DOE SSL Research & Development Program Update

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U.S. Department of Energy

Office of Energy Efficiency and Renewable Energy
Buildings Technologies Program

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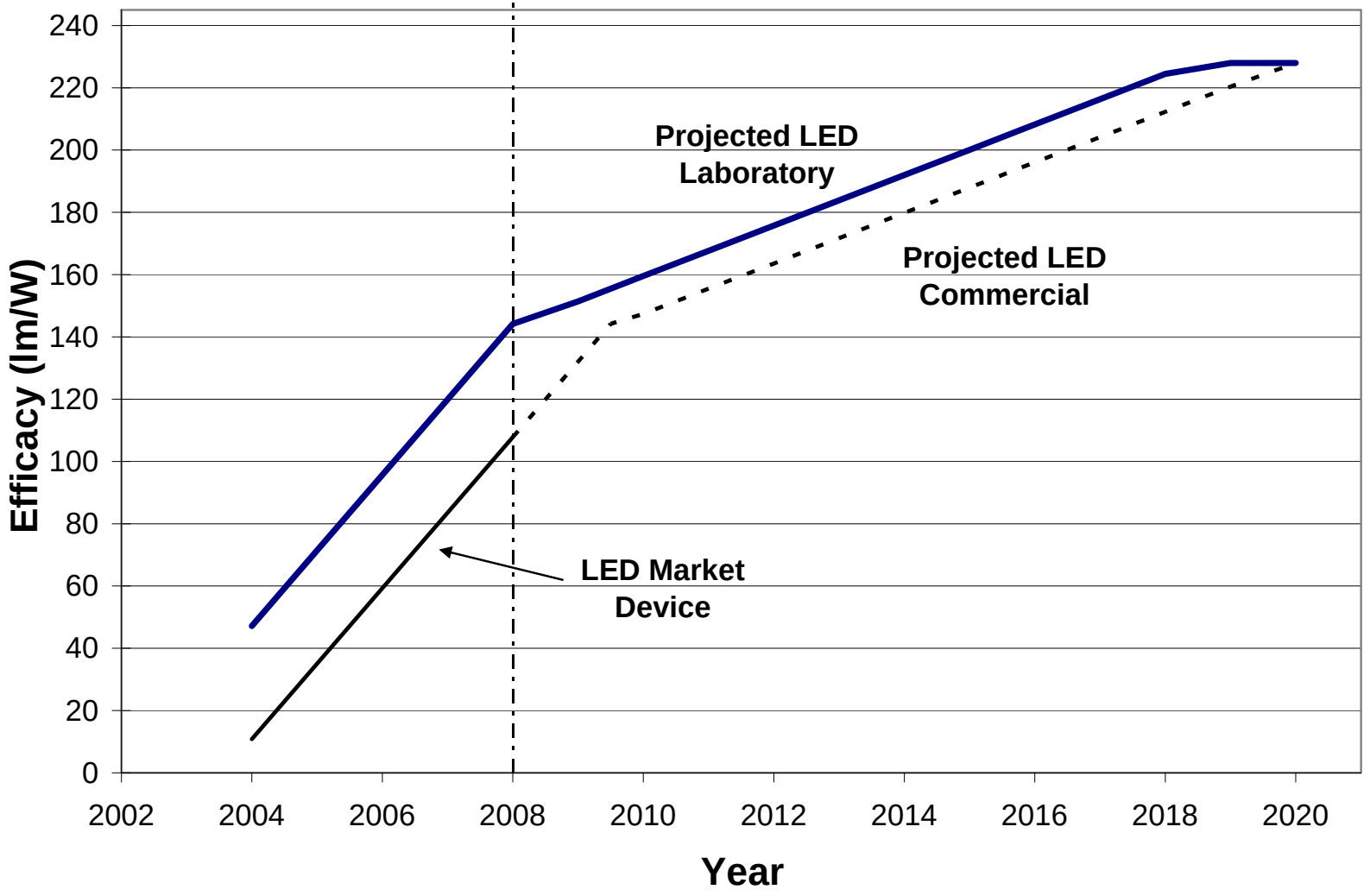
Mission Statement

