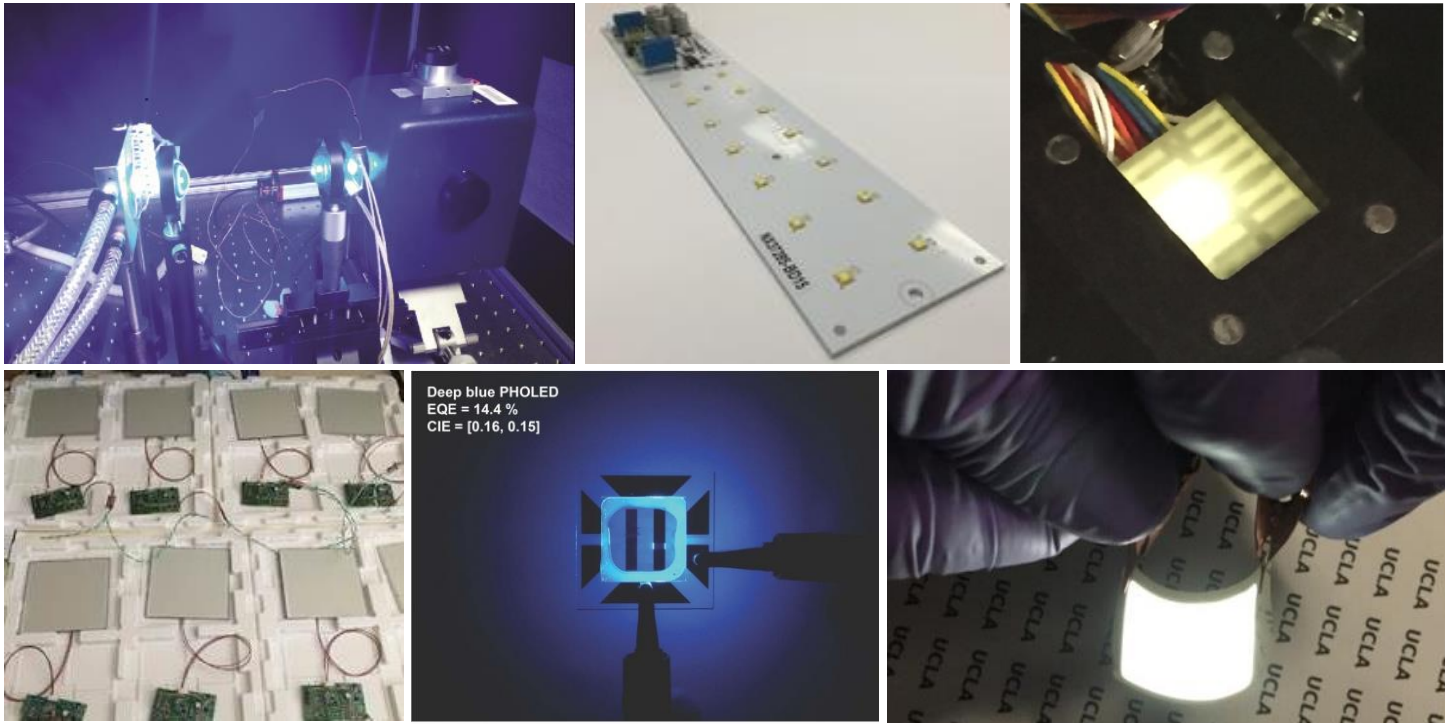
U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

DOE Solid-State Lighting Program



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DOE SSL Program Mission and Goal

MISSION

Through engagement with the lighting community, the DOE SSL Program mission is to **further scientific understanding** on optimizing light spectrum and intensity for numerous applications/tasks **using semiconductor technologies** to **save energy** while also **enhancing human perception, wellbeing, and commerce**.

GOAL

By 2030, develop advanced SSL technologies that — compared to conventional lighting technologies — are much more **energy efficient**, **longer lasting, and cost competitive**, by targeting a product system efficiency of 50 percent with appropriate application spectrum.

Legislative Authority

DOMENICI-BARTON ENERGY POLICY ACT OF 2005, SECTION 912

"**The Secretary shall carry out a Next Generation Lighting Initiative** in accordance with this section to support research, development, demonstration, and commercial application activities related to advanced solid-state lighting technologies based on white light emitting diodes."

