Lumens Per Watt: How Efficient is it Really?

When the conversation is all about energy savings and money saved, often times the attention becomes focused on one seemingly telling figure; Lumens per Watt (L/W). However, this number is not as straightforward as it appears. Not only are there several ways that this number can be calculated, but as discussed in other ***Knowledge Segments*** *– Lumens are only useful if they get to where you need them.*

There are two components to this specification; how much power is being used and how many lumens are being produced. But does this really tell you how efficiently you're lighting your work area? *Only the Lumens that contribute to lighting the intended target can really count towards efficiency!* And then there is the matter of *where* within the system you measure Power and at *what point* you measure Light Output. Both of these values can be measured at different points in the system, resulting in some widely variable claims of efficiency.

The Lumens need to Count. "Lumens per Watt" is really only meaningful if we're talking about "*Useful* Lumens per Watt", because Lumens that are lighting unintended surfaces or outside of "Cut-Off" boundaries are still wasted energy. Is the light being directed towards the intended lighting area? Is it a multi-directional source in which a high percentage of those lumens are lost in inefficient reflectors and/or scattered in uncontrolled directions? Are there optics being used to direct the light path with minimal losses?

Again, Directional or Multi-Directional? What do you need?

- If it is a fixture that delivers light in all directions, then a LED solution that is designed to throw light out to the sides is needed. These types of lamps will waste light, however, if a more directed source is what you need.
- If it is a ceiling or wall mounted fixture that faces a particular direction, then a directional light source will be much more efficient.

Optics, Lenses, & Diffusers will effect Light Output

- Lenses – Clear lenses won't result in much light loss if well designed and made of the correct material…nor will they do anything to direct light.
- Diffusers – Again, do nothing to direct light. Diffusers are used to reduce or eliminate the appearance and glare of the individual light-point sources and create a more uniform light. Diffusers typically reduce the light output (total lumens) by 12 – 20%.
- Optics – Optics take the light generated by the LED and control it in a way to achieve the desired output light pattern. This can be in a long, narrow distribution such as for roadway lighting, or in a square distribution for even illumination of large areas such as parking lots. Optics themselves generally result in very little loss, though light level readings will vary depending on the shape and spread of the distribution pattern. Well-engineered and fabricated optics can perform their function with minimal light loss of only a few percent.

The Efficiency of What? It also needs to be noted what portion of the system we are claiming the efficiency of. The efficiency of the light engine itself can be much higher than the efficiency of the overall light fixture or lighting product.

The light engine efficiency could take into account only the LED or LED array; the total light generated by the LED's divided by the power it takes to operate the array. In this case the efficiency will use the raw total light output of the LED's and only the power that the LED's are using to generate that light. By the time the system is installed and operational, both the light output and the energy consumed have changed to give a more accurate efficiency figure that denotes actual use.

The light output of the end product will be less than the light engine itself due to losses that take place anytime an optic or lens is used, so anything between the LED and the illuminated surface will decrease the Lumen figure. As much as 20% in the case of some diffusers, or combinations of protective lenses and Fresnel or prismatic fixture lenses.

Similarly, the power consumed by the system will increase to take into account losses by the power conversion electronics (this is the efficiency of the driver/power supply combination), as well as power that is used by any other components such as fans, controls, etc. Power supply/driver efficiency will typically add another 10-15% to the light engine power requirements, and another watt or two for cooling would be reasonable.

Another less talked about but now surfacing criteria is the effects of transient power fluctuations. These small and ongoing current variances have become a known cause of component failures and disruption-causing problems to consistent LED operation efficiency; also potentially affecting the life of the individual diodes and light efficacy. There are several companies that are addressing transient issues with state-of-the-art surge protection devices (such as products offered by Eaton Corporation).

So the thing to be mindful of when looking at Lumens per Watt figures are:

Watts: Light Engine vs. System
Lumens: Light Emitting Surface vs. Luminaire Output

Keeping these concepts in mind will help avoid products that are being marketed on disingenuous information.

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