Eco-$mart, Inc.

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Induction Lighting vs HID Lighting

Induction Lighting produces better light at lower operating temperatures and lower cost with 5 times the rated lamp life.

	Induction Lighting	Metal Halide	High Pressure Sodium
Watts- Electrical Usage	200w	400w	400w
Kelvin Temp	5000k	3700k	2100k
CRI	90+	65	22
Rated Lamp Life	100,000 hours	20,000 hours	21,000 hours
Fixture S/P Factor	2.0	1.26	0.76
Fixture Lumens - Photopic	20,500	28,800	40,800
Visual Acuity Lumens	41,000	36,288	31,008
Visual Acuity Lumens Per Watt	191	79	67
Operating Temperature	200° F	900° F	900° F
Annual Operating Cost*	$183.96	$478.21	$477.46

*for comparison only, costs will vary.

Contact Eco-$mart for more information.

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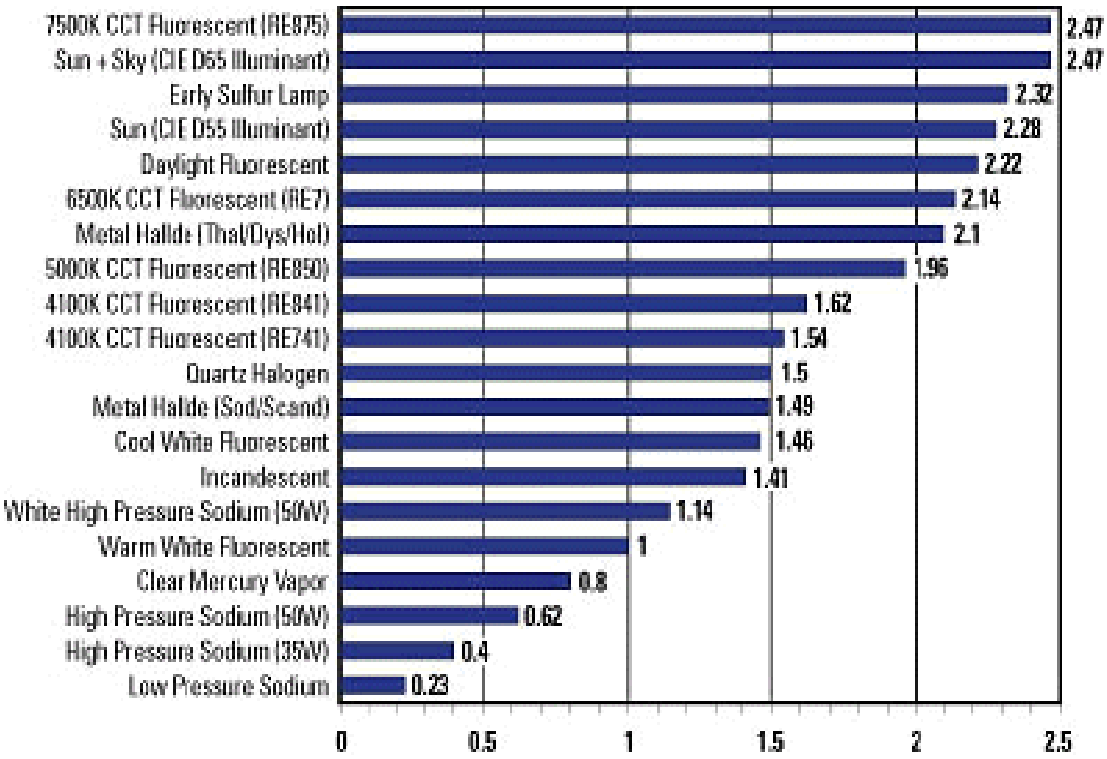
Range of S/P Ratios



Commercially available light sources are available in a range of Scotopic/Photopic (S/P) ratios, but these are often not published by manufacturers, making it difficult for engineers and designers to make use of this performance parameter. Fig. 3

Apply the ratio to the foot candles on the ground for mean visual acuity - the human eye.

Chart and reference by Dr. Sam Berman

Dr. Sam Berman is presently senior scientist emeritus at the Lawrence Berkeley National Laboratory (LBNL). He was the originator and the first leader of the lighting research program. Before joining LBNL, he was professor of physics at Stanford University, where he was a member of the team that founded the Stanford Linear Accelerator.

Application 1.

Ambient lighting also provides task lighting, and Visual performance is important.

