



U.S. Department of Energy  
**Energy Efficiency  
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**Building Technologies Program**

# Commercial Buildings R&D and National Energy Alliances

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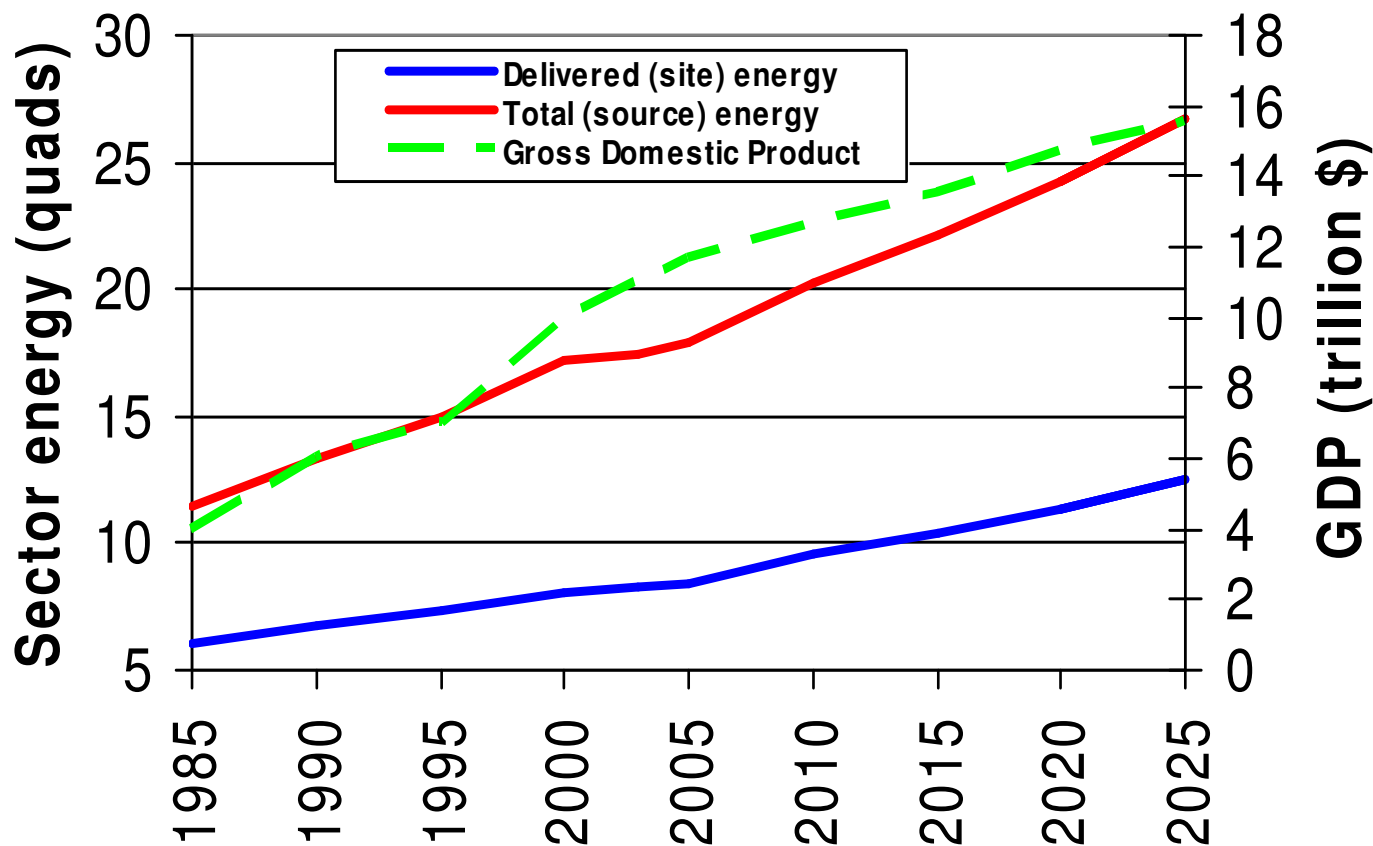


# Commercial Buildings

- 2007 Snapshot
  - 77 billion square feet of floorspace (~2755 square miles)
  - 18.2 quadrillion Btu, 18% of total US energy use
  - 35% total electricity use
  - 1055 million metric tons CO<sub>2</sub> equivalent, 18% US total
- EIA Reference Case Projections
  - 2.11 billion ft<sup>2</sup> added per year through 2030, or 49 billion new additions cumulatively (1740 square miles)
  - ...driving demand for 8.3 additional quads by 2030
  - ...driving 55% of total increase in electricity use
  - ...driving increase in CO<sub>2</sub> emissions of 575 MMT by 2030



# Commercial Sector Trend



- Commercial Sector Energy Use is Growing at 1.6% per year
- Growth is faster than energy efficiency measures



