder. Instead, I vomited. I then did almost nothing but sleeping
11 for the next two days and missed work.

8 **Toxic Encephalopathy**

9 Patient 3 - July 19, 2022

10 To Whom it May Concern:

11 I have been providing psychotherapy, stress management, and cognitive
12 rehabilitation to [patient] for several years. She has also undergone
13 neuropsychological testing and functional brain imaging. Her care is coordinated
14 with her primary treating physician. [Patient] suffers from toxic encephalopathy
15 (ICD-10, G92.8) and hyper-photosensitivity to light, other than the sun (ICD-10,
16 L59.8), specifically light from LEDs.

17 [Patient] should not be considered or labeled as psychosomatic or hysterical
18 but taken seriously regarding her underlying medical condition. In fact, in many
19 ways she is the “Miners Canary.” That is chemical and light pollution affects all of
20 us adversely.

21 Currently, [patient] is suffering significant health problems from photo
22 toxicity due to excessive exposure to high-intensity, artificial light, often produced
23 by light emitting diodes in the blue spectrum. Recently, there have been several
published studies providing increasing evidence of health problems related to
exposure to these kinds of lights. Health problems include disruption of circadian
rhythms and thus sleep, metabolic dysregulation, cancer risk, damage to the eyes,
and behavioral and cognitive dysfunction. Attached to this letter is a list of
references to recent research documents on the problem of photo toxicity.

[Patient] tells me that bright lights have been put up near her home causing
her to experience a number of health problems. She has experienced eye pain,
swelling around her eye, blurred vision, nausea and vomiting, and anxiety. The
effects of these bright lights on her brain are demonstrated by changes in her brain

1 electrical functioning as measured by a quantitative EEG with neurometric
2 analysis. After exposure, health problems can exist for days.

3 I am strongly recommending that these bright lights around [patient's] house
4 be removed. This accommodation should meet ADA guidelines for the disabled.

5 If you have any other questions, please feel free to contact me.

6 B. Robert Crago, Ph.D.

7 Licensed Psychologist, State of Arizona, Certificate #866

8 National Registry of Health Care Service, Providers in Psychology,
9 Certificate #30209

10 ASPPB Certificate of Professional Qualification Psychology, CPQ #2058

11 American Board of Disability Analysts, Senior Disability Analyst/Diplomate
12 #2478-96

13 Biofeedback Institute of America – EEG, Fellow: Certificate #1022

14 Board Certified Diplomate Fellow in Geriatric Psychology (GCICPP)

15 **Attention Deficit Hyperactivity Disorder**

16 Patient 4 - August 27, 2022

17 To Whom it May Concern:

18 I have been seeing and treating [patient] in clinic since 4/9/2022 for ADHD.
19 She has been reporting heightened light sensitivity and pain related to exposure to
20 LED lights at her work since her work scheduled shifted to evenings in mid-July
21 where LED exposure is greater than normal levels of daily living.

22 While [patient] reports her eye doctor finds no functional problem with her
23 eyes, in a study published in Frontiers of Neurology and available online via
National Library of Medicine, 69% of people with ADHD have light sensitivity
issues. As a result, I think this is likely the cause of [patient's] light sensitivity
issues which is exacerbated by the intensity of exposure she is currently
experiencing. If there could be accommodations made that allow her to work in a
safe and pain free environment, this would be optimal for her mental health.

Thank you for your consideration.

Sincerely,

Dr. [Name Withheld] – National Mental Health

Autism Spectrum Disorder

1 Patient 5 – September 20, 2022

2 The use of high-powered LED lights has dramatically changed my life. I
3 have no difficulty using low-intensity LED computer screens and cell phones, but I
4 cannot neurologically tolerate LED car headlights because they capture and steal
5 my attention. LED Daytime Running Lights make me feel high levels of anxiety,
6 to the point of fear. When the ambient lighting is darker, LED headlights are
7 unbearable and painful. If I drive at night, I am forced to close one eye or hold my
8 hand over my eyes.

9 One time I was caught behind a firetruck that turned on LED flashing lights.
10 It was torture for me. Because we were stuck behind the truck with nowhere to go,
11 I jumped out of the car and ran over to the crew in the firetruck and began
12 screaming at them to stop torturing me. When they laughed at me, I fell to the
13 ground screaming and rolling around.

14 I never had these problems with incandescent or halogen or fluorescent or
15 CFL or sodium lighting.

16 April 4, 2019

17 [Patient] is a 54 year old Male. BIB PD from middle school after welfare
18 check due to erratic bx. PT is a 7th grade math teacher and the dept chair of the
19 math dept. PT was hitting self in head and fled school on foot. PT told PD he
20 wanted to die. PT reports he is having problems with the LED lights and the
21 unshielded 5000 Kelvin temp for 2 years. Reports he is getting progressively
22 worse, and the 2 floodlights recently installed at the school torture him mentally.
23 He wanted the lights turned off and when only some could be turned off, he
became upset and cried to the principal's office who took him to the park with the
RN where he rolled on the ground until PD arrived.

Kaiser Permanente

Migraines

Patient 6 - September 20, 2022

A translator / interpreter by profession, now requiring total digital assistance,
this woman experiences severe migraine with unilateral numbness to the face,
nausea, and faintness upon exposure to LED illumination and screens. She has had
several episodes of syncope secondary to exposure to larger quantities of
unexpected LED illumination. She had been informed by a neurologist in her early
twenties to avoid flickering light including strobe and fluorescent, and the like as it
could pose a risk of seizure. She is excluded from all public buildings and is

1 recurrently exposed to LED lighting due to residing in a densely populated city of
2 close urban infill.

3 Patient 7 – August 15, 2020

4 I've been thinking about all the dysfunction in lighting and have concluded
5 that there are two types of people when it comes to lighting - those who are
6 sensitive and those who are not. I have to look away from LED lights when I walk
7 past. This is a nightmare policy scenario because it means that when limits are set
8 based on sensitive groups, the others are going to be complaining. This binary
9 issue needs to be addressed somehow.

10 As for me, I will be on the floor in seconds exposed to indoor florescent or
11 LED light without sunglasses, and even with sunglasses and a ball cap, the eye
12 migraine starts to trigger and will take hold if I am exposed more than say half an
13 hour at Home Depot or Costco. Brighter stores like Walmart or Walgreens give me
14 even less time to get out. I will only get nausea as a result of acute exposure, which
15 will be a function of brightness, color temperature and degree of shielding. Think
16 of shielding as sunglasses and ball cap. In other words, I am out of the store or on
17 the floor in ripping eye pain before getting nausea.

18 When I was a child, I would get the nausea and vomit, but in those days, I
19 did not realize I had a light problem and was not wearing any shielding or filters.
20 In terms of color temperature, without shielding I would say the number would be
21 very low, maybe even less than 2000K, because LED is a flat source which creates
22 a laser-beam type of light. With proper shielding, 2700K may work, but my city
23 didn't consider sensitive receptors, so the only shielding the Cobra street lights
have here is on top for dark skies.

16 Patient 8 – February 3, 2020

17 “I thank the committee very much for this opportunity. I also hope that this
18 can help, in many ways, the others who are suffering around the world from light
19 emitting diode, LED, sensitivity and artificial light sensitivity. I have been made ill
20 from LEDs since 2007. It is more than a sensitivity; it is a disability. I am disabled
21 by my environment, like so many others, and excluded from society. This is also
22 an accessibility issue...”

1 Opening testimony to Irish Parliament, Joint Committee on Disability
Matters¹¹

2
3 Patient 9 – February 3, 2020

4 I have suffered with chronic fatigue syndrome for about 11 years now. Prior
to LED lights becoming common I was able to live a relatively full life. I worked,
could go shopping and was free to drive myself wherever I wanted to go.

5 When intense white LED Daylight Running lights started appearing on cars,
6 I started to feel a lot of pain and discomfort whilst driving even in good daylight
conditions so I hardly drive anymore which is not only very limiting but upsetting
7 as I used to love being on the open road. I also felt that in many scenarios, due to
their excessive whiteness and brightness, they actually made visibility worse, not
8 better.

9 I had to give up a successful career in 2015 at the age of 41 because almost
all offices are now LED lighting and I can no longer go shopping or even go to the
10 pub or out for a meal with family as there is a good chance that I will be ill during
or after being exposed to some LED lights and on the journey to and from. I have
11 been diagnosed by a Neurologist as having chronic migraine caused by LED
lights (no other type of lighting has ever had this effect on me)

12 I accept that chronic fatigue syndrome has possibly made me more sensitive
but it is remarkable that it is only LED light that make me DISABLED in society.

13
14 2017

15 Diagnosis: Chronic Migraine

16 I met [patient] in the neurology clinic today. [Patient] has developed a clear
case of chronic migraine. [Patient] has very marked light sensitivity and has found
17 that LED lights are particularly troublesome for [Patient]. This is difficult as LED
lights are now being used on a more widespread basis. [Patient] describes nausea
18 and sometimes vomiting associated with this headache.

19 [Patient] has tried Propranolol 80mg daily and whilst this has been partially
effective in reducing [Patient's] headaches, this does not help [Patient's] light
20 sensitivity and [Patient] has forgotten to take the medication sometimes.

