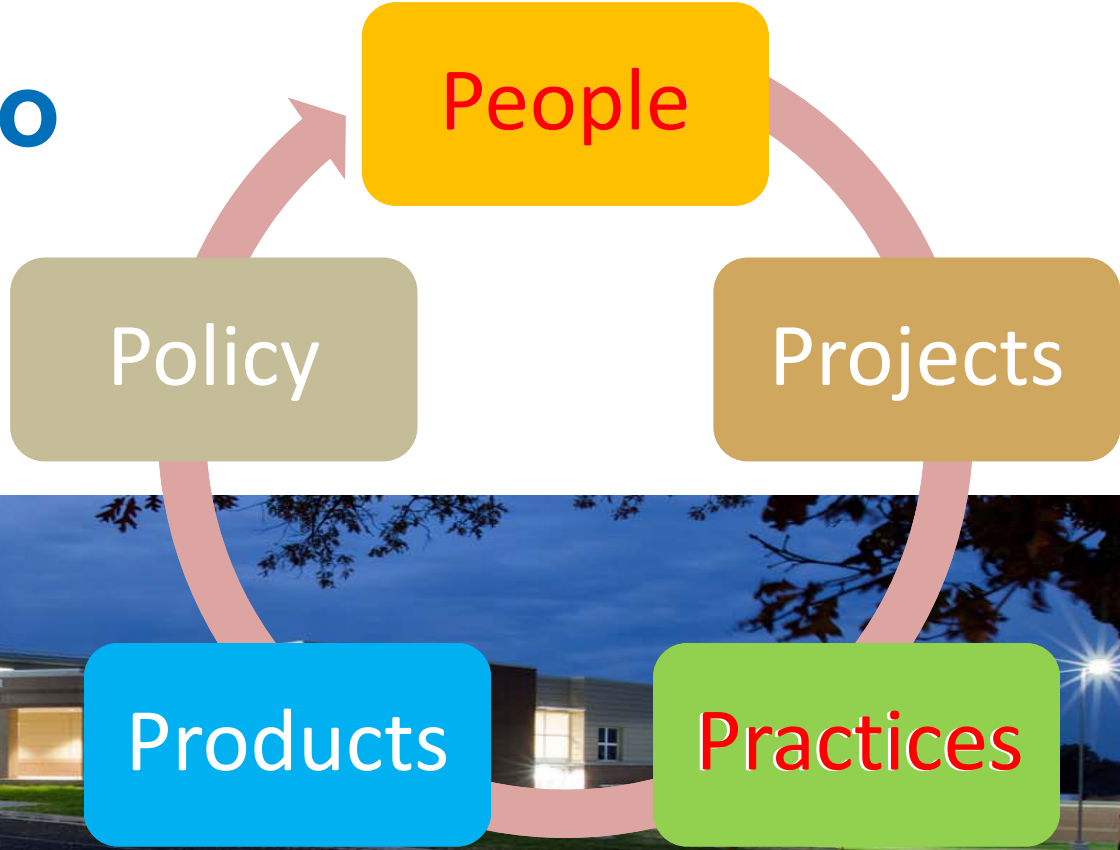


Getting to Zero: Design, Operations and Occupancy

Cathy Higgins, NBI Research Director

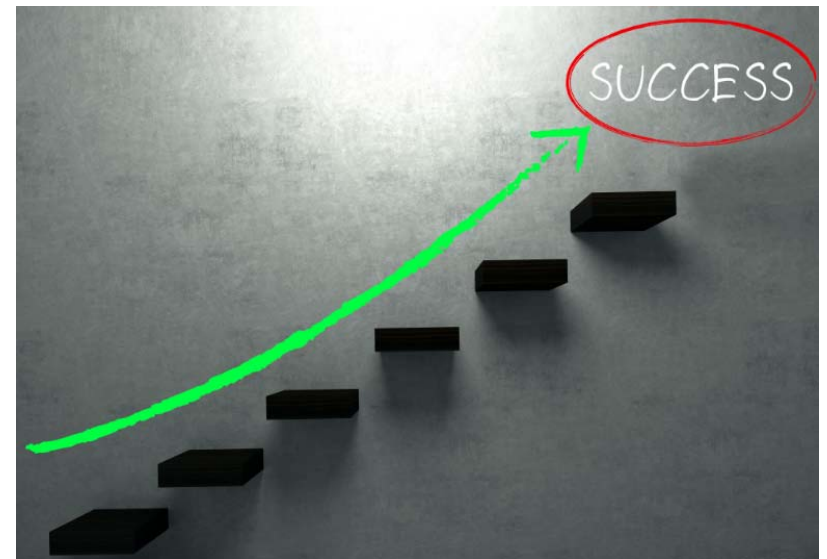
Paths to Zero





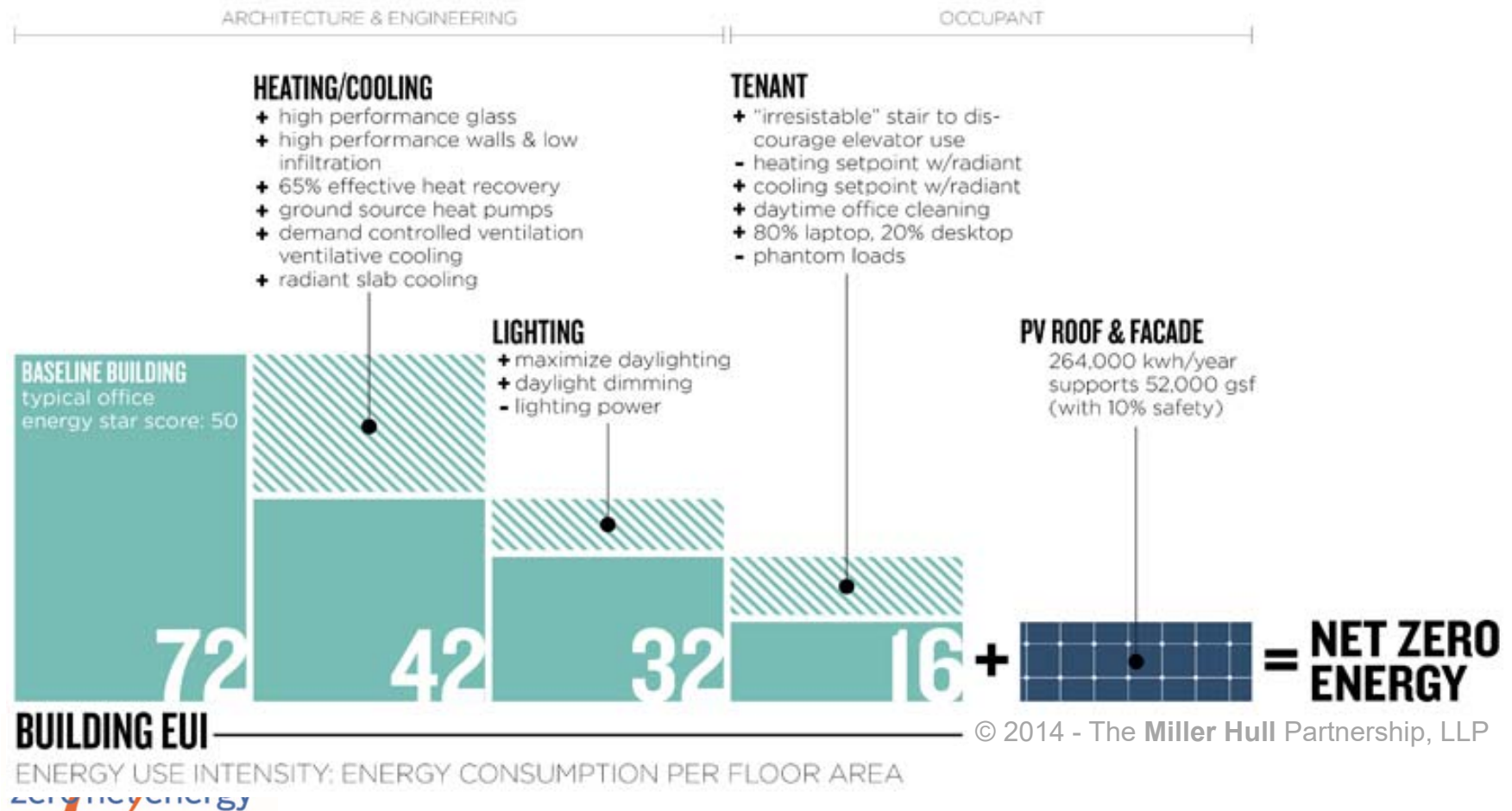
Getting to Zero in 6 Simple Steps

1. **Target** Setting
2. **Contract** to Achieve the Target
3. **Design** to the Target
4. **Build** to the Design
5. **Operate** to the Design
6. **Occupy** to the Design



