2010 Department of Energy Project Management Workshop

March 9 - 10, 2010, Alexandria, VA

U.S. DEPARTMENT OF ENERGY

"Meeting The Challenge"

The Drive for Net-Zero Energy Commercial Buildings

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U.S. Department of Energy

Energy Efficiency and Renewable Energy

Buildings' Energy Use

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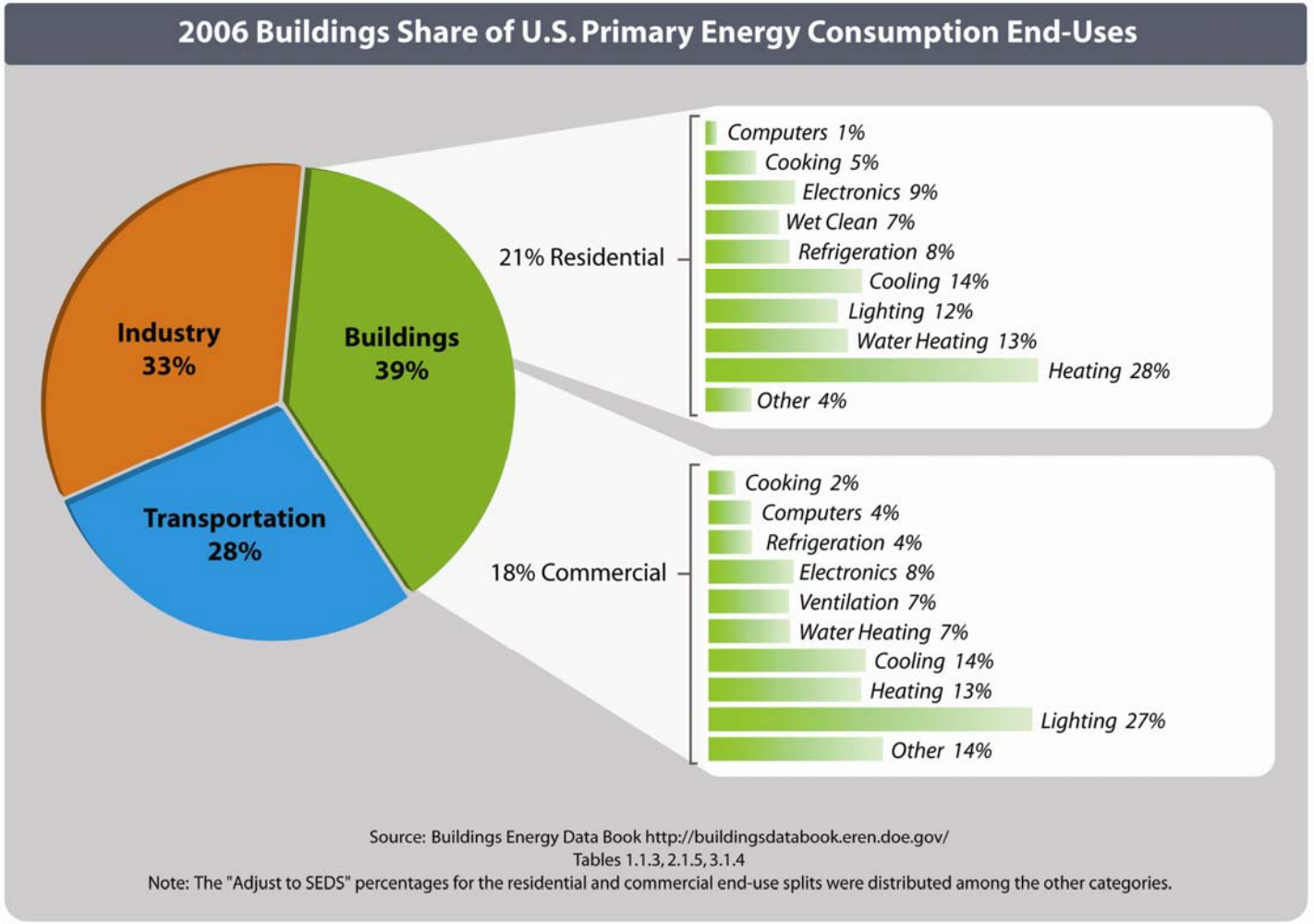

