

ENERGY STAR Qualified Lighting **An Integration Proposal**

Purpose

The purpose of this document is to lay out a proposed framework for enhancing the ENERGY STAR program as it relates to lighting products. Stakeholder comment is encouraged. This document and the input received will inform further refinement for purposes of an EPA/DOE Annual Program Plan for 2010. Any changes to the lighting program will result only after more specific proposal development and a series of comment periods and discussions with stakeholders.

Introduction

On September 30, 2009, the Department of Energy (DOE) and the Environmental Protection Agency (EPA) signed a Memorandum of Understanding (MOU) establishing a new partnership between the agencies on improving energy efficiency in products and buildings. In the area of products, this MOU commits the government to enhancing the ENERGY STAR Program, clarifies roles and responsibilities and establishes a new coordination mechanism.

Consistent with the new MOU, the ENERGY STAR label will identify energy efficient products that offer meaningful energy savings (at an individual and/or national level) over those products typically purchased.

- Specifications will be established, which overlay the consumer perspective and the need to consistently identify top performing products.
- Specifications will be set to recognize products that are cost-effective from the purchaser standpoint; offer at least equivalent functionality and features as standard products; and are proven and broadly available. Cost-effectiveness in terms of payback periods will be defined on a case-by-case basis, taking into account both the expected useful life of the product and the general desirability of shorter payback periods, but will in general be 3-5 years.
- To identify top performing products, ENERGY STAR specifications will be set to identify approximately the top 25% most efficient of models within a product class under the ENERGY STAR specification at the time that specification becomes effective, with consideration of expected improvements in product efficiency and market penetration trends of those products that will take place between establishing a specification and the specification becoming effective.

With respect to energy efficient lighting, the government seeks to enhance the ENERGY STAR Program:

- To better serve the consumer interest in identifying energy saving light fixtures and lamps¹, irrespective of technology

¹ "Lamp" is a technical term synonymous with the consumer term "light bulb."

- By ensuring that testing approaches reward good light output without limiting choice based on aesthetic considerations
- By expanding verification testing across all technologies to drive enhanced quality assurance and increased customer satisfaction

In pursuing these enhancements, the government is committed to:

- A specification revision process that is open and transparent, incorporating the input of partners and stakeholders and allowing adequate transition time
- Capitalizing on the potential for increased administrative efficiency and economies of scale that arise as part of an integrated approach to lighting products under the Program
- Removing any overlap or contradiction among specifications so as to eliminate confusion among stakeholders

Role and Responsibilities

Consistent with its role as brand manager of the ENERGY STAR products program, EPA will manage the development and revision of ENERGY STAR specifications for lighting. (Note: As part of the transition, DOE will complete SSL version 1.2, which includes additional outdoor light fixture categories and the Integral LED Lamps specification, which includes screw-based and other standard replacement lamps.) EPA will also manage education and outreach, partner relationships and program integrity functions such as logo-use monitoring. DOE will support these activities by supporting lighting test procedure development and verification testing.

Background

Lighting is currently addressed by the ENERGY STAR Program through four separate performance specifications as listed below with scopes defined as follows:

- 1) Solid State Lighting (SSL)
- 2) Residential Light Fixtures (RLF)
- 3) Integral LED Lamps
- 4) Compact Fluorescent Lamps (CFL)

The **ENERGY STAR Solid State Lighting specification (SSL V1.1, V1.2 draft)** is limited to luminaires² employing solid state lighting technology and addresses residential, commercial and industrial fixture applications. This specification references test procedures that measure luminaire efficacy, the number of lumens delivered from the fixture for every input watt of power to the fixture including a comprehensive test that accounts for the optical losses within the fixture. The Illuminating Engineering Society's (IES) LM-79 test procedure measures the directional photometric performance of an entire fixture, including lumen output and color performance at each angle at which a fixture emits light. Functional fixture types include

² "Luminaire" is a technical term synonymous to "light fixture."

recessed downlights, desk task lights, and under-cabinet fixtures, to name a few. The scope of the specification currently includes limited residential applications such as task lights, downlights, ceiling mounts, porch lights and pathway lights, among others. Non-residential applications include downlights, task lights, wall wash luminaires and bollards, and others.