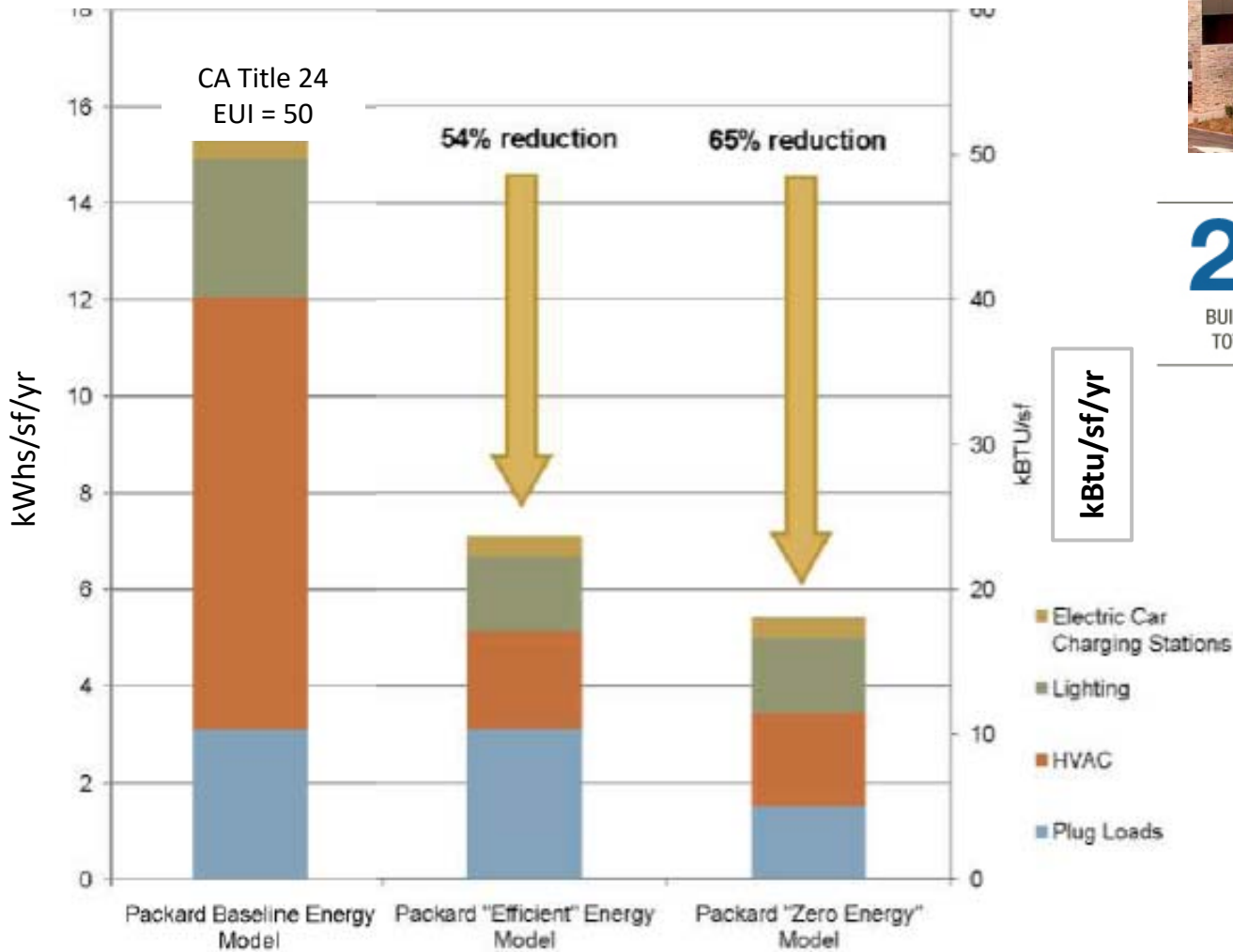
Targeting ZNE

Establishing your solar and energy budget



Packard Building

Target: 18 kBtu/sf/yr (EUI)



$$24 - 28 = -4$$

BUILDING'S TOTAL EUI RENEWABLE PRODUCTION EUI BUILDING'S NET EUI

Actual Performance



Courtesy: EHDD

Leading by Example

Packard Foundation

LEED PLATINUM

49,000 SQUARE FEET

ZNE PERFORMANCE



David and Lucille Packard Foundation | Los Altos, CA

- Two daylit office wings with blinds and shades to control solar heat gain and glare
- Rainwater collected for toilet flushing, irrigation; stormwater is retained on-site.
- 95% of construction waste recycled/salvaged

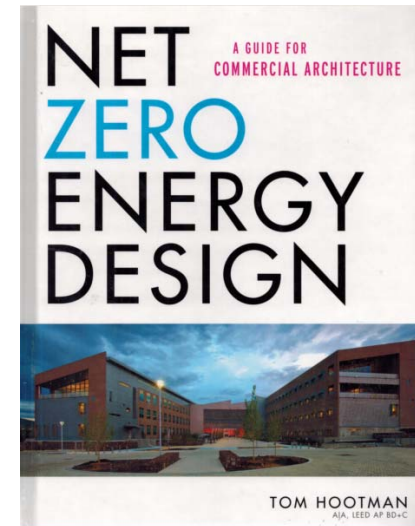
- Energy use can be reduced by 65% through integrated building design and aggressive reductions in plug loads
- Innovative use of roof-mounted photovoltaic panels will offset any energy used



Contract to Achieve the Target (RFPs & RFQs)

RFP Guidelines for Net Zero Energy Projects

- Establish net zero energy as one of the key project objectives.
- Set an annual energy use target appropriate for the net zero energy objective.
- Clarify whether or not on-site renewable energy systems will be part of the RFP; in either case, consider how they will be coordinated with building design and construction.
- Provide a well-crafted project definition, one that takes into account the opportunities and challenges of net zero energy.
- If a separate RFQ is not used prior to the RFP, integrate the guidelines for RFQs stated in the previous RFQ section.
- Establish the selection process and delivery method in support of forming a trust-based, integrated delivery team, whose members are aligned with the project objectives.



Net Zero Energy Design: Tom Hootman

Design to the Target

- Use the Owners Project Requirements to guide the ZNE process:
 - Define Owner's Project Requirements (OPR)
 - Establish the Basis of Design (BoD) - the design team approach

Owner's Project Requirements (OPR)

template revised November 2009

17.1	Introduction
17.2	Owner Requirements Covered Elsewhere
17.3	Project-Specific Design Goals
17.4	Occupancy & Use
17.5	Sustainability and Energy Efficiency
17.6	Building Site
17.7	Transportation & Parking
17.8	Building Envelope
17.9	Indoor Environmental Quality
17.10	Emergency or Backup Power
17.11	Telecommunications and A/V Systems
17.12	Security
17.13	Hazardous Materials
17.14	Furnishings & Equipment
17.15	Commissioning, Inspection, and Q.A.
17.16	Construction Completion & Turnover
17.17	Operation & Maintenance
17.18	Owner Training
17.19	Post-Occupancy and Warranty

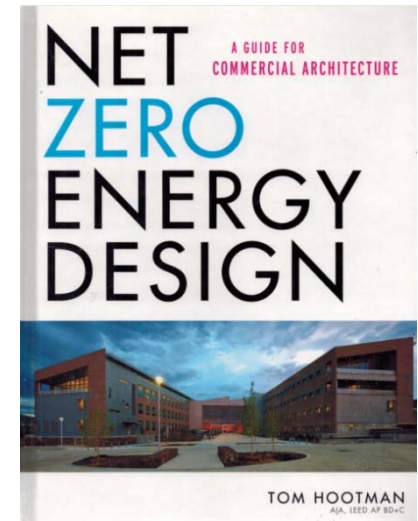
NOTE to PM/Author: Enter the project # in the footer, left side ... delete this + other notes-to-author)

17.1 INTRODUCTION

Along with the other sections of this Facilities Program, this Owner's Project Requirements (OPR) document outlines functional requirements of the project and expectations of how the facility and its systems will be used and operated. The OPR is required for LEED certification of the project, but also serves three broader vital purposes:

Support Guidelines for ZNE

- **Budget Guidelines**
 - Lifecycle, Selection & Pricing, Soft Costs, Renewables
- **Schedule Guidelines**
 - Front load design, Team continuity, Energy Modeling, Iterative Design
- **RFPs and RFQs**
 - Contract the ZNE and EUI target,



