

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.<sup>1</sup>

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,

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

1 with LEDs reaching 100,000,000 nits as of 2018.<sup>2</sup> 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.*”<sup>3</sup> 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.<sup>4</sup>  
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.<sup>5</sup>

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

34 <sup>3</sup> [https://shop.texttalk.se/shop/ws26/40626/files/full\\_size\\_-\\_for\\_start\\_page\\_banner/iec60825-1%7Bed1.2%7Den.pdf](https://shop.texttalk.se/shop/ws26/40626/files/full_size_-_for_start_page_banner/iec60825-1%7Bed1.2%7Den.pdf)

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

36 <sup>5</sup> [https://www.atecorp.com/atecorp/media/pdfs/data-sheets/tektronix-j16\\_application.pdf](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.<sup>6</sup> 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*

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<sup>6</sup> <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.*”<sup>7</sup> Given that light is

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<sup>7</sup> [https://www.researchgate.net/publication/327606703\\_Photobiological\\_safety](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.<sup>8</sup> 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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22  
23 <sup>8</sup> <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/m<sup>2</sup> is 1/1000 of second, whereas the exposure limit to 100 W/sr/m<sup>2</sup> is 10,000 seconds which is 2.78 hours.

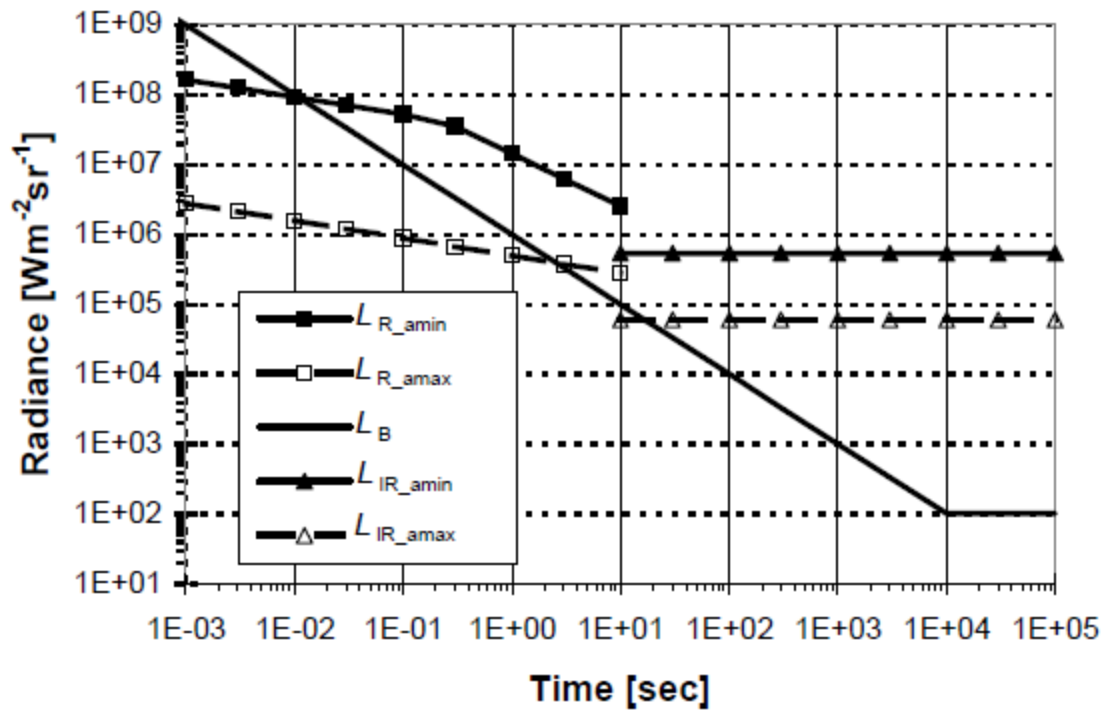


Figure 5.5 Weighted radiance exposure limits vs. time for constant exposure.