Legislative Authority

ENERGY INDEPENDENCE AND SECURITY ACT OF 2007, SECTION 321

(g) Research and Development Program.— (1) In General.— The Secretary may carry out a lighting technology research and development program—(A) to support the research, development, demonstration, and commercial application of lamps and related technologies sold, offered for sale, or otherwise made available in the United States…

SEC. 655. BRIGHT TOMORROW LIGHTING PRIZES.

(a) ESTABLISHMENT.—Not later than 1 year after the date of enactment of this Act, as part of the program carried out under section 1008 of the Energy Policy Act of 2005 (42 U.S.C. 16396), the Secretary shall establish and award Bright Tomorrow Lighting Prizes for solid state lighting in accordance with this section.

Strategic Approach

Key DOE Roles

CONVENE

DOE roundtables and workshops bring innovators together to identify priority challenges

PLAN

Based on those priorities DOE sets technology milestones and creates an annual SSL R&D Plan

CO-FUND

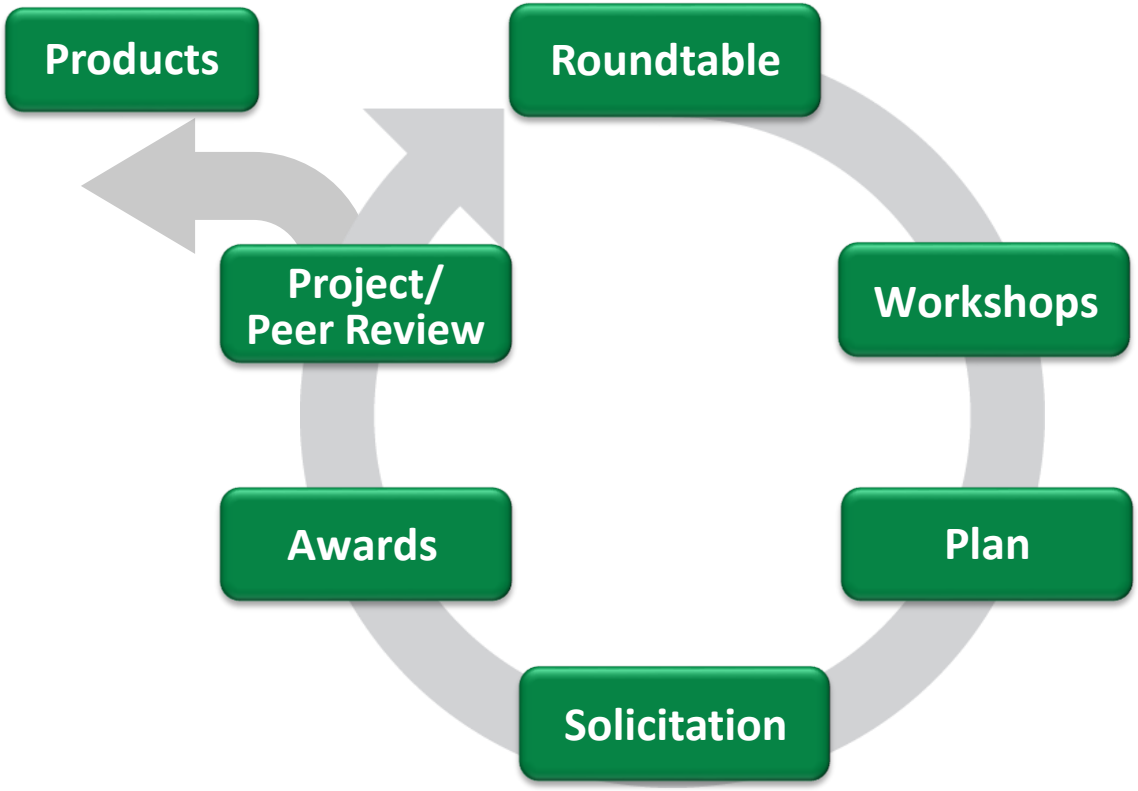
DOE funds competitively awarded and cost-shared projects aligned with the plan

SHARE

DOE ensures open information flow and provides analyses that spur technology advances and inform future R&D priorities

DOE R&D Plan Process

SSL community input from roundtables and workshops shape R&D priorities and DOE solicitations