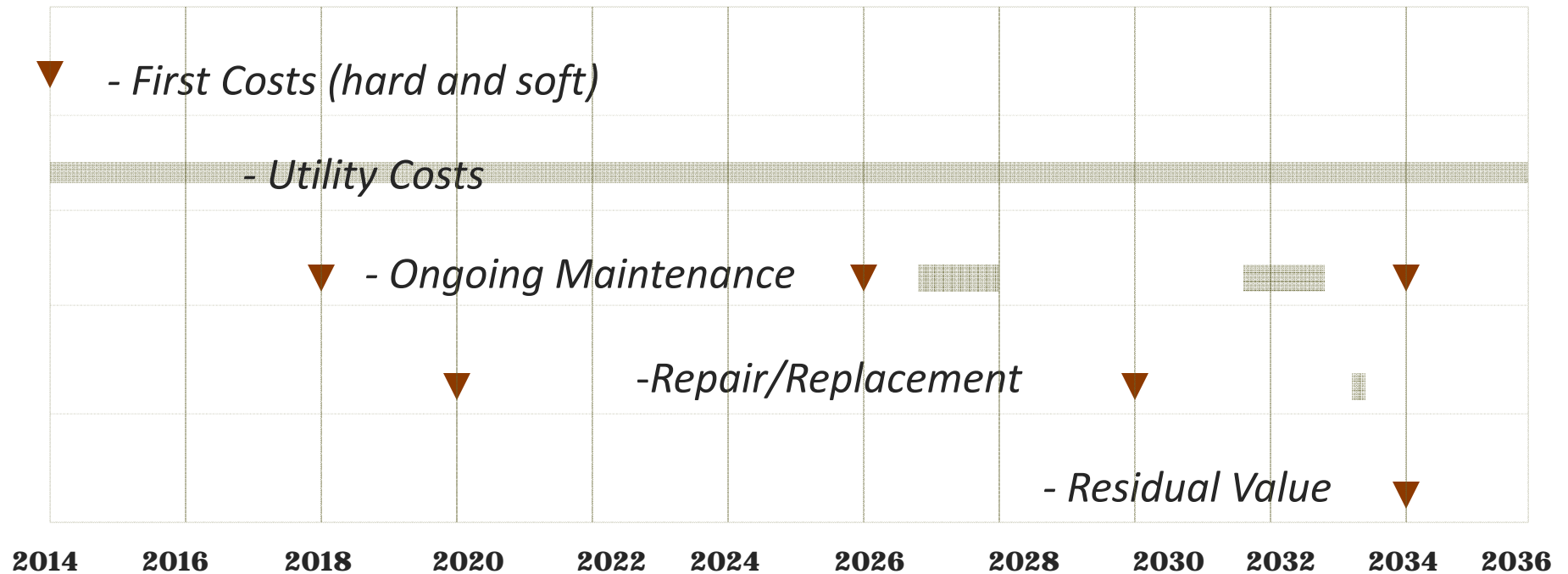
Net Zero Energy Design:
Tom Hootman

Life Cycle Cost Analysis - LCCA

What is the full price of a building?

Life Cycle Cost =

Net Present Value of:



Design Process Strategies

- Team Integration meeting to set Performance Goals
- Design Intent/Owners Project Requirements
- Building Configuration Alternatives
- System Selection and Appropriate Sizing