21
22
23 ¹¹ https://www.oireachtas.ie/en/debates/debate/joint_committee_on_disability_matters/2022-02-03/2/

1 Patient has a normal MR brain scan and neurologic examination today was
2 completely unremarkable.

3 As a first step, I have advised the change in medication as above. If this does
4 not help, other medications we can try including Topiramate. I will review
5 [Patient] back in 4 months' time.

6 Sincerely,
7 [Name Withheld]
8 Salford Royal, National Health Service

9 **Electromagnetic Hypersensitivity Syndrome**

10 Patient 10 – April 1, 2022

11 I have been diagnosed with Electromagnetic Hypersensitivity Syndrome
12 ICD-9 code 995.3 also called electromagnetic radiation sickness, caused, or
13 aggravated by exposure to LED lighting and other fluorescent lighting. Other
14 codes that apply, 368.13 visual discomfort, 780.4 dizziness/vertigo,
15 438.7 disturbance of vision.

16 **Lupus**

17 Patient 11 – March 3, 2022

18 From the time the car dealership installed LED parking lot lights across the
19 street from me, I have had horrible sleep. On the first night after installing the
20 LEDs, I had a bloody nose, which I haven't had since I was little.

21 I have since installed black out curtains, but I still cannot sleep properly. I
22 just feel more defeated every day and thinking of all the natural life in my yard that
23 won't survive because of the LED lights.

24 **Other Cases**

25 Patient 12

26 A man approximately 30 years old experiencing difficulty carrying out his
27 profession, requiring frequent use of his mobile phone in the real estate business.
28 He describes eye discomfort, augmenting to a sensation of 'crawling' into the eyes
29 and associated frontal headache, not diminished despite dimming or decreased blue
30 spectrum on the phone.

1 Patient 13

2 A man approximately 50 years old, builder by trade, experiencing eye pain,
3 strain, and irritation upon viewing LED screen television. Also associated with
4 delayed sleep latency, lighter nature of sleep and fatigue on rising. The eye pain
5 and irritation could persist for several days.

6 **Individual Complaints**

7 Thousands of people have reported discomfort, pain, reduced vision,
8 psychological trauma, and other effects as a result of being subjected to LED light.
9 Below is a selection of these reported cases.

10 Case 1 - “Then a couple of cyclists approach along the riverside path and the
11 profound peace is shattered by intense jolts of shuddering [LED] light that come
12 searing through the space between us. I flinch as they pass, shielding my eyes with
13 my hand. They’re chatting to each other, oblivious, a cheery couple enjoying a
14 beautiful evening cycle. I feel like they’ve punched me in the stomach and
15 screamed in my face.”¹²

16 Case 2 - I think for every one of us [LED lights are] taking a tremendous
17 amount of emotional and physical energy to try to implement and maintain coping
18 strategies so we can engage in even the most basic daily activities. The extra work
19 it is taking to try and get our bodies and brains to listen when we know these lights
20 are dangerous and know we cannot avoid them is more than superhuman (if and
21 when we can just for a moment/second) We should not have to be superhuman just
22 to live on this planet.

23 Case 3 – “Prior to the NHTSA and the DOT allowing LED headlights to be
legal, I never have had any light sensitivity. If I was outdoors and forgot my
sunglasses it was no big deal. Halogen headlights never bothered my eyes, not
even on high beam (though annoying). This all changed when LED headlights
started appearing in this area in early 2019. Every exposure would hurt my eyes
and make them go blurry or "white out" and cause ocular pain. This was a
cumulative effect with every exposure causing my eyes to take longer to recover,
from at first seconds, to minutes, to hours, then days. To protect half of my vision,

¹² <https://lightaware.org/2022/09/what-has-happened-to-light/>
22 of 59

1 I started closing my left eye when meeting LED headlights, leaving the right eye
2 open. This continued until October 31, 2019, when I met a semi-truck with LED
3 headlights so blinding that after meeting it, my right eye (the one I kept open)
4 never recovered. None of the ophthalmologists I have gone to have been able to
5 come up with a diagnosis with the equipment they have, though they recognize
6 there is damage.”¹³

7 Case 4 - Up the road there’s a new business in town where 100s of people
8 are walking down the street. You used to be able to see and avoid the people until
9 they put up mega bright LEDs and now you cannot see a thing- you cannot see
10 where to drive- you cannot see the people-How’s that for energy efficient?
11 Efficient at killing people would have to be the only outcome-and I guess that’ll
12 sustain the planet.

13 Case 5 - “Then the parking lots, street lights, outdoor lighting at customers
14 and in the railroad yard, the number board lights, gauge lights... EVERYTHING
15 went to LEDs and my migraine headaches became constant. I was taking multiple
16 doses of Excedrin, Tylenol, Anacin, and other medications to try to combat the
17 headaches, rage, nausea, and other symptoms that the LEDs were causing until I
18 finally had to quit.”

19 Case 6 – “I can’t be out after dark or for more than 20 minutes of exposure
20 to all the LED streetlights, security lights, stoplights, billboards that flicker which
21 result in a massive headache. So, when I travel, I go with my mom. I drive during
22 the day and she drives after dark. This past fall we went down to Joplin MO to visit
23 family and after the sun went down. I put on dark sunglasses while we are in the
24 county with less lights. As we get to the town/city areas with more lights on, I
25 switch to a sleep mask to block all light, as I haven’t found any other way to block
26 the flicker. There was one corner as we turned, I heard my mom (who was driving)
27 gasp as I SAW light through my sleep mask! and she said that it was a billboard.
28 That is outrageous!”

29 Case 7 – “I was just mentioning that to someone I know today. I knew
30 people who had fluorescent and strobe lighting headaches and seizures. The LEDs
31 are so much worse than anything I’ve seen before.”

¹³ <http://www.softlights.org/wp-content/uploads/2021/05/Damage-to-Eye-Story.pdf>

1
2 Case 8 – “I get headaches all the time now from delivery driving. Now the
job that I've done for 20 years has turned into a mess.”

3 Case 9 – “Thank goodness I don’t get migraines, but tonight every oncoming
4 car blinded me and it was horrible.”

5 6 **Ban Blinding Headlights Petition Comments**

7 Tens of thousands of people have signed a petition demanding that NHTSA
8 ban vehicles with blinding LED headlights. Below are some of the comments
from the petition.

9 Claire Lim – September 20, 2022

10 I had to go on sick leave because of the pain and headaches I was
11 experiencing from these bright white car lights and the blue light from computers. I
12 am no longer able to go for evenings walks nor go anywhere when the skies are
13 greyer, when dusk sets in, and when night falls because of all these dangerously
14 bright white car lights that are turned on all the time and become even more
15 frighteningly intense when contrasted against the night. It is hazardous for me to
16 cross roads, especially at 4 way junctions where all these lights are beaming and
17 radiating me in every direction. Standing and waiting for lights to change, walking
18 on pavement next to to traffic, LED street lamps, LED house lights, and the blue
19 light from computers and phones, etc. - all of these pierce my eyes and brain, make
my head ache and my eyes burn, and cause me to feel nauseous and sick. The
extreme brightness, glare, intensity, and heat coming from these lights are
excruciatingly unbearable. Even on a quiet street, all it takes is one car with these
damn lights to zap the life force out of me and cause me anxiety. Why are these
lights even allowed in the first place? The previous orange car lights worked well,
they were safer and kinder to human eyes. These dangerously bright white car
lights and blue light from electronic devices should be banned immediately.

20 Dwayne Set – September 20, 2022

21 I believe my astigmatism plays a huge role in the danger I feel after passing
22 bright headlights. I keep my eyes in my lane. I avoid looking at them directly, yet I
23 get blinded so often and sometimes it drags on for many seconds and forces me to
slow down aggressively so I dont blindly drive into anything. Both outcomes are

1 dangerous. I try to stay off the roads at night so I dont have to take that risk.

2 Tina Bowen – September 16, 2022

3 I hate those horrible blue lights they make it SO hard to see! This is the
4 whole reason I hate driving at night!!

5 Karma Kurosaki – September 14, 2022

6 They are genuinely dangerous to the safety of others

7 Jane Moran – September 13, 2022

8 It is very blinding driving at night and a car with these types of lights comes
9 towards you.

10 Vanessa Maxon – September 13, 2022

11 These lights are killing people

12 Rae Trudeau – September 13, 2022

13 LEDs are a health hazard and dangerous to drivers. They need to go ASAP.

14 Trina Renae – September 6, 2022

15 When I'm driving at night these headlights makes difficult for me to see the
16 cars approaching me and the Road.

17 Yvonne Merriweather – September 6, 2022

18 The car and truck lights are blinding and could cause an accident.

19 Christopher Carman – August 30, 2022

20 I'm sick of being blinded by these headlights their practically high beams

21 S Harris – August 30, 2022

22 There's no reason for the lights to be as bright as they are. Eyes can't adjust
23 that quickly which means that for a few seconds drivers are literally driving blind.

24 Eliza Rothstein – August 21, 2022

25 Being constantly blinded by ridiculously bright headlights while driving at
26 night is a completely solvable issue and its ridiculous that nothing has been done to
27 address this ever-growing problem.

28 Susan Lopez – August 2022

1 These lights seriously are blinding, they have affected my night vision. Cars
2 are equipped with bright lights when needed. Please go back to the regular
3 headlights.

