

# DOE SSL R&D Overview

## SSL R&D Workshop

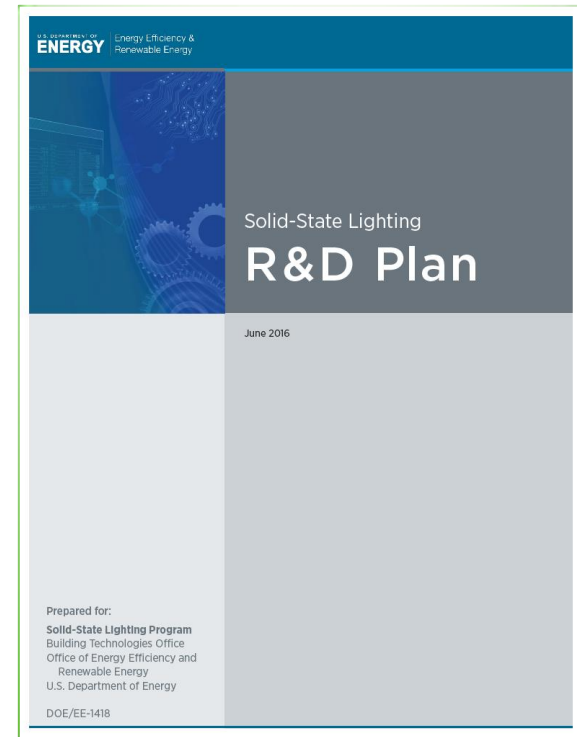
February 1, 2017

**Joel Chaddock, PMP**

National Energy Technology Laboratory  
U.S. Department of Energy

# Annual R&D Plan

- Former Multi-Year Program Plan and Manufacturing Roadmap combined into a single document in 2015
- Updated annually in collaboration with industry partners
- Guides DOE SSL program priorities
- DOE SSL funding opportunity and project selections align with the priorities and targets detailed in the R&D Plan
- Informs not only DOE-sponsored R&D, but also research agendas in academia and industry



# Competitive R&D Elements

**Core Technology Research:** focusing on applied research for technology development, with particular emphasis on meeting efficiency, performance, and cost targets. This research fills technology gaps to overcome technical barriers

**Product Development:** using the knowledge gained from basic or applied research to develop or improve commercially viable materials, devices, or systems

**Manufacturing R&D:** aimed at accelerating SSL technology adoption and encouraging a role for U.S.-based production through manufacturing improvements that reduce costs and enhance product quality

# R&D Funding Opportunity Goals

- Enable energy savings through advancements in source efficacy, performance, cost, quality, and application efficiency
- Encourage the growth, leadership, and sustainability of domestic U.S. manufacturing within the SSL industry

- A.1.2 – LED Emitter Materials Research
  - A.8.2 – Human Light Interactions
  - B.6.4 – Advanced Luminaire Systems
  - B.7.0 – LED Power Supply
  - M.L.1 – LED Luminaire Manufacturing
  - C.1.2 – OLED Stable White Devices
  - C.3.1 – Fabrication Technology Research
  - D.4.2 – OLED Luminaire
  - D.5.3 – OLED Light Engine
  - D.6.3 – OLED Light Extraction and Utilization
  - M.O.3 – OLED Substrate and Encapsulation Manufacturing
- 
- The diagram consists of two green curly brackets on the right side of the list. The first bracket groups the first five items (A.1.2, A.8.2, B.6.4, B.7.0, M.L.1) and is labeled 'LED'. The second bracket groups the remaining six items (C.1.2, C.3.1, D.4.2, D.5.3, D.6.3, M.O.3) and is labeled 'OLED'.

# Current Funding Opportunity Status

2016 SSL R&D Plan released	June 2016
Funding opportunity released	October 12, 2016
Concept papers due	November 14, 2016
Full applications due	January 10, 2017
Reply to reviewer comments due	March 6, 2017
Selection announcement	May 2017
Awards	August 2017