The **ENERGY STAR Residential Light Fixture specification (RLF V4.2, V4.3 draft)** addresses light fixtures sold in the residential segment of the lighting industry, using a variety of technologies including solid state lighting. Applications include all common residential fixtures such as chandeliers, ceiling mounts, wall sconces, bath vanities and portables, among others. The RLF program's energy efficiency requirements are based on source efficiency, that is, measurement of the energy performance of the light source rather than the entire light fixture. This requirement has been used for over 12 years to evaluate compact fluorescent lamp and ballast combinations and is a widely accepted approach for this market segment. One of the advantages of source-based testing is that a single efficient light source can be used in multiple fixture types with limited re-testing requirements, reducing the testing burden on light fixture manufacturers that may make dozens of fixture models that have only slight modifications to the fixture optics (different colors, styles of glass) or finish (e.g. brass, white paint, brushed nickel). These reduced testing requirements in turn increase the selection of ENERGY STAR qualified fixtures for consumers to select. For LEDs, the existing RLF program takes the same approach; the specification holds the existing RLF efficacy requirements the same and extends the requirements to fixtures employing LEDs based on an evaluation of LED light source within (referred to as the "LED light engine")³. This source-based approach provides residential fixture manufacturers the freedom to design fixtures using the aesthetically pleasing, though sometimes optically inefficient materials that many consumers choose to purchase.⁴

The **ENERGY STAR Integral LED Lamp specification** focuses on LED replacements for general service lamps, reflector lamps, and decorative lamps. General lighting applications include standard incandescent light bulb replacements for all types of residential fixtures, and represent a large segment of the residential lighting market given the billions of existing sockets. Reflector lamps include standard reflector shape lamps and also replacements for smaller MR-16 shape halogen lamps. For certain applications, LED-based lamps fill an important gap in the current ENERGY STAR lighting portfolio, since current CFL technology does not perform as well in reflector or recessed applications, and does not provide the aesthetics consumers often seek for residential lighting applications. Performance requirements are based on industry standards, and additional requirements developed by ENERGY STAR.

The **ENERGY STAR Compact Fluorescent Lamp specification (CFL V4.0)** focuses on screw-based replacement lamps for general service lamps, reflector lamps, candelabra-based lamps, and globe shape lamps. The program, started in 1999, is currently operating under version 4.0 and

³ An LED Light Engine includes LEDs (LED packages), a driver & a heat sink as defined in ANSI/IESNA RP-16-05 Addendum A: Nomenclature and Definitions for Illuminating Engineering, 2008.

⁴ LED light engines demonstrated to meet the photometric and electrical performance requirements of the specification can be used to qualify multiple fixtures. In situ thermal testing is required for each fixture design to ensure that actual performance in the field is based on lab tests that simulate actual operating conditions.

has thousands of qualified products on the qualified products list. Performance requirements are based on both industry standards and tests that have been developed specifically for screening by ENERGY STAR, including tests for initial performance and long term performance. The core technology included in this program has made great improvements over the past 10 years, bringing consumers lower priced and higher performing products for residential lighting, though there is still room for improvement in the future.

INTEGRATION PROPOSAL

A lighting integration proposal is provided that addresses lighting in each of three areas:

- Residential light fixtures
- Residential lamps
- Commercial/industrial light fixtures

Changes to the ENERGY STAR program in any of these areas will be instituted only after full opportunity for notice and comment.

Residential Light Fixture Integration Proposal

The ENERGY STAR Program has a long history of setting technology-neutral performance specifications. This approach allows manufacturers across various technologies to compete on a level playing field and ensures that consumers are provided clear and consistent information on energy efficient products generally. Because consumers shop for light fixtures, rather than lighting technologies, it is important for the ENERGY STAR label to mean the same thing in terms of energy savings, regardless of technology. Further, continuing on a path where different technologies are subject to differing expectations puts the government in the role of potentially choosing technology winners and losers, which is not an appropriate or desirable use of the ENERGY STAR Program. In order to facilitate a comparison of fixtures across technologies, and to simplify program administration, the government proposes to integrate the RLF and SSL specifications into a single specification that is to the greatest extent possible technology-neutral in terms of key criteria such as luminous efficacy⁵ and color.