Solid-State Lighting Program Mission

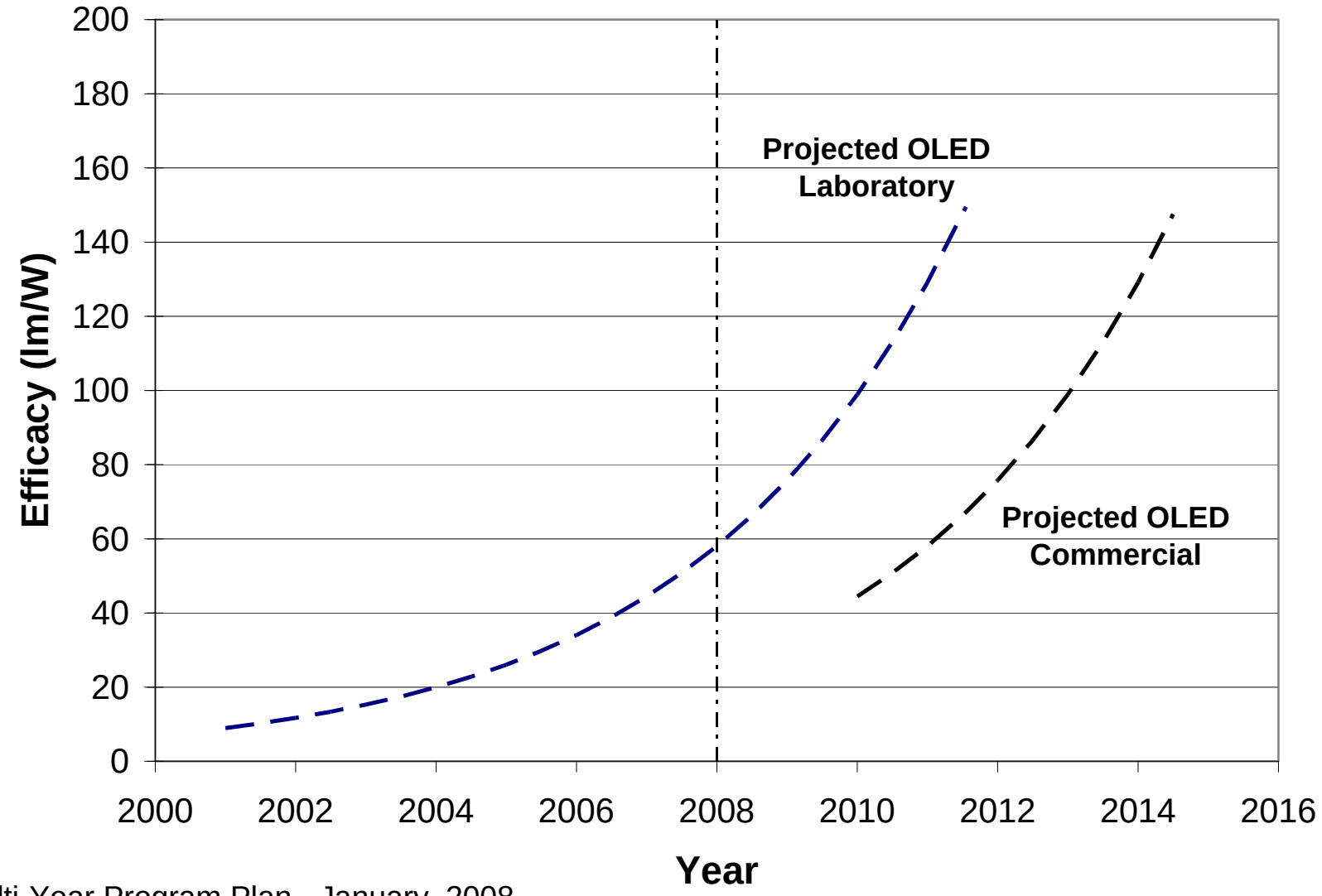
Guided by a government-industry partnership, the mission is to create a new market for high-efficiency, general illumination products through the advancement of semiconductor technologies, to save energy, reduce costs, and enhance the quality of the lighted environment.

White-Light LED Efficacy Targets



SSL Multi-Year Program Plan - January, 2008. Cool white LED Efficacy Projection

White-Light OLED Efficacy Targets



SSL Multi-Year Program Plan - January, 2008.