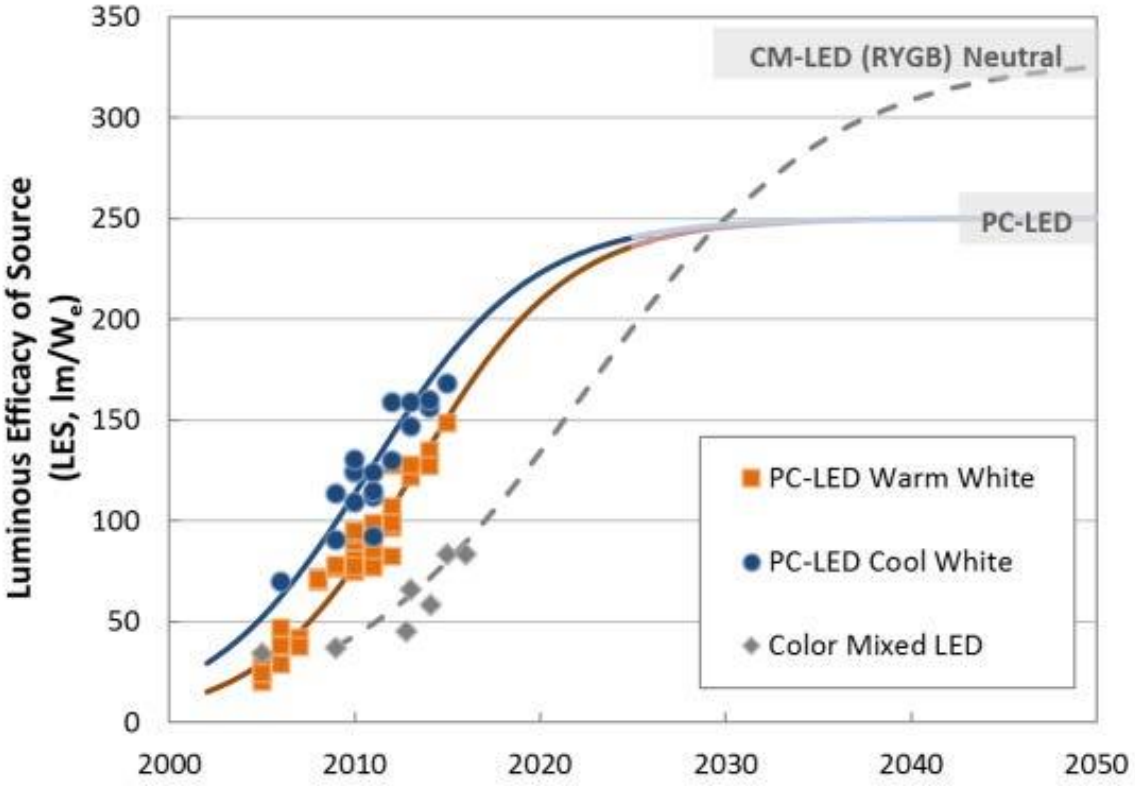


DOE targets push industry to levels of efficacy and performance that might not otherwise be achieved.

Analysis of emerging products prompts improvements, informs R&D priorities.

