



U.S. Department of Energy
Energy Efficiency and Renewable Energy

SSL Technology Evolution

ENERGY STAR® Solid-State Lighting Stakeholder Meeting

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US Department of Energy

**Office of Energy Efficiency and Renewable Energy
Buildings Technologies Program**

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Table of Contents

1

Technology Tsunami

2

DOE SSL Program

3

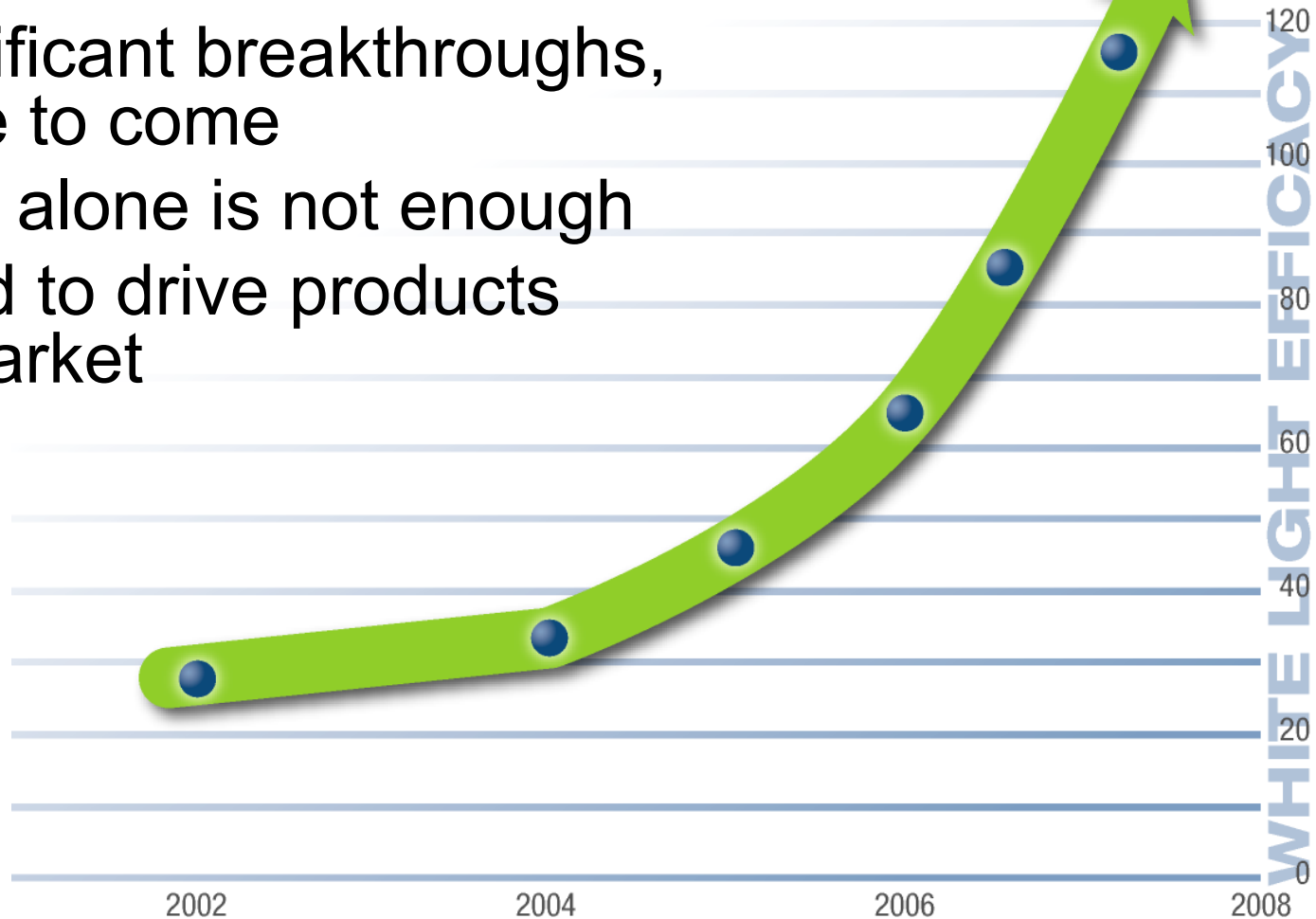
DOE Market Deployment



SSL on the Move

What's Next?

- Significant breakthroughs, more to come
- R&D alone is not enough
- Need to drive products to market





New Product Announcements

- *“Philips Lumileds shatters 350 mA performance records with 115 lm/W LED”*
January 2007
- *“Seoul Semiconductor introduces world’s brightest LED, a 240 lumens single die light source” [100 lm/W]*
December 2006
- *“Nichia delivers 92 lm/W at 350 mA”*
November 2006
- *“Cree delivers first 160-lumen white power LED” [85 lm/W]*
October 2006



Seoul Semiconductor



Cree Inc.