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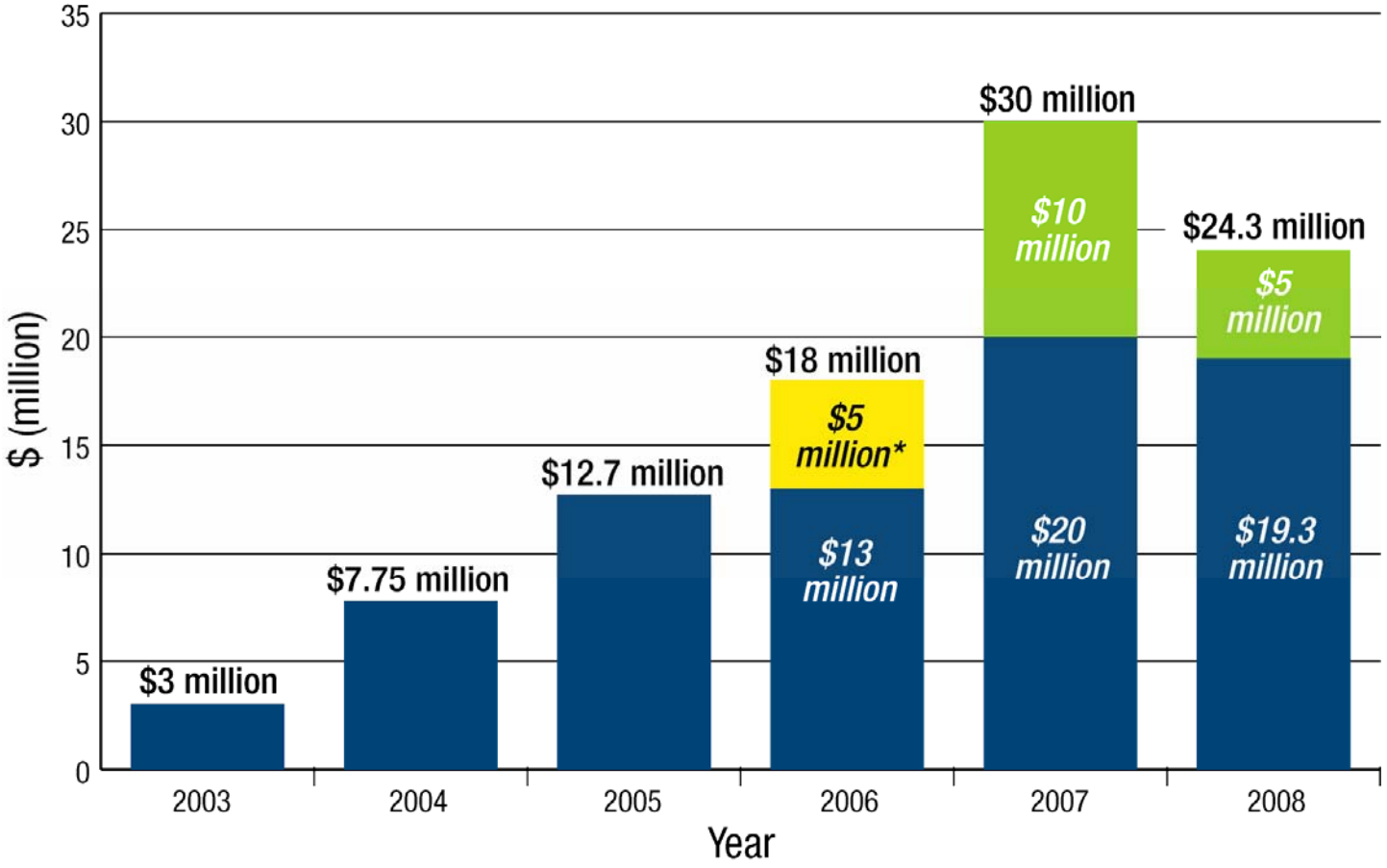
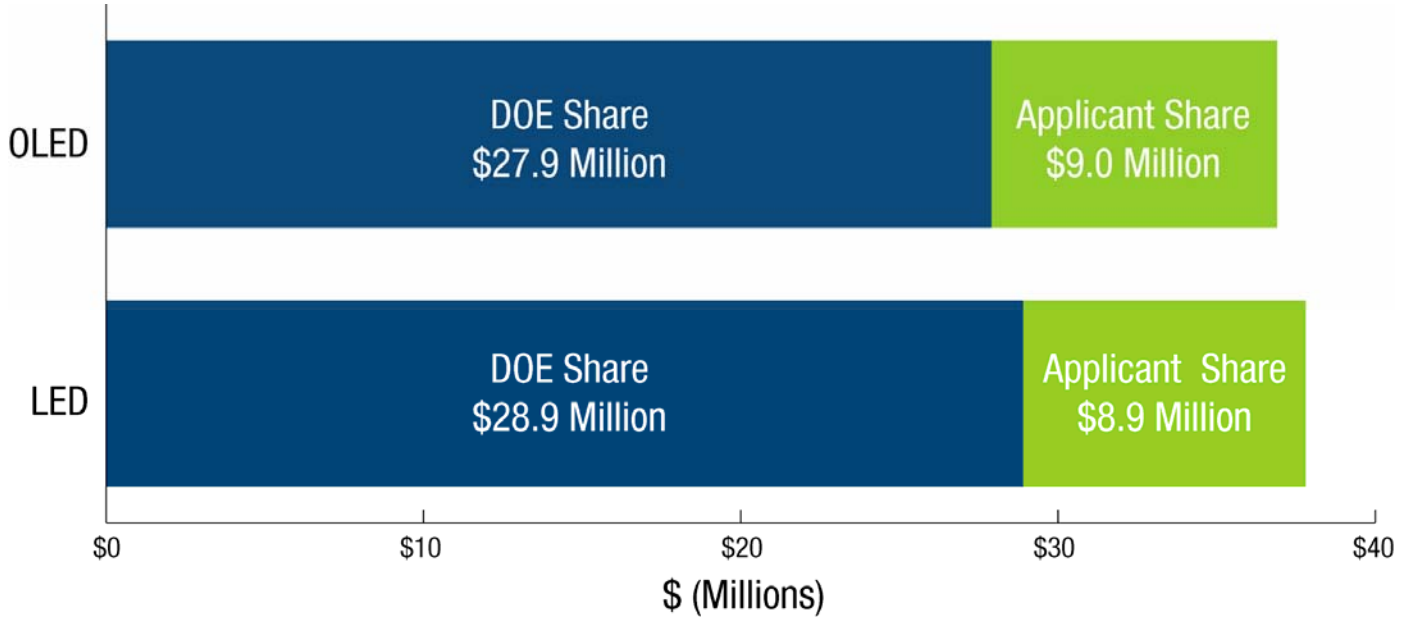
Congressional Appropriations