# How Do We Reverse the Trend?

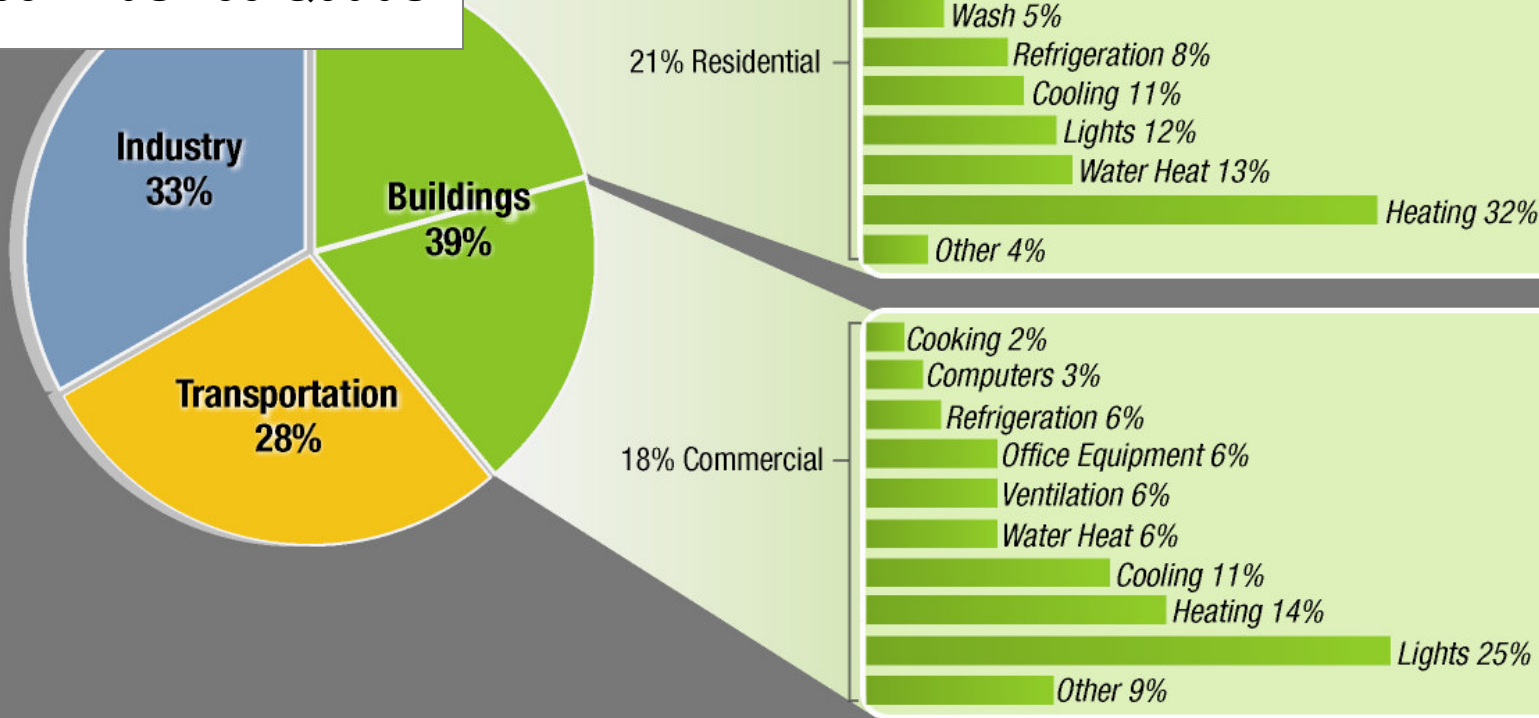
- Understand the potential
- Understand the commercial market
- Set aggressive goals
- Find research gaps
- Engage early adopters creating partnerships
- Establish paths for achieving savings



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**Total US Consumption  
in 2004 was 100 Quads**

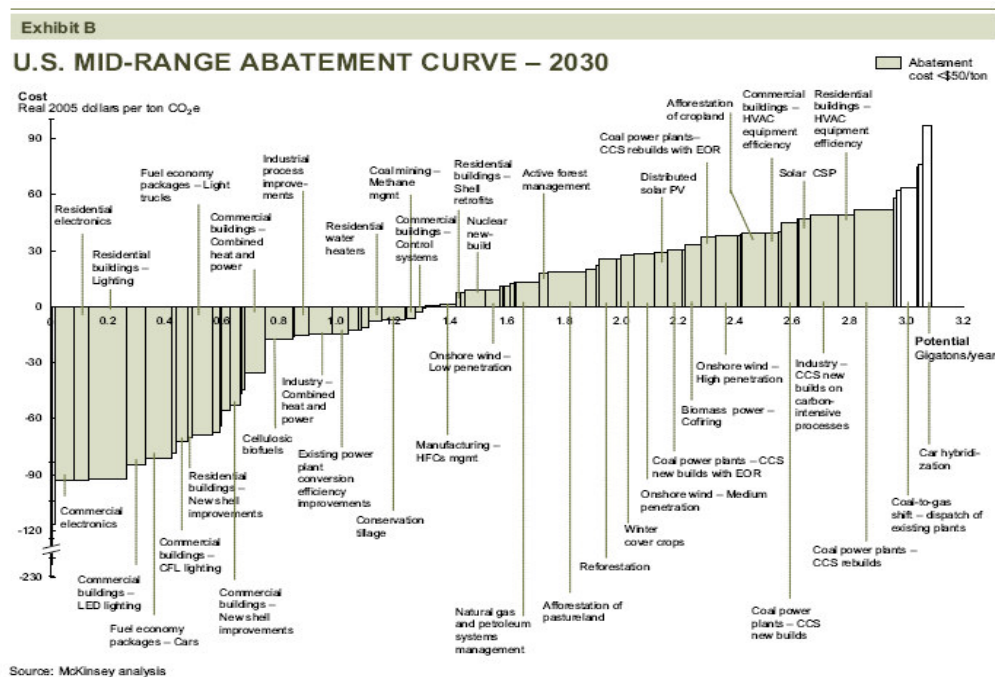


Building Sector construction and renovation accounts for 9% of GDP and employs 8 million people. Energy utility bills total \$325B each year.



# Building Energy Efficiency is the Lowest Cost (No-Cost) Way to Impact Carbon

- “Energy efficiency improvements in... buildings...make up the largest cluster of negative-cost abatement opportunities.”
- Most improvements use existing technology
  - 70% (500 megatons) available before 2020
  - Could offset 70% of incremental power load forecast in the reference case



Source: “Reducing US Greenhouse Gas Emissions: How Much at What Cost?”  
McKinsey & Company and The Conference Board, November 2007