Commercial Square Footage Projections

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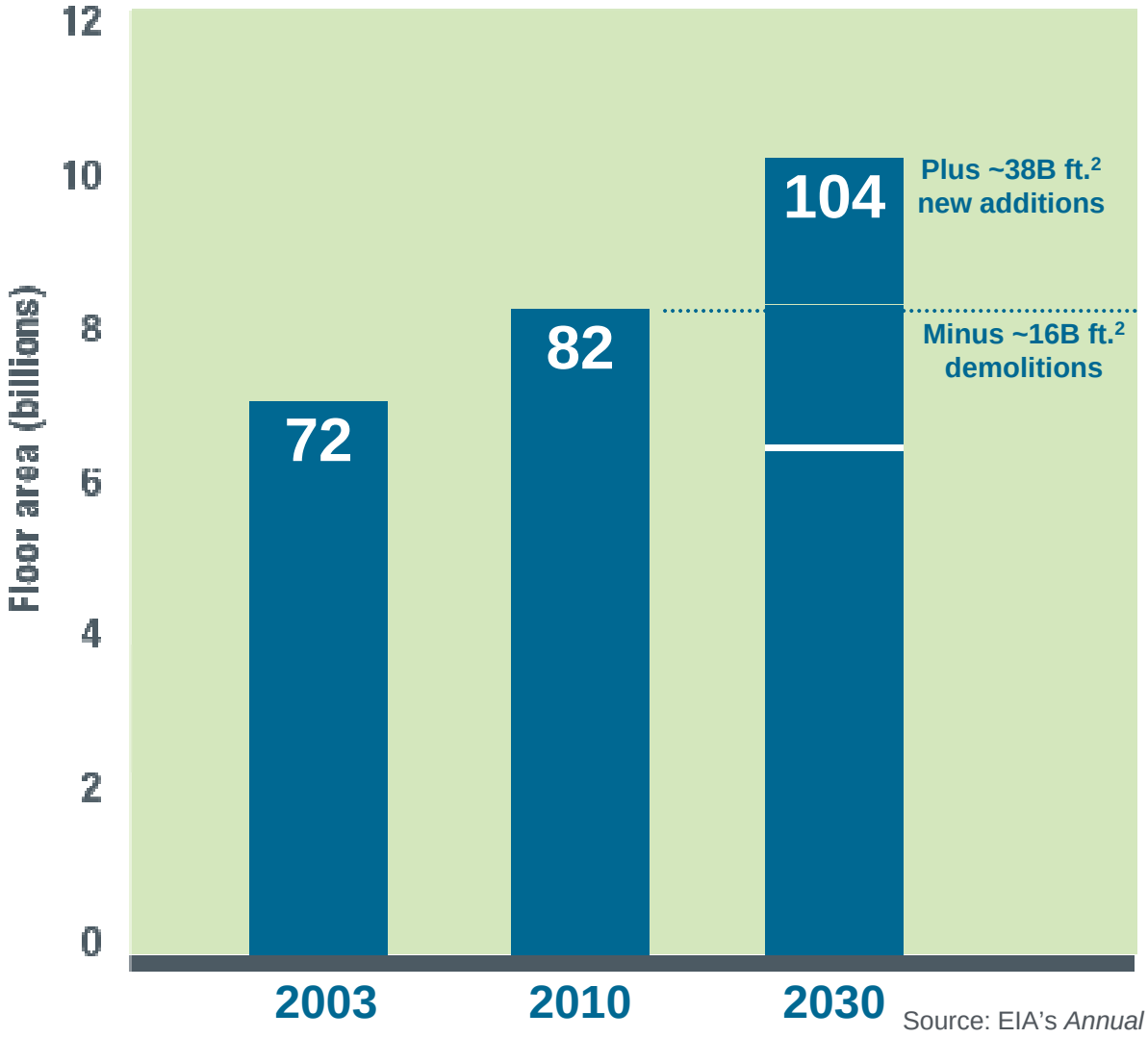
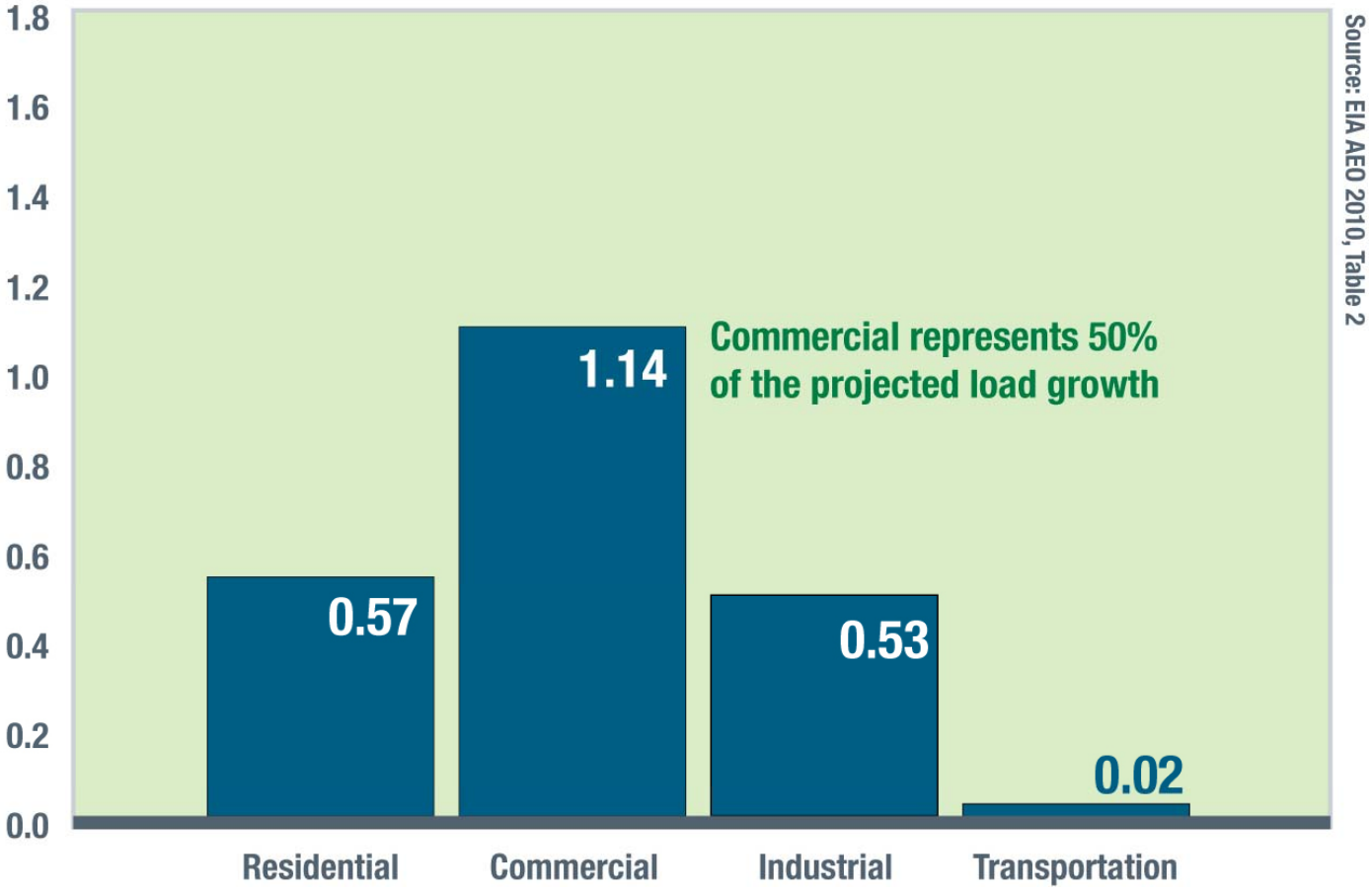


Source: EIA's *Annual Energy Outlook 2009*, Table 3.