4 Jay Yang – August 2022

5 Too many people swap out their bulbs for these super bright LEDs and
6 aiming them high. I've been blinded too many times from oncoming traffic with
7 these LEDs and have to change my rear view mirror and side mirrors when
8 they are behind me because it's so blinding. These lights need to be illegal. Cops
9 and highway patrol need to pull them over.

10 Julie Gorn – August 2022

11 these bright lights make driving at night VERY difficult.

12 Bruce Devan – August 15, 2022

13 This is a horrible traffic hazard --- exponentially worse when used on
14 higher-profile vehicles like SUVs and large pickups. But even with regularly-sized
15 cars, it's made it so that I can hardly see the road ahead, whether it's someone
16 coming astride in the other lane, or oncoming traffic. I don't see a single benefit
17 here. I'm not sure why these are necessary -- for safety?

18 Katrina Toice – August 8, 2022

19 LED cause migraines

20 Kimberly Ann Denault – July 27, 2022

21 These lights are completely unnecessary & DANGEROUS! The human eye
22 is not meant to constantly dilate & be flooded with blinding light one second, and
23 then plunged into darkness the next. Your eyes cannot physically possibly adjust
that fast! If someone blinds you with these horrible led headlights and then
someone crosses the street in front of you in the dark, you could possibly hit them!
It is insane! They give me headaches and eye aches. LED headlights WILL kill
people. In fact, they probably already have

Amanda Gutz – July 21, 2022

 As a migraine sufferer with light sensitivity, these headlights make it very
difficult to drive at night.

Brooke Miller – July 2, 2022

1 Driving with double astigmatism at night was hard enough before these
2 headlights. even in my 20s, I've almost completely given up driving at night due to
3 these too bright headlights.

4 Mike M – June 9, 2022

5 I get constant migraine and I think it's from driving at night, these LEDs
6 aren't it. I've been blinded to the point that I'm almost driving towards the light
7 which can cause a friggin' accident.

8 Bruch Kalashnikov – April 21, 2022

9 To be accurate. LED = light emitting diode. JUST Like a Laser Diode. LED
10 "lights" are NOT LIGHTS! But dirty unfocused, un-natural LASERS! They have
11 NO PLACE on vehicles!!

12 Ariel Coriaty – March 22, 2022

13 I already have awful astigmatism making night driving awful already...
14 These headlights have made it A WHOLE LOT WORSE. They need to be
15 banned/outlawed immediately!!!

16 Scylina Spikes – March 17, 2022

17 I am signing this petition because these led headlights are dangerous and can
18 cause vision complications. I have personally experienced these led headlights are
19 blinding me at a stop light and driving on the road. It is not safe for anyone and
20 will cause unfortunate accidents.

21 Cheyenne Maier – March 16, 2022

22 I'm signing because my family friend was a severe car accident that left her
23 hospitalized from a 6 months due to being blinded by an LED headlight and
swerving off the road

Chloe Harris-Adams – March 13, 2022

I genuinely cannot see at night due to these lights. I've caught myself in the
other lane or on the side of the road because these lights blinded my vision to the
point I could not see the lane lines. I have chronic migraines and any time I drive at
night these induce them without fail.

Faralyn Padilla – March 9, 2022

1 The LED lights give me headaches and make night driving unsafe because I
2 can't see curbs or islands. I try not to drive at night, but have resorted to wearing
3 sunglasses at night if I must drive.

4 Jamie Cormier – March 4, 2022

5 I'm 26 and can barely drive at night due to the sheer amount of cars with
6 these lights. They blind me from my rear and side mirrors unless I hunch over the
7 steering wheel, which is incredibly dangerous. I am also autistic and suffer from
8 migraines so even a drive around the block is a guaranteed pain attack unless I pull
9 over but even then I can't avoid the oncoming brights. These lights have even
10 stunned me DURING DAYTIME! It's ridiculous that car manufactures think bright
11 blue is better. It hurts! Please change the law and ask manufacturers to do light
12 recalls!!! How can I hold down a job safely if I can't drive at dawn or after dark?
13 It's beyond my control.

14 Makalia Carpenter – February 24, 2022

15 I have an astigmatism and these LED headlights make driving dangerous
16 and nearly impossible.

17 Cristi Carlson – February 16, 2022

18 I am tired of being blinded by HID and LED car lights, even in day time, but
19 especially the night time. Furthermore, The American Medical Association stated
20 they find that increased levels of LED and blue light can cause blurriness,
21 migraines, sleep apnea, heart disease, even cancers.

22 Joyce Hinman – February 14, 2022

23 As someone with an astigmatism in both eyes, these lights are quite
blinding. I have driving glasses that don't even work with the LED and HID lights.

R Em – February 6, 2022

It seriously is causing me harm. I drive on single lane highways often
throughout Ontario and I am fearing for my life because of oncoming and even
traffic following me. I cannot see, it is basically a guessing game with me praying
that I do not fly off the roadway into a ditch. Blinding is an understatement.

Jenny Isadore – January 31, 2022

LED head lights are blinding and very dangerous. Especially at night in the
rain when you can't see the lines on the road or anything in front of you because
you're blinded by LED head lights.

1
2 Eve Daniels – January 26, 2022

3 I struggle to drive at night with bright lights like this and almost had an
4 accident. I had my eyes tested and they are fine, it's purely people with lights too
5 bright

6
7 Esther Smith – January 25, 2022

8 I know first hand the effects this has on my health and how it has made my
9 life so restricted both indoors and out . People need to know the effects it has on
10 photosensitive people and in fact non photosensitive too. The impact on health is
11 phenomenal and it needs to be better understood & circulated to all and significant
12 action taken to address this issue .

13
14 Eileen Lanati – January 24, 2022

15 These auto lights are causing much distress to my eyes during daytime but
16 especially at night and I know I'm not the only one. Something must be done to
17 stop this agenda to blind American citizens.

18
19 William Babington – January 23, 2022

20 LED lights can cause seizures in people with epileptic photosensitivity.

21
22 Faith Rich – January 21, 2022

23 I have Irlen's Syndrome and walking in the dark is horrendous because of
these lights, worse when I am driving in low light! They because me significant
pain.

Jeanette Park – January 19, 2022

Photophobia migraine and other similar conditions. These new lights are not
a move in a positive direction, they are a set back.

Mark Adams – December 30, 2021

I have had to quit my job as an Uber driver because I can no longer see when
driving at night. This directly leads to bar patrons deciding to drive themselves
because they don't have another option, which also adds to PEOPLE DYING.

9. Electromagnetic Frequency Radiation Exposure

In the March 11, 2020, study titled *Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It*¹⁴, the researchers wrote, “*we found there are presently several direct and indirect arguments which strongly suggest that EMF exposure and even chemicals may cause or contribute to cause EHS.*”

Figure 6 shows the Extremely Low Frequency, Low Frequency, and Radio Frequency portions of the electromagnetic spectrum that were considered in the study referred to above. What must be noted here is that human visible light is also part of the electromagnetic spectrum. We are not aware of any study that proves that visible light should be excluded from discussions about EMF exposure.

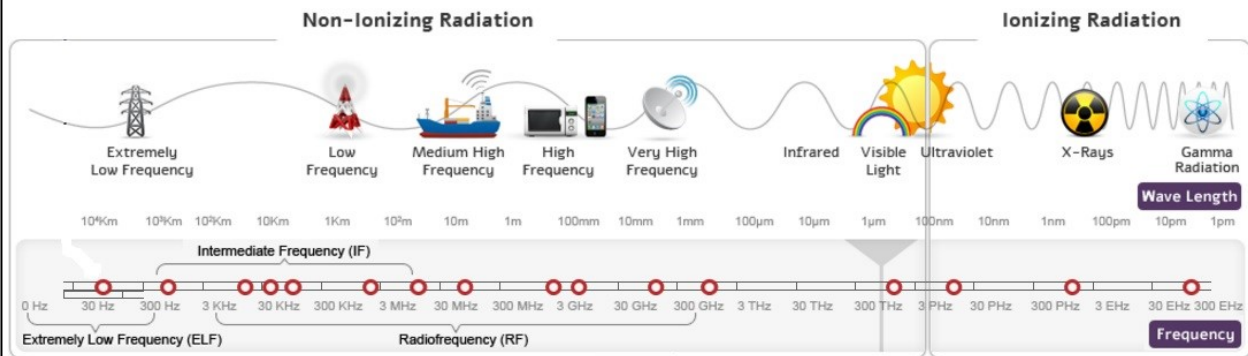


Figure 6 - Electromagnetic Spectrum¹⁵

The TNUDA center in Israel states, “*The main public concern regarding potential health risks of non-ionizing radiation focuses on the possibility that non-ionizing radiation has non-thermal effects (i.e., effects which are not directly related to heating).*”¹⁶ These concerns include radiation in the human-visible portion of the electromagnetic spectrum.

The neurological effects of human-visible radiation from flat surfaces such as LEDs has not been well studied. Yet, there is clear and compelling evidence from the empirical data, as evidenced in this document, that the non-uniform

¹⁴ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7139347/>

¹⁵ <https://www.tnuda.org.il/en/physics-radiation/what-radiation/electromagnetic-radiation-spectrum>

¹⁶ <https://www.tnuda.org.il/en/health-consequences-%E2%80%93-background>

1 radiance of flat surface radiation, including from LEDs, has serious and significant
2 adverse health impacts on humans.

