DOCKETED	
Docket Number:	19-BSTD-03
Project Title:	2022 Energy Code Pre-Rulemaking
TN #:	236447
Document Title:	John Moody Comments on Title 24 Update
Description:	N/A
Filer:	Patty Paul
Organization:	John Moody
Submitter Role:	Public
Submission Date:	1/25/2021 2:59:13 PM
Docketed Date:	1/25/2021

5 January 2021

California Energy Commission
Media and Public Communications Office
1516 Ninth Street, MS-29
Sacramento, CA 95814-5512

COMMENTS ON 2022 UPDATE TO TITLE 24 REGUALTIONS – LIGHTING

I understand that the California Energy Commission will be updating the Title 24 building regulations soon, including lighting requirements, and that the CEC is required to consider public health impacts of these regulations. In this regard, I wish to let you know that I am what would be referred to in environmental health parlance as a "sensitive receptor". My sensitivity is only to light, primarily artificial lights, such as florescent and LED, which my eyes perceive as overwhelmingly bright and very painful. I have lived and suffered with this disorder since childhood and about 10 years ago was ultimately diagnosed as having chronic migraine photophobia or "migraine variant" by my neuro-ophthalmologist and my neurologist at UC Davis. The variant from a normal migraine is that my eyes hurt instead of my head and the trigger is only artificial light. Here is how I react when exposed to these lights, as I explained to the doctors:

> *Within a few minutes of exposure to typical office florescent and LED lights, for example, my lower eyelid muscle or nerve will start stiffening and twitching about to go into lock spasm. It feels like a sickly transformation of these soft tissues is occurring from normal function into pain mode. Once this happens, my eyes become super-sensitized to light and I feel a sense of panic and fear and not without reason. I know that if I don't get out of the light quickly, the eye migraine process will begin, including throbbing eye and orbital pain for days, abdominal upset, blurred vision, loss of coordination, stumbling, making mistakes and other issues rendering me virtually non-functional. This process or "migraine wave", once it begins, is usually irreversible and takes days to run its course, during which period I am confined to a dim or dark room. For short duration light exposures, I can sometimes avoid the process with a nasally-injected triptan medication, which is quite expensive. When I am in eye migraine as described, in addition to all the other symptoms, my eyes will look all bloodshot if my head is inverted for a few minutes first and then righted. I have also noticed bright white or blue unshielded LED lights such as in parking areas actually "lase" or lash the surface of my eyeball, causing a bruising, aching pain that lasts for weeks.*

As a career environmental professional, I notice that my eyes seem to be reacting to artificial light as if it were a toxic waste consistent with the formula "Toxicity = Dosage x Exposure" as in the environmental health arena. The brighter the (white or blue) light, or longer the duration of exposure, the greater the eye pain and longer it takes to get out of the migraine. There is a threshold light exposure level below which I do not go into eye migraine or can rescue out of it with medications, if I act quickly enough and get out of the light. For decades I was in and out of eye doctor's offices futilely trying to explain my problem only to be met with skepticism and disinterest. They told me that bright light is

needed for proper vision and cannot cause eye pain at normal office levels. The reason for this belief was that the eyes are connected to the vision part of the brain, not the trigeminal nervous system, which detects pain such as one might experience at the dentist. However, recent research by doctors at eye centers such as Harvard (e.g., Dr. Rami Burstein) and the University of Utah (e.g., Dr. Katheen Digre) have overturned this orthodoxy, and the research has shown that light sensitive retinal cells may be connected to the trigeminal nervous system, at least for some people, and that light can indeed cause neurologically-based eye pain. Research also indicates that neurological photophobia such as I have described maybe be a separate condition from migraine but with similar symptoms. This is an area of active research and it may be years before the medical basis for neurological photophobia and other light sensitivity disorders are understood. One thing appears to be clear, however, with regards to photophobia patients – exposure to bright lights indoors or outdoors can cause the equivalent of dental pain in and/or around the eye as orbital trigeminal nerves are activated by the brain.