While a single approach to measuring efficacy may not be practical for all fixtures due to the wide variety of optical characteristics among fixtures, the ultimate goal is to consistently apply testing approaches across all technologies and all fixture types. EPA recognizes that evaluating light fixture efficiency in terms of “power in” and “light out” (consistent with SSL V1.1, for example) offers potentially valuable incentive towards fixture designs that optimize overall performance. This kind of whole-fixture evaluation rightfully benefits technologies, such as LEDs, that deliver light more effectively.

⁵ “Luminous efficacy” is a technical term denoting energy efficiency.

Table 1: Current Approaches to Measuring Energy Efficiency

Existing Specification	Decorative Lighting Testing Procedure	Functional Lighting Testing Procedure
EPA: RLF V4.2 (rev pending)	ASSIST Recommends Vol. 4	ASSIST Recommends Vol. 4
DOE: SSL V1.1 (rev pending)	IES LM-79	IES LM-79

One of the key issues that needs to be resolved when proposing to combine the current light fixture programs is the categorization of light fixtures and how they are evaluated for energy efficiency. The lighting industry has recognized this as an important issue, and has developed a guidance document for the purposes of clarification. In a document co-authored by the National Electrical Manufacturers Association (NEMA) and the American Lighting Association (ALA), residential fixture types were classified as either “decorative,” “functional” or “both.” In the short term, EPA and DOE are proposing to leave the RLF and SSL specifications in place with the clarification that eligibility to qualify LED-based light fixtures under RLF V4.2 will be limited to decorative fixtures⁶ as defined by NEMA and ALA.⁷ This change represents a clarification to EPA’s existing RLF V4.2 specification, and makes the number of fixtures that could qualify much smaller and more specific than formerly proposed. We believe that this change is necessary in order to allow for more technical work on standards for LED light engines to develop, as well as further work on the development of specific fixture “bins” for decorative and functional fixtures, which would be subject to different test procedures for energy efficiency.

For fixtures that are currently covered by the existing SSL specification, we are proposing that no immediate changes to the performance levels, fixture categories, or test procedures are warranted. The existing test procedure for fixtures, LM-79, provides a strong and well recognized technical basis for evaluating the existing SSL fixture categories and will remain in place.

For the longer term, EPA will initiate a formal specification revision effort that will:

- examine and, to the greatest extent practical, align luminous efficacy and color (Color Rendering Index & Correlated Color Temperature) requirements across technologies
- consider, refine and incorporate a definition for functional vs. decorative fixture applications so as to appropriately subject fixtures to fixture-based vs. light engine-based testing for purposes of evaluating luminous efficacy

⁶ Fixture types denoted as “decorative” will be subject to evaluation according to the ASSIST Recommends test procedure for LED light engines. [ASSIST Recommends Volume 4](#), Issue 1: Recommendations for Testing and Evaluating White LED Light Engines and Integrated LED Lamps Used in Decorative Lighting Luminaires, revised April 2009.

⁷ [LSD 51-2009](#): Solid State Lighting—Definitions for Functional and Decorative Applications, NEMA Lighting Systems Division & American Lighting Association, 2009.

- examine the appropriateness and optimal timing of subjecting all fixtures (i.e., fluorescent luminaires) meeting the definition of a functional application to fixture-level performance testings
- reference a national standard for LED light engine testing for purposes of qualifying fixtures meeting the definition of a decorative application⁹

This effort will be pursued with stakeholder notice and comment, starting with a draft specification to be released by mid February 2010. The release of this draft will be followed by the ENERGY STAR Program's standard stakeholder input process involving multiple draft proposals, comment periods and stakeholder meetings before revisions are finalized and effective dates are established.

Replacement Lamps

Consistent with the rationale for integrating the ENERGY STAR fixtures specifications, EPA plans to examine the CFL and Integral LED Lamps specifications for potential future integration. Technology-neutral luminous efficacy and color requirements for both directional and non-directional bulbs will be explored. Given that the CFL specification is newly revised (V4.0, December 2008) and the Integral LED Lamp specification has just been released, it is anticipated that this effort will be initiated after review and revision of the fixture specification is complete, likely beginning the fall of 2010.

Integration of the two lamp specifications into a single technology-neutral specification provides the ENERGY STAR program with an opportunity to potentially strengthen efficacy requirements to ensure, consistent with Program principles, that only top performing "light bulb" products receive the certification mark. Advancements in CFL performance relative to cost and pending changes to lighting performance standards mandated by the Energy Independence and Security Act of 2007 may warrant increased stringency.

