

Most of us recognize the familiar blue and white Energy Star label—a mark of energy efficiency that we use to guide our purchases of energy-saving dishwashers, refrigerators and other appliances. Soon, we'll see that familiar label on solid-state lighting products, helping buyers make informed decisions about LED products that save energy, relative to standard technology.

The Energy Star program, a voluntary program jointly managed by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA), establish-

improves incrementally, and the criteria are updated every few years. For solid-state lighting, that approach simply won't work. The rapid pace of solid-state lighting technology advances led DOE to design a unique two-category approach—one that allows for early participation of a limited range of products, while setting more rigorous performance targets for future products.

- **Category A** addresses near-term applications where solid-state lighting can be appropriately applied today. This category includes undercabinet kitchen lighting, commercial shelf-mounted task lighting, portable

B serves as a target for lighting manufacturers as they develop products over the next several years and applies to all types of solid-state lighting systems.

This two-category approach recognizes the learning curve and unique issues involved in applying solid-state lighting to general illumination. This approach should also increase the likelihood that first buyer experiences with Energy Star solid-state lighting products will be good ones, unlike first experiences with CFLs.

At the same time, the rapid pace of solid-state lighting technology

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es industry-wide criteria that manufacturers can use to promote qualifying products. In September 2007, DOE issued Energy Star criteria for solid-state lighting and we anticipate the first Energy Star-qualified products will appear in late 2008. The new criteria apply to both residential and commercial products used for general illumination.

TWO-PRONGED APPROACH

For many other Energy Star products, the technology and market are more mature. The technology

desk/task lights and recessed downlights for residential and commercial applications. It also includes outdoor porch, step and pathway lighting. These applications were specifically chosen based on their suitability for solid-state lighting and the current status of the technology.

- **Category B** encompasses a much wider range of future applications that will emerge as the technology matures, and removes the prescriptive product types established in Category A. Category

advances cannot be ignored. Be prepared for frequent updates to the criteria; DOE intends to periodically review and update the criteria to parallel technology advances and ensure that the criteria continue to reflect "best of class." At some point in the next three to five years, Category A will be dropped completely and Category B will become the sole basis for the Energy Star criteria.

LUMINAIRE EFFICACY IS KEY

The criteria are based on compliance with existing lighting industry

Table 1: General Requirements for Category A and B Luminaires

Correlated Color Temperature (CCT)	The luminaire must have one of the following designated CCTs (2,700K, 3,000K, 3,500K, 4,000K, 4,500K, 5,000K, 5,700K, 6,500K) and fall within the 7-step chromaticity quadrangles defined in the criteria.
Color Spatial Uniformity	The variation of chromaticity must be within 0.004 from the weighted average point on the CIE 1976 (u',v') diagram.
Color Maintenance	The change of chromaticity over the lifetime of the product must be within 0.007 on the CIE 1976 (u',v') diagram.
Color Rendering Index (CRI)	Indoor luminaires must have a minimum CRI of 75.
Power Factor	Luminaires must meet the following requirements: <ul style="list-style-type: none"> • Residential: 0.7 • Commercial: 0.9
Off-State Power	Luminaires must not draw power in the off state (with exception for integral controls, limited to 0.5 watts).
Warranty	A three-year warranty must be provided.
Thermal Management	Luminaire manufacturers must adhere to device manufacturer guidelines, certification programs and test procedures for thermal management.

* The complete Energy Star criteria detail additional requirements for module/array lumen depreciation, automatic daylight control for outdoor residential luminaires, power supply and packaging as well as application-specific requirements for CCT, luminaire efficacy, zonal lumen density and minimum light output. See http://www.nrel.gov/ssl/energy_star.html for the complete criteria.

reference standards and test procedures where appropriate, as well as new or revised standards and test procedures currently being developed by lighting industry organizations. See **Table 1** for general requirements for Category A and B products.

The principal energy efficiency metric used in the new criteria is luminaire efficacy (net light output from the fixture divided by the input power, measured in lumens per watt). In the February edition of this column, we talked about the importance of using luminaire efficacy as the standard for measuring LED “game” performance, for reasons inherent in the technology. “Game” performance refers to measuring luminaire performance as a whole, as opposed to traditional testing methods that separate lamp ratings and fixture efficiency, or methods for testing LED devices or arrays without control electronics and heat sinks. The idea of measuring game performance is a new concept for the lighting industry at large, which is used to measuring light source energy efficiency based on system efficacy.

The soon-to-be-published IESNA LM-79, “Approved Method for the Electrical and Photometric Testing of Solid-state Lighting Devices,” specifies a standard test method for solid-state lighting based on luminaire efficacy. Additional standards and test procedures necessary to address the nuances of solid-state lighting technology (and referenced in the Energy Star criteria) are being finalized by IESNA and other organizations. We anti-

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pate these key standards and test procedures will be completed by their respective organizations imminently, in time to support the Energy Star qualification process.

HOW CLOSE ARE WE?

There are likely a few solid-state lighting products on the market today that would qualify for the Energy Star label under Category A; more will emerge now that the criteria have been issued. Consider this: the minimum luminaire efficacy required under Category A ranges from 20 lumens per watt for outdoor step lights to 35 lumens per watt for recessed downlights. You may recall the October 2007 LED Watch column noted a downlight tested through the DOE CALiPER program that performed well above the Category A minimum value. We expect more products like this high-performance downlight will emerge as manufacturers strive for the Energy Star label.

In comparison, Category B compliance is a completely different league, like college football versus the NFL. Category B sets a more aggressive efficacy requirement of 70 lumens per watt—double the highest value of 35 lumens per watt for Category A recessed downlights. But “doubling” is not how DOE arrived at this number. To compete in the marketplace, solid-state lighting products must match the performance of the best traditional lighting sources. For example, the best available high-performance T8 fluorescent lamp and electronic ballast systems have a system efficacy of about 100 lumens per watt. These fixtures are about 70

percent efficient, so their luminaire efficacy is approximately 70 lumens per watt. The current target for Category B Energy Star compliance is set at that level to match.

DOE expects a significant number of general illumination products will be able to achieve 70 lumens per watt luminaire efficacy within one to three years. The department will continue to track technology advances, and will update the criteria efficacy targets and add product types as needed in order to keep pace with solid-state lighting technology developments. Our overarching goal is to ensure that the Energy Star label reflects the highest efficiency, highest performance products on the market.

For more information, or to download the complete Energy Star Criteria for Solid-State Lighting, visit www.netl.doe.gov/ssl/energy_star.html. More details on the Energy Star requirements and qualification process will be available soon on this website, along with updates on LM-79 and other new test procedures referenced in the Energy Star criteria.



James Brodrick is the lighting program manager for the U.S. Department of Energy, Building Technologies Program. The Department’s national strategy to guide high efficiency, high-performance solid-state lighting products from laboratory to market draws on key partnerships with the lighting industry, research community, standards organizations, energy efficiency programs, utilities and many other voices for efficiency.