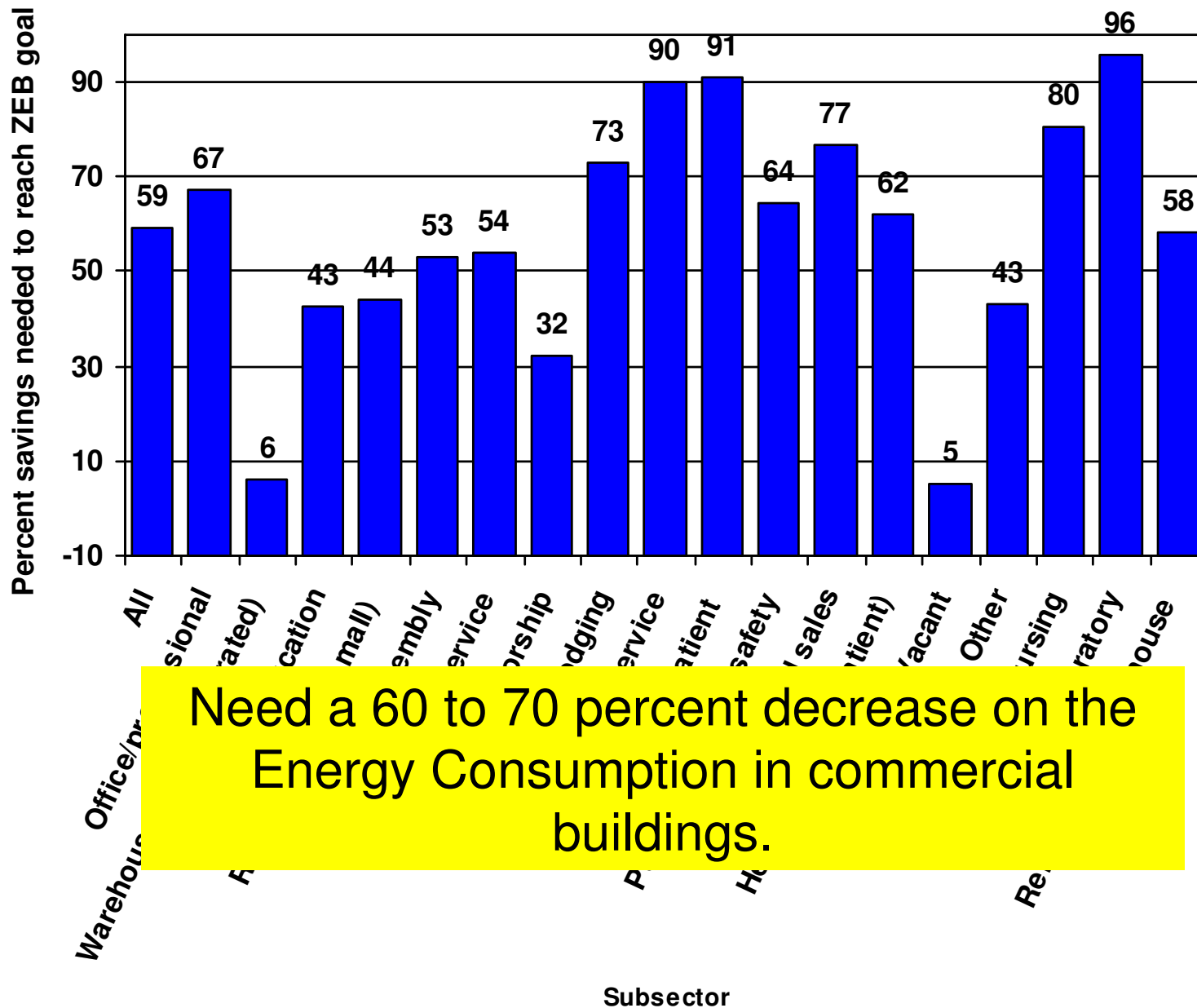
# The Potential

- What level of savings is achievable?
- Assessment of opportunities
- Created a model of the commercial stock—exercise with today's and future technologies



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