Solid-State Lighting Manufacturing R&D Workshop

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EERE’s National Mission

Create American leadership in the global transition to a clean energy economy

1) High-impact research, development, and demonstration to make clean energy as affordable and convenient as traditional forms of energy

2) Breaking down barriers to market entry
Clean Energy – Ready for Launch

Global Clean Energy Investment, 2004–2012 (Billions of $)

Clean Energy Manufacturing Initiative – FY14: $500M+

Objectives:
1) Increase U.S. competitiveness in the production of clean energy products
2) Increase U.S. manufacturing competitiveness across the board by increasing energy productivity

Initiative Approaches:
• Manufacturing R&D
• Facilities for manufacturing innovation and demonstration
• Energy productivity
• Competitiveness analysis
• Partnerships and engagement
“Wide Band Gap Semiconductors for Clean Energy Initiative”

New Cross-Cutting EERE Initiative –

Advanced Manufacturing, Buildings, Vehicles, Solar, Wind

Power Electronics: GaN and SiC projected to garner 22% of $15B discrete power electronics components market by 2020*

- Silicon carbide IGBT; 15 kV, 100 A
- 50 kHz from Cree, Inc.
- Potentially 100-lb transformer

8,000-lb, 60 Hz Distribution Transformer

Solid-State Lighting: LED WBG market share expected to grow to $84B by 2020*

Source: Beyond Silicon: Plotting GaN and SiC’s Path within the $15B Power Electronics Market
$70M Manufacturing Innovation Institute: Wide Band Gap Power Electronics

- DOE will lead an institute in support of NNMI, as called for by the President in the State of the Union
- Led by EERE’s Advanced Manufacturing Office
- Award selection announcement target—Fall 2013
Clean Energy Manufacturing Competitiveness Analysis

Utility PV – 2011 Reductions

Source: SunShot Vision
Silicon PV: Comparative Cost Assessment

1H 2012 Costs

Module $\eta = 14.9\%$

Source: Original Clean Energy Manufacturing Initiative – SunShot research
The Opportunity

Clean Energy Manufacturing Initiative

Opportunity to align efforts toward common purpose

SSL Manufacturing R&D Initiative

Wide Bandgap Semiconductors for Clean Energy Initiative
Solid State Lighting – How Far We Have Come...

2003
Traffic signals, key chains

2013
LED products for just about every application
Successful Partnerships - EERE Solid State Lighting Program

Millions of LED products have EERE funded R&D inside

- Cooper Lighting Lumark® LED roadway lighting
- GE Evolve™ LED roadway lighting
- Leotek LEDGreen King Cobra™ streetlight
- Philips Wide-Lite VizorLED parking garage lighting
- Cree AR troffer
- Redwood Systems sensors
- Cree CR6 downlight
- Philips GreenPerform LED high bay
- Philips Lightolier Alcyon LED
- Philips Advance LED drivers for UL Class 1—Fixed
- Soraa Vivid LED MR16
- Finelite HP-4 Direct/Indirect
LED Bulb Cost and Efficacy Trends

Lamp Efficacy has increased 50% since 2010

Lamp cost has dropped 70% since 2010
SSL Manufacturing R&D Initiative

Since 2009, DOE has funded 17 SSL manufacturing R&D projects:

- Competitively selected
- Cost shared
- Derived from DOE Roadmap
Results from EERE-Funded R&D

**Veeco:** Improvements to MaxBright™ Multi-Reactor System increase throughput and LED device yield

Reduce cost of ownership by 24%

**KLA-Tencor:** Inspection system improves LED manufacturing yields and minimizes waste

Provides estimated customer savings of over $2M in 6 months

**Ultratech:** Adapted lithography tool lowers manufacturing cost of high-brightness LEDs

Achieves return on investment in 3–6 months and reduces capital expenses by almost 30%
Cree, Inc. (Durham, NC) - $2.3M
Scalable Light Module for Low-Cost, High-Efficiency LED Luminaires

Eaton Corporation (Menomonee Falls, WI) - $2.4M
Print-Based Manufacturing of Integrated Low-Cost, High-Performance SSL Luminaires

Philips Lumileds Lighting Company (San Jose, CA) - $1.8M
Development and Industrialization of InGaN/GaN LEDs on Patterned Sapphire Substrates for Low-Cost Emitter Architecture
2013 SSL Manufacturing R&D Project Selections: OLED

**OLEDWorks, LLC** (Rochester, NY)
Innovative High-Performance Deposition Technology for Low-Cost Manufacturing of OLED Lighting - $1M

**PPG Industries, Inc.** (Pittsburgh, PA)
Manufacturing Process for OLED Integrated Substrate - $2.3M
Expanding our Partnership...

How can the U.S. capture a greater share of manufacturing value add in the rapidly growing SSL industry?

What are credible pathways/strategies?
Let’s continue to dialogue... Thank you

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