https://energy.gov/eere/ssl/research-development

2017 LED Program Targets

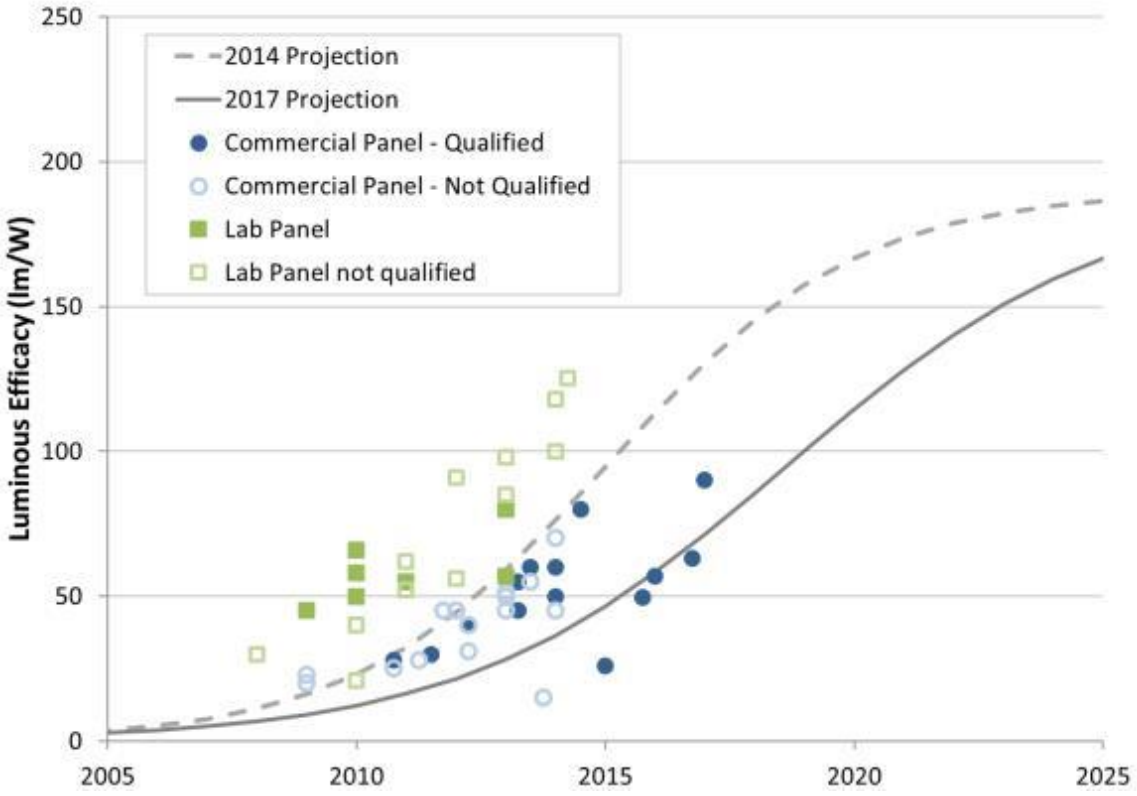


Best performing LEDs are only halfway to DOE goals

Significant technology development headroom remains

https://energy.gov/eere/ssl/downloads/solid-state-lighting-2017-rd-plan-suggested-research-topics

2017 OLED Program Targets



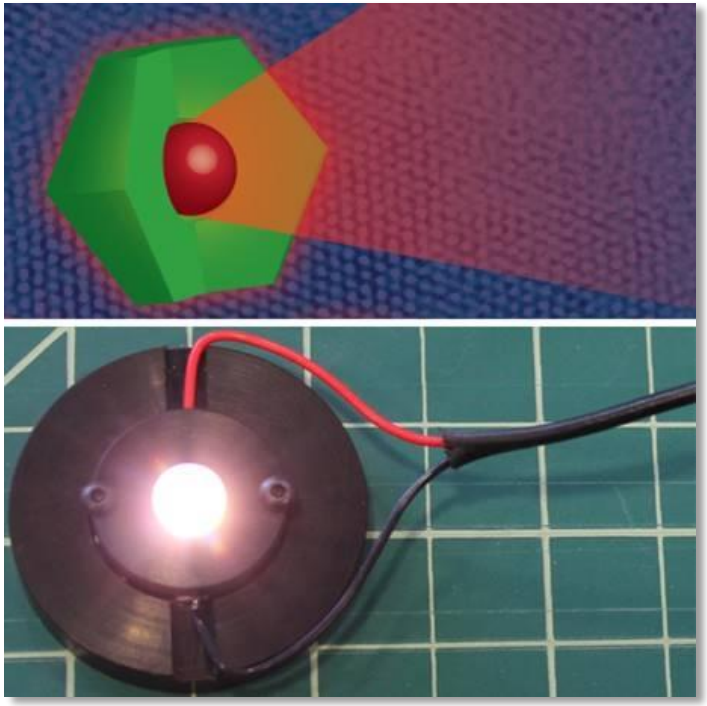
Significant potential to meet goals

Enabling technologies (materials, light extraction, anodes, encapsulation) have been demonstrated, but need to be integrated in low-cost manufacturing processes

https://energy.gov/eere/ssl/downloads/solid-state-lighting-2017-rd-plan-suggested-research-topics

R&D Challenges for LEDs

- Emitter materials
- Down converters
- Emitter architectures for system efficiency
- Encapsulation
- Package/module integration into luminaires
- Novel luminaire systems



Los Alamos National Laboratory is advancing the use of quantum dots as LED narrow-band downconverters.