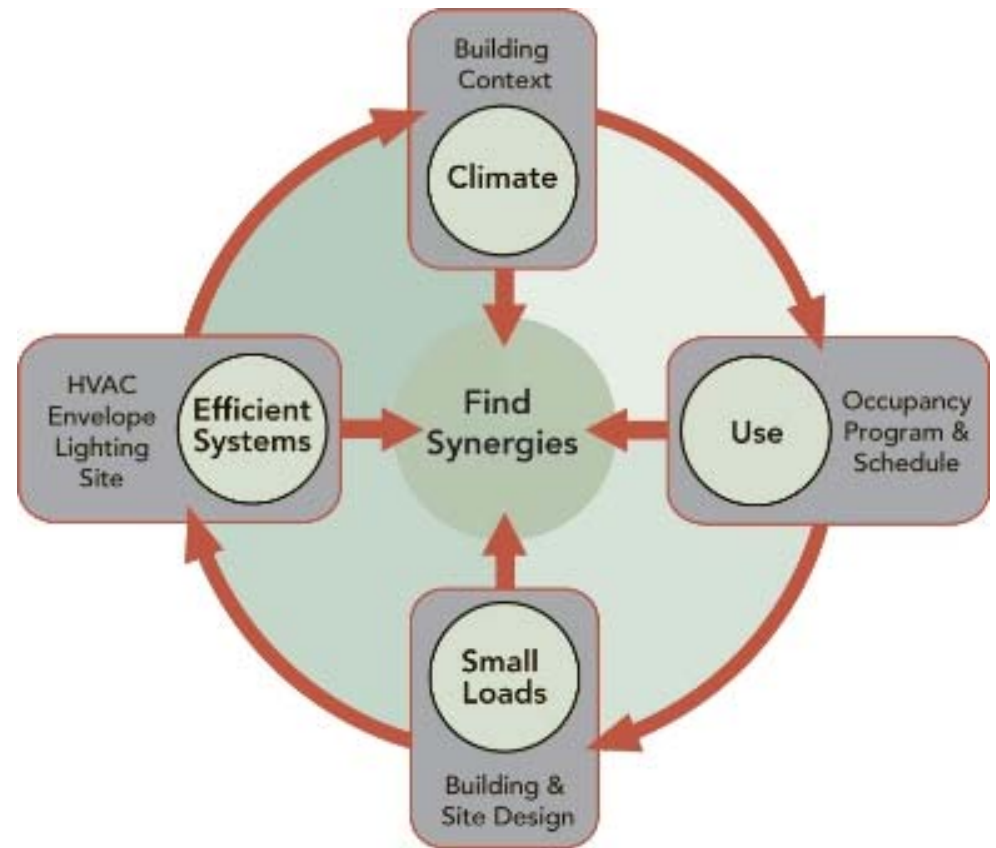


Diagram: Betterbricks

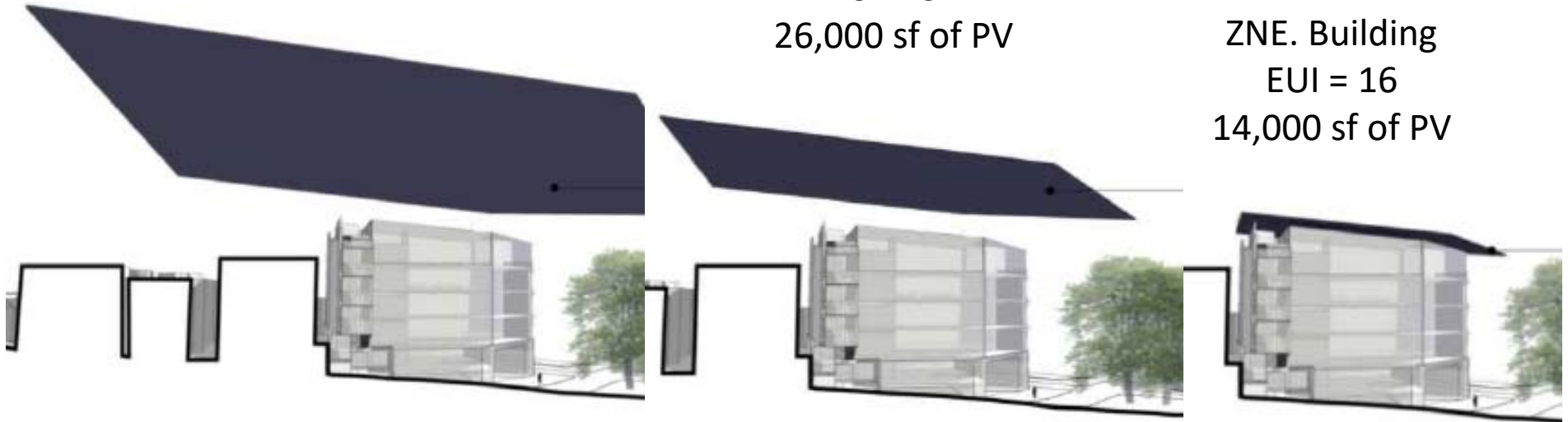
Bullitt Center Solar Budget



Typical U.S. Building
EUI = 92
64,000 sf of PV

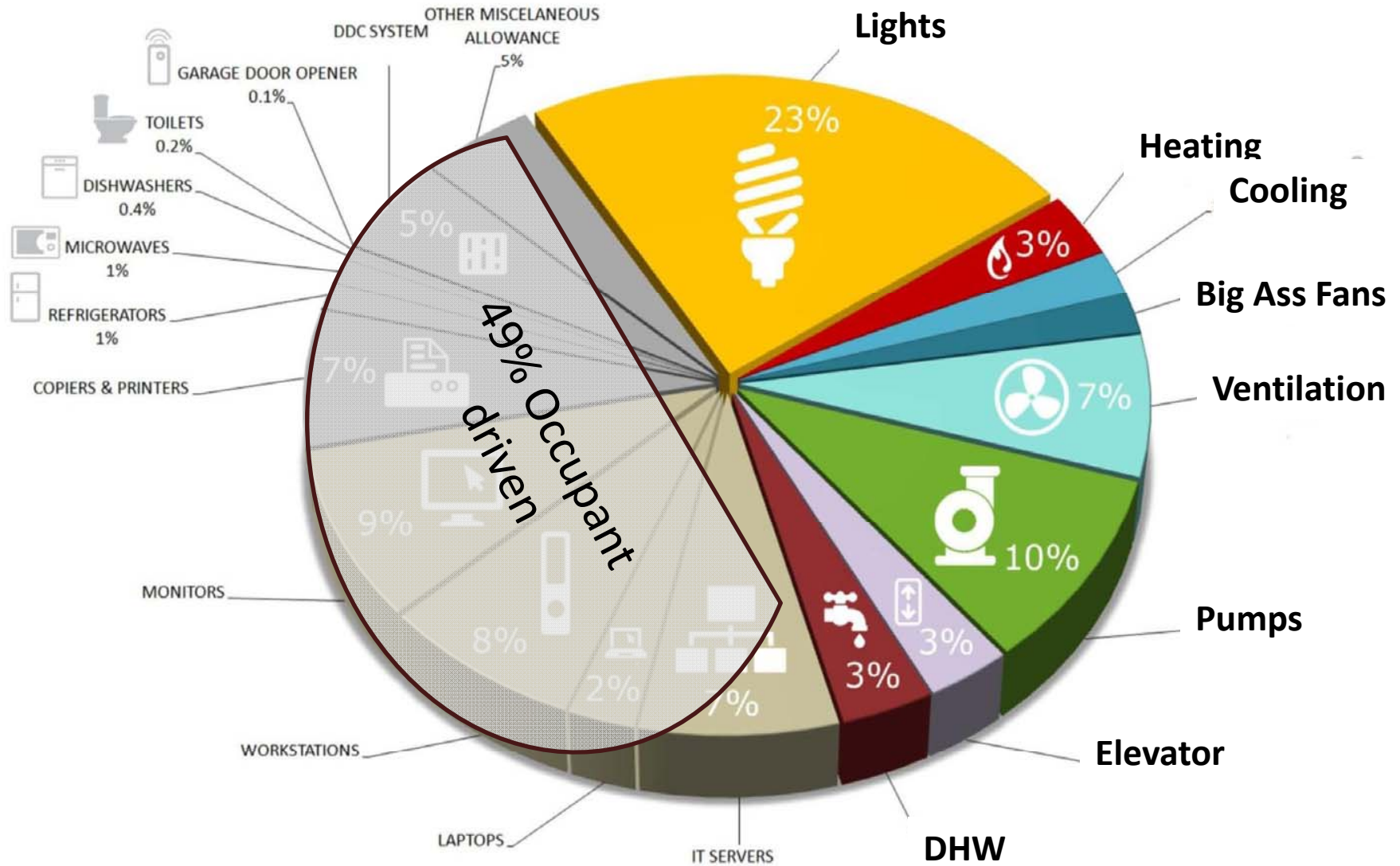
High Performance Building
EUI = 32
26,000 sf of PV

ZNE. Building
EUI = 16
14,000 sf of PV



Courtesy: PAE Consulting Engineers

Bullitt Center Modeled Energy Use 16 EUI



Courtesy: PAE Consulting Engineers

Design: Passive First



West Façade: Edith Green, Wendell Wyatt
Federal Bldg. Portland, OR

DESIGN/ANALYSIS

WEST ELEVATION SHADING STRATEGY

Shading reduces the heat gain on the building minimizing the energy needed for cooling.



West Façade
Reeds provide avg. 50% shading

South & East Facades
Combination vertical + horizontal shades

North Façade
No shading



Courtesy: SERA Architects

Getting to ZNE

1 INTEGRATED PROCESS

Addressing systems through integrated design.



Chartwell School | Seaside, CA

2 DESIGN STRATEGIES + TECHNOLOGIES

Passive First!

Experienced team

Building Configuration: orientation, reduced window ratio, directional variation of glazing

Heat and glare reduction: shading exterior and interior, max. insulation, cool roof, night flush,

Plug Control: wired at outlets, design for Off, occupant dashboards

Monitoring

Envelope: High performance glazing, automated interior shading,

HVAC: Multiple systems, DOAS, Heat or Energy Recovery, Natural Ventilation, GSHP, Heat Pumps, Hydronic distribution, Underfloor Air Distribution /Displacement,

Lighting: Controlled for occupancy, hours and daylight, LEDs increasing

Plug Controls

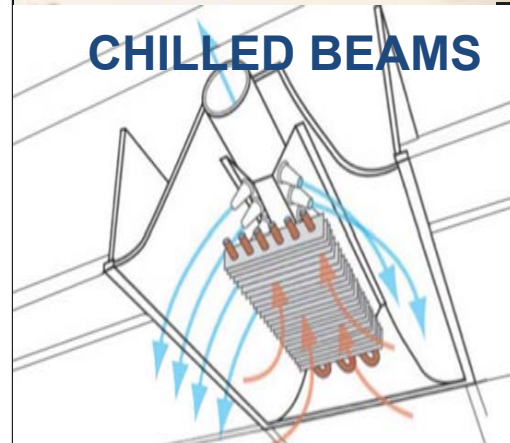
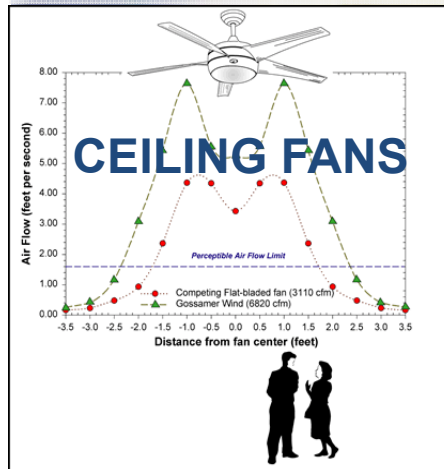
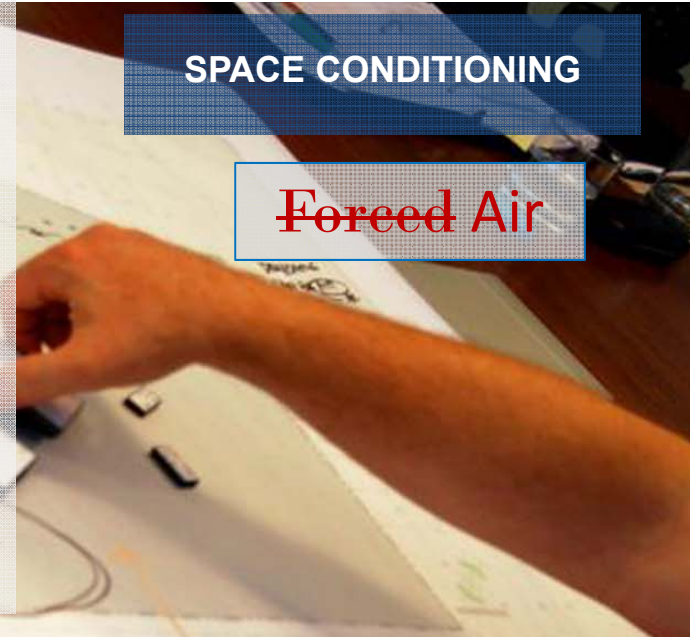
Technology Trends

Passive
Solutions 1st

then

HVAC

- Ground Source **Heat Pumps**
- **Radiant** Heating/Cooling & Chilled Beams
- **Energy Recovery** Systems – air and water
- Ventilation
 - Natural
 - **Dedicated Outdoor Air Systems (DOAS)**
 - Demand Control Ventilation (DCV)



Design to the Target ZNE Retrofit Actions

Low intervention:

- Remote Audit
- Retro-commissioning
- Controls: Building Tuning
- Plug Load Savings/Policy
- Operator and Occupant Training
- Infiltration Reduction Measures

Medium intervention:

- Lighting/Daylighting
- HVAC Equipment Upgrades
- Controls: System Upgrade
- Opportunistic Envelope Insulation

• High intervention:

- HVAC System Switching
- Envelope Upgrade
- Window Replacement
- Renewable Energy System