3 The World Health Organization International Classification of Diseases
4 (ICD-10) code T66 is titled “Unspecified effects of radiation” and includes
5 radiation sickness.¹⁷ The ICD-10 injury code for *Exposure to other nonionizing
radiation* is W90.¹⁸ Thus, an adverse health effect from exposure to radiation,
including LED visible radiation, is covered by these codes.

6 The Centers for Disease Control warns that: “*As with other toxins, ‘the dose
7 makes the poison.’* It is the radiation dose, or the amount of radiation, that is the
8 critical issue in determining health consequences.”¹⁹ The “dose” includes the
9 intensity, duration, number of exposures and sensitivity of the individual.²⁰ Dose
restrictions for non-uniform radiance visible light are necessary to protect human
health.

10 Here are some statistics of classes of people in the world whose health may
11 be more harmed by LED visible radiation than other classes of people.

- 12 50,000,000 people with epilepsy.²¹
- 13 75,000,000 people with autism.²²
- 14 620,000,000 people with blue eyes.²³
- 15 709,000,000 elderly people.²⁴
- 16 1,000,000,000 people with migraines.²⁵
- 17 2,200,000,000 children.²⁶

18 ¹⁷ <https://icd.who.int/browse10/2019/en#/T66-T78>

19 ¹⁸ <https://nciterms.nci.nih.gov/ncitbrowser/ConceptReport.jsp?dictionary=ICD-10-CM&code=W90&ns=ICD-10-CM>

20 ¹⁹ Health Effects of Radiation: Health Effects Depend on the Dose, Centers for Disease Control,
<https://www.cdc.gov/nceh/radiation/dose.html#how>.

21 ²⁰ https://www.radiologyinfo.org/en/info/safety-hiw_09

22 ²¹ <https://www.who.int/news-room/fact-sheets/detail/epilepsy>

23 ²² <https://www.tpathways.org/faqs/how-many-people-have-autism/>

24 ²³ <https://www.aucklandeye.co.nz/about/blog/7-interesting-facts-about-blue-eyes>

25 ²⁴ <https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf>

26 ²⁵ <https://migraine.com/migraine-statistics>

²⁶ <https://www.humanium.org/en/children-world/>

1 The lessons learned from other pollutants and toxins, such as asbestos, lead
2 and smoking, indicate that the longer a government refuses to follow established
3 science, the more harmful it is for people’s health and the economy. That LED
4 radiation can be hazardous is settled science and the majority view in peer-
5 reviewed scientific communities.

6 Public health means the health of the population, including the health of the
7 most sensitive members of the population, which was a guiding principle adopted
8 by Congress in connection with setting any ambient exposure standards under the
9 Clean Air Act.²⁷ Those disabled by LED visible radiation are “the most sensitive
10 members of the population” and their numbers are growing.

11 LED radiation emissions are an environmental hazard for those who are
12 disabled by LED visible radiation. LED radiation emissions are also an
13 environmental hazard for vulnerable populations such as children and the elderly,
14 and for the unsuspecting public who have not been informed of the health hazards
15 of LED radiation emissions.

16 LED poisoning involves severe physiological injuries directly associated
17 with LED radiation exposure manifested as a constellation of symptoms ranging
18 from discomfort to neurological and immunological disorders to debilitation and
19 life-threatening impairments.

20 Common LED poisoning symptoms directly associated with LED radiation
21 exposure include sleep disturbances, chronic fatigue, mood disturbances
22 (depression/ anxiety), skin problems (including skin lesions), dizziness, balance
23 disorder, cancer, vision problems, nose bleeds, nausea, reproductive problems,
24 headaches, migraines, panic attacks, anxiety, and seizures, among others.

25 Many of those who are now disabled by LED visible radiation had no
26 previous problem navigating in the world, but after exposure to LED visible
27 radiation, their access to basic services such as hospital care, post offices and
28 libraries became restricted. As a result of their injuries, they reported their

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²⁷ “The Challenge of Nonionizing Radiation: A Proposal for Legislation,” Karen A. Massey, referencing H.R. Rep. No. 294 at 50, 95th Cong, 1st Sess. 136, reprinted in [1977] US. Code Cong & Ad. News 1077, 1215, <https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=2692&context=dlj>.

1 condition cost them their jobs and have become so-called ‘LED refugees.’ Many
2 are high-functioning individuals, such as engineers, doctors, and teachers.

3 **Ionizing Radiation and Non-Ionizing (RF) Radiation**

4 There has existed an apparent dichotomy between ionizing and non-ionizing
5 (RF) radiation, that only ionizing radiation can cause biological injury. However,
6 upon closer examination, the distinction becomes meaningless, as biological injury
7 can also occur with non-ionizing radiation. Kent Chamberlin, Professor and Chair
8 Emeritus of the Department of Computer and Electrical Engineering of the
9 University of New Hampshire explains why the distinction is not material since
10 they both produce biological effects.

11 “The electromagnetic spectrum defines the range of frequencies over
12 which electromagnetic waves can propagate, and that range of
13 frequencies includes wireless communication signals as well as visible
14 light, X-rays, and gamma rays. In general terms, the electromagnetic
15 spectrum can be partitioned into two categories, ionizing and non-
16 ionizing, and the delineation between those two categories is
17 determined solely by frequency, where signals at frequencies higher
18 than that of ultraviolet light are known to be ionizing and those below
19 that frequency are non-ionizing.

20 “Ionizing radiation has sufficient energy to dislodge electrons from
21 the atom or molecule and if that occurs, it will create an ion. Common
22 examples of ionizing radiation sources are X-rays, nuclear radiation,
23 and gamma rays from space. The impacts of ionizing radiation are
well documented and are known to cause serious illness if the amount
of exposure to that radiation is high enough and if it occurs over a
sufficiently long period of time. Exposure to non-ionizing radiation
also causes biological harm, although the mechanism for that harm is
different from that of ionizing radiation.

“Both ionizing and non-ionizing radiation can cause heating effects in
biological tissues, and the degree of heating is proportional to the
magnitude of the radiation, not the frequency. It is recognized that
excessive heating of biological tissues can damage those tissues, and
current regulatory limits were established with the assumption that
non-ionizing radiation is safe provided that the radiation is below the
thermal threshold.”

1
2 LED visible radiation can cause physiological injury below the thermal
3 threshold. Therefore, the distinction being drawn between ionizing and non-
4 ionizing radiation, as it relates to visible light radiation, becomes meaningless. As
5 confirmed by Dr. Beatrice Golomb, “*much or most of the damage by ionizing
6 radiation, and radiation above the thermal limit, occurs by mechanisms also
7 documented to occur without ionization, and below the thermal limit.*”²⁸

8 **10. The 450nm Wavelength**

9 Blue light from digital devices and the sun transforms vital molecules in the
10 eye’s retina into cell killers, according to optical chemistry research at The
11 University of Toledo.²⁹ Blue light has a frequency of 400-500 nanometers on the
12 electromagnetic radiation spectrum. This particular wavelength is a dual-edged
13 sword for cellular organisms, including humans, because this wavelength controls
14 circadian rhythms, but also causes cell damage which is cumulative and
15 irreversible.

16 When we understand that LED vehicle headlights contain large spikes of
17 blue wavelength light that is directed straight, or nearly straight, into the eye, and
18 typically at night, we must realize how damaging this is to the eye and to circadian
19 rhythms. When we further understand that LED street lights also contain large
20 spikes of blue wavelength light and that LED street lights are left on all night, we
21 further strengthen our comprehension of how dangerous this situation is for human
22 health. A September 14, 2022, study published in Science Advances concludes
23 that LED streetlights with blue wavelength light have altered the composition of
the light in the atmosphere. The exposure of blue wavelength light pollution is
having serious and significant negative impacts on human and ecological health.³⁰

²⁸ Letter by Dr. Beatrice Golomb, Professor of Medicine, UC San Diego School of Medicine, Aug. 22, 2017, <https://mdsafetech.org/wp-content/uploads/2017/09/golomb-sb649-5g-letter-8-22-20171.pdf>. Dr. Golomb is Professor of Medicine, Univ of CA, San Diego School of Medicine; she was a Robert Wood Johnson Clinical Scholar and Postdoctoral Fellow, Computational Neurobiology Laboratory, Salk Institute; she won the Robert Wood Johnson Generalist Physician Faculty Scholar Award; she has been in Who’s Who in America since 2000; and she participated in numerous expert panels. See full CV at <https://www.golombresearchgroup.org/pagecv>.

²⁹ http://news.utoledo.edu/index.php/08_08_2018/ut-chemists-discover-how-blue-light-speeds-blindness

³⁰ <https://www.science.org/doi/10.1126/sciadv.abl6891>

1 Because LEDs emit visible radiation from a flat surface, the emitted
2 radiation has non-uniform radiance, which is unlike the essentially uniform
3 radiance emitted by a curved surface emitter such as an incandescent light bulb.
4 Photometric measurement formulas that were developed for curved surface
emitters and which assumed uniform luminance/radiance cannot be used for flat
surface emitters where each point in space has a different energy.