I am not a medical doctor, but would venture a guess that I am not the only person in the world with this eye migraine problem. More likely “diagnosis bias” occurred where a doctor will not diagnose a condition that he or she has not been trained in or that their medical education indicates is not possible. This becomes a self-fulfilling prophesy as persons with a condition not believed to be possible are not correctly diagnosed.

Artificial light that causes pain defeats the purpose of artificial lighting and renders those affected as second-class citizens. Living with this disorder has been difficult, and even more so since the wide adoption of LED lights for lighting streets, cars, residential neighborhoods and downtown. Here in Davis where I live, I have not been able to go for an evening walk since the LED street lights were installed in 2016. Then came the intense, glary decorative LED house lights sold at every warehouse and hardware store, destroying the night time ambiance in my neighborhood. Prior to LEDs, my street was lit with tall sodium vapor lights widely spaced apart creating dark areas between them. I used to walk for an hour each night getting healthy exercise without all the light exposure I would get in the daytime. I could also look up at the sky and identify the constellations. I would also hear the screech of the barn owl flying overhead looking for prey. I very much enjoyed my evening walks and not being able to take them since 2016 has negatively affected both my happiness and my physical health. To add insult to injury, I paid a lot of money when I bought my house 25 years ago in mello roos taxes that collectively paid for the green spaces in my neighborhood that I can no longer use. I estimate that I have suffered tens of thousands of dollars in lost use and enjoyment of property, but you really can’t put a price on loss of lifestyle.

I understand that the CEC’s mission is to reduce the carbon footprint by requiring renewable energy and energy efficiency in lights, appliances and buildings. I understand that the CEC is also required to balance the public health effects of such changes. When I look out my door at night, however, I see nothing but bright glary LED street and house lights that hurt my eyes and have destroyed the healthy darkness I enjoyed so much. In the Attachment 1 photos, you can see that none of the light is shielded and all of it is inappropriate and not needed in my neighborhood. Interestingly, the photos of

the LED lights all show phantom blue smears indicative of reflection from the camera lens, whereas a photo of my home shop light, a 60 watt incandescent bulb, does not.

I also notice that a significant number of outdoor LED lights are left on all day. I have driven by a nearby city park (Slide Hill) at 4 a.m. and noticed that the play area portion of it is lit up like mid-day with scary, glary, tall bright white LED lights that have no business in a city park. I could go on and on – airports, train stations, warehouse districts, transportation corridors etc. etc. See Attachment 2 photos. The CEC should require justification for artificially lighting spaces that are appropriately lit by natural light under given conditions (e.g., day, night, dusk) given the ability of the eye to adopt to lower levels of light, potential adverse impacts on sensitive receptors, and the waste of energy in producing unnecessary/unwanted light. White and blue light are today what cigarettes were in the 1950s – widely used but unhealthy.

Perhaps the ultimate solution to this problem is to regulate light, like other pollutants, under CalEPA. That said, the goals of energy efficiency and reducing light pollution and trespass are consistent and the CEC is in a position to fix some of the light pollution problems in the 2022 regulation updates.

I submit the following recommendations for lighting regulations:

1. An evaluation of what levels of light are needed considering energy savings and human needs should be conducted. Sensitive receptors should be considered in interior and exterior lighting design to ensure they are not harmed or in discomfort.

2. Eliminate or strictly limit the use of blue and white light for interior and exterior lighting. Health considerations should not take a back seat to energy and cost savings and in the long run, the negative externalities resulting from unhealthy lighting will prove much more expensive.

3. Lighting in public places should be warm in color temperature (e.g., 2200 to 2700 Kelvin) and be properly shielded and diffused for aesthetic reasons and to protect sensitive receptors. The Spectral G-index should range from 1.5 to 3 depending on degree of shielding and relevant factors for the area. People should not be required to look at light bulbs or LED light filaments. Interior lighting should be shielded to direct the light upward or sideways and have a diffusion covering

4. Where higher color temperature lighting is installed (never more than 2700K), such as industrial districts, robust containment measures should be required (e.g., shielding, diffusing, dimming). Pole height should also be appropriate for the area so as not to broadcast beyond the area intended to be lit or cause light trespass in surrounding areas.

