

Terms, studies, and examples of good LED lighting in cities and neighborhoods.

Correlated color temperature = CCT. Warmer colors are lower numbers. For comparison, the old familiar high pressure sodium lights are about 2300 Kelvin. The new white lighting most cities are putting in is 4000K which has good color rendition, sharpness and peripheral detection. The problems are health related in terms of circadian disruption, sleep problems and faster growth of some cancers when melatonin is suppressed.

Additional problems are environmental as it is extremely disruptive to ecosystems and the skies surrounding the cities using it, and glare is inherently greater due to both the shorter wavelength which scatters worse and the eye's extra sensitivity to blue and green at night.

AOK are 2700K to 3000K lights (similar to the familiar 2700K warm white light bulb) which are a good compromise which preserves a lot of the benefits of LED lighting while mitigating a lot of the other problems.

Studies showing preference for warm white LEDs when included in the test mix. I could not find one instance of the whiter light being the most preferred when warm LEDs were also tested.*

Often neighborhood surveys resulted in choice of dimmer bulbs which provide enough light to meet the need and will reduce energy use (\$). Or, dimmers can be installed to reduce brightness of LED street and park lights at specific time(s) which will reduce energy use.

- Chinese study finds that 3000K is overall the best color for street lighting, balancing visibility, color rendition, haze performance and glare:
<http://ieeexplore.ieee.org/stamp/stamp.jsp?reload=true&arnumber=7328247>
- Philips finds that its new 3000K street light is preferred in studies in Lyon, France and Sichuan, China (where 63% preferred it to white LED lighting):
http://www.ledinside.com/news/2013/7/philips_first_introduces_3000k_warm_white_led_road_lighting_solutions_to_chinese_market_20130705
- Davis, CA City Council minutes, study of new LED street light fixtures following protest, and decision. See pages 5 and 6 (last two [ages]):
<http://citycouncil.cityofdavis.org/Media/Default/Documents/PDF/CityCouncil/CouncilMeetings/Agendas/20141021/09-LED-Streetlights-Update.pdf>
- Study for Nantucket downtown historical lights, see particularly section 4.3.3 on document page 53 for preference for warm color (not pdf page), Figure 29 on page 55 for color results bar graph, Recommendation 5 at the bottom of page 76, and Conclusion 7 on page 78 in

*Source: Debbie Moran,
Resident of Houston, TX.

which the most preferred colors were the warmest (either 2400K or 4000K with an amber diffuser) and the one considered best for brightness was a 2700K light...the 4000K light loses out everywhere! The Nantucket study is great because they have a graph of the results of polls on color temperature which compared HPS, 3000K and 4000K. 4000K was dead last by quite a margin. Nantucket also has another great paragraph. It points out that often cities test the wrong thing in the first place, only how objects look directly under the light, not the lighting's effect on the entire street scene. See:

<http://wp.wpi.edu/nantucket/files/2014/11/NEO-IQP-Final-Report.pdf>

- **Calgary** chooses warm white street lights for residential areas:
<http://www.calgary.ca/Transportation/Roads/Pages/Traffic/Traffic-signals-and-streetlights/Energy-Efficient-LED-Lighting-FAQs.aspx>
- **Scarsdale, NY chooses warm white low glare LED street lights:**
http://www.ledinside.com/news/2016/1/new_york_town_considers_installing_warm_white_led_streetlights
- **Chinese study finds that 3000K is overall the best color for street lighting, balancing visibility, color rendition, haze performance and glare:**
<http://ieeexplore.ieee.org/stamp/stamp.jsp?reload=true&arnumber=7328247>
- **Computer makers respond to blue light at night health problems. (Important because many city governments think that they don't need to bother with warmth since everyone is ruining their health with cell phones and computers anyway):**
<http://www.vancitybuzz.com/2016/01/apple-blue-light-night-shift-ios-9-3/>

Computer app that takes blue out: <https://justgetflux.com/>

Also cell phone apps such as Twilight for Android

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Monrad Engineering: Lighting consultant for Tucson LED conversion provided this information for Houston City Council

New 3000K LED street lighting and parking garage fixtures hitting the market with latest LED chipsets in 4Q/2015 1Q/2016 are only 4% to 7% less efficient than 4000K chips per GE, Hubbell, and Acuity Brands. This value is well within the margin of error for any street lighting calculations or models. >GE recently stated 3000-4000K fixtures were 1.5-4% different but would be equal in efficiency by end of 2016 - cmw.<

**Tucson, AZ new 3000 Kelvin LED street lights - all dimmable for more energy savings.
Tucson Intl Airport lighting @ 3000K**

Lake Worth, FL @ 2700K

Davis, CA @ 2700K

Oceanside, CA @ 3000K (Five other CA cities joining this approach soon,)

Cambridge, MA @ 3000K

Gloucester, MA @ 3000K

Phoenix reconsidering 4000K and has added 3000K and 2700K to list going out to bid soon.

Los Angeles - 4000K initial city-wide spec, 3000K now being used for later residential modernizations, dimmable...crime there has gone up - contrary to one report that was not accurate.

San Francisco - 2700K in residential areas, dimmable system.

Poughkeepsie, NY - 3000K in residential areas.

Western Riverside County (in programming) 2700K Residential, 3000K Commercial.

Honolulu 4000K originally specified; project put on hold, with new 3000K spec likely.

Calgary, Alberta: warm white LEDs in residential neighborhoods in response to health concerns: <http://www.calgary.ca/Transportation/Roads/Pages/Traffic/Traffic-signals-and-streetlights/Energy-Efficient-LED-Lighting-FAQs.aspx>

Fort Huachuca, AZ: Colonel Smith Middle School, 3000K with only overnight Amber LED arrays operating.

Sahuarita, AZ: Walden Grove High School Park, 3000K with only overnight Amber LED arrays operating.

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Resident of Houston, TX.