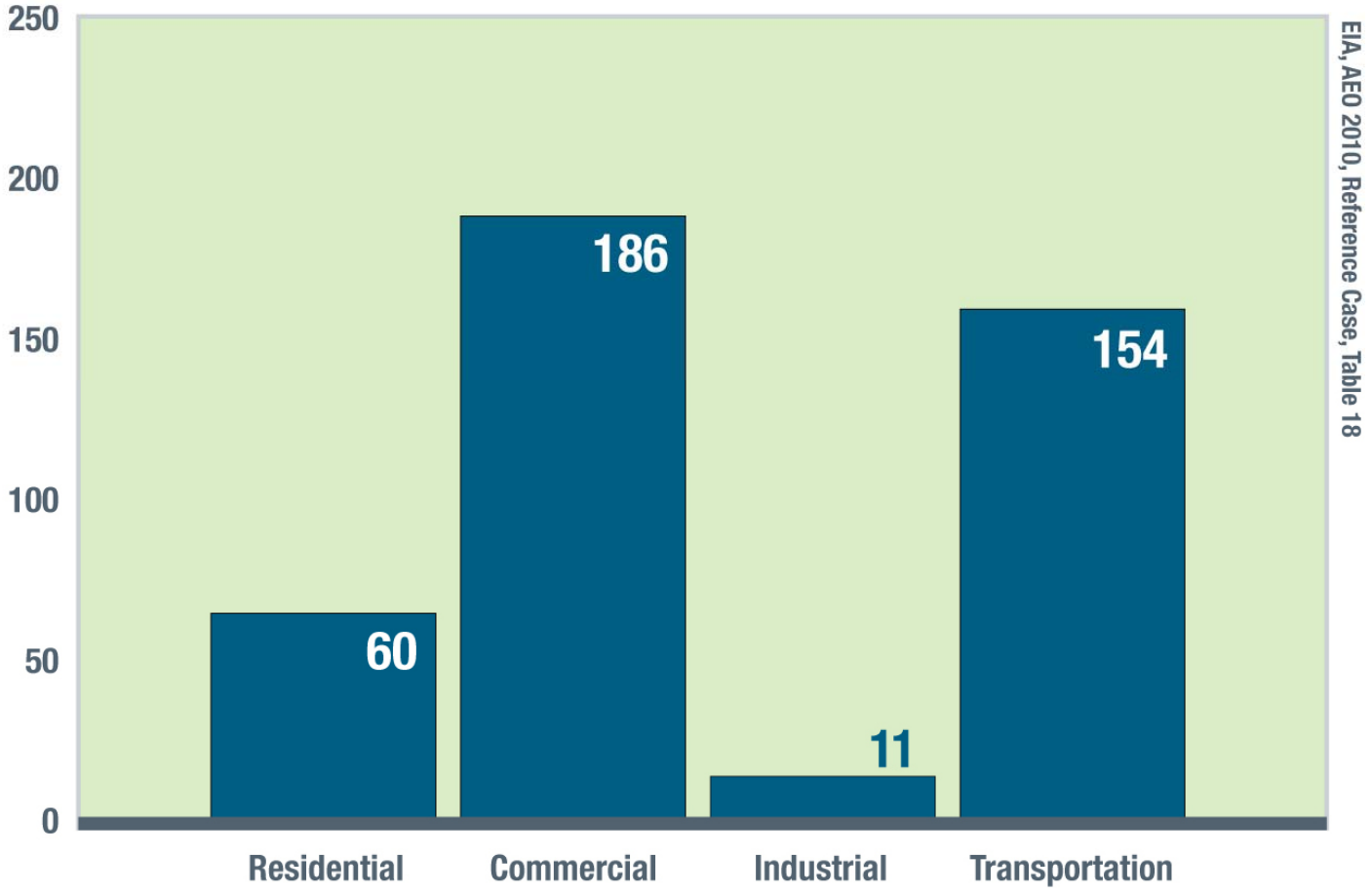
Projected Electricity Growth

2010 to 2025, by End-Use Sector *(site quad)*



Projected Increase in Carbon Dioxide Emissions

2008 to 2030, by End-Use Sector *(MMTCO$_2$-e)*



Goals for Commercial Buildings

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2050
All commercial buildings are ZEB (EISA 2007)
83% reduction in U.S. GHGs by 2050 (Obama)

2040
50% of commercial building stock is ZEB (EISA 2007)

2039
All New are ZEB (EISA 2007)
Stock energy performance 50% better w.r.t. CBECS 2003 (CBI Performance Goal)

2025
Improve New 70% with 5-year payback or less (CBI Performance Goal)

2020
17% reduction in GHGs rel. to 2005 (Senate Proposal)

2015
Improve New 50% (CBI Performance Goal)

OK, but what is Zero Energy… lots of definitions

ZEB Renewable Hierarchy

1. Energy Efficiency
   – daylighting, CHP, passive solar
2. Footprint supply options
   – building mounted PV or wind
3. Site supply options
   – parking lot PV or wind
4. Imported supply options
   – wood chips, ethanol
5. Renewable credits

ZEB Definitions

- **Net-Zero Site Energy:** produces as much renewable energy as it uses annually, when accounted for at site.
- **Net-Zero Source Energy:** produces (or purchases) as much renewable energy as it uses annually, when accounted for at source. Source energy refers to primary energy used to extract, process, generate, and deliver energy to the site.
- **Net-Zero Energy Costs:** building in which money the utility pays the building owner for the renewable energy the building exports to the grid is at least equal to the amount the owner pays the utility for energy services and energy used annually.
- **Net-Zero Energy Emissions:** produces (or purchases) enough emissions-free renewable energy to offset emissions from all energy used in the building annually. Carbon, nitrogen oxides, and sulfur oxides are common emissions that ZEBs offset.

Can we get to Net-Zero Energy?