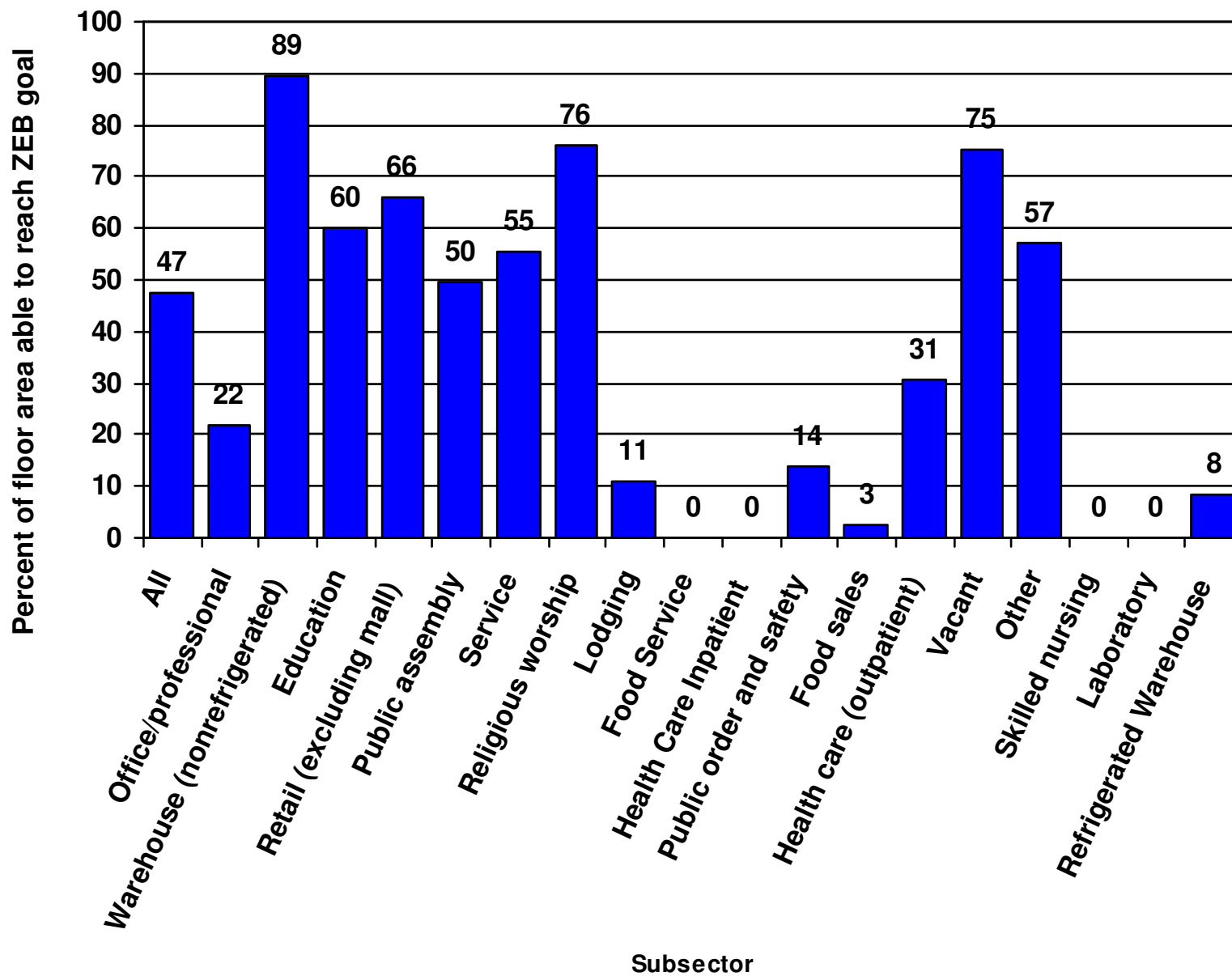
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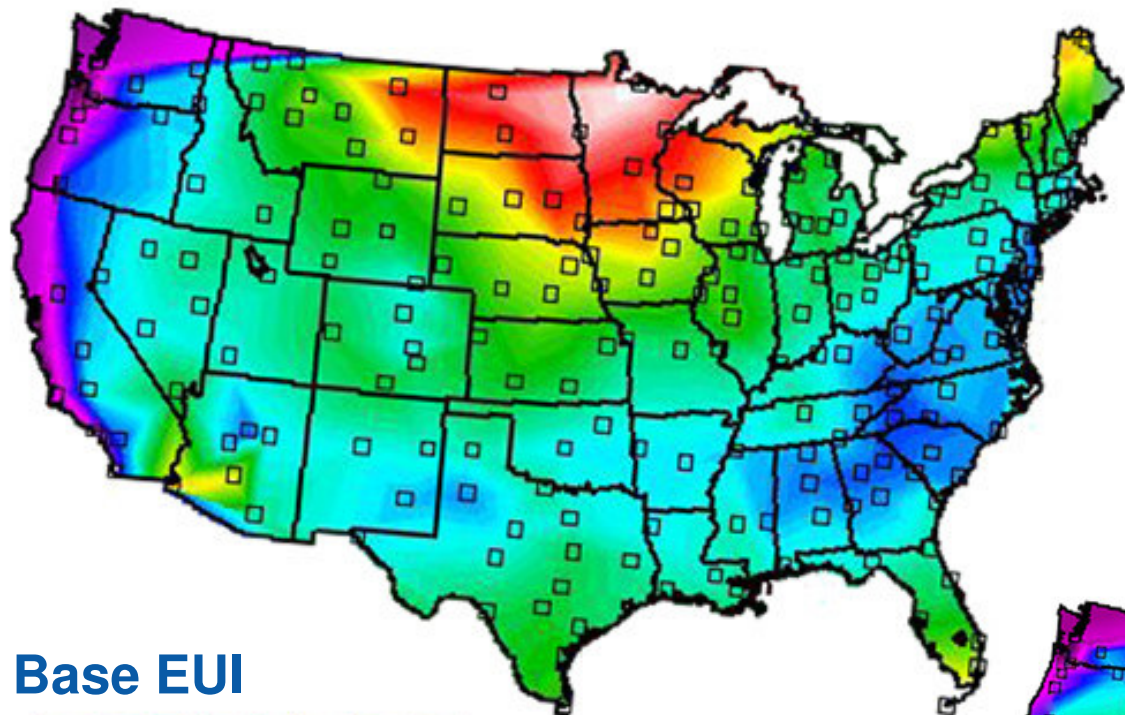
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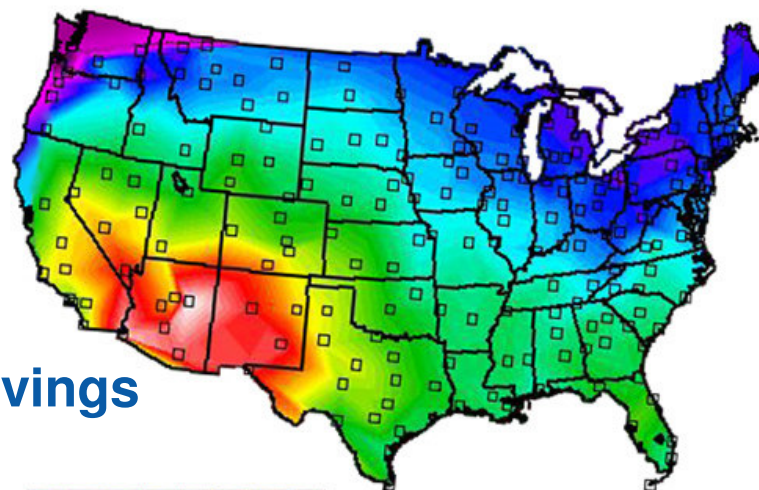
## Base EUI