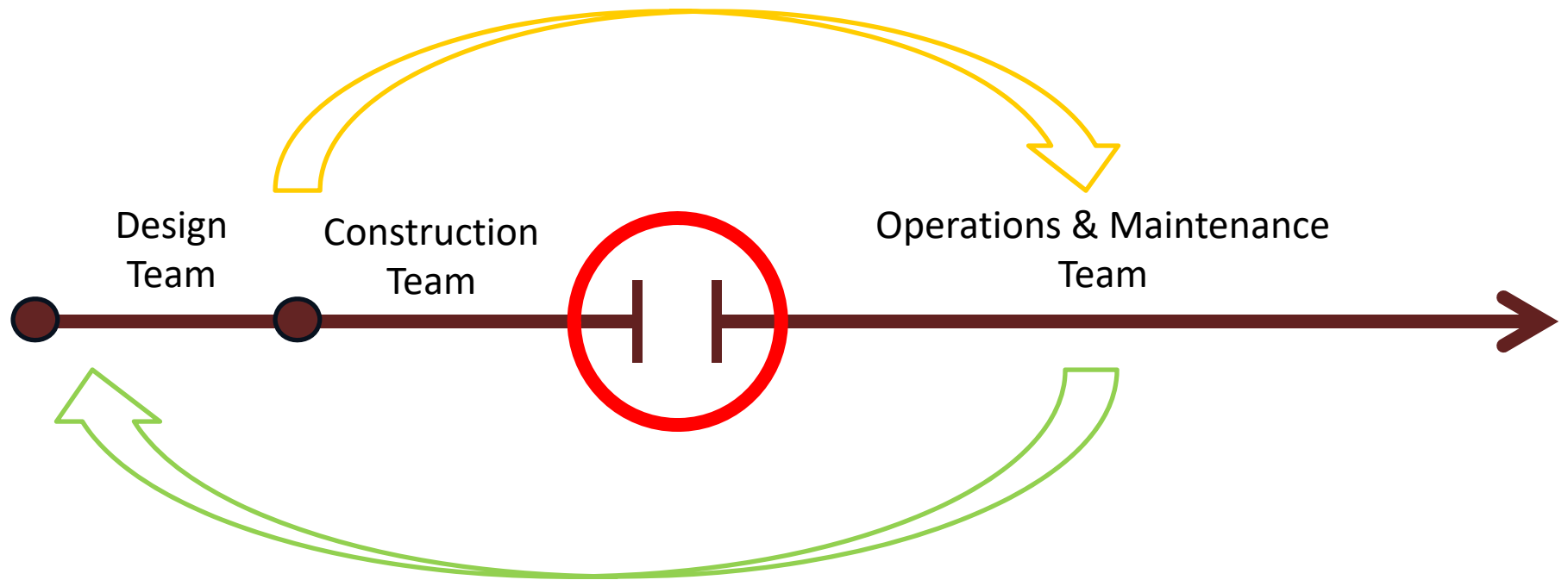
CATALYZING THE FUTURE OF ZERO NET ENERGY BUILDINGS.
2019 Getting to Zero Forum
14, 2016 | Grand Hyatt Denver

Operate and Occupy to ZNE



Filling the Performance Gap

Integrating operations team into the design process



Measure and Track

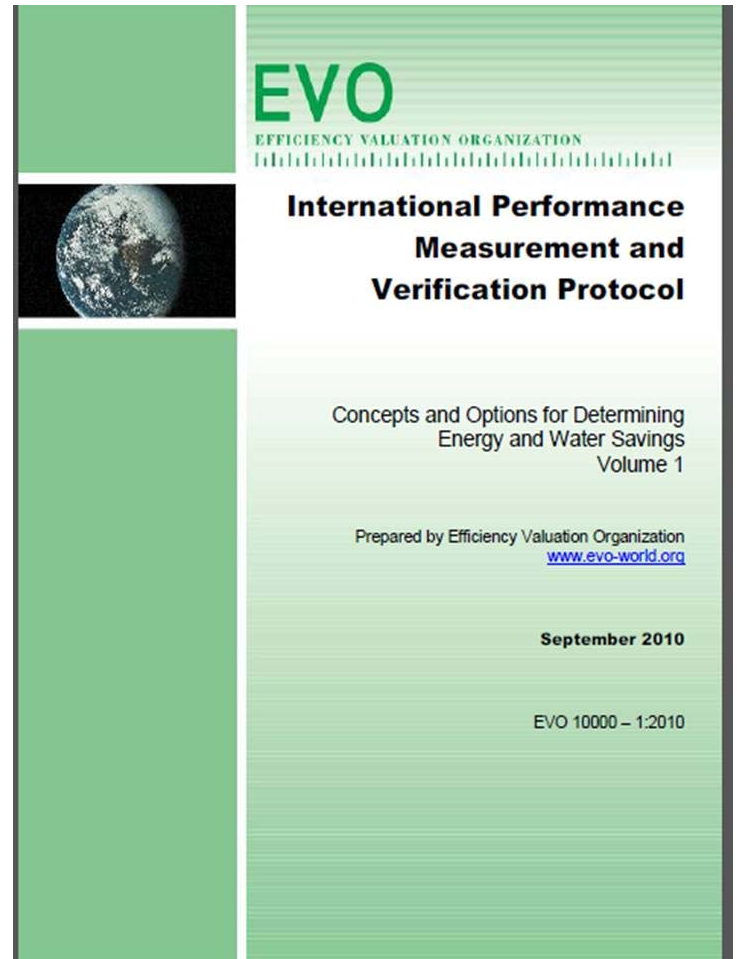
You can't improve what you don't measure

Measurement and verification of building performance

- Standardized Protocol: IPMVP

Design for Measurability

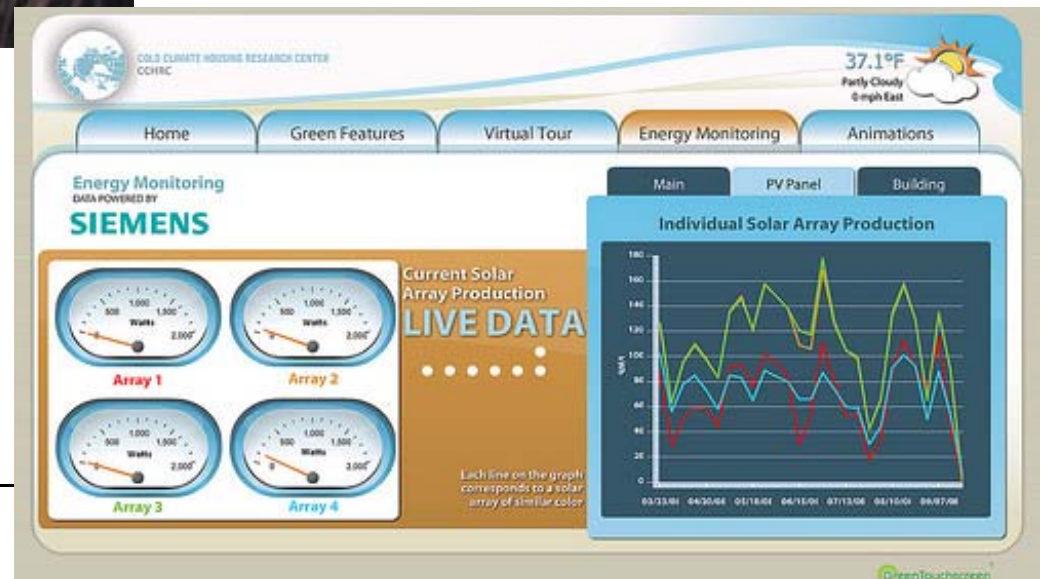
- Submetering & Electrical Circuits
- Controls: Data Trending
- Make sure you can *use* measured data to improve performance!



Operational Strategies: Start Up Strategies

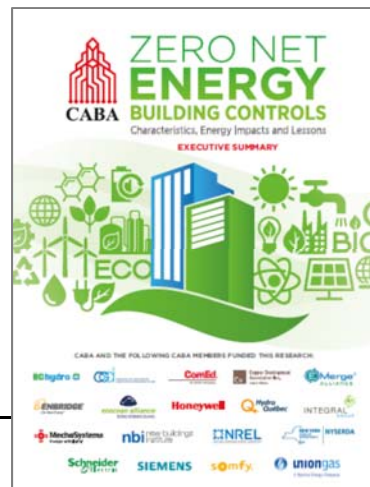
- Initiation and Training to start building operation on the right track
 - Owner Orientation
 - Operator Training
 - Metering and Feedback Plan
 - Equipment Purchase Standards for Fit-out
 - Occupant Training
 - Maintenance Plan