Unique and Potentially Better Technology

- Heat transfer
- Low voltage DC
- Small emitter
- Directional
- Shades of white light



Halley LED Desk Lamp



Table of Contents

1

Technology Tsunami

2

DOE SSL Program

3

DOE Market Deployment



The Legislative Authority

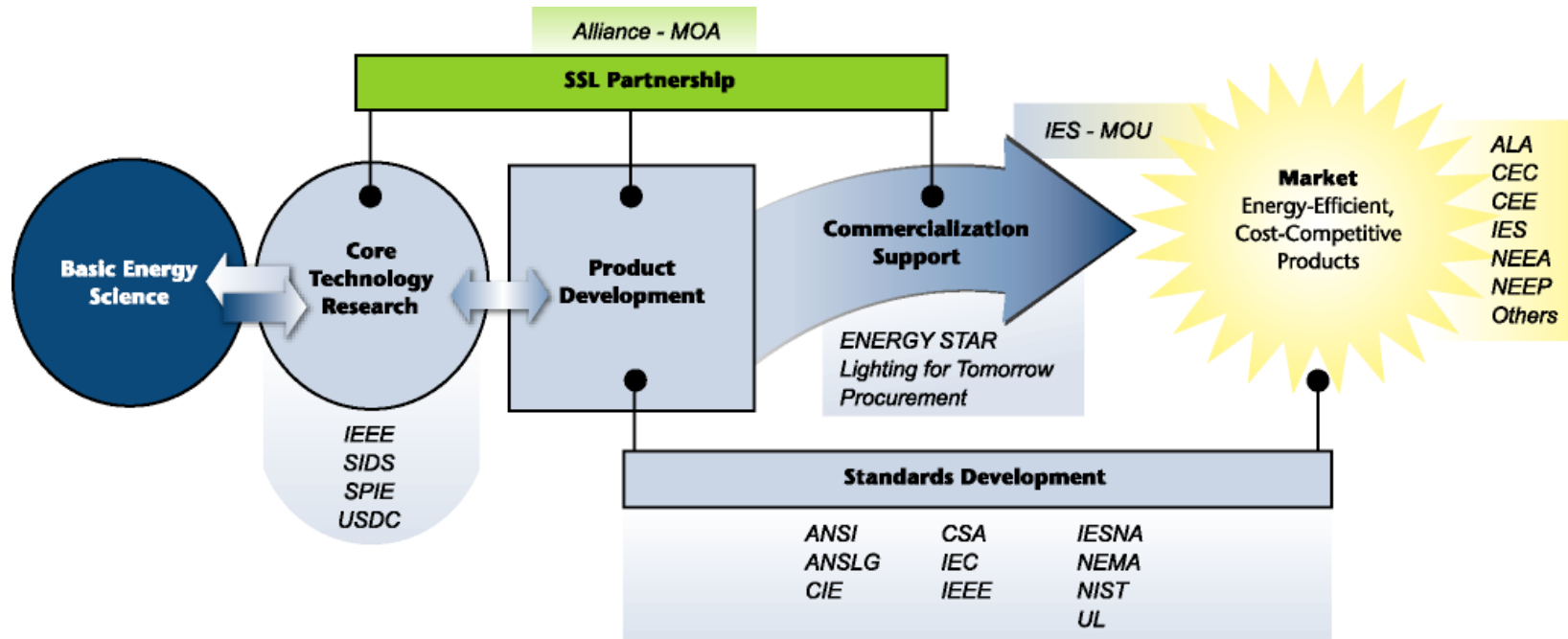
Domenici-Barton Energy Policy Act 2005

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.”



DOE SSL Technology & Market Partners





DOE Solid-State Lighting Workshop

- 260 attendees at annual meeting
- Purpose: DOE program planning; & network
- Luminaire manufacturers (34)
- Lighting designers
- Source manufacturers
- Trade Associations
- Energy Efficiency Programs
- Utilities



SSL Partnership Next Generation Lighting Industry Alliance MOA

“The Parties will conduct activities in support of research, demonstration and deployment of solid-state lighting (SSL) technologies for general lighting applications.”