Technical Potential

- Assessment of the Technical Potential for Achieving Net Zero-Energy Buildings in the Commercial Sector
  www.nrel.gov/docs/fy08osti/41957.pdf

- Methodology for Analyzing the Technical Potential for Energy Performance Across the Commercial Sector
  www.nrel.gov/docs/fy08osti/41956.pdf

Great Potential in Commercial Buildings

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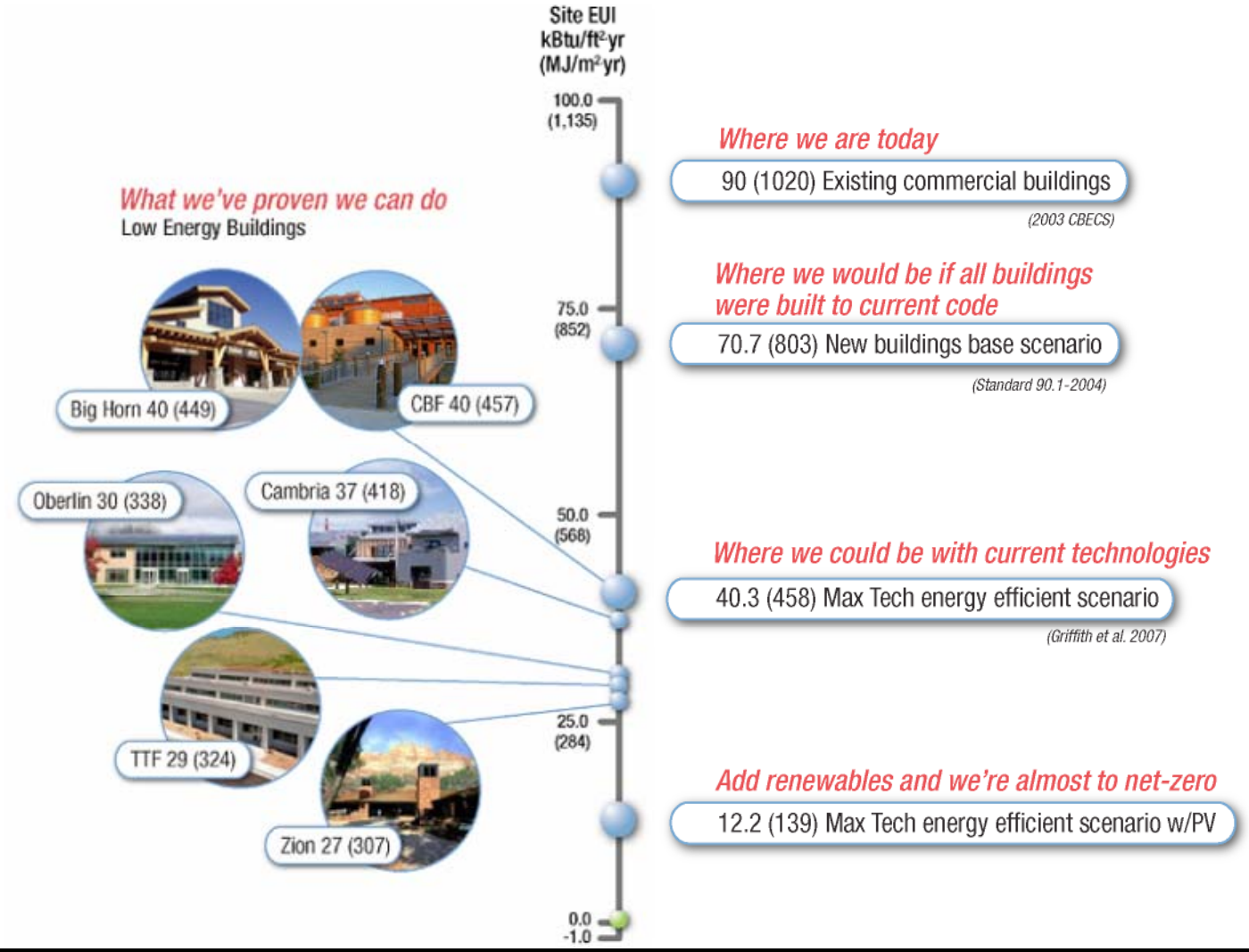
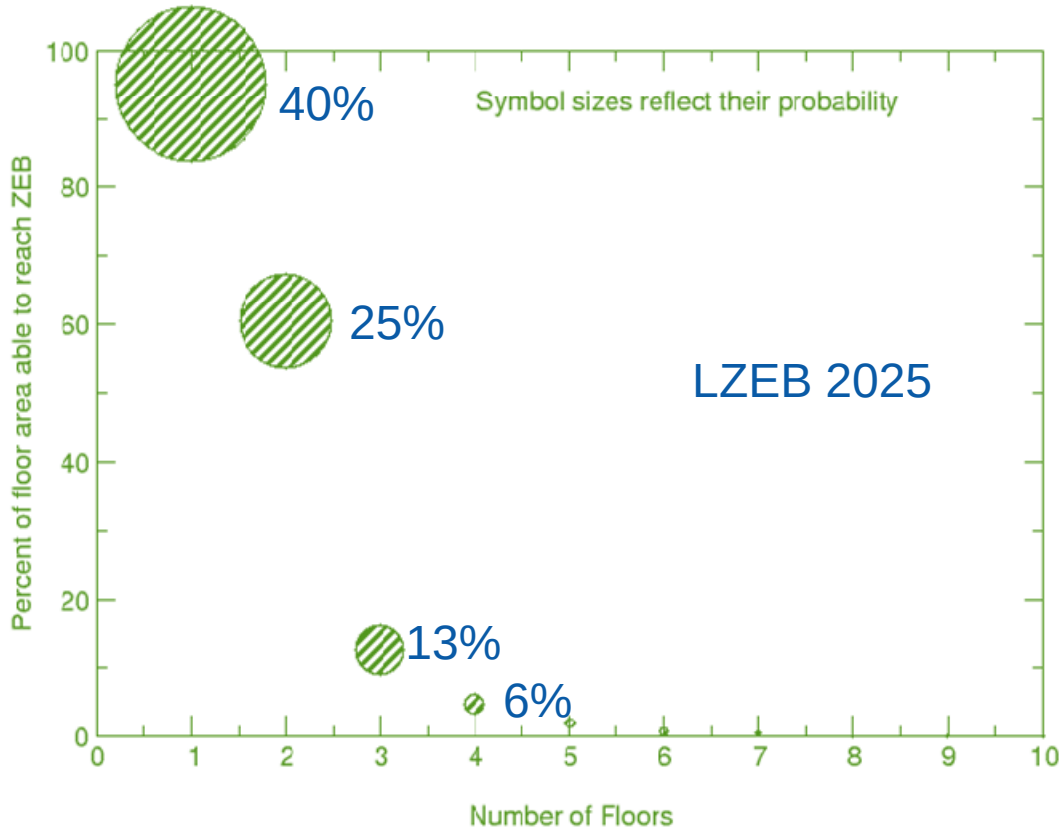