Site net EUI kBtu/ft<sup>2</sup>-yr

45

58 kBtu/ft<sup>2</sup>-yr



## % Savings Net



% Savings

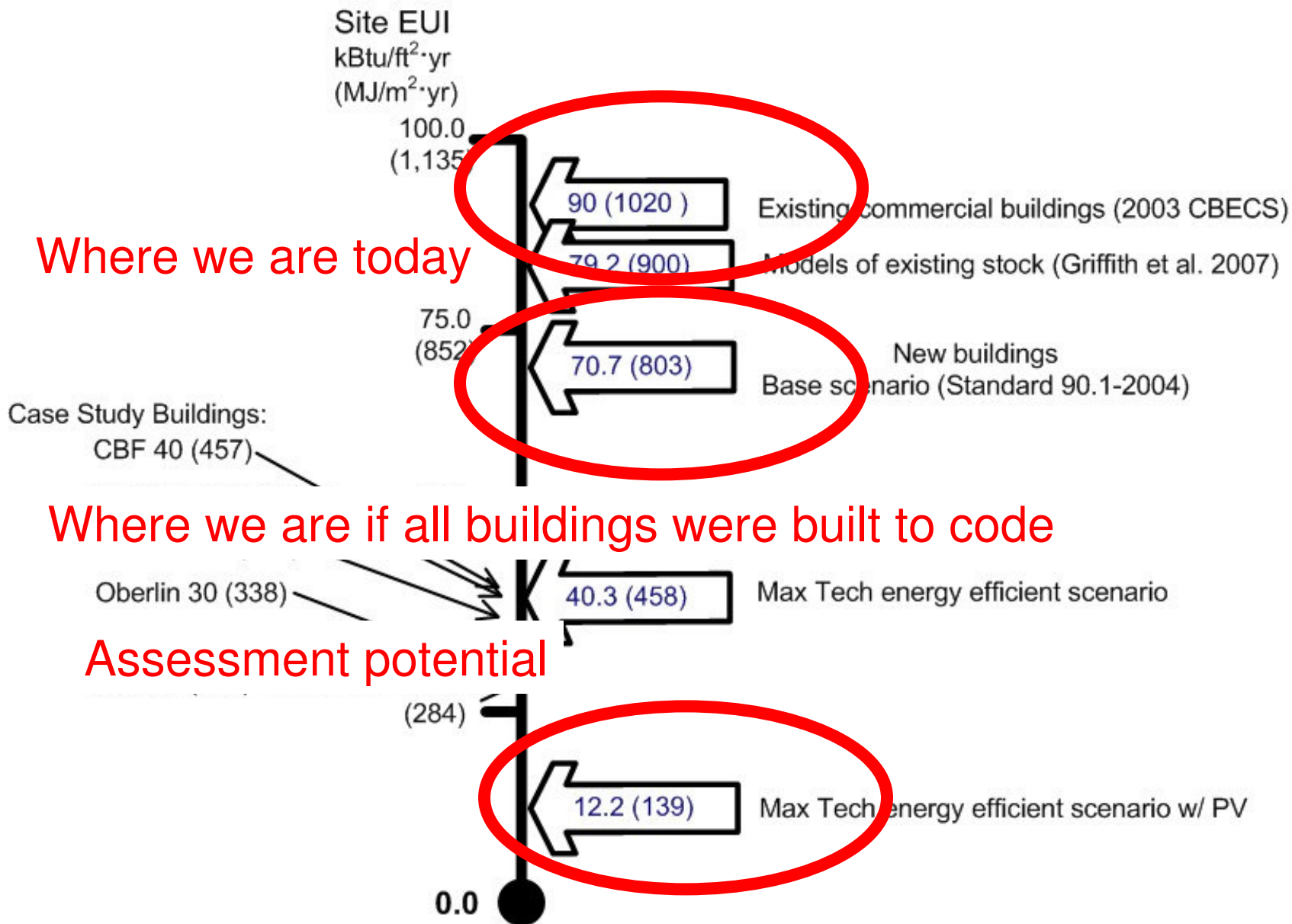
64%

97%



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# DOE Analysis

- Helped to inform industry partners of potentials to set goals in the future
- CBECS, Assessment, Simulation work
- Provides framework for broad goals



# DOE's Buildings Technologies Program Goal

Create the conditions for low- and zero-energy commercial buildings (LZEBs) to be market viable by 2025.



# Advanced Building Analysis

- Low energy buildings are possible today
- DOE worked with Design Teams
- Common data acquisition to tabulate results
- Examined common lessons learned to create low-energy buildings
- Based on 6 detailed case studies



# Case Study Buildings

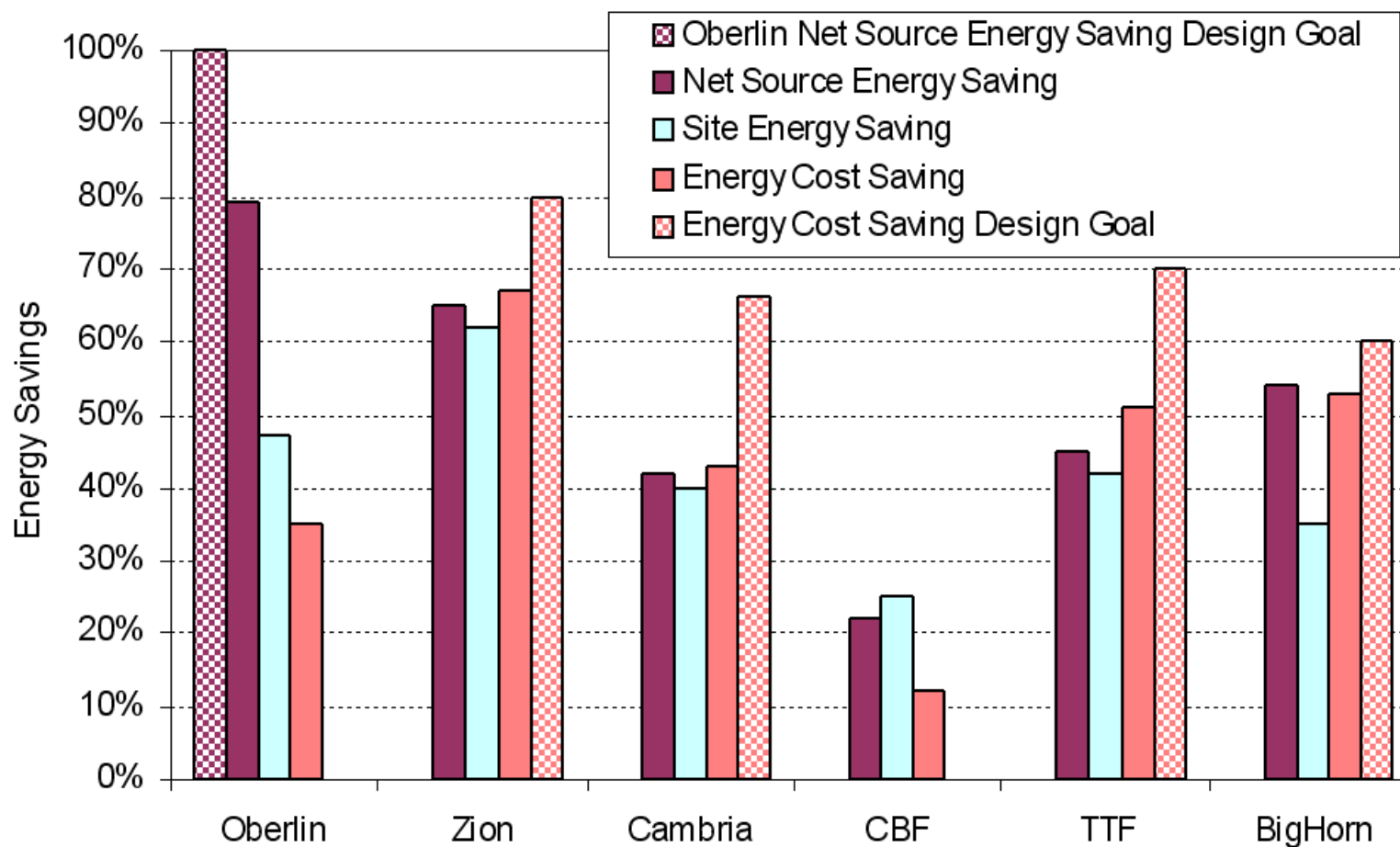
- Oberlin College Lewis Center
  - Oberlin, Ohio
  - goal: zero net site energy use (79%)
- Zion Visitor Center
  - Springdale, UT
  - goal: 70% energy cost savings (65%)
- Cambria Office Building
  - Ebsensburg, PA
  - goal: 66% energy cost savings (43%)
- Chesapeake Bay Foundation (CBF)
  - Annapolis, MD
  - goal: LEED 1.0 Platinum Rating (25%)
- Thermal Test Facility (TTF)
  - Golden, CO
  - goal: 70% energy savings (51%)
- BigHorn Home Improvement
  - Silverthorne, CO
  - goal: 60% energy cost savings (53%)
- Science House, Science Museum of Minnesota
  - St. Paul, Minnesota
  - goal: zero net site energy use (139%)





# Results

## Measured Energy Savings vs. Design





# Core Building Simulation Engine

- EnergyPlus
- Forward thinking—what models will be needed to create next generation of buildings
- Critical for analysis and providing support to industry
- Multi-lab, university, and industry developed