# Historical View of Projects

Light Emitting Diode			
Technology Gap	# Projects	Total Funding	Percentage of Funds
A.1.1 - Alternative Substrates	6	\$6,358,989	3%
A.1.2 - Emitter Materials Research	23	\$36,210,101	17%
A.1.3 - Down Converters	12	\$18,634,860	9%
A.2.1 - Light Extraction Approaches	3	\$3,202,693	1%
A.2.2 - Novel Emitter Materials and Architectures	6	\$9,378,023	4%
A.4.4 - Manufacturing Simulation	1	\$425,000	0%
A.5.1 - Optical Component Materials	1	\$1,967,373	1%
A.6.3 - System Reliability Methods	1	\$3,561,176	2%
B.1.2 - Semiconductor Materials	3	\$10,155,219	5%
B.1.3 - Phosphors	3	\$8,567,818	4%
B.3.6 - Package Architecture	14	\$25,128,894	12%
B.5.3 - Diffusion and Beam Shaping	1	\$1,448,473	1%
B.6.1 - Luminaire Mechanical Design	1	\$1,091,907	1%
B.6.2 - Luminaire Thermal Management	4	\$8,564,141	4%
B.6.4 - Novel Luminaire Systems	6	\$8,520,040	4%
B.7.4 - Electronics Component Research	2	\$4,744,346	2%
M.L.1 - Luminaire Manufacturing	4	\$16,462,624	8%
M.L.3 - Test and Inspection Equipment	2	\$15,589,241	7%
M.L.4 - Tools for Epitaxial Growth	4	\$33,403,149	15%
M.L.5 - Wafer Processing Equipment	1	\$2,382,740	1%
M.L.6 - LED Packaging	1	\$1,097,648	1%
	<b>99</b>	<b>\$216,894,455</b>	<b>100%</b>

Organic Light Emitting Diode			
Technology Gap	# Projects	Total Funding	Percentage of Funds
C.1.1 - Novel Device Architectures	7	\$10,522,163	9%
C.1.2 - OLED Stable White Devices	13	\$18,818,618	16%
C.1.4 - Material Degradation	1	\$825,000	1%
C.2.2 - Electrode Research	6	\$6,620,080	6%
C.3.1 - Fabrication Technology Research	1	\$4,000,000	3%
C.6.3 - Novel Light Extraction Approaches	7	\$8,174,298	7%
D.1.1 - Implementation of Materials & Device Architect	7	\$21,580,865	18%
D.2.1 - Substrate Materials	2	\$4,766,671	4%
D.2.2 - Low-Cost Electrode Structures	1	\$1,835,998	2%
D.4.2 - Luminaire Integration	3	\$5,486,404	5%
D.6.2 - Panel Packaging	1	\$4,955,031	4%
M.O.1 - OLED Deposition Equipment	2	\$3,293,293	3%
M.O.2 - Integrated Manufacturing & Quality Control	3	\$20,500,342	17%
M.O.3 - Substrate & Encapsulation Manufacturing	2	\$7,097,434	6%
	<b>56</b>	<b>\$118,476,197</b>	<b>100%</b>

Entire project portfolio: <http://energy.gov/eere/ssl/project-reports>

# Funding Mechanisms Relevant to SSL

- Core Technology, Product Development, Manufacturing R&D
  - [energy.gov/eere/ssl/financialopportunities](http://energy.gov/eere/ssl/financialopportunities)
- Office of Science - Basic Research
  - [science.energy.gov/grants](http://science.energy.gov/grants)
- Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants
  - <http://science.energy.gov/sbir>
  - <http://www.nsf.gov/eng/iip/sbir/>
- Energy Frontier Research Centers (EFRCs)
  - <http://science.energy.gov/bes/efrc>
- Advanced Research Projects Agency—Energy (ARPA-E)
  - <http://arpa-e.energy.gov/>
- Advanced Manufacturing Office (AMO)
  - [energy.gov/eere/amo/advanced-manufacturing-office](http://energy.gov/eere/amo/advanced-manufacturing-office)
- Loan Programs Office (LPO)
  - [energy.gov/lpo/loan-programs-office](http://energy.gov/lpo/loan-programs-office)

# Collaborative R&D OLED Testing Opportunity

## Purpose

- Develop a collaborative R&D framework to accelerate developments in OLED lighting technology and manufacturing

## Benefits

- Quicker turnaround for funding vs. solicitations
- Less daunting application
- Rapid results
- Collaboration with panel manufacturers
- Costs DOE less

<https://energy.gov/eere/ssl/oled-testing-opportunity>





# Additional Input Mechanisms

- Workshops: R&D, Technology Development, Connected Lighting Systems
- Industry Meetings: LED Roundtable and OLED Stakeholder
- Application focused roundtables: Animal Responses to Light, Human Physiological Responses to Light, Roadway Safety, Horticultural Lighting
- Working groups: LED System Reliability Consortium (LSRC)
- Investigation/Analyses: market assessments, energy savings forecasts, lesson-learned, etc.

# Learn More About Current Projects



Poster session provides opportunity to learn, share project updates, and ask questions