5. Motion activated lights are not a substitute for appropriate lighting and shielding for a given space. Interior lights that automatically turn on and off should allow the user to over-ride the energy saving feature to protect sensitive receptors.

6. Lighting requirements should take into account the fact that most people work on computers and can work in dark mode, which does not require bright office lights. Reading dark print on a white background wastes energy because of the need for backlighting. Too much backlighting also makes it harder to read. People should not be exposed to light bulbs, rather, shielding should be employed to direct the light sideways or upward.

7. Residential exterior lighting fixtures should be strictly limited to warm, low intensity lights (i.e., no blue or white house lights) and the lighting element should not be visible to the eye. Such lights should be limited to one in number and only be turned on for a specific purpose such as expecting arrival of a guest at the home. Outdoor houselights should also be directed down and/or have proper shielding so as not to cause light trespass. Also, they should not be left on after 11 p.m., nor come on in the early morning or evening when people are going to or returning from work.

8. Outdoor lights should be not be left on during the daytime and warnings/penalties should be imposed on those who do leave them on. As a general rule, it is better to have too little light than too much. Human eyes have evolved over millions of years and are extremely well adapted to low-light conditions.

The above recommendations imply the need for a profound change in the way the State of California and the CEC manage light pollution. Changes away from bright, glary lighting have the potential to usher in a new renaissance era of lighting that delivers the best of both worlds – the warm, soft healthy glow of a black body radiator and energy efficiency.

Thank you for the opportunity to comment on the proposed updates to Title 24 and please feel free to contact me if you have any questions or need any clarification regarding my comments.

Sincerely yours

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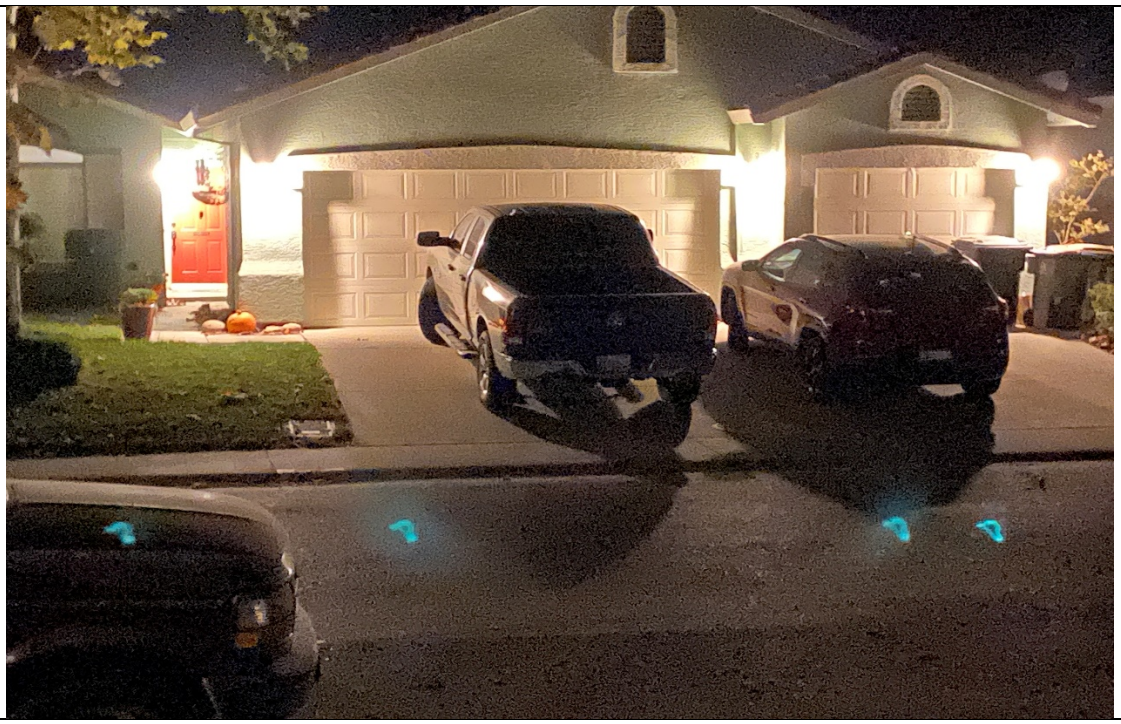
ATTACHMENT 1 –
PHOTOS OF TYPICAL LED RESIDENTIAL AND STREET LIGHTS
MACE RANCH, DAVIS, CALIFORNIA