# Tools

- Optimization Engine development
- Methods for non-linear optimization to move through parameter space
- Used as the tool for the K-12 schools
- Used as the analytical engine and compliance engine for next generation tools in California standard (Title 24)



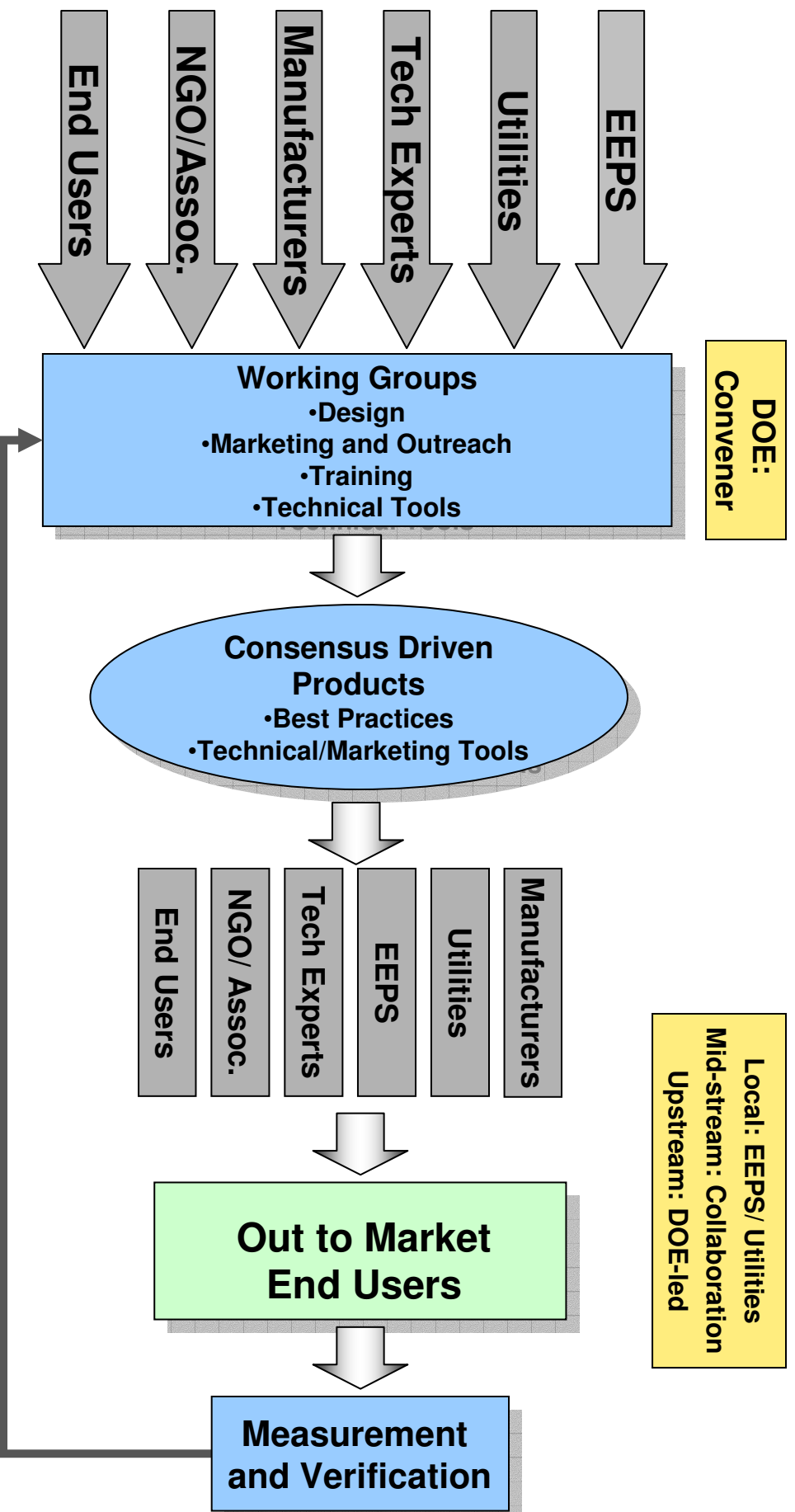
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# Commercial Lighting Initiative

CLI Partnering Model solicits participation and input from stakeholders throughout the process





## Progress & Next Steps

- Lighting solutions have been developed for six types of retail buildings with decreased energy consumption ranging from 33% - 63% below 90.1-2004.
- Webtool development well underway, launch planned for Spring 2008.
- Peer Review through February for Lighting Solutions, Energy and Economic Analysis, Webtool.
- Working Groups are being formed to support adoption, use, marketing, outreach, and M&V. Pilot projects to use *Lighting Solutions* are actively being sought.

### Project Parameters

- Specialty Market: 30K Sq. Ft, 30' Ceiling Height
- Grocery: 50K Sq. Ft., 20' Ceiling Height
- Small Box 1: 24K Sq. Ft, 14' – 20' Ceiling Height
- Small Box 2: 19K Sq. Ft. 14' – 20' Ceiling Height
- Discount Big Box: 100K Sq. Ft, 20' Ceiling Height
- Pharmacy: 10K Sq. Ft., 15' Ceiling Height

### Standardized Format

- Project Description/  
Narrative
- Key Plan
- Design Vignettes
- Control Schedules
- Luminaire Schedule
- Calculations