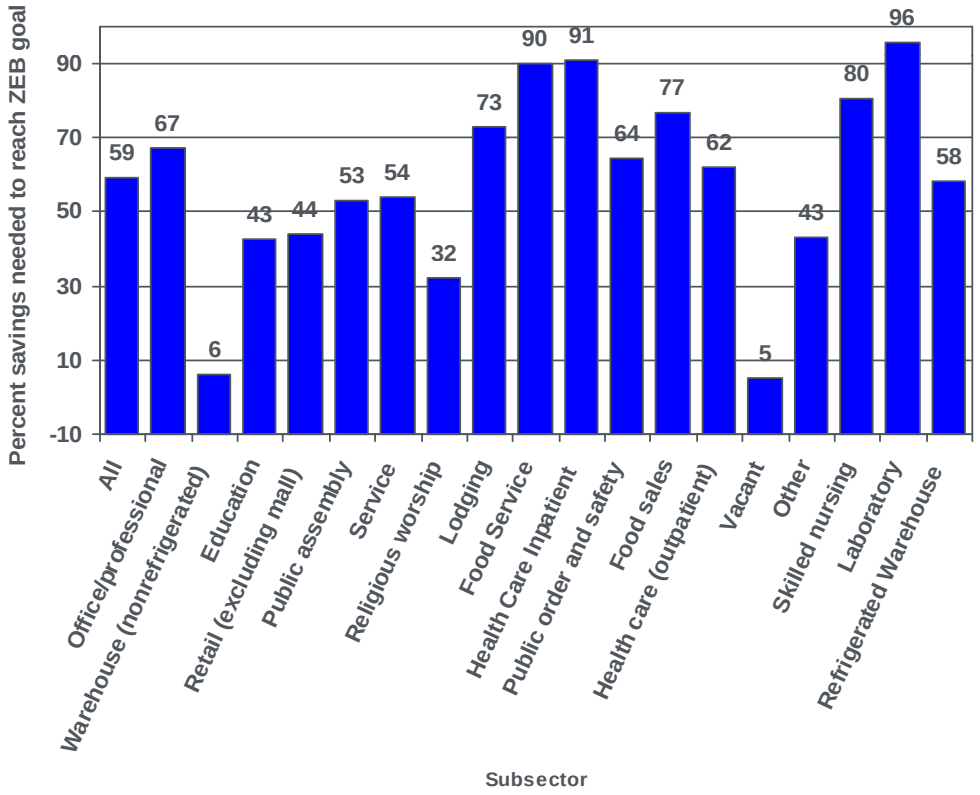
ZEB Characteristics

- Number of floors impacts ability to reach ZEB goal
- Roof area
- Daylighting



Energy Efficiency

Need 60% to 70% decrease in energy consumption of commercial buildings



Low-Energy Case Study Buildings

- **Oberlin College Lewis Center—Ohio**
  Goal: zero net site energy use (79%)
- **Zion Visitor Center—Utah**
  Goal: 70% energy cost savings (65%)
- **Cambria Office Building—Pennsylvania**
  Goal: 66% energy cost savings (43%)
- **Chesapeake Bay Foundation—Maryland**
  Goal: LEED 1.0 Platinum Rating (25%)
- **Thermal Test Facility—Colorado**
  Goal: 70% energy savings (51%)
- **BigHorn Home Improvement Center—Colorado**
  Goal: 60% energy cost savings (53%)

Six Buildings

- Each had committed owners
- Each set aggressive energy goals
- Each was monitored for at least one year
- Each building was successful
- Each had some problems
- Many of the problems were similar

ZEB Database

First Database of Net-Zero Energy Buildings:
http://commercialbuildings.energy.gov/

Building	Location	Floor Area (ft^2)	Annual Purchased Energy ($kBtu/ft^2$)
Aldo Leopold Legacy Center	Baraboo, WI	11,900	-2.02
Audubon Center at Debs Park	Los Angeles, CA	5,020	
Challengers Tennis Club	Los Angeles, CA	3,500	-0.0955
Environmental Tech. Center, Sonoma State	Rohnert Park, CA	2,200	-1.47
Hawaii Gateway Energy Center	Kailua-Kona, HI	3,600	-3.46
IDeAs Z2 Design Facility	San Jose, CA	6,560	-0.00052
Oberlin College Lewis Center	Oberlin, OH	13,600	-4.23
Science House	St. Paul, MN	1,530	0

System Details

Building	Building Use	PV System Size	% Savings w/o PV	Floors	HVAC System Type
Aldo Leopold	Commercial office	406	70%	1	GSHP; Radiant Slab; Earth-Tube; Natural Ventilation
Audubon Center	Recreation; Park	25	?	1	Solar Hot Water; Absorption Chiller; Natural Ventilation
Challengers Tennis Club	Recreation	6	60%	2	Natural Ventilation
Environmental Tech. Center, Sonoma State	Higher education; Laboratory	3	80%	1	Natural Ventilation; Passive Solar Heating/Cooling; Thermal Mass; Radiant Heating
Hawaii Gateway	Commercial office	20	80%	1	Natural Ventilation; Cold Sea Water to Cool Air
IDeAs Z2	Commercial office	30	60%	2	GSHP; Radiant Slab
Oberlin College	Higher education; Library; Assembly	160	54%	2	GSHP; Radiant Slab
Science House	Interpretive Center	8.8	60%	1	GSHP; Natural Ventilation; Passive Solar Heating