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 Streetlights<sup>9</sup>

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*

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<sup>9</sup> <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.<sup>10</sup> Many

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<sup>10</sup> <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 migraplesy. 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**

19           Patient 6 - September 20, 2022

20           A translator / interpreter by profession, now requiring total digital assistance,  
21 this woman experiences severe migraine with unilateral numbness to the face,  
22 nausea, and faintness upon exposure to LED illumination and screens. She has had  
23 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...”  
23

1 Opening testimony to Irish Parliament, Joint Committee on Disability  
2 Matters<sup>11</sup>

3 Patient 9 – February 3, 2020

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

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

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

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

21 2017

22 Diagnosis: Chronic Migraine

23 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  
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  
and sometimes vomiting associated with this headache.

[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  
sensitivity and [Patient] has forgotten to take the medication sometimes.

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<sup>11</sup> [https://www.oireachtas.ie/en/debates/debate/joint\\_committee\\_on\\_disability\\_matters/2022-02-03/2/](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.”<sup>12</sup>

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

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<sup>12</sup> <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.”<sup>13</sup>

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.”

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<sup>13</sup> <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  
24 swerving off the road

25 Chloe Harris-Adams – March 13, 2022

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

30 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*<sup>14</sup>, 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.

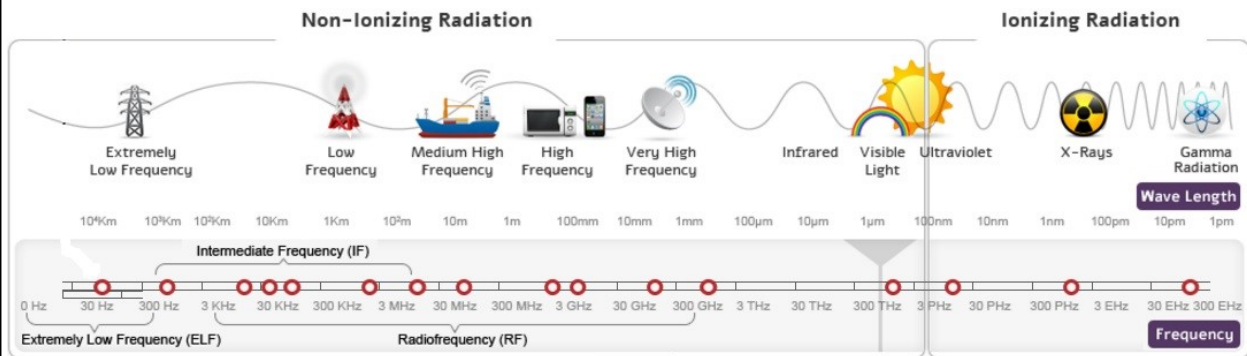


Figure 6 - Electromagnetic Spectrum<sup>15</sup>

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).*”<sup>16</sup> 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

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

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

<sup>16</sup> <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.<sup>17</sup> The ICD-10 injury code for *Exposure to other nonionizing  
radiation* is W90.<sup>18</sup> 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.”<sup>19</sup> The “dose” includes the  
9 intensity, duration, number of exposures and sensitivity of the individual.<sup>20</sup> 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.<sup>21</sup>
- 13 75,000,000 people with autism.<sup>22</sup>
- 14 620,000,000 people with blue eyes.<sup>23</sup>
- 15 709,000,000 elderly people.<sup>24</sup>
- 16 1,000,000,000 people with migraines.<sup>25</sup>
- 17 2,200,000,000 children.<sup>26</sup>

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

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

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

21 <sup>20</sup> [https://www.radiologyinfo.org/en/info/safety-hiw\\_09](https://www.radiologyinfo.org/en/info/safety-hiw_09)

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

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

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

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

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

<sup>26</sup> <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.<sup>27</sup> 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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<sup>27</sup> “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.*”<sup>28</sup>

## 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.<sup>29</sup> 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.<sup>30</sup>

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<sup>28</sup> 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>.