*Congressional Directive

SSL R&D Project Funding



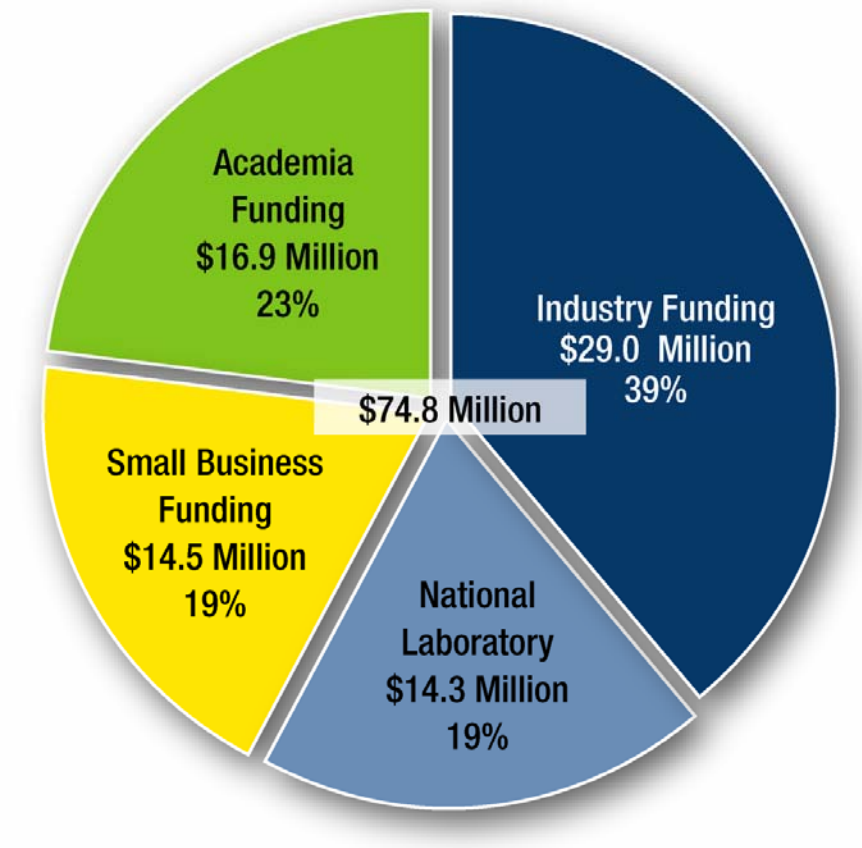
Total Contract Value of Projects: $74.8 million* (51 projects)

- OLED: $36.9 million (25 projects)
- LED: $37.8 million (26 projects)

* The total contract value includes DOE funding ($56.8 million) and applicant cost-share ($17.9 million).

Who's Getting the R&D Money?

- DOE funds SSL research in partnership with:
  - Industry
  - Academia
  - National labs



Total Portfolio: LED Core Technology

	# of Projects	Funding ($ million)
Light Emitting Diode Core Technology		
Large-area substrates, buffer layers, and wafer research	3	$2.5
High-efficiency semiconductor materials	12	$15.6
Strategies for improved light extraction and manipulation	1	$2.5
Phosphors and conversion materials	2	$2.5
Total	**18**	**$23.1 million**