Destruction of night time by street, parking and apartment lights

Ridiculously bright street light serving no useful purpose.



Four very bright house lights where even one would be too bright. Note the phantom blue light

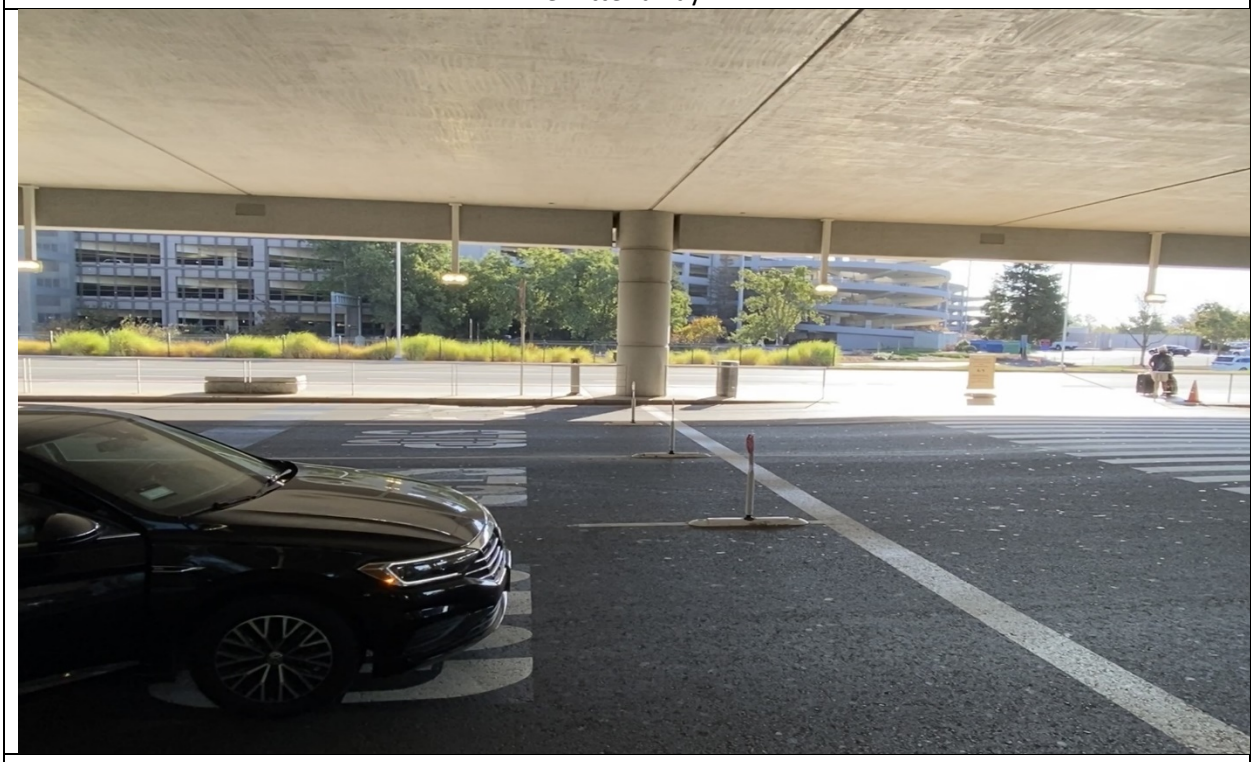
Typical house lights that did not exist in 2016 – why are they needed now?

Unnecessary exterior house lights left on all day and night. Decorative lanterns have clear glass and serve no useful purpose other than curb appeal.