<sup>29</sup> [http://news.utoledo.edu/index.php/08\\_08\\_2018/ut-chemists-discover-how-blue-light-speeds-blindness](http://news.utoledo.edu/index.php/08_08_2018/ut-chemists-discover-how-blue-light-speeds-blindness)

<sup>30</sup> <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.<sup>31</sup> 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.

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

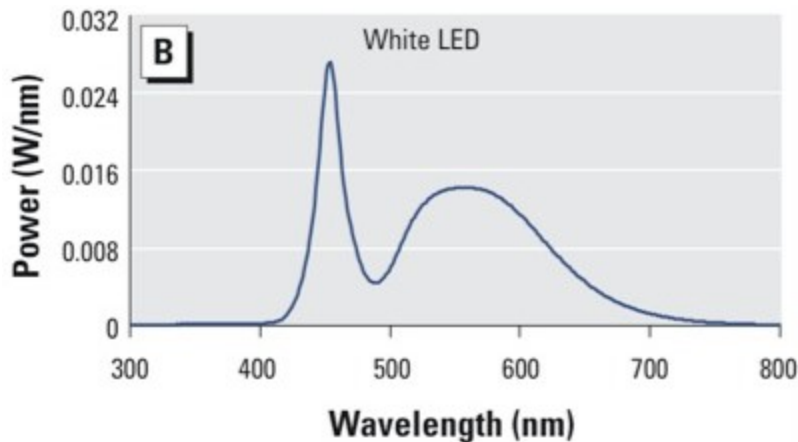


Figure 7 - White/Blue LED Spectral Power Distribution

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.<sup>32</sup> 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