New Existing Buildings Target

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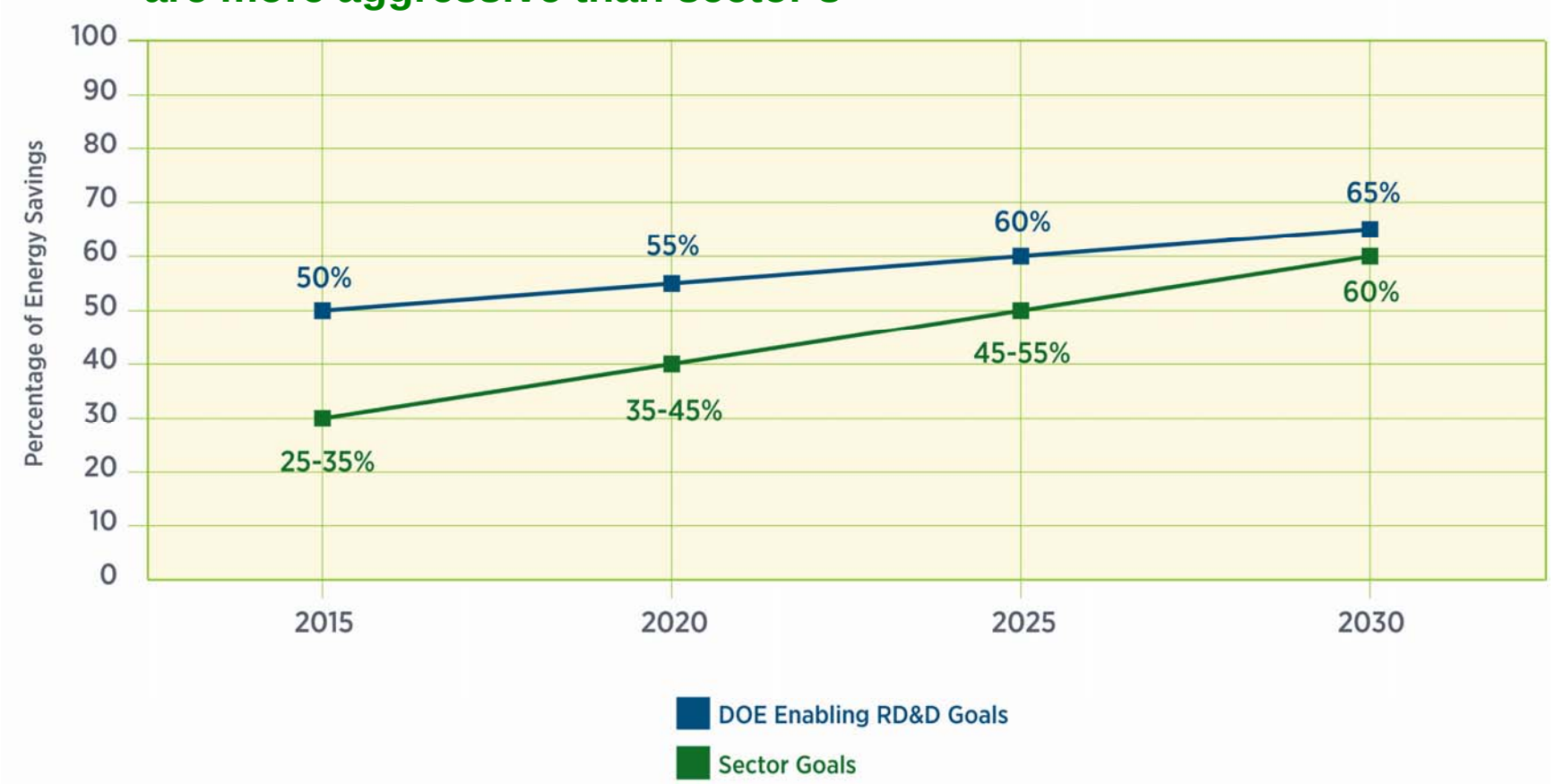
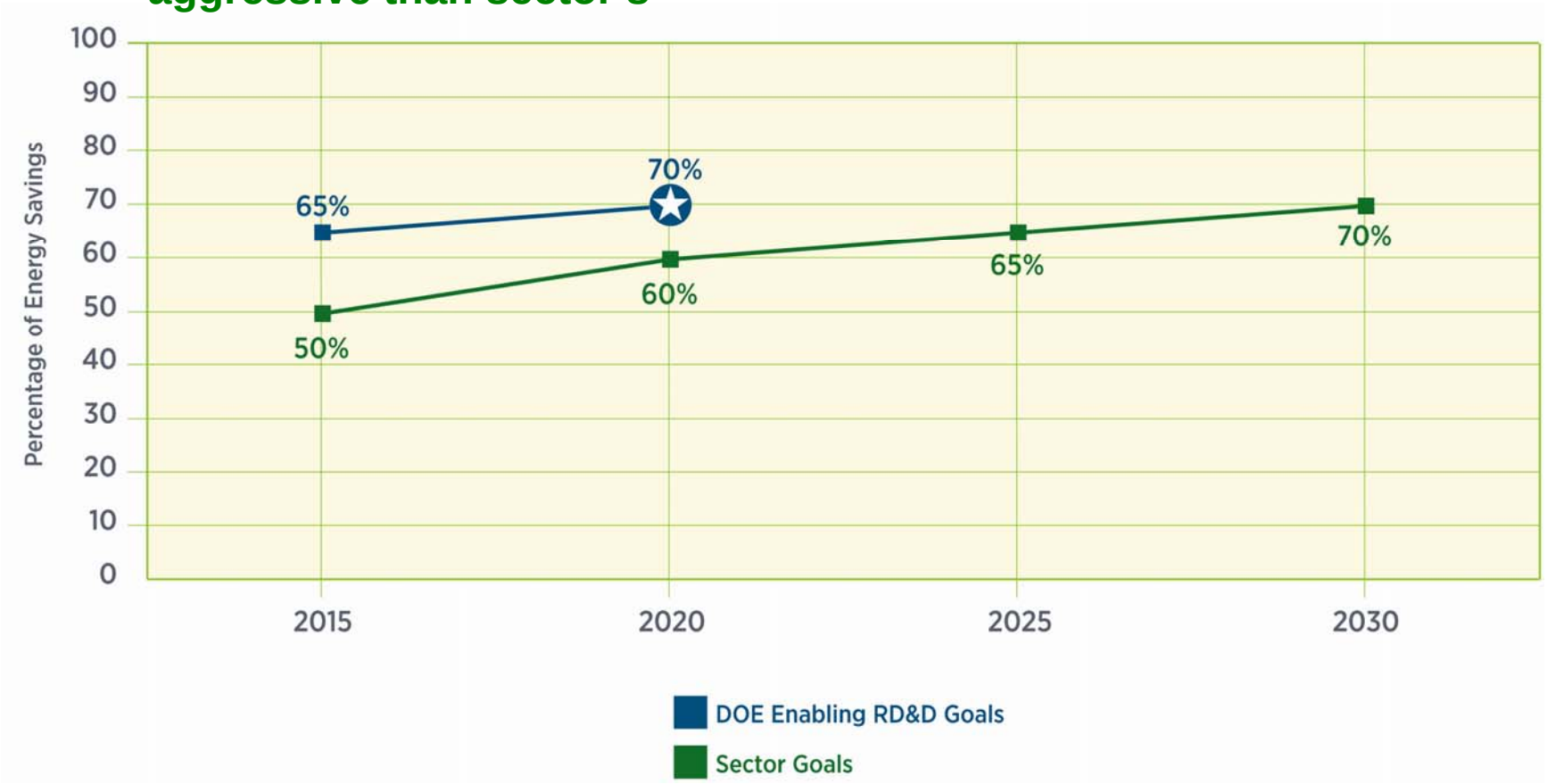
RD&D and Commercial Building Partnership targets are more aggressive than sector's