Total Portfolio: OLED Core Technology

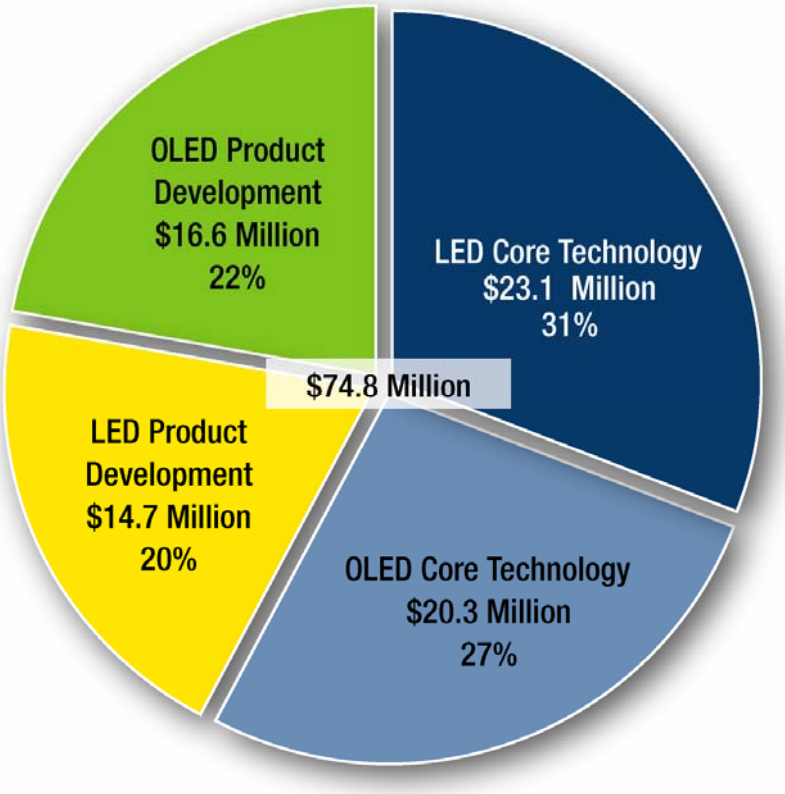
	# of Projects	Funding ($ million)
Organic Light Emitting Diode Core Technology		
Novel materials and device architectures	7	$8.6
Improved contact materials and surface modification techniques to improve charge injection	1	$1.7
Applied research in OLED devices	1	$0.8
Research on low-cost transparent electrodes	5	$5.2
Investigation (theoretical and experimental) of low-cost fabrication and patterning techniques and tools	1	$4.0
Total	**15**	**$20.3 million**

Total Portfolio: Product Development

	# of Projects	Funding ($ million)
Light Emitting Diode		
Manufactured materials	2	$3.9
LED packages and packaging materials	3	$4.5
Electronic development	1	$2.6
Optical coupling and modeling	2	$3.7
Organic Light Emitting Diode		
Practical implementation of materials and device architectures	3	$4.9
Practical application of light extraction technology	3	$6.6
OLED encapsulation packaging for lighting applications	3	$5.0
Module and process optimization and manufacturing	1	$0.1
Total	**18**	**$31.3 million**

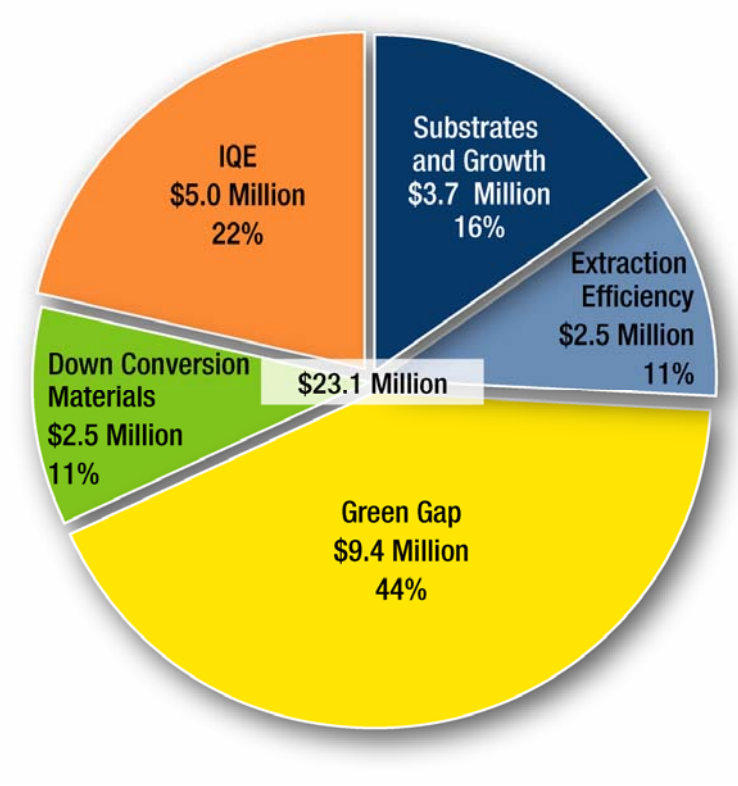
LED and OLED Core and Product Research

- Of 51 total projects:
  - 18 are LED core research
  - 8 are LED product development
  - 15 are OLED core research
  - 10 are OLED product development