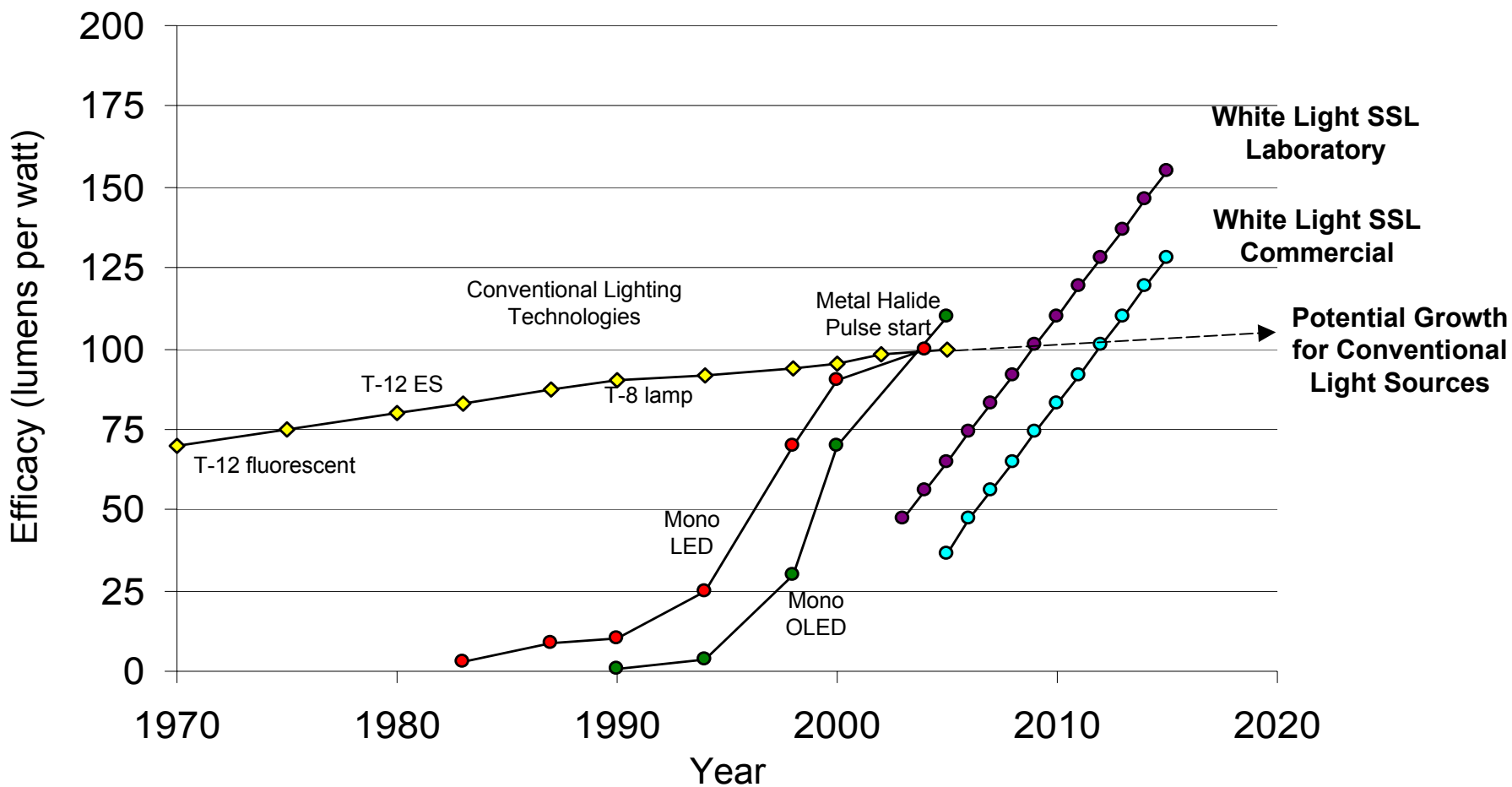
“...create criteria for voluntary market conditioning programs, such as ENERGY STAR®”

Members:

Acuity Brands Lighting ♦ Air Products & Chemicals, Inc. ♦ CAO Group ♦ Color Kinetics ♦ Corning, Inc. ♦ Cree, Inc. ♦ Dow Corning ♦ Eastman Kodak Company ♦ GELcore LLC ♦ General Electric Company ♦ Lumileds Lighting LLC ♦ LPI, LLC ♦ OSRAM Opto Semiconductors ♦ Osram Sylvania ♦ Philips Electronics North America Corp. ♦ 3M Corp.



