Guiding SSL Technology Advances

The U.S. Department of Energy Solid-State Lighting (SSL) program builds collaborative efforts with the lighting industry and research community to guide SSL technology innovation.

The Next Generation Luminaires™ competition encourages technical innovation and recognizes excellence in LED product design. *Photo courtesy of Lumenpulse.*

The DOE SSL program has been deeply involved in SSL R&D for over a decade—challenging industry with aggressive goals for efficacy and performance, and monitoring emerging products to identify performance issues early on, alerting manufacturers to needed improvements.

Despite rapid advances, SSL technology is actually in its early years. When it comes to U.S. energy and carbon savings, almost 95 percent of its potential remains untapped. Continued innovation and breakthroughs in materials, processes, product designs, control systems, and manufacturing are still needed to realize the full potential of the technology.

SSL products are now available for most lighting applications, from living room table lamps to high power sports stadium lights. Today's products can match or exceed the performance and energy efficiency of the most efficient conventional lighting technologies, including fluorescent and high intensity discharge sources. However, unlike conventional sources, SSL technology still has significant room for additional performance and efficiency improvements, through better materials, optics, electronic design, and system intelligence.

An area of particular interest is connected lighting that integrates LED sources with network interfaces and advanced sensors and controls. Such systems can not only drastically improve the energy performance of lighting and other building systems, but also have the potential to enable a wide array of services, benefits, and revenue streams that would enhance the value of lighting systems.

The DOE role is to work closely with the industry and lighting user/specifier community to realize this full potential, rather than settling for "good enough." Potential benefits include cutting U.S. lighting-related electricity use as much as 75 percent by 2035, along with related environmental benefits, improved lighting quality and service, cross-cutting technology breakthroughs, economic savings, job creation, and U.S. technology leadership.

Strong partnerships among DOE, industry, researchers, lighting specifiers and users, and standards and testing bodies are critical to realize the full potential of SSL technology. Without this level of public-private partnership, the true risk to SSL technological progress is rapid commoditization, characterized by extreme price pressure, degraded product quality, and the loss of manufacturing to foreign countries. Lighting is entering a new age, with advanced solid-state sources, intelligence, and networking capabilities poised to create new benefits and functions in addition to providing basic illumination. The United States is well positioned for leadership in this new environment. DOE provides competitive research funds, objective technical expertise, and public benefits-oriented convening power to improve the likelihood of success.

Research and Development Thrusts

SSL program R&D investments span the spectrum from core technology research and product development to manufacturing and technology application R&D.

Core technology research projects focus on applied research for SSL technology development, with particular emphasis on meeting efficiency, performance, and cost targets. Conducted primarily by academia, national laboratories, and research institutions, this research in areas such as materials science, light extraction, thermal management, and electrical properties fills technology gaps, provides enabling data, and significantly advances the knowledge base.

Product development projects use the knowledge gained from basic or applied research to develop or improve commercially viable materials, devices, or systems. Conducted primarily by industry, technical activities focus on a targeted market application with fully defined

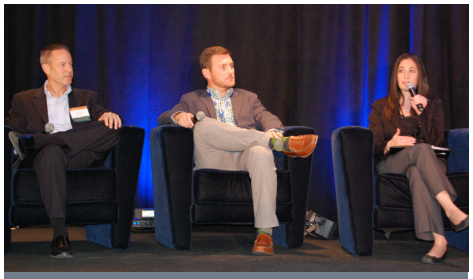
price, efficacy, and other performance parameters necessary for the success of the proposed product.

Manufacturing R&D projects seek to reduce costs and enhance quality in SSL products, addressing the technical challenges that must be overcome to enable SSL to compete with existing lighting on a first-cost basis. Focus is on significant leaps forward in manufacturing equipment, processes, or monitoring techniques, and on fostering U.S. leadership in SSL manufacturing.

Technology application R&D projects monitor SSL technology advances and provide field and laboratory evaluations of emerging products, including LED lighting systems that involve network interfaces and advanced controls. Impartial analysis from DOE identifies and characterizes technology issues early on, alerting manufacturers to needed improvements, and helping to put detailed information into the hands of buyers. In contrast to a single project focus, application technology R&D projects address broad issues related to technology performance, with a view that spans the entire industry. This approach creates highly effective feedback loops, inducing manufacturers to make technology improvements with their own funding, more quickly than would otherwise occur. It also feeds back into DOE planning for R&D priorities, allowing DOE to make more informed decisions on R&D investments.

Expert Information Exchange

DOE annual workshops reach a range of program stakeholders with information about DOE-funded R&D projects, and about the technical challenges encountered in real-world applications of SSL. The information exchange is two-way: attendees provide extensive input and guidance back to the DOE SSL program via plenary session question-and-answer periods, technology-specific breakout sessions, one-on-one meetings, and informal networking at the workshops.



DOE SSL workshops provide a forum to engage partners and accelerate information sharing.

In addition, DOE regularly organizes roundtables and joint planning sessions with key lighting industry participants. Because LED technology and products continue to evolve so quickly, it is imperative that DOE has frequent interaction with key researchers, manufacturers, lighting users, energy efficiency programs, retailers, and other stakeholders both to share the latest information and data, and to seek their input on technology needs. This input informs updates to the SSL R&D Program Plan.

DOE technical information and analysis are widely shared via the SSL program website, which offers a rich collection of resources. This information is also shared via invited presentations at major lighting industry events such as LIGHTFAIR® International and Strategies in Light®, as well as through webinars and resources such as fact sheets, white papers, and journal and trade press articles. Timely information on the technology, new products, and field experience is critical for successful development and adoption of SSL technology in the United States in pursuit of the technology's energy savings potential.

DOE hosts annual roundtables with representatives from industry, independent test labs, and standards-setting groups.

SSL Partnerships

The DOE SSL program strategically partners with private industry and industry associations to accelerate the development of SSL. DOE's partnership with the Next Generation Lighting Industry Alliance (NGLIA) enhances the manufacturing and commercialization focus of the DOE portfolio by utilizing the expertise of this organization of SSL manufacturers. DOE partners with the Illuminating Engineering Society of North America (IES) and the International Association of Lighting Designers (IALD) to provide their professional designers and specifiers with specific, actionable technical information they can use to ask tough questions of their vendors, and thereby exert significant influence on technology development. Together, DOE, IALD, and IES sponsor the Next Generation Luminaires™ competition to recognize excellence in commercial LED products.

The SSL program also serves as a "go to" resource for related programs within DOE, coordinating on R&D projects related to SSL with the Office of Science Basic Energy Sciences' (BES) Small Business Innovation Research (SBIR) program, the Energy Frontier Research Centers (EFRCs), and the Advanced Research Projects Agency-Energy (ARPA-E). Within the Office of Energy Efficiency and Renewable Energy, the SSL program coordinates with the Advanced Manufacturing Office, the Building Technologies Office, and the Federal Energy Management Program to provide technical information and resources related to SSL.