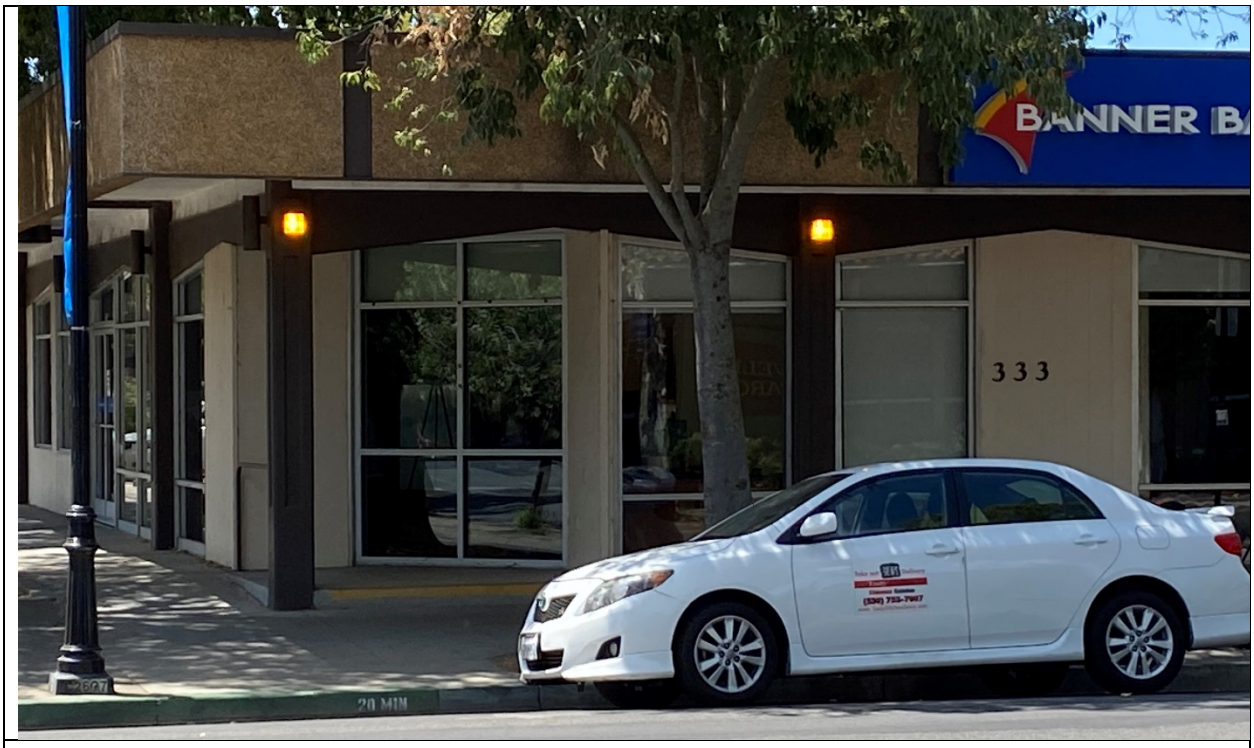
Bright LED Porch Light and Blue LED Flood Light in Your Face

ATTACHMENT 2 – PHOTOS OF UNNECCESSARY LED LIGHTS AT SMF AND DOWNTOWN DAVIS

Glary parking garage light at Sacramento Airport (SMF). Note blue ghosting marks identical to LED emitter array.



Poorly-designed, migraine-triggering pendant lights in arrival gate area. Light must not be shined directly into a person's eyes. High energy blue wavelength light feels terrorizing.



Downtown Davis - Exterior business lights left on all day. I complained to the tenant, a bank, and was told they are only a tenant; the lights are operated by the City.

"Prison lights" at Slide Hill Park, Davis. Lights left on all night tranforming night into day. Also left on during day.

Slide Hill Park, Davis – “Glare bomb” LED Parking Area lights left on all night in residential area.

Photo of home 60 W incadescent trouble light for comparison to photos of LED lights – No blue ghosting marks visible.