5 Therefore, when measuring the effects of 450nm blue wavelength light on
6 eye cells or other molecular structures, the energy of the radiation must be
7 measured precisely at each point in space, and each measurement data point must
8 be measured separately, as the energy arriving at one location on the eye will be
9 different at a second location on the eye. The measurement precision must be at
10 the femtometer or picometer scale due to the small dimensions of an LED chip.
Previous techniques that averaged the energy of the light across the eye can no
longer be used with light emitted by a flat surface source such as an LED because
such averaging will invalidate the results.

11 Figure 7 shows the spectral power distribution of a custom-made white light
12 LED used to test the impacts of blue wavelength light on a rat model eye.³¹ Here
13 we see that the power is measured using radiance, in this case Watts per
14 nanometer. We contend that this resolution is not precise enough for investigating
15 the full effects of LED light on the eye, as the precision should be Watts per
16 picometer or Watts per femtometer, which is 1,000 to 1,000,000 times more
17 precise than that used in this study. However, radiance is the proper metric.
18 Because LED light is so intense at such small scales, the effects on the eye at peak
19 radiance will likely occur more rapidly and with more damage than shown with
20 less precise measurement. The results of studies such as this one are not
21 invalidated, but the true impacts are underrepresented due to the lack of required
22 precision.

23 ³¹ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3948037/>

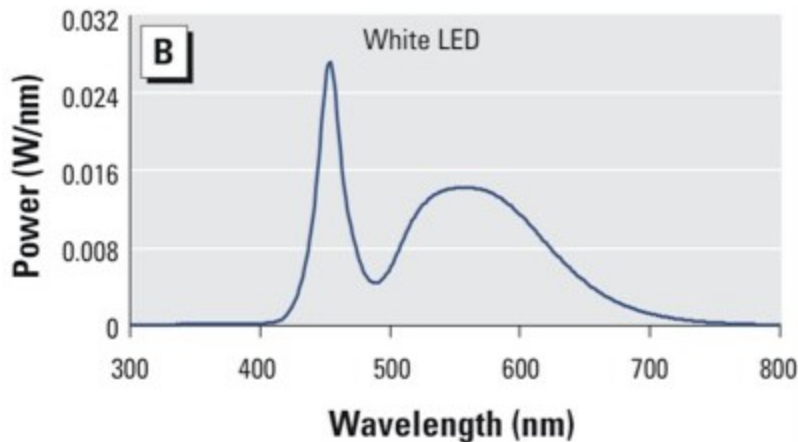


Figure 7 - White/Blue LED Spectral Power Distribution

The authors of the 2014 study described above concluded that blue wavelength light “causes irreversible retinal neuronal cell death in rats.” Because of this research, the authors stated, “Thus, we suggest a precautionary approach with regard to the use of blue-rich “white” LEDs for general lighting.” As we know, precaution was not used and unregulated blue-rich LEDs were allowed to proliferate across the world.

On March 1, 2022, the LED display industry published the Eyesafe Display Requirements 2.0 which uses a rating system called Radiance Protection Factor to provide consumer information about the amount of 450nm wavelength light emitted by an LED display.³² This document references ICNIRP and ANSI standards, which are standards created by industry. While these standards may provide useful information, they are non-binding, and are not a substitute for government regulation.

What the Eyesafe standards do show is that the industry understands that visible radiation at approximately 450nm is dangerous for the eye and adversely impacts circadian rhythms. The Eyesafe standard states, “Research has demonstrated that acute exposure to intense blue light causes photochemical damage (“phototoxic effects”) to retinal cell physiology”. Given that the LED industry acknowledges that 450nm light causes photochemical damage to the eye, there should be no doubt that there must be federal regulation of 450nm

³² <https://eyesafe.com/pdfs/Eyesafe-Display-Requirements-20-April2022.pdf>

1 wavelength in products such as LED streetlights, LED vehicle headlights, LED
2 floodlights, LED strip lights in vending machines, and electronic billboards.

3 The Eyesafe document states, “*The display must be set at 200 nits for the*
4 *test procedure.*” However, high powered LED products such as LED streetlights
5 and LED vehicle headlights already exceed 1,000,000 nits and can be as high as
6 100,000,000 nits, and these LED products are used in outdoor environments at
7 night when biologically there should be zero nits of artificial blue wavelength light.
8 Such high-powered LED products necessitates government regulation of the
9 450nm wavelength to protect the comfort, health, and safety of the public.

10 Comfort, health, and safety regulations for blue wavelength light from LEDs
11 must include the non-uniform radiance of flat surface emitters. The regulations
12 must use radiance as the regulation metric and precision must be at the femtometer
13 or picometer scale. For example, restrictions on power from 400nm to 500nm
14 would be specified in Watts per femtometer and a measurement precision of
15 femtometers for any detector.

16 **11. Temporal Modulation**

17 Cellular systems are exquisitely sensitive to pulsing, flickering, and flashing
18 of electromagnetic radiation, including visible radiation. The range of visible
19 radiation for humans is approximately 380nm to 700nm, but different species have
20 different ranges of perception, as shown in Figure 8. As well, different species
21 have different rates at which they take snapshots of the information provided by
22 the visible radiation.
23

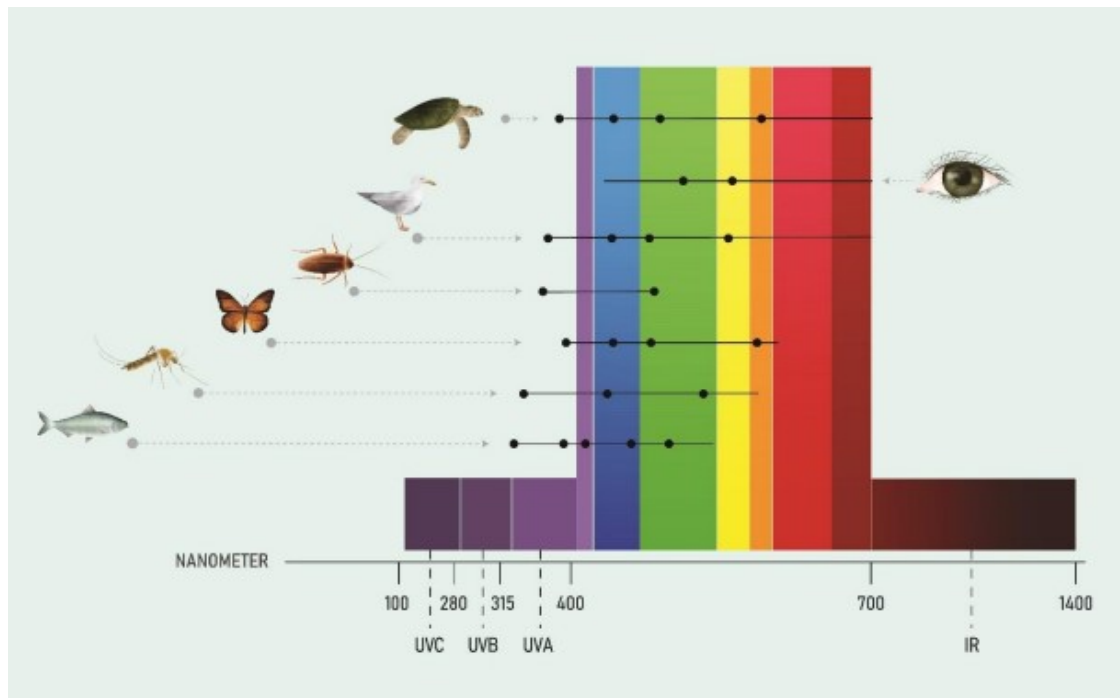


Figure 8 - Visible Range of Different Species

Temporally, that is relating to time, whether the radiation is continuous or varying has profound effects on the human nervous system, and if the radiation is varying, then how the radiation is modulated is also of critical importance when attempting to understand the impacts of the radiation.

Flutter

For LEDs, photons are emitted from a flat surface chip which can create a flutter depending on factors such as temperature, physical characteristics of the chip, and input current. We are not aware of any substantial discussion of the impacts of this flutter on human health, and research should be conducted in this area.