In this case, the lighting should be judged on the basis of achieving the clearest vision. Research has determined that the relevant photometric factor is the equivalent pupil luminance or illuminance which is given by the quantity P[(S/P)0.78], where P is the photopic amount and the exponent (0.78) of the S/P value has been determined empirically in laboratory studies.
Consider the comparison of two T8, 32-watt (W) readily available fluorescent lamps costing about the same and with the same color rendering index (CRI) of 85. For this example, lamp A would have a correlated color temperature (CCT) of 3500 Kelvin (K), and 2950 initial rated (photopic) lumens. Lamp B would have CCT of 5000K and 2800 initial rated (photopic) lumens. The choice of lamp is generally made on grounds of luminous efficacy, which favors lamp A. On the basis of the new findings it is the visually effective lumens that should be compared, which means multiplying the photopic lumens by the factor (S/P)0.78.
The S/P value for the lamp A is S/P = 1.4; for lamp B, S/P = 1.9. As a result, lamp B produces more visually effective lumens than lamp A (4619 for lamp B, 3835 for lamp A). In other words, lamp B is 20% more visually effective per watt than lamp A, just the opposite of current wisdom.

Barriers to Application?

It has been more than 13 years since the first studies demonstrating significant rod activity at typical interior light levels along with arguments for major consequences in lighting practice, were published in the Journal of the IES Since then over a dozen papers have been published and many presentations have been made at national and international venues. Except for a few lighting retrofit companies that have adopted the new findings, there is a noticeable lack of mention of these results by the mainstream lighting community. Even a basic property of lamps, namely their S/P value, is absent from the lamp industry catalogues.

Why? Perhaps there is great difficulty in accepting a substantial and sometimes nearly radical change from what has been the standard practice for the entire past century, even though this change is supported by solid scientific evidence. Witness the dramatic example of the computer environment where the relevant photometric quantity needs to shift from photopic to scotopic illuminance.

What is even more surprising is the total absence of any attempts by the small lighting research community to replicate and independently confirm or deny the findings. In other scientific areas there is usually a mad rush to replicate, disprove, or confirm a new and revolutionary result. The only response from this lighting research community has been to either ignore the new results or to claim they are irrelevant.

Vision scientists have given names to the cone and rod sensitivity functions, which are referred to as photopic and scotopic responses. The new research findings explain how to put these together to yield a valid measure of brightness for the full scene viewing of lighting practice. One might think that it would take two light meters to achieve the evaluation, but in many lighting applications the traditional light meter can be used if an additional property of the lighting is known.

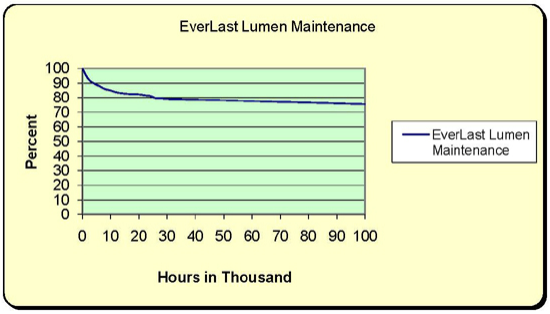
For any light source or any lighting that has a stable and approximately constant color temperature, the ratio of scotopic to photopic output is a fixed constant independent of intensity, which can be measured with instruments and can be supplied by the lamp manufacturer. Once this ratio is known, a scotopic value can be determined simply by multiplying the known ratio by the measured or given photopic value. The specific ratio is noted as the quantity S/P where S is the scotopic measure and P is the analogous photopic measure. The new research explains that brightness perception is simply correlated to the value $(S/P)^{0.78}$ rather than just P alone. See attached energy user news as a reference.