Occupant & Operator Engagement



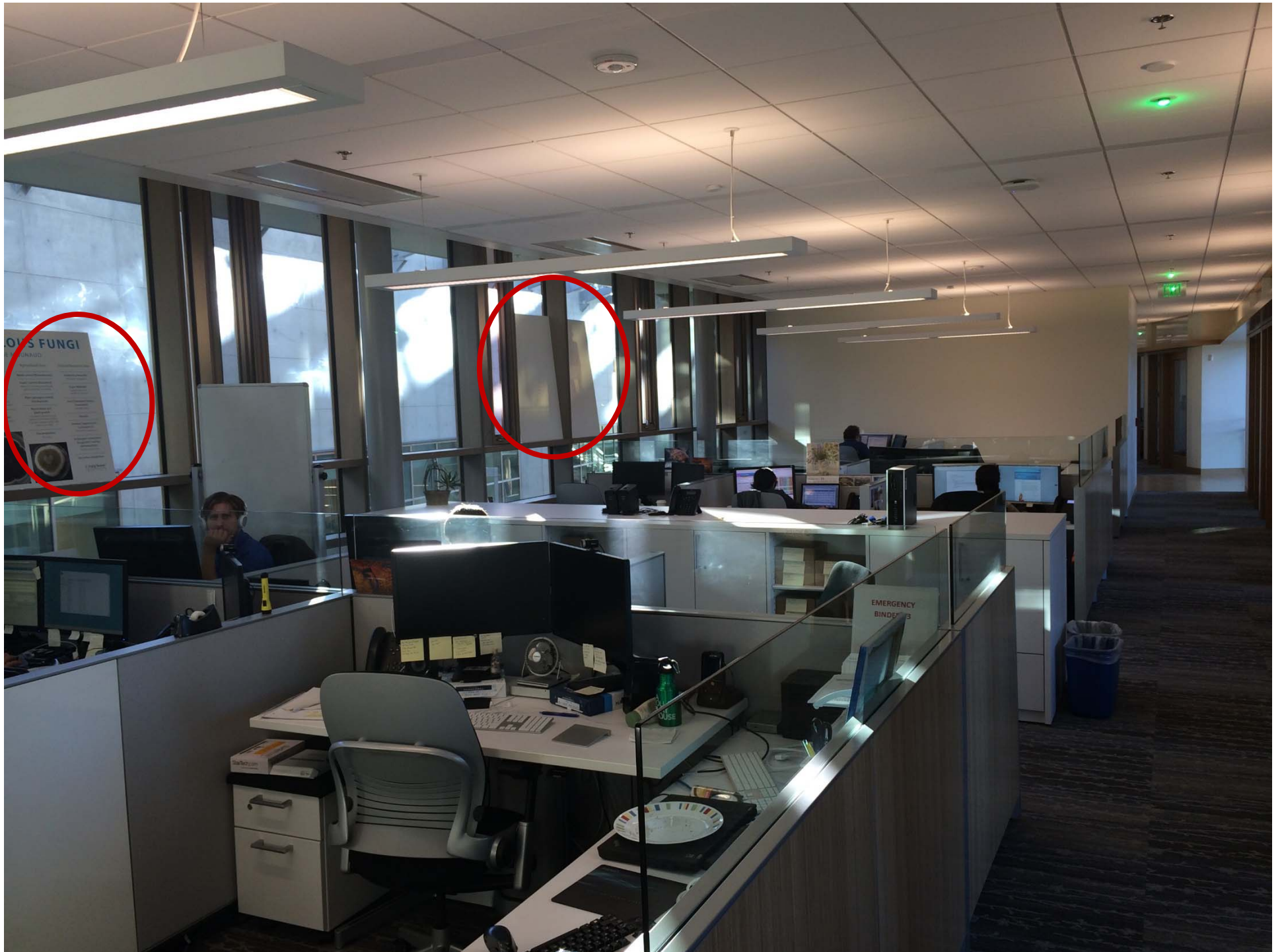
Get Control of Controls

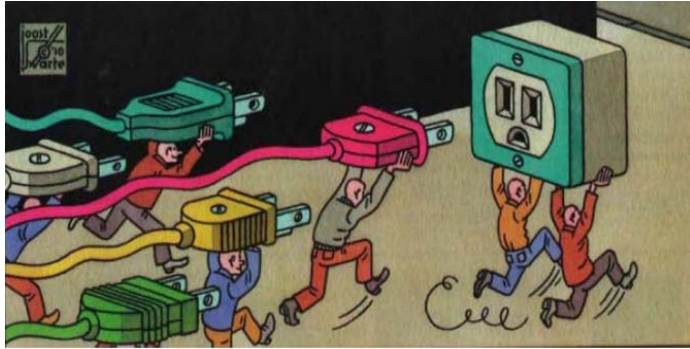
- Design for 'Off'
- User-friendly
- Intuitive
- Consistent
- Organized



Those Pesky People







Types of Plug Control

- **Software:** equipment power management software – turn it off when not in use
 - Controls at device or over IT network
- **Hardware:** plug strips, sensors, timers, etc.
 - Controls at device or circuit level
- **People:** Prompts, Feedback, Campaigns, Green Policies, Competitions



Plug Load Best Practices Guide Managing Your Office Equipment Plug Load

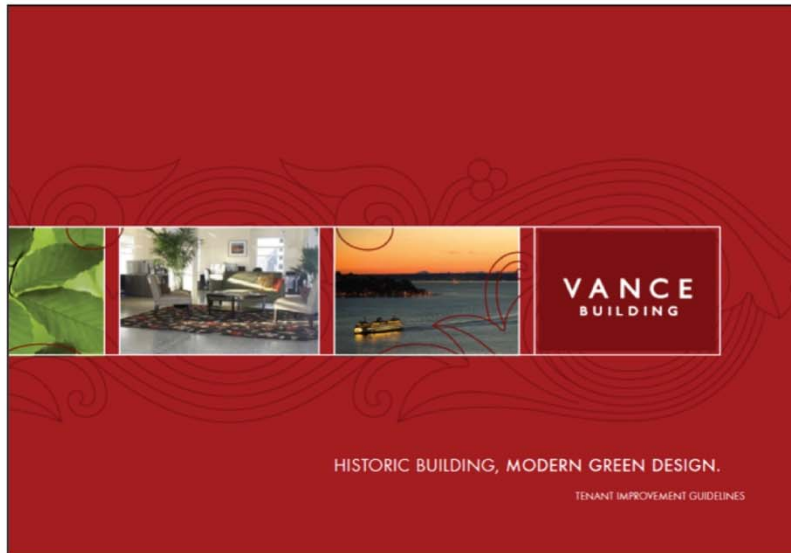
Guide to Energy Savings

Plug loads can be managed through low- and no-cost measures that are relatively straightforward to implement.

This Guide shows how simple changes can cut costs and save energy in offices.



TENANT STRATEGIES



OPERATING YOUR GREEN SPACE

How you manage the details of ongoing operations in your space after you take occupancy can have a tremendous impact. Here are some things to consider:

Purchase Energy Efficient Equipment and Products

- Use ENERGY STAR-rated equipment to ensure efficient computers, copiers, and appliances that reduce the consumption and expense of electricity.
- Buy recycled paper products and other office products with high post-consumer recycled content.

Control Energy Consumption

- Switch off overhead lighting whenever possible, harness daylight, and use task lighting rather than light the entire space.
- Actively manage electrical equipment, such as copiers and computers, to reduce their power consumption and heat gain and to ensure maximum comfort.
- Tailor the heating to your needs using the Danfoss temperature control valves on the ocean radiators. Please contact the building manager if you need assistance setting the valves for the temperature that is right for you.

Maximize Natural Ventilation and Thermal Comfort

During warmer times of the year, use windows, shading, and ceiling fans to improve indoor air quality and enhance thermal comfort. Here are some things you can do:

- Increased air movement (operable windows): Open both the top and bottom of the windows to encourage natural ventilation through the circular movement of fresh air, which enters through the bottom as stale air exits through the top. Studies have shown that naturally ventilated buildings generally have fewer incidences of sick building syndrome because greater quantities of outside air are introduced.
- Increased air movement (ceiling fans): Use ceiling fans to increase air movement, which can typically lower the effective comfort temperature by 3° Fahrenheit.



User Experience: Occupant Survey Summary

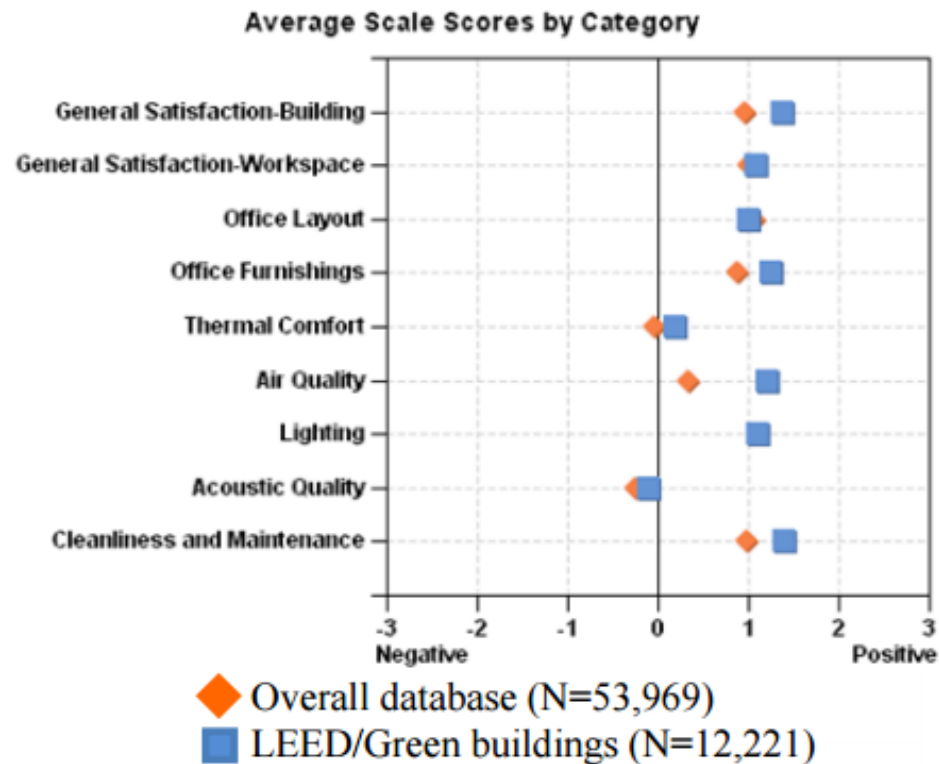


Figure 1. Average scores from CBE web-based survey for LEED/Geen buildings and overall database