<sup>32</sup> <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

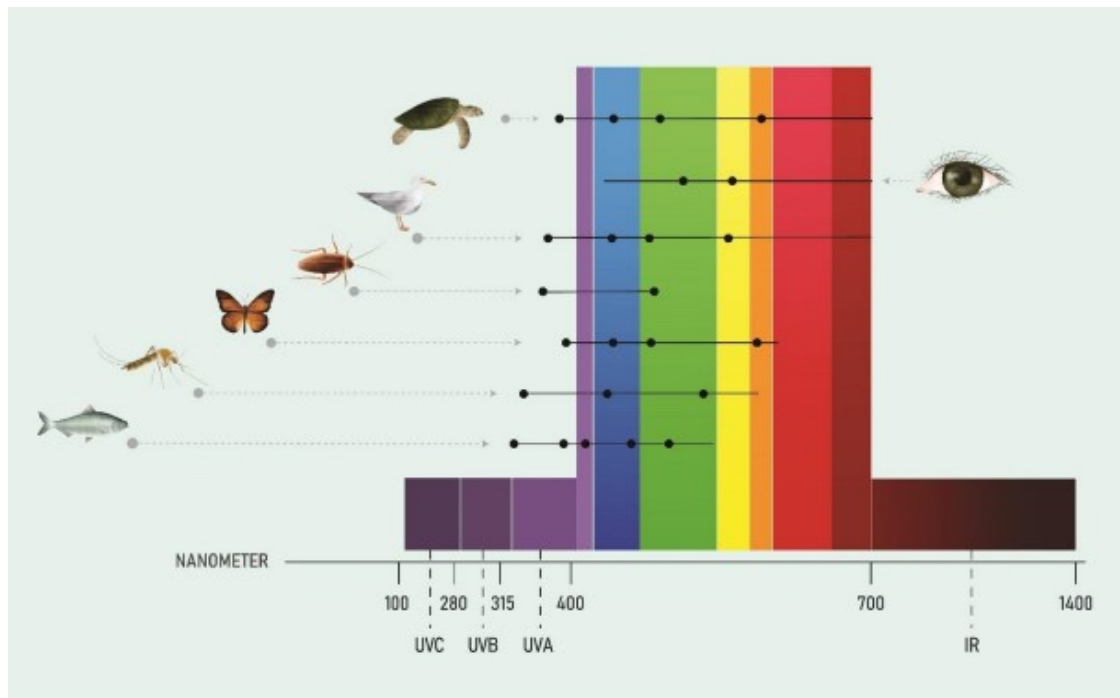


Figure 8 - Visible Range of Different Species

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

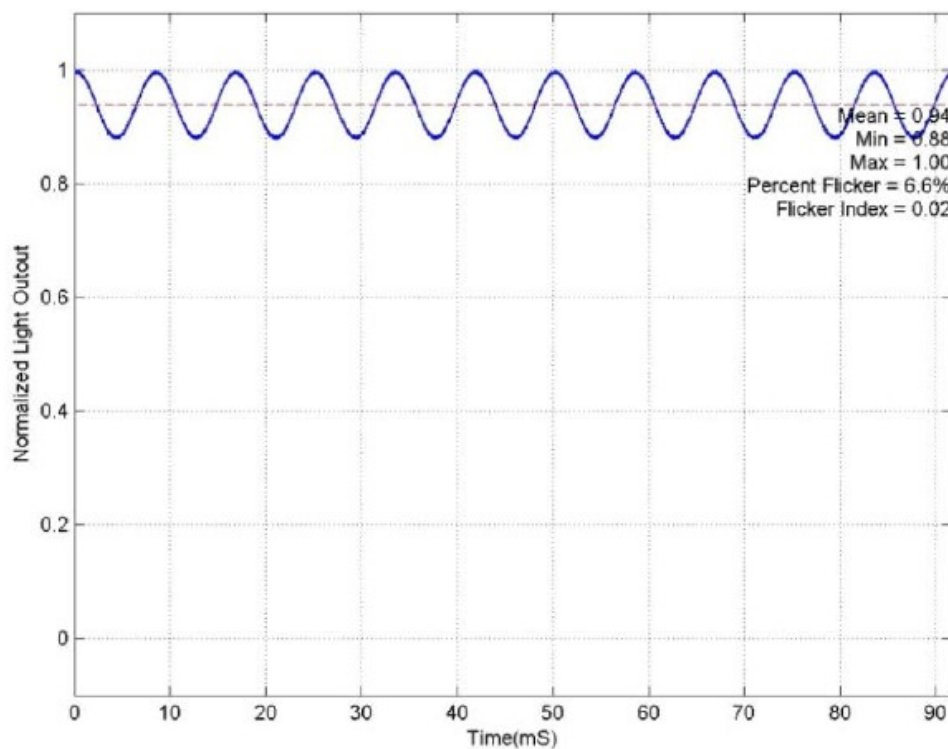
Flicker is caused by changes to the input current or voltage over time. An LED requires direct current to power the LED, yet a typical mains circuit provides power via alternating current. Thus, circuitry is required to convert the alternating current to direct current. This conversion will produce radio 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%



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Figure 9 - Modulation of Incandescence<sup>33</sup>

<sup>33</sup> <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.