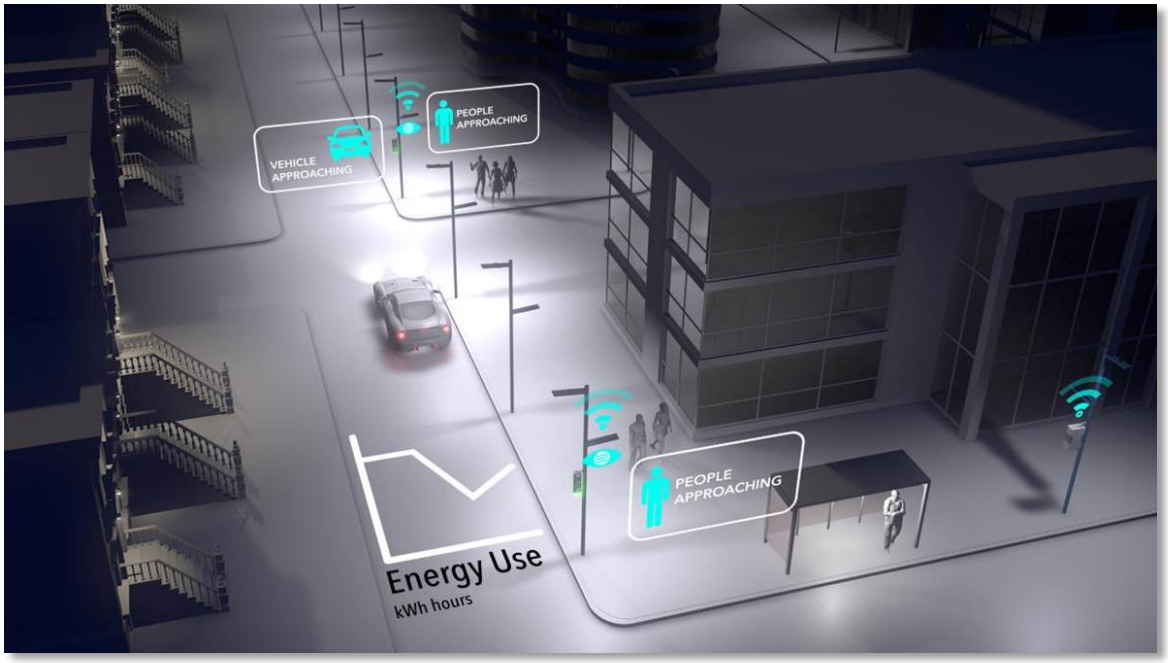
R&D Challenges for OLEDs

- Stable white devices
- Light extraction concepts
- Luminaire development
- Panel light extraction
- Deposition equipment

Arizona State University develops stable and efficient white OLEDs based on a single emissive material.

R&D Challenges for SSL in Total

- Connected lighting
- Color rendition
- Form factors
- Glare
- Reliability
- Action spectrum
- Human-light interactions



Connected lighting systems hold the potential to deliver improved energy performance and lighting quality, along with a host of other benefits.

Broad Mix of R&D Partners

Invited Projects: Wednesday, May 2

Project Title	Organization	PI
Understanding, Predicting, and Mitigating Catastrophic Shorts for Improved OLED Lighting Panel Reliability	Penn State University	Chris Giebink
Combining Fluorescence and Phosphorescence to Achieve Very Long Lifetime and Efficient White OLEDs	University of Southern California	Mark Thompson
Enhanced Light Extraction from Low Cost White OLEDs (WOLEDs) Fabricated on Novel Patterned Substrate	Iowa State University	Ruth Shinar
Eliminating Plasmon Losses in High Efficiency White Organic Light Emitting Devices for Lighting Applications	University of Michigan	Stephen Forrest
Stable White Organic Light-Emitting Diodes Enabled by New Materials with Reduced Excited-State Lifetimes	Georgia Tech	Bernard Kippelen
Low Cost Corrugated Substrates for High Efficiency OLEDs	North Carolina State University	Xiangyu Fu

Invited Projects: Wednesday, May 2

Project Title	Organization	PI
Mask-Free OLED Fabrication Process for Non-Tunable and Tunable White OLED Panels	OLEDWorks	Jeff Spindler
Stable and Efficient White OLEDs Based on a Single Emissive Material	Arizona State University	Jian Li
Identification and Mitigation of Droop Mechanism in GaN-Based Light Emitting Diodes (LEDs)	University of California, Santa Barbara	James Speck
High Performance Green LEDs for Solid State Lighting	University of California, Santa Barbara	James Speck
Improved Radiative Recombination in AlGaInP LEDs	Lumileds	Theodore Chung
Narrow Emitting Red Phosphors for Improving pcLED Efficacy	Lumenari	Daniel Bugaris

Invited Projects: Thursday, May 3

Project Title	Organization	PI
Graded Alloy Quantum Dots For Energy Efficient Solid State Lighting	Columbia University	Jonathan Owen
Highly Integrated Modular LED Luminaire	General Electric	Ramanujam Ramabhadran
Novel Lighting Strategies for Circadian and Sleep Health in Shift Work Applications	University of California, San Diego	Gena Glickman
Investigating the Health Impacts of Outdoor Lighting	Virginia Tech	Ron Gibbons