Influencing Developers

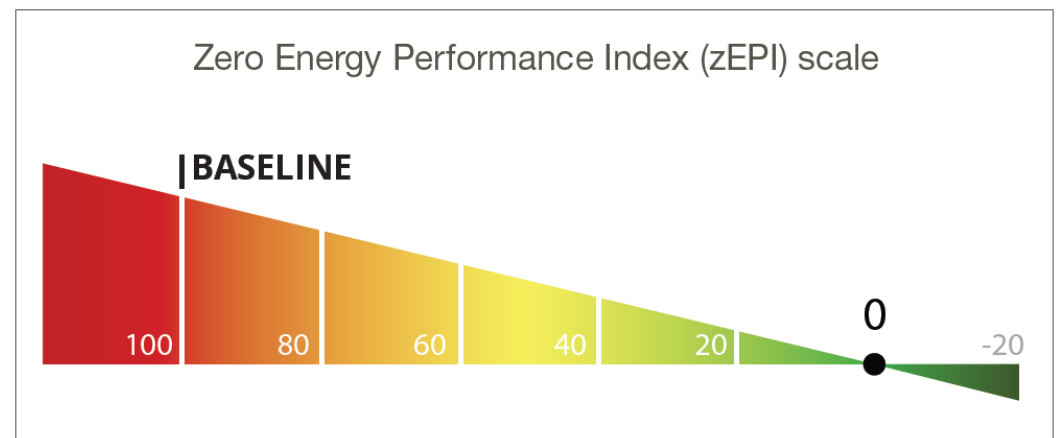
CATALYZING THE FUTURE OF ZERO NET ENERGY BUILDINGS.
Zero Net Energy Forum
October 12-14, 2016 | Grand Hyatt Denver



Convene Leadership and Set Goals

Use appropriate metrics to communicate goals and measure success

- Energy, Cost, GHG emissions
- Percent improvement versus absolute goal
- Consider non-energy benefits as articulated by the \$3 (utilities), \$30 (rent), \$300 (payroll) rule



newbuildings.org/code_policy/zepi/

Energy Star

Leverage Energy Star tools and resources:

- Energy design guidance checklist
- Target finder for determining energy performance target
- Letter of Intent for Commercial Real Estate Developer/Owner and Architect of Record
- Benchmark and track performance with Portfolio Manager



“How To” Series

How to Apply for the Designed to Earn the ENERGY STAR®

Architects can help their clients reduce their carbon footprints and energy costs by designing buildings to earn the ENERGY STAR. These buildings are designed to perform in the top 25 percent of similar buildings nationwide. This document provides instructions to apply for Designed to Earn the ENERGY STAR recognition for a design project.



What is Designed to Earn the ENERGY STAR?

Designed to Earn the ENERGY STAR is awarded to eligible commercial new construction and multifamily high rise properties that are in the design or construction phase and the total annual estimated energy use achieves an ENERGY STAR design score of 75 or higher.

Eligibility Criteria

- ✓ Your commercial design project meets the project requirements listed in Appendix A.
- ✓ Your multifamily high rise project meets the requirements listed in Appendix B.
- ✓ Your design project is saved in Portfolio Manager.

Overview of the Application Process

1. The Architect of Record (AOR) completes all application documents for commercial properties:
 - ✓ Statement of Energy Design Intent
 - ✓ AOR Letter of Intent
 - ✓ Owner Letter of Intent
 - ✓ SPP Partnership Agreement, if applicable
 - ✓ Design Profile (optional)
2. Applicant completes all application documents (noted in Step 3B) for multifamily high rise (MFHR) projects.
3. AOR or MFHR applicant submits documents to EPA.
4. EPA notifies the applicant of their status once the review process has been completed.

Eligible Property Types

- ✓ Bank Branch
- ✓ Courthouse
- ✓ Data Center
- ✓ Distribution Center
- ✓ Financial Office
- ✓ Hospital (General Medical & Surgical)
- ✓ Hotel
- ✓ K-12 School
- ✓ Multifamily High Rise
- ✓ Non-Refrigerated Warehouse
- ✓ Office
- ✓ Refrigerated Warehouse
- ✓ Retail Store
- ✓ Senior Care Community
- ✓ Supermarket/Grocery Store
- ✓ Wholesale Club/Supercenter
- ✓ Worship Facility

June 2015

1




Green Real Estate Sustainability Benchmark - GRESB

- Applies to environmental, social and governance (ESG) issues
- Assess sustainability related strategies and objectives at the organizational level
- Looks at policies at both the organizational and portfolio level
- Now includes a stand-alone Developer Assessment

Sector Leaders - North America

Property type	Entity name
Retail - Listed	The Macerich Company
Retail - Private	Pine Tree
Office - Listed	Kilroy Realty Corporation
Office - Private	MetLife/Norges Bank Investment Management Joint Venture - MetLife Investment Management
Industrial	Prologis
Residential - Listed	Equity Residential
Residential - Private	Rose New Jersey Green Affordable Housing Preservation Fund - Jonathan Rose Companies
Residential - Private	Leslie York Mills (MLYM Inc.) - The Minto Group
Residential - Private	Greystar Equity Partners Fund VIII - Greystar Investment Management
Residential - Private	Invesco Real Estate
Diversified	Invesco Real Estate 
Diversified - Retail/Office	Oxford Properties Group (OMERS) - Oxford Properties Group
Diversified - Residential/Office	Multi-Employer Property Trust/MEPT Edgemoor - Bentall Kennedy Group 

 Global Sector Leader

North American office portfolios have the highest average GRESB Score

GRESB – Developer Assessment

- For companies and fund managers that focus on development activities rather than managing standing investments
- Evaluates ESG performance of actions related to new construction and major renovations
- Provides institutional investors with qualitative insights into the ESG performance of their real estate investments
- Participants receive a score card free of charge but will have to pay a fee to receive a benchmark report

2016 Developer Participants

- China Overseas Land & Investment Ltd.
- China Resources Land
- Godrej Properties
- Goodman Group
- Arch Capital Management Co. Ltd.
- Aviva Investors
- AXA Investment Management
- Bioconstruccion y energia alternativa
- CDH Investments
- Harrison Street Real Estate Management, LLC
- HDFC Limited
- Kendall Square Logistics Properties, Inc.
- Keppel Land Limited
- Lendlease
- MacFarlane Partners Investment Management
- Redwood Group Asia
- Scape Australia
- SOCAM Development & TAN-EU Capital
- Tishman Speyer

Portfolio Example: Gundersen Health Systems, Lacrosse, WI



48 buildings - >2.5 million square feet
Aggressive EE and generation toward ZNE goals

Portfolio Results

Measured Energy Stats

$$141 - 109 = 32$$

BUILDING'S
TOTAL EUI

RENEWABLE
PRODUCTION RPI

BUILDING'S
NET EUI

Site Energy Use Index (EUI) kBtu/SF/year

Emissions (lbs.)	2008	2015	% Reduction
SO ₂	241,011	15,027	94%
NO _x	161,729	31,771	80%
CO ₂	80,846,997	5,751,799	93%
Mercury	2.4	0.3	87%
Particulate Matter	434,928	39,542	91%



Photo: Gundersen

Gundersen Take Aways



Efficiency makes financial sense

- New ZNE buildings at a low cost premium – **only 3-5% in Gundersen's case.**

Community scale allows more to get to Zero Net Energy

- High density and energy-intensive building types can more readily get to ZNE

Solar PV isn't the only option

- Gundersen has taken advantage of wind, biogas, and biomass which can come into play especially when expanding zero net energy to a portfolio of buildings.

Setting goals is paramount

- Set an energy usage goal for the building as a first step

**The leadership of a champion drives performance
and leads to success**

what part will you play in
solving the greatest
challenge of our time?