Accelerated R&D for White Light SSL



SSL Laboratory and Commercial Curves, revised May 2006



Table of Contents

1

Technology Tsunami

2

DOE SSL Program

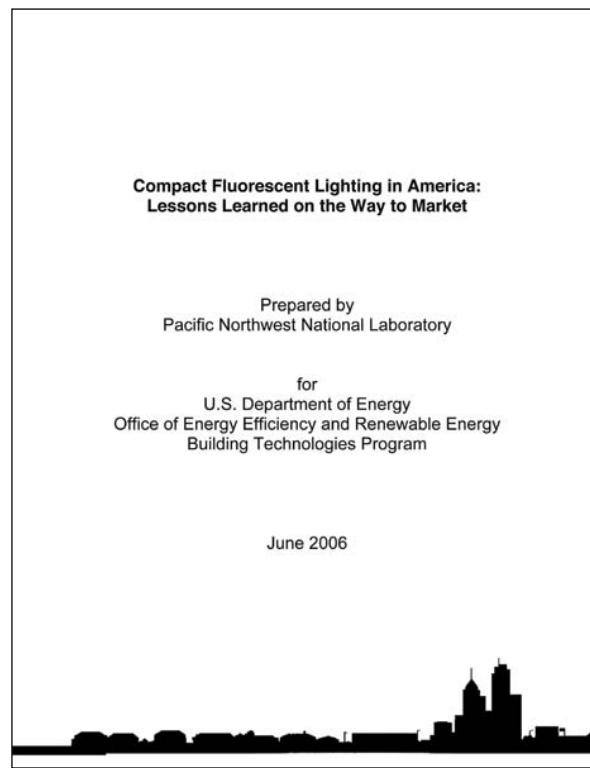
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DOE Market Deployment



Compact Fluorescent Lighting in America: Lessons Learned on the Way to Market

- Valuable lessons
 - Be aggressive about dealing with technology failures that affect main benefit claims
 - Know and admit technology limitations
 - Don't introduce inferior products; first impressions are long lasting
 - Accurate incandescent equivalency on packaging is critical
 - Manufacturers and energy-efficiency groups should coordinate to establish minimum performance requirements
- Use to avoid "CFL Part II"
- Apply to SSL commercialization path





Lighting for Tomorrow: SSL Competition

- For first time, 2006 LFT included SSL competition
- Entries allowed for: undercabinet, portable desk/task, outdoor
- Proposals due Sept. 15; 34 proposals received
- Judging on Oct. 11; winners announced
- Winning luminaires displayed at 2007 DOE SSL Workshop





Commercial Product Testing Program

- Program publicly announced at Workshop in DC in October 2006
- Purposes: assist DOE program planning; assist SSL test procedure refinement; inform buyers
- 4 products tested to date: downlights, under-cabinet light, task light
- 12 more in process
- Primary measurements include: total lumens, luminaire efficacy, CCT, CRI, spectral power distribution, electrical measurements
- Test results available:
www.netl.doe.gov/ssl/comm_testing.htm



SSL Fact Sheet Series

- Written for efficiency program and facility managers
- Five completed in '06
- Five more coming in '07

The image shows a stack of seven fact sheets from the SSL Fact Sheet Series. The visible titles from top to bottom are:

- Thermal Management of White LEDs
- Lifetime of White LEDs
- Color Quality of White LEDs
- Energy-Efficient Lighting and Light-Emitting Diodes
- Energy Efficiency of White LEDs
- LED Application Series: Recessed Downlights
- Energy Efficiency and Renewable Energy

 Each fact sheet includes technical information, diagrams, and tables. For example, the 'Energy Efficiency of White LEDs' sheet features a table comparing light sources:

Light Source	Typical Lumens (lm) per Watt (lm/W)	Typical Energy (kWh) per 1000 lm-hr
Incandescent	15-20	100-150
Compact Fluorescent (CFL)	50-80	30-45
LED (typical)	80-100	20-25
LED (high-end)	100-150	15-20

 The 'LED Application Series: Recessed Downlights' sheet includes a table comparing different light sources:

Light Source	Typical Lumens (lm) per Watt (lm/W)	Typical Energy (kWh) per 1000 lm-hr
Incandescent	15-20	100-150
Compact Fluorescent (CFL)	50-80	30-45
LED (typical)	80-100	20-25
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Standards & Test Procedures Development

- DOE leadership – March and October workshops convene key standard organizations
 - Prospect of ENERGY STAR SSL criteria primary driver
 - Agreement to accelerate process
 - Maintain master roadmap of activities

Standards & Procedures In Development

- Definitions (IESNA RP-16) – under ANSI committee review
- Drivers (ANSI C82.XX) – draft out for committee review and comment
- Lumen maintenance (IESNA LM-80) – draft in final development
- Luminous Flux (IESNA LM-79) – in first official round for committee comment
- Chromaticity (ANSI C78.377) – draft out for committee review and comment
- LED Safety Outline of Investigation (UL 8750) – in draft for industry review
- Luminous Intensity (CIE 127) – under development



For More Information

For more information and ongoing updates on
the DOE Solid-State Lighting Program, visit:

www.netl.doe.gov/ssl