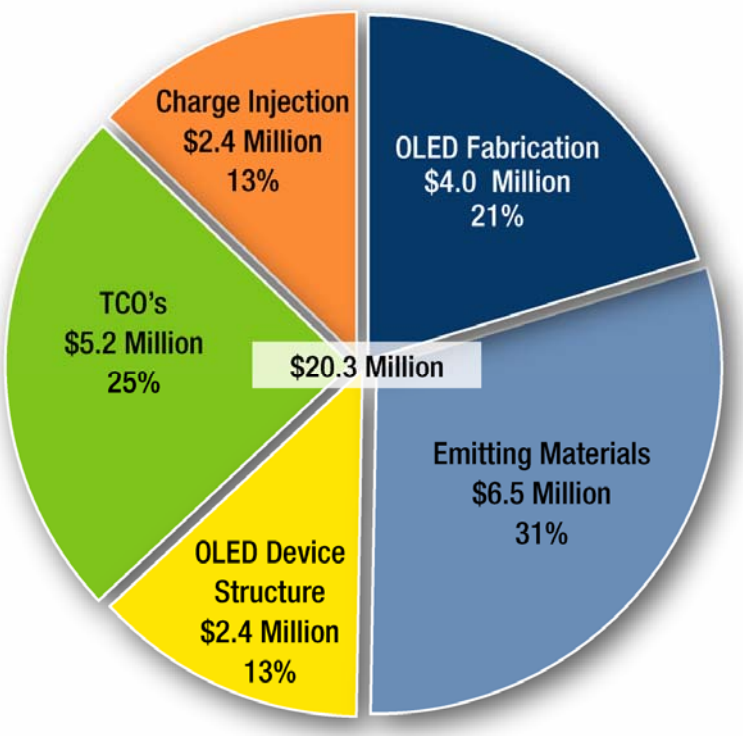
LED Core Research

- Of 18 total projects:
  - 6 are researching the green LED IQE gap
  - 5 are researching substrates and growth
  - 4 are studying IQE
  - 2 are studying down conversion materials
  - 1 is studying extraction efficiency