DIALOG TIME

Oberlin College Adam Joseph Lewis Center for Environmental Studies | Oberlin, OH



Operations & Occupancy

Questions & Answers

“hat hoch exists . ust e ossible”



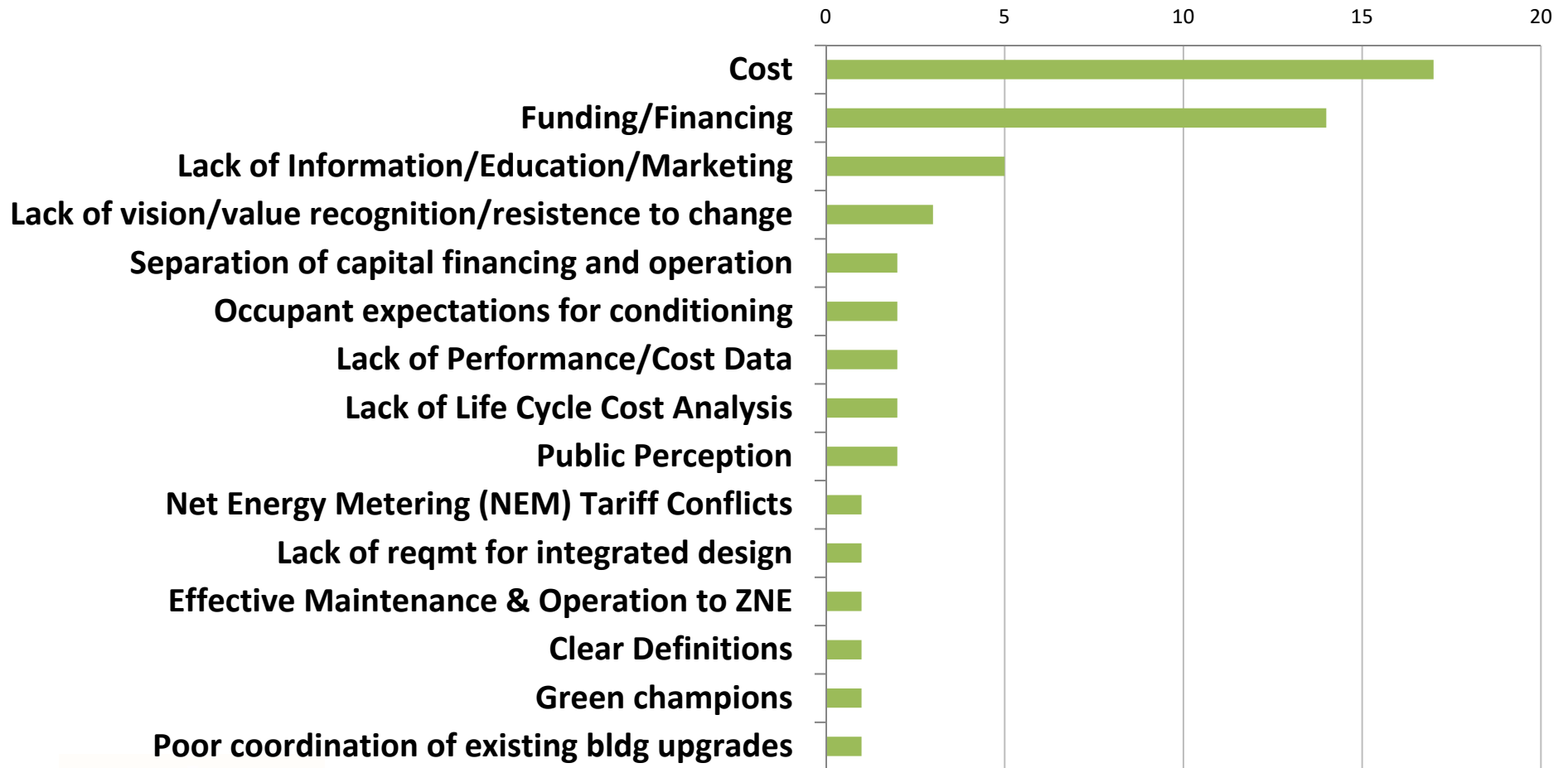
Closing Discussion



Discussion:

What are some of the barriers facing local governments in getting to ZNE?

PERCEIVED BARRIERS TO ZNE



LESSONS LEARNED

What we Heard from the Early Adopters

Institutional Barriers

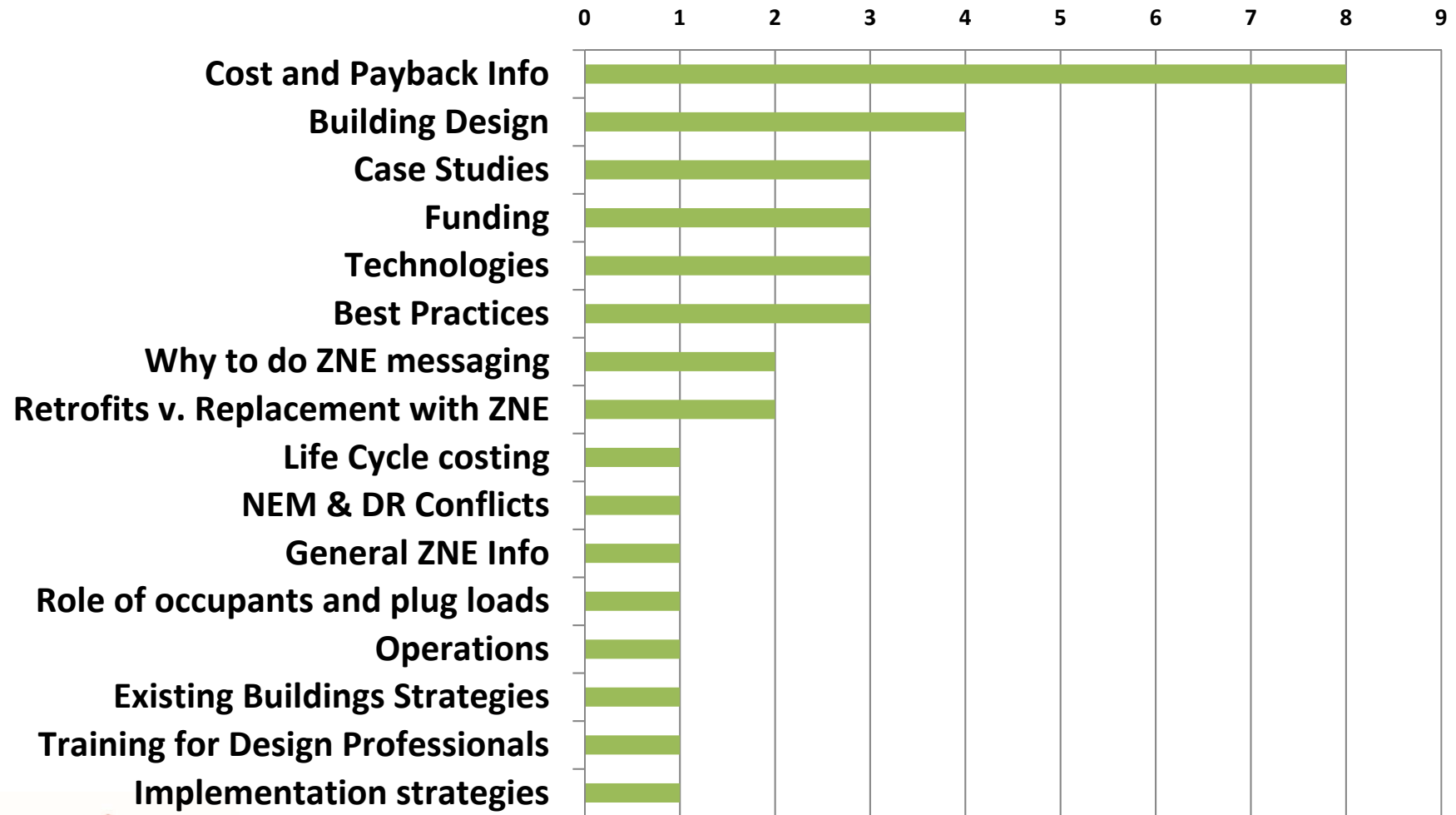
1. **Limitations on procurement structure** does not support a design-build or integrated design process.
2. **Typical state and local contracts** are not performance based.
3. **State and local govts** are risk averse so are hesitant to be experimental
4. **Need internal reserve funds** for up front energy efficiency investments
5. **Limits on oversizing renewables** are a challenge
6. **Lack of qualified O&M staff** for public buildings to plan for or operate to ZNE performance.



Discussion:

What do local governments need to help them advance ZNE in their own portfolios, policies and communities?

INFORMATION NEEDS



LESSONS LEARNED

Early Adopters need greater resources & support.

1. **Networks and forums** to share lessons learned and resources
2. **Incentives and programs** to support energy modeling, LCA, integrated design process
3. **Tools for communication**, marketing, and education
4. **Templates** for policy, contracts, performance specifications
5. **Cost & Financing Information**
6. **Education & Training**, including: integration of ZNE into building delivery models, ZNE operations and role of behavior
7. **More Built Examples/Case Studies**
8. **Removal of Policy Barriers**: Creative Delivery Options



What you can do today to get started

1. Develop your ZNE Plan
2. Create the supporting policy
3. Get & Use the ZNE Communication Tools & Planning Workbook
4. Build capacity by education, collaboration, and convening



BayREN 2016 Fall Forum: ZNE For Local Governments Workshop

PHOTO: SF PUC, Low Energy Building, San Francisco

Share your Feedback



Take the Feedback Survey:

www.surveymonkey.com/r/BayREN_ZNEWorkshop

ZNE for Local Government Workshop

Thank you!

For more information and resources
visit: www.newbuildings.org/zero-energy

Contacts:

Cathy Higgins, higgins@newbuildings.org

Heather Flint Chatto, heather@newbuildings.org