Flicker

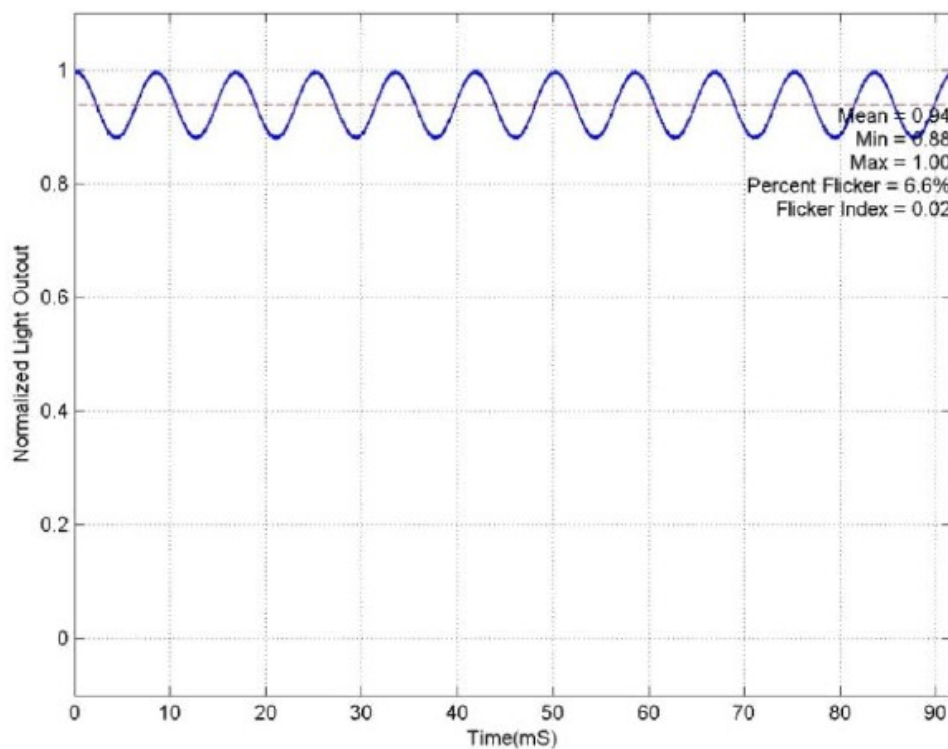
Flicker is caused by changes to the input current or voltage over time. An LED requires direct current to power the LED, yet a typical mains circuit provides power via alternating current. Thus, circuitry is required to convert the alternating current to direct current. This conversion will produce radio frequency electromagnetic radiation and temporal flicker. In addition, dimming systems such

1 as on LED vehicle headlights will also create flicker, sometimes consciously
2 noticeable, and other times subconsciously noticeable.

3 **Flashing and Strobing**

4 There does not seem to be a consensus agreement about the difference
5 between a flashing light and a strobing light, although a strobing light is often
6 considered more intense or at a higher rate than a flashing light. However, there is
7 no definitive qualification for either type of temporal pulsing.

8 When the visible radiation is pulsed, there is a length of time for the pulse to
9 cycle and there is a decay rate and ramp-up rate within that cycle and percent of
10 change in intensity. Figure 9 shows the temporal intensity modulation for an
11 incandescent light bulb. The percent change during the cycle is approximately
12 6.6%



21 *Figure 9 - Modulation of Incandescence³³*



³³ <https://ieeexplore.ieee.org/document/7118618>

1 On the other hand, because of the electronic circuitry, LEDs can exhibit
2 100% percent change of intensity during a cycle, as shown in Figure 10. This is
3 also known as square wave flicker.

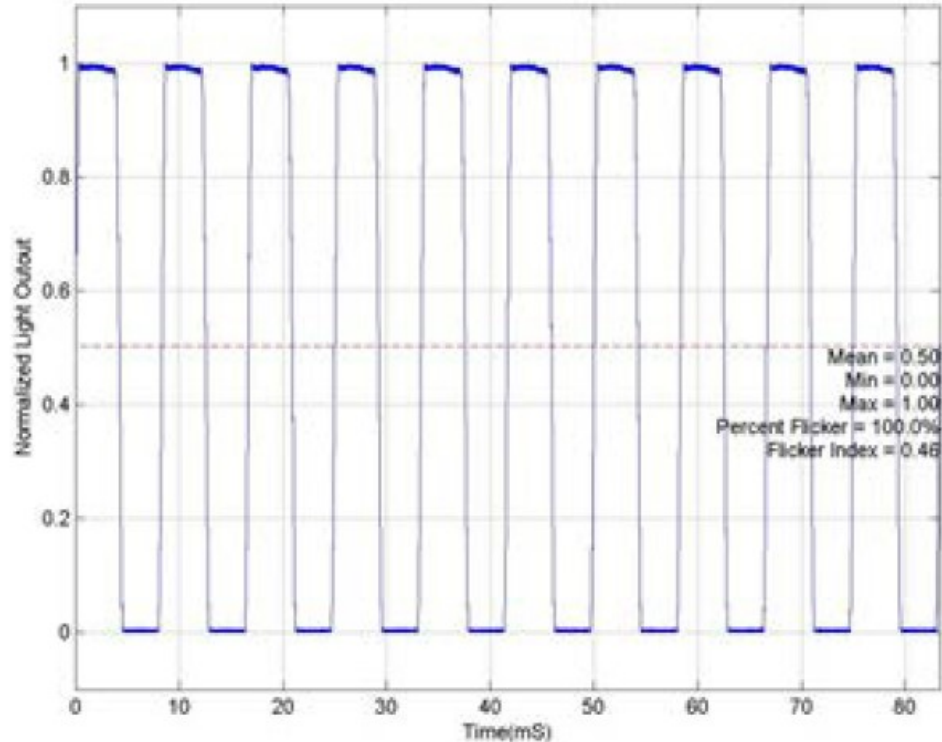


Figure 10 - Modulation of LED

15 The neurological health impacts of square wave flicker are significant and
16 these impacts are dependent on the intensity of the radiation, the frequency of the
17 change, the depth of the change, and the number of radiation devices present.
18 Regulation of LED product flicker is a critical necessity.

19 12. Spatial Non-Uniformity

20 LEDs emit light from a flat surface, creating a directed beam of non-uniform
21 energy. We are not aware of a natural emitter of this type of radiation. Therefore,
22 besides the categories of ionizing versus non-ionizing radiation, there is also the
23 category of uniform energy radiation versus directed energy radiation. With the
exception of laser light, government regulation of directed energy radiation is
missing.

1
2 The small size of an LED chip and the intense density of the directed energy
3 radiation emitted by the chip requires extremely precise measurement, at the
4 picometer and femtometer scale in near field, meaning approximately 1
5 micrometer from the chip. This presents a problem of how to measure the energy
6 arriving at the eye with such precision. Studies on the impacts of LED visible
radiation on the eye and the human nervous system must use the specifications for
peak luminance from the chip maker of the LED used in the LED device, and then
correlate that peak luminance to the effects on the test subjects.

7 In addition to the peak luminance, there is a significant effect caused by the
8 changing luminance of the spatial radiation profile. Flat surface LEDs emit
9 radiation in a generally Lambertian shape, which means that the energy arriving at
10 the human subject will be non-uniform. Humans are not evolutionarily designed
11 for absorbing non-uniform radiation, so the effects of this spatially non-uniform
12 radiation are unpredictable. The lack of study and regulation of the spatial non-
uniformity of LED visible radiation, coupled with square wave flicker, is likely the
cause or partial cause of many of the documented cases of epileptic seizures,
migraines, panic attacks, nausea, and other adverse neurological reactions.

13 Federal regulation of LED visible radiation must include restrictions on
14 spatial non-uniformity, peak luminance/radiance, and precision measurement at the
femtometer or picometer scale.

15 16 **13. Discrimination**

17 The widespread introduction of products using LEDs has created a new class
18 of disabled people who are disabled by LED visible radiation. A person who is
19 disabled by LED visible radiation has a Hidden Disability, meaning a disability
20 that is primarily neurological in nature.³⁴ Injuries caused by LED radiation
exposure give rise to “impairment[s] that substantially limit[s] one or more major
life activities” under the Americans with Disabilities Act.”³⁵

21
22 ³⁴ Invisible Disabilities: List and Information -

23 <https://www.umass.edu/studentlife/sites/default/files/documents/pdf/Invisible%20Disabilities%20List%20%26%20Information.pdf>

³⁵ 42 U.S.C. §12102(1)(A).

1
2 There is a growing body of evidence showing that the population of those
3 disabled by LEDs is large and that those who are disabled by LEDs are suffering
4 significant injuries from exposure to LED light, both static and flashing. Yet, due
5 to lack of federal regulations, LEDs are now nearly everywhere, creating an
6 unbearable situation where those who are disabled by LEDs have nowhere to go to
7 be safe.

8 **14. Personal Stories of those Disabled by LEDs**

9 As noted earlier, epidemiological data refers to observed health effects. Due
10 to the lack of formal research articles on the neurological effects of flat surface
11 visible radiation from LEDs on humans prior to the release of LED products, we
12 must review the collection of data from real world experiences that have occurred
13 since the release of LED products. These stories of people whose lives have been
14 severely impacted by LED visible radiation serve to justify the need to regulate
15 LED visible radiation.

16 **MarieAnn, New York**

17 MarieAnn was diagnosed with epilepsy and migralepsy early in life. The
18 use of medication did not control these conditions, so MarieAnn carefully adapted
19 her lifestyle to avoid anything that would trigger seizures. MarieAnn fully
20 participated in life as a mother, avid gardener, teacher, pharmacist, choral singer
21 and enjoyed numerous other activities.

22 This all changed with the introduction of LED lights. MarieAnn reports that
23 her first recollection of LEDs having an adverse impact on her life was of the red
LED alarm clocks found in hotel rooms in 1980s. While these LEDs did not
trigger a seizure, they made her feel nauseous, so she would cover up the alarm
clock LEDs during her hotel stay.

MarieAnn's first exposure to a high-powered LED occurred around 2014.
The exposure to the LED light triggered one of the worst seizures she had had in
her lifetime to that point. Prior to this time, MarieAnn had done well to limit her
exposure to seizure triggers, resulting in just a handful of seizures over several
decades of living. However, since 2014, MarieAnn has now suffered hundreds of

1 life-threatening seizures which occur nearly every time she is exposed to LED
2 light, even for exposures of less than 1 second.