Commercial/Industrial Light Fixtures

Under SSL V1.1, LED commercial downlights, under cabinet shelf lights, desk task lights, wall wash luminaires, and bollards are currently eligible for ENERGY STAR qualification, and there are several pending commercial and industrial lighting categories in the draft of SSL V1.2. Setting out performance expectations for these products as they enter the market serves an important purpose; however, limiting eligibility to SSL technologies puts other equally efficient, potentially more cost-effective commercial lighting technologies at a competitive disadvantage and fails to provide commercial lighting purchasers with complete information in terms of their energy efficient options. As resources allow, EPA plans to explore a technology-neutral specification for commercial lighting, building on relevant elements of SSL V1.1.

⁸ IES LM-79 for LED-based functional fixtures, LM-41 for fluorescent functional fixtures.

⁹ IES LM-xx-200x: IES Approved Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature (in draft December 2009).

EPA proposes that ENERGY STAR specifications finalized by DOE for commercial outdoor lighting as part of V1.2 will remain separate from any integrated specification for residential lighting. Going forward, EPA will work with DOE to broaden applicability of the ENERGY STAR specification as it applies to commercial outdoor lighting so that a range of technologies can participate.

Verification Testing

In addition to performance requirements related to energy consumption, a critical element of each ENERGY STAR specification is a set of quality metrics designed to ensure that qualifying products do not sacrifice quality in the pursuit of superior product efficiency. This is of great importance with lighting products, as consumers are generally very perceptive of differences in quality between lighting products. The performance baseline on which current ENERGY STAR lighting specifications are built is the incandescent lamp, a technology which set a high bar in terms of color appearance, color rendering, start and run-up times, and initial cost, among others, with the obvious major flaw being energy consumption.

Consumers' first exposure to ENERGY STAR is often through lighting products, specifically compact fluorescent lamps, which are heavily promoted to help reduce our nation's demand for electricity. Their relatively low cost (compared for instance, with a qualified kitchen appliance), is another reason that consumers often first interact with ENERGY STAR by retrofitting their light fixtures with qualified CFLs. It is therefore important that consumers' first impression of ENERGY STAR be a positive one, hopefully leading them to consider more expensive qualified products to expand their household energy savings beyond lighting.

For the above reasons and others, it is important to maintain a robust, comprehensive quality assurance program for ENERGY STAR qualified lighting products. In addition to the government verification testing programs outlined below, over the past nine years, EPA and DOE have received independent testing data on ENERGY STAR qualified lighting products from the Program for the Evaluation and Analysis of Residential Lighting (PEARL). Sponsors of this program have in recent years voiced a strong preference to see this program sunset in favor of government-run, manufacturer-funded verification testing programs.

Existing ENERGY STAR Quality Assurance Testing for Lighting Products

The ENERGY STAR program maintains a quality assurance program for each of its qualifying lighting product categories:

PEARL: Since the year 2000, energy efficiency program sponsors, EPA and DOE have funded this quality assurance program focused mainly on CFLs. This program is in its ninth round of testing, but is being phased out given that the new CFL program requirements call for manufacturer-funded quality assurance testing.

RLF, QA4: The Residential Light Fixture (RLF) program, as part of the Partnership Agreement entered into by manufacturers, maintains a quality assurance program known as QA4. Products are selected through both a random and nomination process, which includes input from stakeholders with the data fed back to EPA for action.

CFL Third Party Testing and Verification Program: The Compact Fluorescent Lamp (CFL) program operates the Independent ENERGY STAR CFL Third Party Testing and Verification Program, funded by manufacturing partners and required by the Partnership Agreement that they sign to participate with ENERGY STAR.

SSL Third Party Testing and Verification Program: The relatively new Solid State Lighting (SSL) program includes within its specification an outline of a Quality Assurance Testing program that will also use independent, partner-funded third-party testing facilities to provide an active system to verify the quality of ENERGY STAR qualified SSL fixtures in the marketplace.

Integral Lamp Third Party Testing and Verification Program: The Integral LED Lamp specification includes details of an Independent ENERGY STAR Integral LED Lamp Third Party Testing and Verification Program. All partners of this ENERGY STAR program will be required to participate as outlined in the Partnership Agreement. The proposed language and requirements of this program are nearly identical to that of the CFL program.