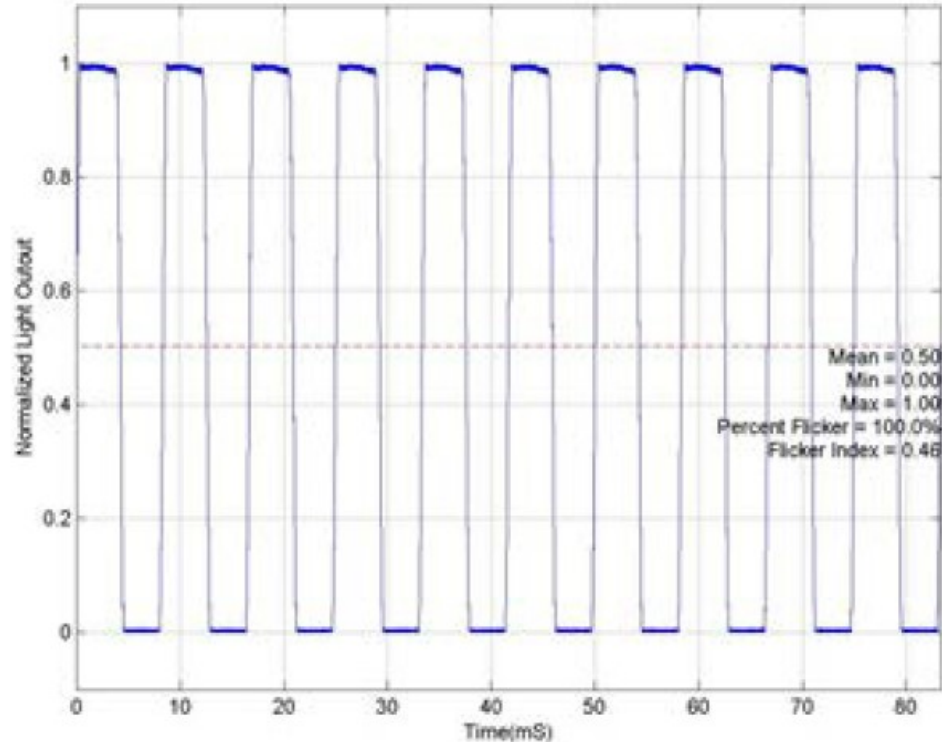


Figure 10 - Modulation of LED

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.<sup>34</sup> 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.”<sup>35</sup>

21  
22 <sup>34</sup> Invisible Disabilities: List and Information -

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

<sup>35</sup> 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  
8 streetlights would put her life at risk and that the existing High-Pressure Sodium  
9 lights caused her no ill effects. The mayor and council ignored her pleas and  
10 installed the LED streetlights, including on her street.

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

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

22 In another incident, a village police vehicle made a traffic stop on  
23 MarieAnn's street. From the upstairs room, MarieAnn caught a brief glimpse of  
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.

MarieAnn and her family now must take extreme precautions to transport  
MarieAnn to and from her house to the farm or to visit relatives. Their actions  
include putting MarieAnn into the back seat of the car and covering her head with  
a blanket so that she won't be exposed to LED light. Another adaption they have  
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.<sup>36</sup> 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

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<sup>36</sup> <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 2<sup>nd</sup> 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  
police who then chased Mark through the neighboring park, handcuffed him, and  
took him to the County mental health hospital. Mark was then held against his will  
for four days at two different hospitals and was given strong doses of anti-  
psychotic pills. During this time, the medical staff diagnosed Mark with mild  
Autism Spectrum Disorder and noted that Mark's collapse was triggered by the  
impacts from the LED lights.

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

On September 3, 2021, Mark was a passenger in a car which was behind a  
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.



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*Figure 12 - LED Airport Lighting*

21 Because Kristina has been working with doctors and neurologists for many  
22 years, her doctors have brains scans that document her progress. After the city and  
23 airport installed LED lights, the brain scans showed how her brain functioning was  
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 Heidi has been diagnosed with epilepsy. However, despite the epilepsy  
4 diagnosis, Heidi has been a productive member of society by managing her  
5 exposure to triggers that might cause seizures.

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

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



22 *Figure 13 – Rectangular Rapid Flashing Beacon*



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.



14 *Figure 15 - LED Porch Lights*

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

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.<sup>37</sup> 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.

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<sup>37</sup> [https://www.oireachtas.ie/en/debates/debate/joint\\_committee\\_on\\_disability\\_matters/2022-02-03/2/](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.  
24 Regulations for flat surface radiation must include restrictions on spatial non-  
25 uniformity, peak luminance/radiance, spectral power distribution, and temporal  
26 restrictions on flutter, flicker, flashing, and strobing.

27 In 1968, Congress passed the Radiation Control for Health and Safety Act  
28 and stated, "*Congress declares that the public health and safety must be protected  
29 from the dangers of electronic product radiation. Thus, it is the purpose of this  
30 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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