3 As LED products proliferated, avoiding LED light became more and more
4 difficult. MarieAnn and her family moved to a small village in upstate New York
5 in search of a safe place to live. For a while, this plan worked. Then, in 2019, her
6 village decided to switch to LED streetlights. MarieAnn pleaded with the mayor
7 and council to not make the switch, warning them that the switch to LED
streetlights would put her life at risk and that the existing High-Pressure Sodium
lights caused her no ill effects. The mayor and council ignored her pleas and
installed the LED streetlights, including on her street.

8 The switch to LED streetlights caused MarieAnn to suffer hundreds of
9 breakthrough seizures, debilitating migraines, and physical injuries from the loss of
10 muscle and brain control during the seizure. To protect her life, MarieAnn now
11 travels every night, before the LED streetlights turn on, to a farmhouse where she
sleeps in an attic.

12 One afternoon at the farm, MarieAnn was walking along the country road
13 when a US Postal Service mail truck appeared with LED headlights turned on. As
14 soon her eyes received the LED light, MarieAnn suffered a seizure and landed in a
15 ditch on her back by the side of the road. When she recovered from her seizure,
the postal truck was long gone, it was nearly dark, and she had to make it back to
the farmhouse covered in dust and feeling nauseous.

16 In another incident, a village police vehicle made a traffic stop on
17 MarieAnn's street. From the upstairs room, MarieAnn caught a brief glimpse of
18 the red and blue LED lights on the police vehicle and immediately felt the light.
MarieAnn was able to turn away quickly enough to avoid a full seizure, but she
spent the rest of the day in bed feeling sick.

19 MarieAnn and her family now must take extreme precautions to transport
20 MarieAnn to and from her house to the farm or to visit relatives. Their actions
21 include putting MarieAnn into the back seat of the car and covering her head with
22 a blanket so that she won't be exposed to LED light. Another adaption they have
23 made is to drive routes that have very little traffic and very few services and
buildings where LED lights might be in use. This can turn a one-hour trip into a
four-hour trip, but at least MarieAnn can sit in the front seat without the blanket
over her head.

1
2 However, on July 8, 2022, MarieAnn was the front seat passenger in a car
3 driven by her son when they encountered a pedestrian crossing device called a
4 Rectangular Rapid Flashing Beacon that flashes high-intensity strobing LED light
5 into the eyes of oncoming drivers and passengers. This LED strobing light
6 triggered the worst seizure MarieAnn has suffered to date. The seizure lasted for
7 one and a half minutes, and during this time MarieAnn was thrashing violently in
8 the car and she hit her head on the side window hard enough that her doctor
9 diagnosed her with a severe concussion. The recovery from this incident took
10 months, with her doctor telling her to avoid any activity that involved thinking.
11 During the recovery period, MarieAnn's speech was slowed, and she had difficulty
12 remembering words.

13 MarieAnn is doing everything possible to convince government officials to
14 protect her life from the effects of LED visible radiation, but it has been a long,
15 depressing effort, with little-to-no remorse or empathy from government officials.
16 MarieAnn filed a petition with the New York State Public Services Commission
17 which they ignored until MarieAnn and her family went door-to-door collecting
18 signatures that they submitted to the Commission, forcing the Commission to
19 accept her petition to eliminate the LED streetlights in her village. This is now a
20 NYSPSC public case 21-02623.³⁶ The NYSPSC has not acted on MarieAnn's
21 petition as of this writing.

22 **Mark, Oregon**

23 Mark is a healthy adult with past careers in computer programming and
teaching middle school math. Mark's life changed dramatically with the
introduction of high-powered LED lights on cars, floodlights and streetlights, and
the advent of LED strobing lights on vehicles.

Around 2016, Mark began to notice the alien white light emitted by the LED
Daytime Running Lights on Cadillac vehicles. Mark describes these lights as
stealing his attention in a way that felt like the lights had an evil soul, forcing him
to acknowledge their presence. Looking at these lights made Mark feel like he was
in the presence of an evil being. Mark would make great effort to look away, but

³⁶ <https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=21-02623&CaseSearch=Search>

1 that effort was psychologically exhausting. Over time, more and more of these
2 LED DRLs and LED headlights began appearing and it became more and more
3 exhausting to try to avoid looking at these LED lights.

4 One evening, Mark came home to find that his city had replaced all of the
5 HPS lights in his neighborhood with 5000K LED streetlights. Mark was shocked
6 and immediately depressed. Instead of the soft glow of HPS, the harsh white of
7 LED streetlights made his neighborhood unbearable to live in. One of the LED
8 streetlights was directly outside of his 2nd story apartment and flooded his living
9 room and kitchen with this harsh, bright light. After a year of campaigning and
10 activism, the city agreed to change five of the LED streetlights on Mark's street to
11 3000 Kelvin, but this still left the neighborhood unwalkable at night due to the
12 anxiety, agitation, discomfort, and fear that these LED streetlights caused Mark.

13 As the LED lights proliferated, Mark became more and more frazzled as the
14 danger around him continued to grow with LED car headlights, LED flood lights
15 on buildings, LED streetlights, and flashing LED lights. At Mark's work for a
16 public school district, the district installed 5000K LED outdoor floodlights that
17 were aimed directly into the eyes of those who came onto the school campus.
18 Every day when Mark went to work, these LED floodlights tortured him and the
19 psychological trauma became significant.

20 On April 3, 2019, after the school district rejected Mark's request to remove
21 the LED floodlights, Mark suffered a complete mental collapse during classroom
22 teaching. Mark ran to the school office and began screaming uncontrollably,
23 rolling on the floor, and smashing his head with his hands. The school called the
24 police who then chased Mark through the neighboring park, handcuffed him, and
25 took him to the County mental health hospital. Mark was then held against his will
26 for four days at two different hospitals and was given strong doses of anti-
27 psychotic pills. During this time, the medical staff diagnosed Mark with mild
28 Autism Spectrum Disorder and noted that Mark's collapse was triggered by the
29 impacts from the LED lights.

30 That incident left Mark unable to continue working due to extreme anxiety
31 and sensitivity to environmental lights, sounds, and smells. Mark was forced to
32 resign from work and has not been a member of the work force since that event.

33 On September 3, 2021, Mark was a passenger in a car which was behind a
34 fire truck using LED strobe lights. Mark took the photo of the fire truck shown in

1 Figure 11. The intensity and strobing of the LED lights overwhelmed Mark's
2 nervous system, and it came to the point where he jumped out of the car and ran
3 over to the fire truck and begged them to stop torturing him with their LED
4 strobing lights, a request that caused the fire truck occupants to laugh. Finally,
5 Mark had another psychological meltdown and fell to the pavement in front of the
6 firetruck, rolling on the ground and screaming. Mark eventually stood up and ran
7 away but was eventually found and taken home after the fire truck left the area.



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16 *Figure 11 - Fire Truck*

17 These are just a few of the major incidents Mark has experienced with LED
18 lights, but Mark now lives in a constant state of fear and anxiety. Mark has moved
19 several times since LEDs came out, trying to find a safe place to live, away from
20 LED lights; but there is nowhere safe anymore. Mark now spends his time mostly
21 at home to protect himself from the ravages of LED lights.

22 Mark has filed a discrimination complaint against the Federal Highway
23 Administration over their authorization of LED strobe lights, case number FHWA-
2022-0375. The FHWA has not acted on this complaint as of this writing.

Kristina, Alaska

1
2 Kristina was a dynamic business woman until a stay at a hotel with mold
3 changed her life. Kristina's exposure to toxic mold triggered a loss of focus and
4 memory and this was quantified by her neurologist as a loss of 8 IQ points. The
5 toxic mold poisoning led to an inability to continue her previous work and Kristina
6 spent nearly a decade researching and working with doctors and neurologists on
7 recovery. Toxic mold poisoning leads to greatly increased sensitivity to lights,
8 sounds, and smells, so Kristina developed strategies to eliminate toxicity from her
9 environment such as filtering the air and water and eating healthy foods.

10 After all those years recovering from the toxic mold poisoning, Kristina's
11 health suddenly took a nosedive when her city replaced the existing HPS
12 streetlights with LED. Then, the airport near Kristina's house replaced the parking
13 lot lights with LEDs and now Kristina can no longer access the airport without
14 feeling sick. Kristina took the photo of the airport LED lighting shown in Figure
15 12.



16
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18
19 *Figure 12 - LED Airport Lighting*

20 Because Kristina has been working with doctors and neurologists for many
21 years, her doctors have brains scans that document her progress. After the city and
22 airport installed LED lights, the brain scans showed how her brain functioning was
23 adversely impacted by the LED visible radiation, proving that LED visible
radiation causes negative neurological reactions versus the HPS light that does not
cause these neurological reactions.

1

2 **Heidi, Minnesota**

3

4 Heidi has been diagnosed with epilepsy. However, despite the epilepsy
5 diagnosis, Heidi has been a productive member of society by managing her
6 exposure to triggers that might cause seizures.

7

8 In 2022, the company where Heidi worked moved to a different office that
9 had LED lights. Suddenly, Heidi was no longer able to function properly at work
10 without suffering auras, nausea, and severe headaches. Heidi was forced to stay at
11 home away from work while attempting to convince her boss that the LED lights
12 needed to be replaced. Eventually, the boss consented and removed the LED
13 lights, which enabled Heidi to return to work.