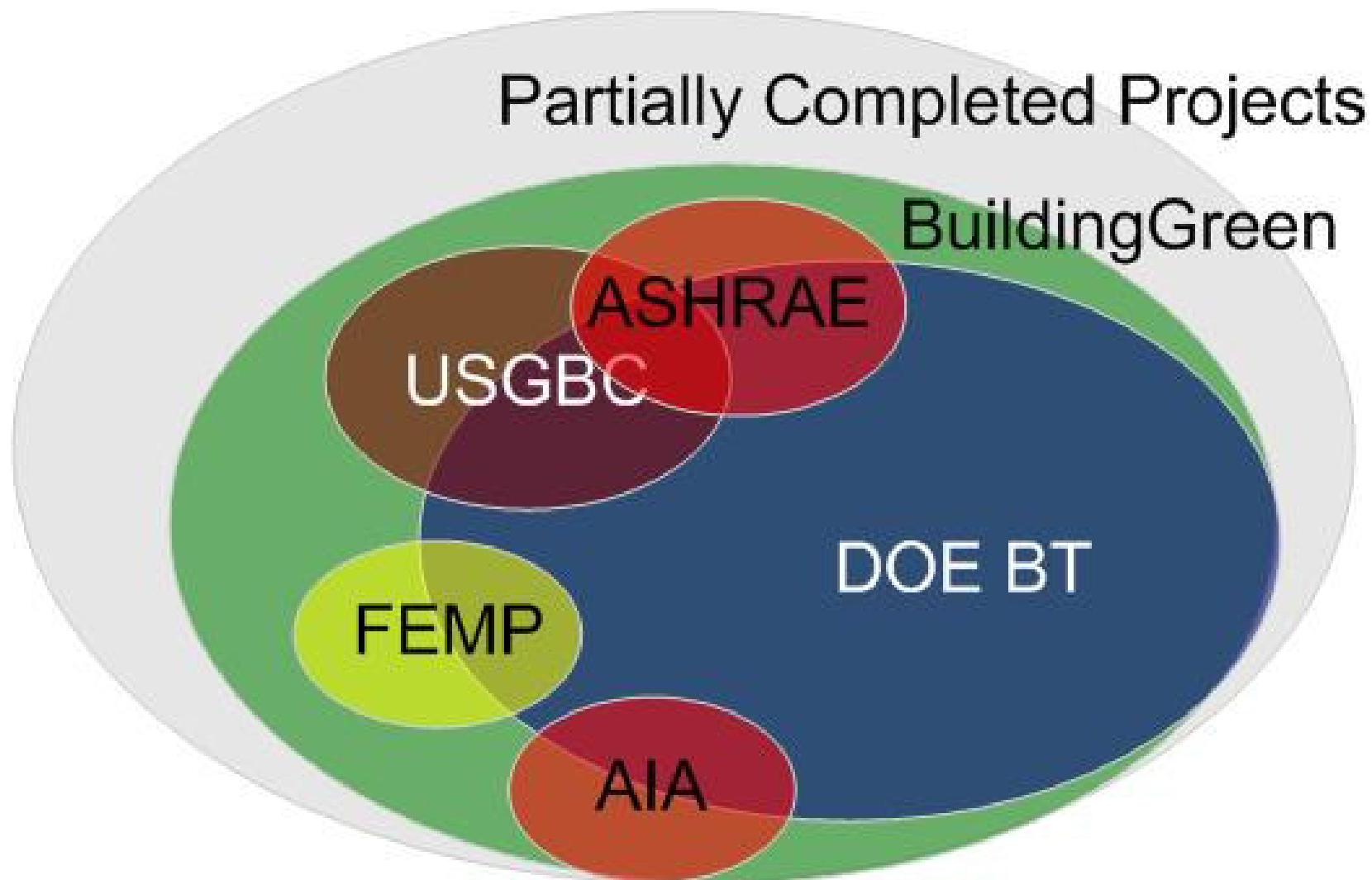
# High-Performance Buildings Database

- Share successes and lessons learned about projects
- Public database
- [www.highperformancebuildings.gov](http://www.highperformancebuildings.gov)



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# Database Partners

- USGBC
- Federal Energy Management Program
  - New Federal buildings must be entered by Executive Order 14123
- AIA Top Ten Winners
- USGBC LEED™ case studies
- Massachusetts Technology Collaborative
- Efficiency Vermont
- USGBC Cascadia Chapter
- Department of Energy
- ASHRAE/IESNA/AIA Advanced Energy Design Guide case studies
- New Buildings Institute (links data from Getting to 50 database)
  
- We know of others that are linking the data
- 3-D models (SketchUp) available for many of the buildings in a new Google Earth layer



# Commercial Goal and Performance Targets

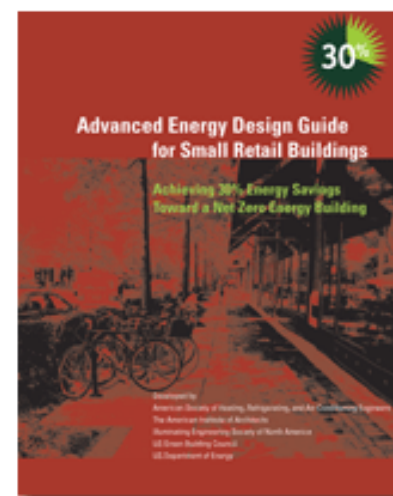
- Marketable Zero Energy Commercial Buildings by 2025
  - Net-zero is grid-connected building that, over course of year, produces with renewable sources as much energy as it consumes
- BT role
  - Focus on reducing energy demand
  - Facilitate successful integration of renewable energy technologies
- Strategic goal allows for acceptance of low energy and net zero energy buildings in the marketplace.
- Performance Targets for ***whole-building*** improvements in new construction
  - 50% by 2015
  - 70% by 2025
  - Relative to ASHRAE/IESNA/ANSI Standard 90.1-2004.



# Where Are We Now?

## 30% Design Guides

- Partnership with ASHRAE, IESNA, USGBC, AIA
- DOE funded analysis and some production costs
- Member organizations train and sell materials
- Prescriptive Guides for 30% Energy Savings over Standard 90.1-2004 <1999>
  - Small Retail
  - Small Office
  - K-12 Schools (Jan 2008)
  - Warehouses (Feb 2008)
  - **Lodging (Fall 2008)**
  - **Hospitals (Winter 2008)**
- 30% Complete in 2008





# Going Forward: Commercial Building Strategy

- National Energy Alliances
  - Strategic alliances with businesses and organizations for targeted building types/market sectors
  - Baseline and share best practices
  - Participate in volume purchases for equipment to pull suppliers to higher levels of efficiency and reduce cost
- National Accounts
  - Work directly with market leaders to optimize current standard design for increasing levels of efficiency and build, monitor, replicate, and share with National Energy Alliances
- Building Package Research and Development
  - DOE sponsored development of advanced design guide products, building decision tools, and technology option sets to support realization of 50% and better buildings



# National Energy Alliances

- Informal associations grouped by market sector
- Retail market selected as first alliance based on EIA's CBECS (30-40% of commercial sector energy use)
- Recognize that market sectors are not homogeneous
- Yet within each, similar business models



# National Energy Alliances

- Planning 4 alliances
  - Retail Chains
  - Portfolio Owner / Operator (Offices, REITs, Finance)
  - Institutional (including Colleges and Universities, State and Local Government, Hospitals and Healthcare)
  - Lodging (Lodging Chains, Owner Built and Operated)
- Voluntary Effort
  - Building owners and operators
  - Design and construction firms
  - Standards bodies
  - NGOs and other energy advocates
- Some of the same organizations represented here today could be a member of one or more of these alliances
- Charter members of Retail Energy Alliance in place and effort will be launched in February 2008