Targets for New Construction

RD&D and Commercial Building Partnership targets are more aggressive than sector's



Advanced Energy Design Guidance

"… others use the guides selectively to inform specific components of the building design. The AEDGs are also being used to support energy efficiency retrofit projects and on building types that are outside the targeted small commercial markets." **Evaluation of the Market Impact of ASHRAE Advanced Energy Design Guides, Energy Center of Wisconsin**

FY11 and beyond *(guidance will be Web-based)*

- Continue to create guidance for new (also applies to retrofits): 50% in 2010; 70% by 2020
- Create guidance specifically for existing: 30% in 2011; 50% by 2020
- Will ultimately feed into master tool interface for systems-level *building* solutions

Commercial Technology Solutions & Decision Tools

- Systems-based solutions designed to identify 40–50% energy savings
  - Commercial Lighting Solutions (active)
- **FY10:**
  - Developing daylighting, supermarket refrigeration, packaged HVAC systems
- **FY11:**
  - Deploy daylighting, supermarket refrigeration, packaged HVAC systems solutions
  - Add two solution sets targeting ventilation/indoor environmental quality and envelope
  - Will ultimately feed into master tool interface for systems-level *building* solutions

Market Transformative Systems Solutions

- Web-based whole-building decision tool that reflects the interaction of building systems and allows the user to optimize all aspects of the building to achieve desired performance and price targets
- Will include information and guidance from AEDGs, technology specifications, and commercial technology solutions
- Begin development in FY12

Market Outreach and Demonstration Critical to Reaching Goals

Commercial Building Energy Alliances (CBEAs)

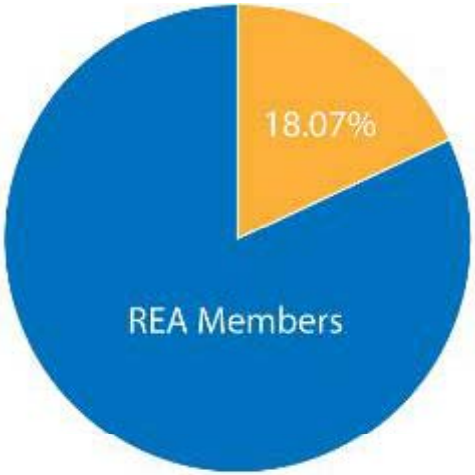
Informal associations among building owners and operators who want to reduce energy consumption

Current CBEAs	CBEAs in Development
– Retailer Energy Alliance (launched February 2008) – Commercial Real Estate Energy Alliance (launched April 2009) – Hospital Energy Alliance (launched April 2009)	– Higher Education Energy Alliance (launching Spring 2010) – Government Energy Alliance (launch TBD)

Market Share of Alliance Members

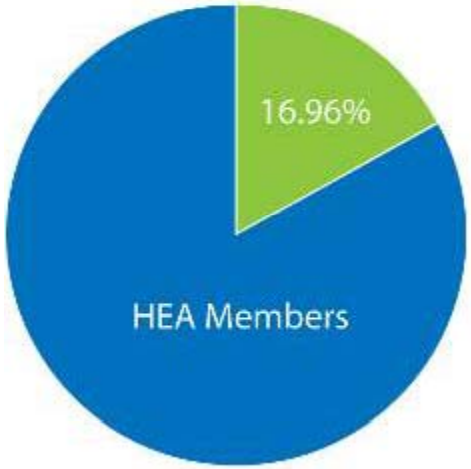
(as of February 2010)

Retailer Energy Alliance



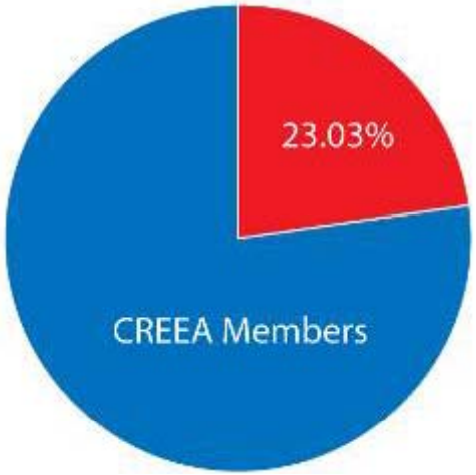
- 46 member companies
- 2.548 billion sq. ft.

Hospital Energy Alliance



- 34 member companies
- 323 million sq. ft.

Commercial Real Estate Energy Alliance



- 51 member companies
- 5.856 billion sq. ft.