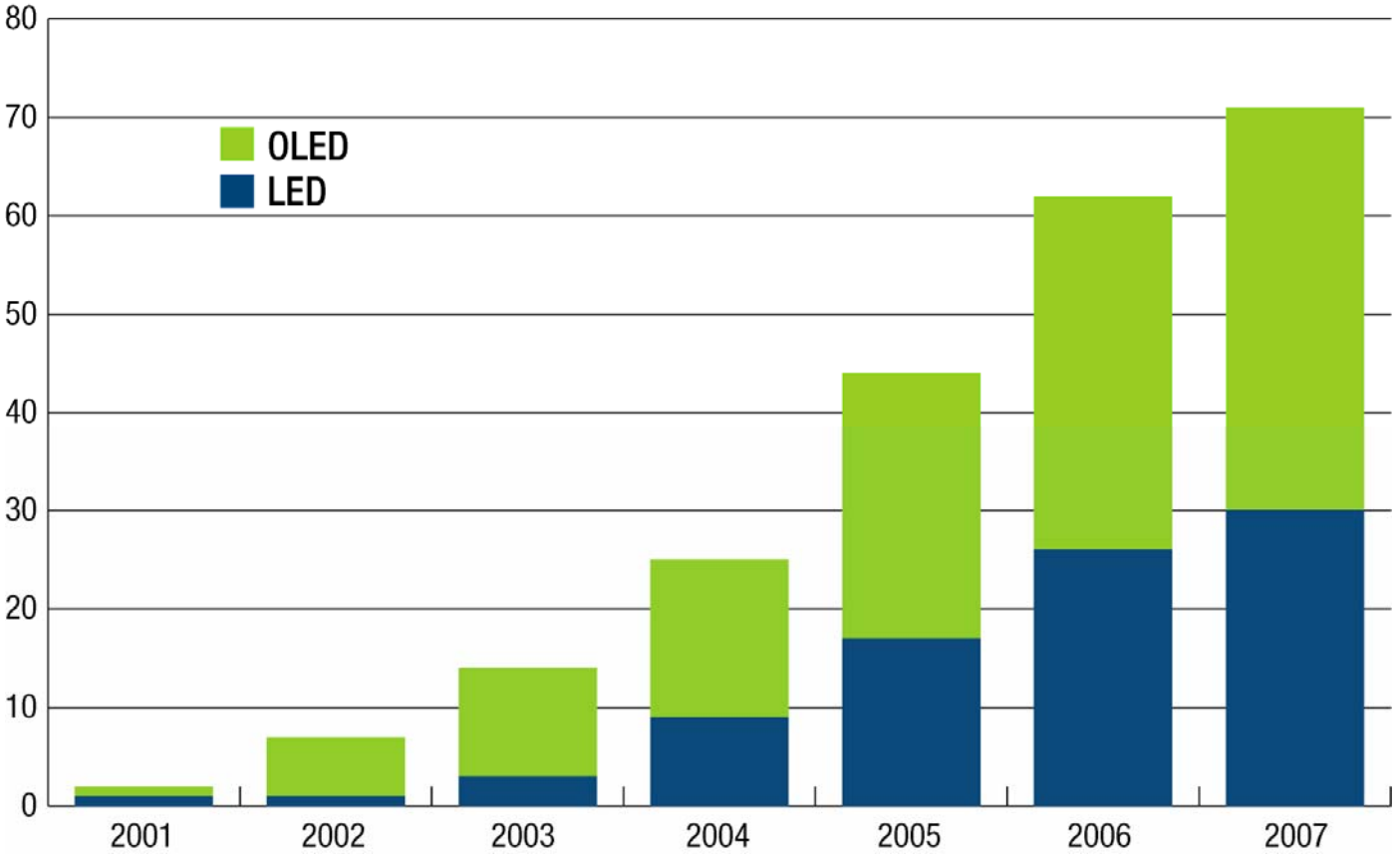


OLED Core Research

- Of 15 total projects:
  - 5 are studying emitting materials
  - 5 are researching transparent conductive oxides
  - 2 are studying charge injection
  - 2 are researching OLED device structure
  - 1 is studying OLED fabrication



SSL R&D Intellectual Property, Cumulative Patent Applications by Year



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Cree, Inc. Demonstrates Cool White Multi-Chip Prototype

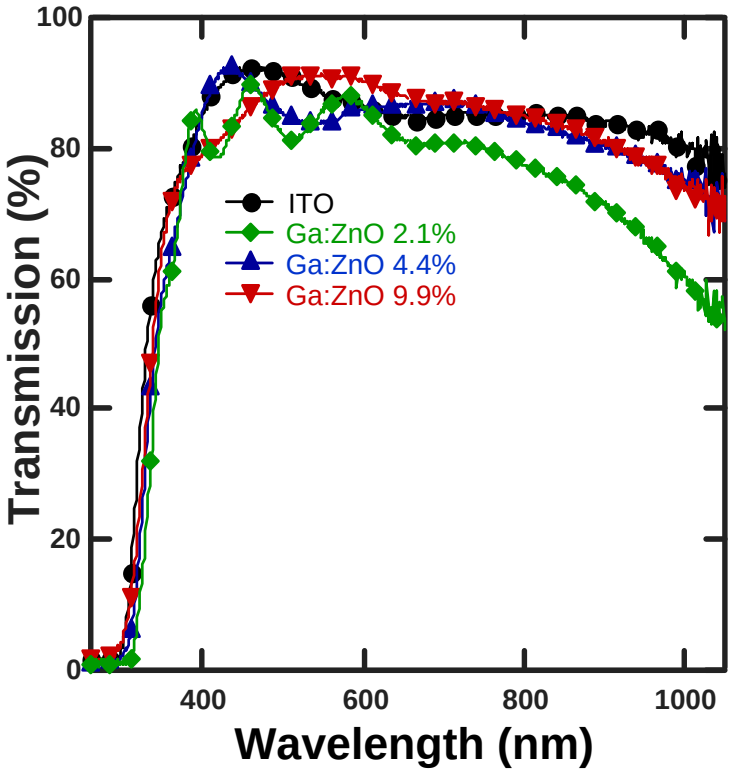
- LED prototype: 88-95 lm/W at 350 mA
- Consumes approx. 8W
- Based on EZBright chip technology platform, with prototype packaging technology

Philips Solid-State Lighting Solutions Develops Advanced LED PAR Lamp

- PAR lamp: 54 lm/W
  - Significantly more efficient than LED PAR 38 lamps
  - 4-5 x more efficient than incandescent PAR 38 lamps
- Hybrid-LED source
  - Advanced LED package and system integration technology
  - Novel driver technology
  - Unique optical arrangement

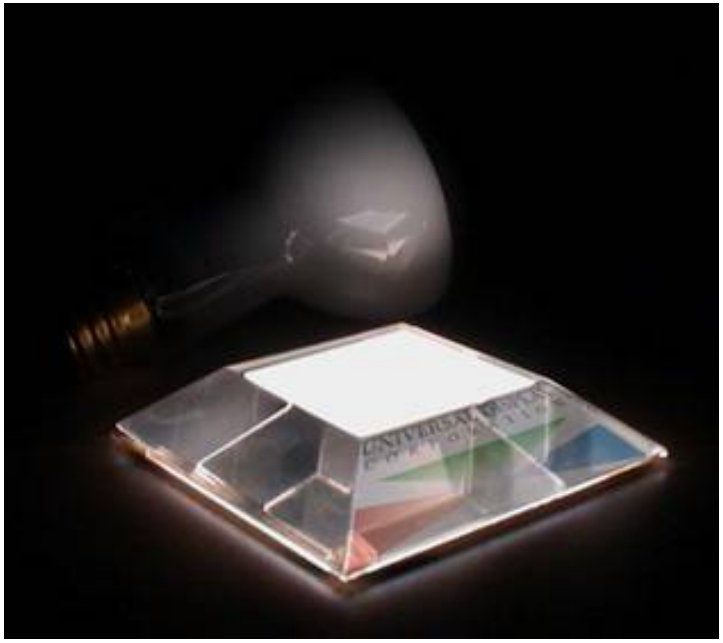
NREL/PNNL Demonstrate OLEDs Based on Gallium Doped ZnO