# Retail Energy Alliance

- **Charter Members**

- Wal-Mart, Target, Whole Foods, Best Buy, Food Lion, Kohl's Home Depot, Staples (others in progress)

- **Five sub-markets (example organizations)**

- Food Sales/General Merchandise (e.g., Wal-Mart, Target, or "Big-Box")
- Food Only (e.g., Whole Foods, Food Lion)
- General Merchandise Only (e.g., Home Depot, Kohl's, Best Buy)
- Food Service (e.g., McDonald, Starbucks)
- Warehousing and Distribution (e.g., United Parcel Service, Fed Express)

- Will include new construction and existing buildings



# Planned REA Activities

- Building portfolio benchmarking by retail market type
- Technology procurement
- Technology demonstration
- Best practice for design and operation
- Low-energy building prototype
- Low-energy technology packages
- Training and mentoring



# Planned REA Activities: Baseline Existing Portfolios

- Alliance members submit benchmark data on current buildings (Q2 FY08)
  - Size and Location
  - Age
  - Energy use by fuel
  - Energy Service equipment (HVAC, Lighting, refrigeration)
- Data analyzed and provided to all Alliance members (Q3 FY08)
  - Data presented in aggregate fashion masking individual stores and owners
  - Show average current energy consumption of the portfolio of buildings and basic building characterization data
- Best in class asked to help develop “Best Practices” study
- Less in class asked to participate in application of Best Practices
- Re-Baseline annually and mark progress



# Planned REA Activities: Technology Procurements

- Alliance members can “move the market” by joining together to specify equipment with energy performance characteristics which are beyond what the market might offer, or to help reduce the cost of “cutting-edge” equipment through a mass buy
- DOE has used this approach successfully in the past, such as in the introduction of (efficient) compact fluorescent lamps with attributes – from geometry to brightness - allowing for easy substitution of incandescent lamps
- Alliance develops short list of desired equipment (Q1 FY08).
- DOE will develop draft specifications and accompanying energy analysis (Q2 FY08)
  - Analysis informs alliance members as to which equipment procurements may be pursued first
  - Prioritized list used in successive rounds of procurements
- Once the prioritized list has been approved by members, DOE will issue an RFP (Q3 FY08)
  - DOE analyzes responses, but does NOT procure
  - RFP is intent to purchase by Alliance



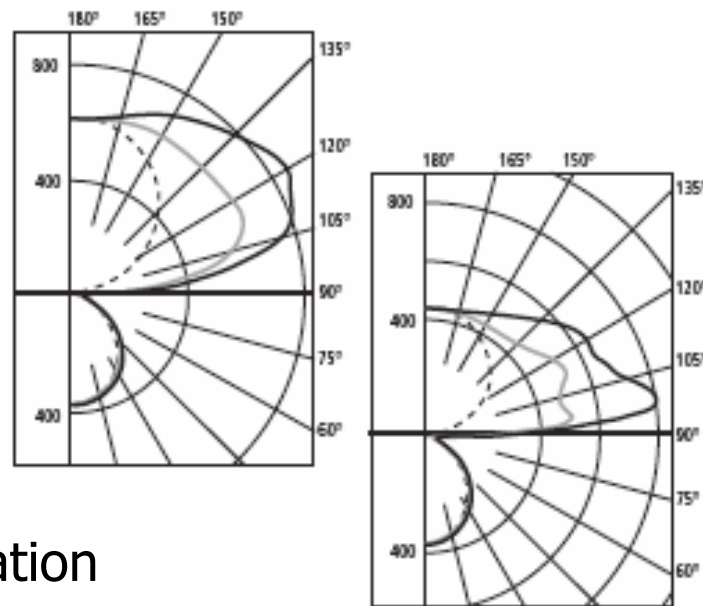
# Planned REA Activities: Technology Option Sets

- Intended for direct use with National Accounts however information and tools available to Alliance members for early adoption
- Address specific energy efficient solutions (such as illumination) for a specific building type or process-specific design
- Commercial Lighting Initiative (CLI) is an example of a TOS that is being developed for the retail “Big-Box” market



# Technology Option Set: CLI

- Integrated Lighting System Packages
  - Lamp + Ballast + Luminaire + Layout/Reflected Ceiling Plan (RCP) + Controls + Installation + Commissioning guidance
- Detailed light specifications
- Expert design → Energy savings
- Include daylighting where possible
- Website delivery
  - Open with a decision tree
  - Description of Lighting Packages
  - Links to incentive programs
  - Compliance tool for custom designs
  - Follow-up for Measurement and Validation





# Planned REA Activities: Building Decision Tools

- Developed to support building prototype redesign for National Accounts
- Tools integrate across TOSs to help select solutions appropriate to the building type and owners/designer performance target
- Present a continuum of efficiency levels from 30% to 50% and beyond
  - National Account may select a particular level of performance for prototype design and construction
  - Other Alliance members can use tool to pick alternative energy efficiency performance levels based on their design needs, business model, and other constraints



# National Accounts

- One or more National Accounts within each NEA
- DOE will provides technical assistance team to help National Accounts with the design, analysis and retrofit/construction of low-energy buildings
- Each National Account will construct at least one low-energy building (30% less energy than ASHRAE 90.1-2004) using the most cost effective and energy efficient technologies available—based on their *business model*
- Ultimate goal: prototype designs for each building type that achieve at least 50% energy savings as compared to ASHRAE Standard 90.1-2004
  - HOWEVER National Account will select design & associated efficiency level, that meets its cost constraints and operating needs
  - BUT full spectrum of choices, as embodied in the Building Design Tool, from 30 to 50% energy savings, or greater, will be analyzed and documented for Alliance
- First REA National Account prototype design (FY 08)
  - Probably “Big-Box” (Food Sales/General Merchandise) or a Food Sales national chain
  - DOE works with National Accounts for other REA building types to develop additional prototype designs and Tools



# Retail Energy Alliance

***REA is by and for retailers.*** REA members agree to:

- Participate in 2 live conferences per year
- Participate in conference calls every 2 months
- Share benchmark energy and building characteristics data
- Share additional energy related information, such as:
  - Results of equipment tests
  - Planned equipment purchases
  - Best practices in building operation and maintenance including any regional variation such as evaporative cooling in southwest
- Retail Executive Roundtable convened by Assistant Secretary
  - February 21<sup>st</sup>, Washington, DC
- Followed by REA launch



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# Thanks!

Contact me for additional information on  
REA, other EAs, or National Accounts

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