Key Alliance Activities

- **Commercial Technology Solutions**

  Targeting 50% Energy Savings at the System Level
  - Commercial Lighting Solutions
  - In development:
    - Packaged HVAC Systems Solutions
    - Supermarket Refrigeration Solutions
    - Daylighting Solutions

- **Supplier Summits**
  - Dialogue between commercial building owners and operators and suppliers
  - Upcoming summits
    - Lighting (Las Vegas, May 11, IES/LIGHTFAIR)
    - Envelope (Miami, June, AIA/AIA National Convention)

Key Alliance Activities

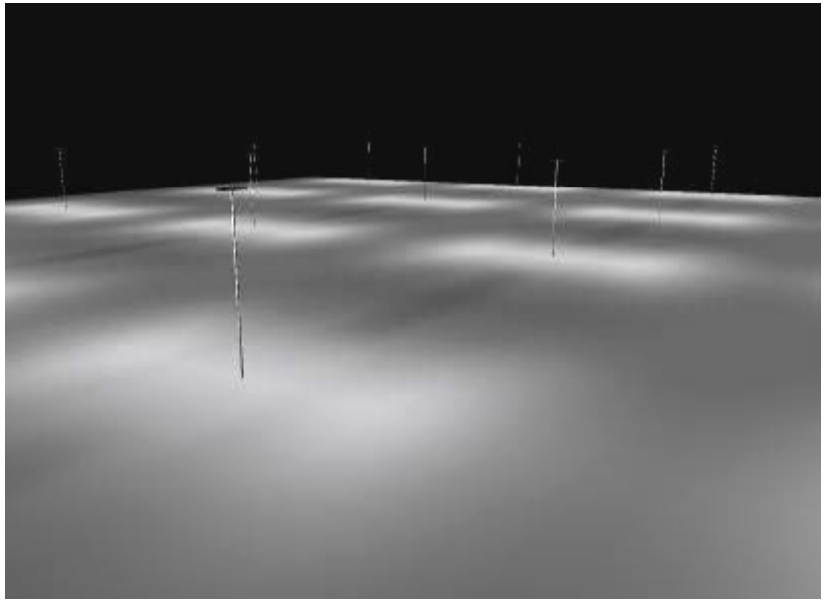
- **Technology Identification and Screening**
  - Nominated, promising energy-efficient technologies are evaluated by DOE and national laboratories
  - Speeds application of “proven” technologies in commercial buildings
  - Supports identification of suitable technologies for possible Technology Specifications

- **Technology Specifications**
  - First project: LED Outdoor Area Lighting
    - Installed at Walmart in Leavenworth, KS
  - Pending:
    - Rooftop HVAC
    - LED Parking Garage Lighting
    - LEDs for Refrigerated Display Cases

CBEA Technology Specifications: LED Site (Parking Lot) Lighting

- Why LEDs make sense for commercial parking lots
  - save energy
    - enhanced luminaire optical efficiency
    - better total system efficacy (lumens per watt)
    - control capability (e.g., dimming)
  - reduced maintenance costs
  - improved uniformity
  - environmentally friendly
- Timing
  - REA working group established April 2008
  - specifications completed early 2009
  - installed at test site July 2009

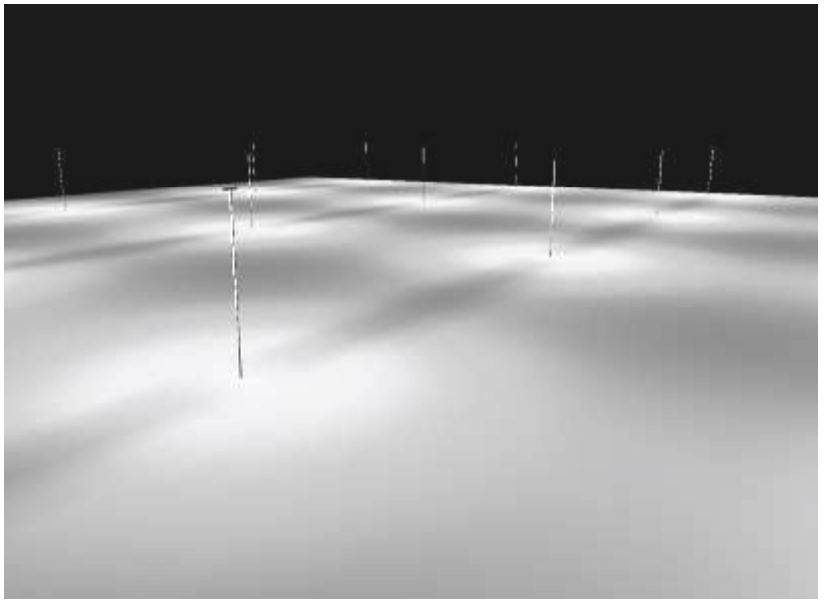
Metal Halide Parking Lot



Average: 3.5
Maximum: 9.0
Minimum: 0.9
Max : Min: 10.0

455W MH

LED Parking Lot



Average: 2.8
Maximum: 5.2
Minimum: 1.2
Max : Min: 4.3

218W LED

What it looks like

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SUPERVALU
Tradition, excellence and future promise.

Commercial Building Partnerships

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- DOE has partnered with more than 20 companies who have agreed to:
  - ***build one new building at 50% less energy*** than Standard 90.1
  - ***retrofit a building that uses 30% less energy*** than the CBECS baseline or 30% less than the mean of their building portfolio
- Labs provide technical assistance
- Recovery Act provides funding for second solicitation
- Funding should allow selection of 50–75 new CBPs

Commercial Building Partnerships

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- **Currently looking for proposals from organizations[1]:**
  - construct a new building that uses 50% less energy than ASHRAE/IESNA Standard 90.1-2004;
  - retrofit a building that uses 30% less energy than the CBECS baseline or 30% less than the mean of their building portfolio;
  - upgrade one technology throughout their building portfolio that will result in a 40–50% energy reduction as compared to the mean of the portfolio
  - Iconic/Exemplary Buildings:
    - ZEBs
    - Very low energy in an existing building
- **Will target higher energy reductions in existing each round**

1. Private businesses, federal agencies, municipalities, states, academic institutions, and nonprofits.

Conclusion

- DOE sets a high bar: substantial leaps toward net-zero energy performance
- Commercial partners define the research agenda, identifying technologies to advance their portfolios
- National labs bring unique strengths and technical support to solve pressing needs of partners
- Commercial partners invest in major projects and bring the results to the marketplace
- CBI: *Innovate, measure, document, replicate to accelerate change*