CALiPER Program: While not part of ENERGY STAR, the [DOE Commercially Available LED Product Evaluation and Reporting](#) (CALiPER) program has established itself as an independent, objective source of information for comparing product performance, and identifying technology trends and issues that need to be addressed in the DOE R&D program.

Expansion of Efforts

As with the integration of lighting programs within ENERGY STAR, to strengthen the overall performance of qualified lighting products on the market, reduce verification testing program complexity for ENERGY STAR partners, and achieve greater administrative efficiencies, EPA and DOE will work towards the goal of integrating the above efforts into one unified lighting verification testing program. Under this renewed effort, DOE will work with EPA to administer a more aggressive program, with DOE handling the consolidation of testing programs and program management, and EPA working with the data generated by the testing program to take appropriate enforcement action such as disqualification of products when necessary.

Table 2: Current Lighting Testing Programs for ENERGY STAR Lighting Products

Product Category	Current Testing Program	Funding Source, Testing	Funding Source, Program Administration	Planned Next Steps
Compact Fluorescent Lamps	Contained in ENERGY STAR partnership agreement	Manufacturing Partner	Manufacturing Partner	Continue with current program
Residential Light Fixtures	Contained in ENERGY STAR partnership agreement	Manufacturing Partner	Government	Shift funding of administration to manufacturers
Solid State Lighting	Contained in ENERGY STAR partnership agreement	Manufacturing Partner	Manufacturing Partner	Launch of program contained in ENERGY STAR SSL V1.1 Program Requirements
Integral LED Lamps	Contained in ENERGY STAR partnership agreement	Manufacturing Partner	Manufacturing Partner	Launch of program contained in current Integral LED Lamp Specification

Testing Program Proposal

In the short term, to avoid any halt to current efforts, EPA and DOE will continue to manage and administer their respective testing programs as written and designed. At the same time, EPA and DOE will begin the development of a more comprehensive testing program for all lighting products beginning with the administrative consolidation of existing programs.

Interaction with Lighting Facts Label

In an effort to encourage “truth in labeling” for lighting products, DOE created the SSL Quality Advocates program showcasing LED luminaire manufacturers who commit to testing products and reporting performance results according to industry standards. For lighting buyers, designers, and energy efficiency programs, the [Lighting Facts label](#) provides information essential to evaluating products and identifying the best options. This label is slated to be a requirement in the pending Integral LED Lamps specification. Also, the Federal Trade Commission (FTC) is examining the Lighting Facts label closely as an example of what could become a national label for replacement lamps.

Test Procedure Refinement

Energy efficient lighting is unique in that it is one of the few energy saving technologies that is undergoing rapid change. In order to document energy savings and ensure ongoing quality for products that fall under the government's ENERGY STAR Program, ongoing support for the development of laboratory test methods, test procedures, and industry standards is essential. Under the new MOU, DOE will be primarily responsible for fulfilling this task.

Table 3: Initial List of Test Procedures and Research to Advance and Develop

Technology	Specific Testing Need	Current Status	Next Steps
Solid State Lighting	Lumen Maintenance Projection Method	IES TM-21 under discussion.	Encourage rapid development of TM-21.
	Test procedure for LED light engines	Interim test procedure complete (ASSIST Recommends Vol. 4). Industry standard in draft.	Support development of industry standard for LED Light Engines.
CFL and LED	Dimmer compatibility	Draft standard in development.	Perform research to support test procedures and compatibility tests.
Outdoor Lighting	Development of technology-neutral test procedure for inclusion in SSL V1.2.	Under discussion with industry.	Support further research and refinement of definitions.

ENERGY STAR Qualified Lighting Integration - Next Steps

Please submit comments on this proposal to Kate Buck (KBuck@icfi.com) by January 8, 2010.

In conjunction with the EPA/DOE Annual Program Plan scheduled for release by the end of January, 2010, EPA/DOE plan to:

- Formalize clarifications, as appropriate, on the interim treatment of SSL decorative light fixtures under RLF V4.2.
- Propose the process and major issues to be addressed as part of a specification revision for residential light fixtures.
- Launch SSL testing program referenced in ENERGY STAR SSL V1.1.
- Continue support for the development of TM-21 lumen maintenance projection method.
- Begin support of LED light engine standard development, technology-neutral outdoor lighting test procedure development and dimming research.