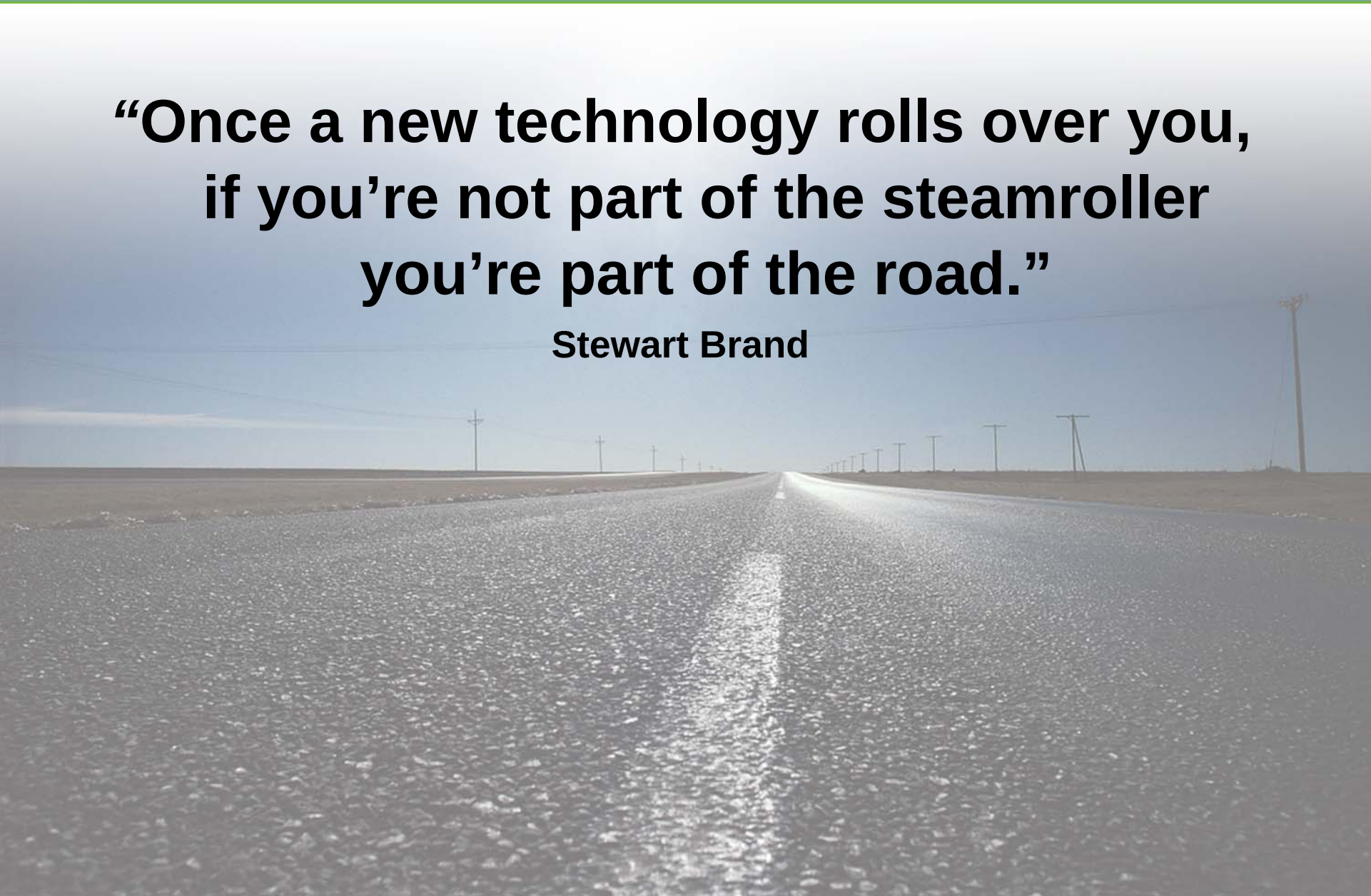
- Performance comparable or superior to ITO based diodes
  - Conductivity, transparency equal or better
  - Less expensive
- Potential for new generation of designable TCO materials



UDC WOLED™ Features Highly Efficient Phosphorescent Emitters

- All-phosphorescent white OLED: 45 lm/W at 1000 cd/m^2
- Enabled by lowering operating voltage, increasing outcoupling efficiency, with highly efficient emitters
- Warm white emission: CRI of 78





“Once a new technology rolls over you, if you’re not part of the steamroller you’re part of the road.”

Stewart Brand