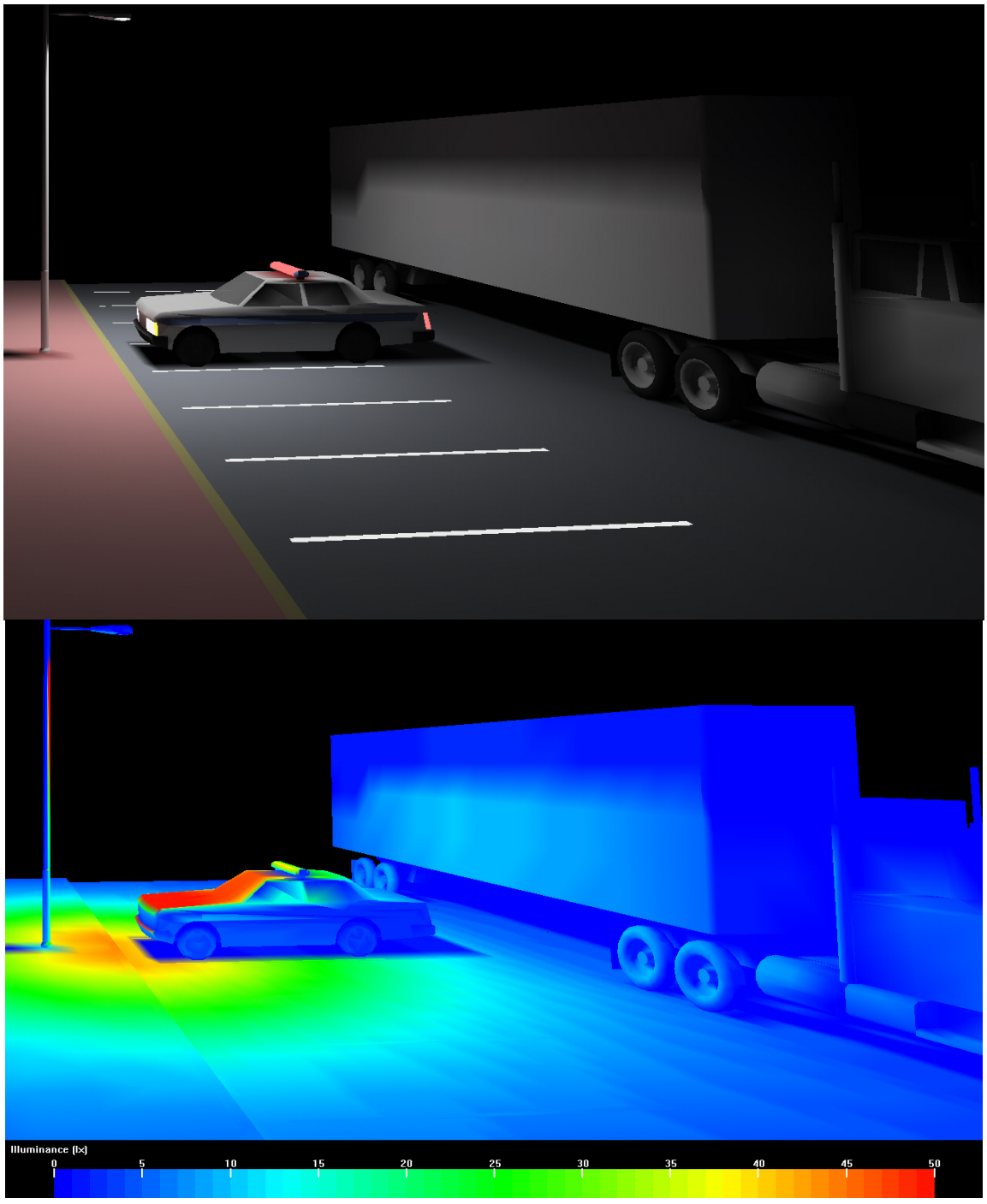
An example will illustrate the simplicity and usefulness of the new research findings. Consider a comparison between two lamps: A low color temperature (HPS) 2100k, and in comparison to the cooler Induction lamp which has a color temperature of 5000k in this case. The S/P ratio for the 2100k lamp is given by a lamp catalogue value of 0.57 while the value measured for the Induction lamp is 2.10. Thus, the two lamps when lighting the same scene will yield an equal sensation of brightness with the regular HPS street light photopic illuminance of the 2100k lamp needing to be about 38% higher than the photopic illuminance of the Induction lamp.

That value is obtained by computing the ratio [20,212 Scotopic lumen of Induction lamp by 14,592 lumen of HPS lamp] or in this case the Induction is 38% more visually effective per watt than HPS and or after 10,000 hours lumen depreciation this would reach larger differences which employs the rule given above as specified by the research findings. See simulation results utilizing various fixture and induction lights

	Fixture Performanc	Photopic Lumens (Mean Lumens)	Scotopic/Photopic	Scotopic Lumens (Pupil	Lumen Depreciation at	Net Pupil Lumens at 10,000 hrs	Net Usable Illuminance at 10,000
HPS 250watt w/ prismatic lens.	78%	25,600	0.57	25,600 x0 .57 = **14,592**	32%	9,721	9,721 x 78 = **7582**
Everlast 100watt Cobra with clear lens.	94%	9,625	2.10	9,625 x 2.1 = **20,212**	14%	17,382	17,382 x .94 = **16,339**

Induction Lamp





Simulation Results using the Induction Lamps