14

15 During this same time frame, Heidi’s city installed Rectangular Rapid
16 Flashing Beacons on city streets. One day while Heidi was driving in the city, a
17 pedestrian pressed the button and the RRFB began strobing LED visible radiation
18 into Heidi’s eyes and she suffered seizure symptoms of auras, nausea, wobbly legs,
19 and pain in her eyes. Figure 13 shows the intense, unregulated LED light of an
20 RRFB.



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1 The city has refused to engage with Heidi to protect her from LED light, so
2 Heidi has filed a complaint with the Minnesota Human Rights Department which
3 has issued a Charge of Discrimination against the city. As of this writing, the
4 city has yet to respond to the charge.

5 **Kristen, Iowa**

6 Kristen has been diagnosed with lupus, so avoiding light has almost always
7 been part of Kristen's life. Then, in February 2022, a car dealership across the
8 street installed LED floodlights. Kristen took a photo of these LED lights which is
9 in Figure 14.



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18 *Figure 14 - Blue Light from Parking Lot*

19 The photo in Figure 14 is an excellent example of the true nature of LED
20 floodlights, with excessive amounts of toxic blue wavelength light. As we can see
21 in the photo, this powerful light invades Kristen's home and property. On the first
22 night that these LED lights were installed, Kristen woke up with a bloody nose.
23 This was the first time in decades that Kristen has suffered a bloody nose.

24 Since that first night, Kristen's sleep has been poor, and she has suffered
25 significant anxiety and painful headaches. Kristen is an avid defender of wildlife
26 and she has noticed a severe decline in butterfly and bird populations in her yard

1 since the LED floodlights were installed. Kristen’s symptoms and experiences
2 align with the numerous research studies showing that blue wavelength light is a
3 toxin and environmental and health hazard.

4 Despite repeated efforts by Kristen to have the city enforce nuisance codes
5 and to have the car dealership remove the toxic LED lighting, neither city officials
6 nor the car dealership owner have acted to protect Kristen from the LED visible
7 radiation.

8 **Ken, Michigan**

9 Ken is a hardworking single parent who was in good health until LED lights
10 appeared. In 2021, Ken’s neighbors installed the LED porch lights shown in
11 Figure 15. The intensity of LED lights is overpowering and Ken felt like he was
12 being emotionally attacked by these lights. Ken requested that the neighbors shield
13 their lights, but they refused, and the situation has escalated into a legal battle.



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21 *Figure 15 - LED Porch Lights*

22 The emotional toll of LED lights must not be underestimated and must be
23 considered when devising comfort, health, and safety regulations for LED light. In
this case, the neighbors are causing severe emotional stress for Ken because the

1 intensity of the LED light is too powerful for Ken's nervous system. However,
2 due to lack of regulations, the neighbors have not been required to restrict the
3 amount or intensity of visible radiation being directed at Ken. Federal regulations
4 are needed and these regulations must protect the most vulnerable just as well as
5 the least vulnerable.

6 **15. International Stories of LED Visible Radiation Harm**

7 The stories of harm are not confined to just the United States

8 **Nina, New Zealand**

9
10 Nina is fluent in several languages, has worked as medical doctor, as a
11 specialist medical translator internationally, and she has worked at high levels in
12 environmental public health. All of this skill and talent is now unavailable to
13 society because Nina is disabled by LED visible radiation and therefore unable to
14 participate in public life.

15 Nina is unable to neurologically tolerate LED visible radiation from any
16 LED product including computer screens, cell phones, indoor and outdoor lighting,
17 vehicle lighting and other LED illuminated consumer products. In the presence of
18 LED light, she develops immediate onset of pallor, nausea and rapidly develops
19 migraine of three-day duration with associated left-sided facial and arm numbness
20 and on occasion syncope.

21 Nina now has no place of safe recourse. In fact, her own home has become
22 unsafe due to LED lighting entering through windows from neighboring housing.
23 To protect herself Nina now spends her day in a single room at a neighbor's house
which looks upon a brick wall or in a farm park distant from urban infill where she
can experience some degree of visual and physical freedom. At evening when dark
folds, she returns to her own house and blocks the outside light as well as possible
with curtains and must additionally close her eyes to prevent migraine.

For travel in a vehicle, Nina must close her eyes for the entire trip so that she
does not see the ubiquitous environmental LED light sources such as from public
buildings, vehicles, shopfronts, housing, marinas, and boats and any other structure

1 illuminated by LEDs enroute. Nina has lost ability to earn income, so she is reliant
2 upon her husband's income and is depleting her life savings so she and her husband
3 can afford to live. Nina's husband must also do all shopping as Nina cannot go into
any store as these stores are illuminated with LEDs.

4 New Zealand's decision to introduce LED illumination has transformed
5 Nina's active life of work, sport, voluntary activities, and financial security to one
6 of ill health, social exclusion, and an insecure future. New Zealand generally
7 follows US/European regulations for radiation, so there are currently no adequate
8 regulations in New Zealand for LED visible radiation

8 **Elaine, Ireland**

9 Elaine told her story to the Irish Parliament, Joint Committee on Disability
10 Matters on February 3, 2022.³⁷ Elaine opened her testimony by stating, "*I thank
11 the committee very much for this opportunity. I also hope that this can help, in
12 many ways, the others who are suffering around the world from light emitting
13 diode, LED, sensitivity and artificial light sensitivity. I have been made ill from
14 LEDs since 2007. It is more than a sensitivity; it is a disability. I am disabled by
15 my environment, like so many others, and excluded from society. This is also an
16 accessibility issue.*"

17 In her testimony, Elaine explains how her brain cannot cope with LED
18 lights, even from far away. Elaine's statement that the LED visible radiation
19 affects her even from away is testament to the density of LED light and its ability
20 to travel long distances with little dispersion. This makes LED light far more
21 powerful and dangerous than point/spherical source light.

22 Elaine says that the most distressing symptom of LED light is a burning
23 sensation in her brain. Elaine says she is inundated by LED light from cars,
flashing LEDs, LED street signals, farm machinery and more. Elaine notes that
since LED light is visible from space, this is proof that LED visible radiation
travels long distances. Elaine testified that LED light leaves her in constant pain.

³⁷ https://www.oireachtas.ie/en/debates/debate/joint_committee_on_disability_matters/2022-02-03/2/

1 As is the case for many, Elaine moved to the country in an attempt to find a
2 safe place to live, away from LED light. However, LED products have now made
3 their way out to the countryside and Elaine is now confined to her house, 18 hours
4 a day in the winter, with blackout shades blocking LED light from the
5 environment.

6 Elaine concludes her remarks by asking, “How do we access civic life?”

7 **Tim, England**

8 Tim had a successful career as an engineer, but in 2015 Tim was forced to
9 give up his career because offices switched to LED lighting. LED visible radiation
10 causes Tim pain, nausea, and chronic headaches. Tim can no longer safely visit
11 the grocery store because of the risk of encountering LED headlights or because
12 the store has switched to LED lighting. Tim was previously diagnosed with
13 chronic fatigue syndrome, but this diagnosis did not prevent him from living a full
14 life. Only since LEDs came out has Tim become fully disabled, unable to be a
15 contributing member of society.

16 Tim’s story is yet another example of a person disabled by LED visible
17 radiation moving to the countryside in an attempt to find an environment free from
18 the discrimination of LED lights. Tim is now mostly confined to his home, unable
19 to leave without fear of encountering an LED light.

20 **16. Conclusion**

21 LEDs emit visible radiation from a flat surface, creating a directed energy
22 beam. Any regulations that had been previously created for uniform energy visible
23 radiation cannot be simply applied to visible radiation from a flat surface.
Regulations for flat surface radiation must include restrictions on spatial non-
uniformity, peak luminance/radiance, spectral power distribution, and temporal
restrictions on flutter, flicker, flashing, and strobing.

24 In 1968, Congress passed the Radiation Control for Health and Safety Act
25 and stated, "*Congress declares that the public health and safety must be protected
26 from the dangers of electronic product radiation. Thus, it is the purpose of this
27 subpart to provide for the establishment by the Secretary of an electronic product*

1 radiation control program which shall include the development and administration
2 of performance standards to control the emission of electronic product radiation
3 from electronic products and the undertaking by public and private organizations
4 of research and investigation into the effects and control of such radiation
5 emissions." It is clear that Congress understands that electromagnetic radiation is
6 dangerous and that the public must be protected from the harms of electromagnetic
7 radiation. Other than radiation already regulated by the Atomic Energy Act of
8 1954, Congress did not limit the FDA's authority to regulate electromagnetic
9 radiation, and Congress did not absolve the FDA of its duty to regulate
10 electromagnetic radiation at all frequencies and for all spatial shapes and for all
11 temporal modulation scenarios.

12 Therefore, given the mandate by Congress in 1968 that the FDA shall
13 regulate radiation, the FDA must publish comfort, health, and safety regulations
14 for LED products. In addition, because so many LED products are now already in
15 the environment, the FDA must notify the manufacturers of LED products that
16 they are responsible for submitting petition requests to the FDA for approval of
17 their product and that these manufacturers are responsible for removal of any
18 unsafe LED product from the environment.

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