Today’s session sponsor:
Thank you to our sponsors!

nbi new buildings institute

redefining what’s possible in the built environment
Upcoming Getting to Zero Webinars

All sessions 10-11:30 am Pacific/1-2:30 pm Eastern

January 13, 2016  Both Sides of the Meter
February 17, 2016  From Policy to Practice
March 16, 2016  Strategies for Getting to Zero
April 20, 2016  Beyond a Building
May 18, 2016  ZNE Policies within and Across Borders

More information at newbuildings.org/demand-webinars

Save the Date
October 12-14, 2016 | Denver, CO
ZNE in the Occupancy Phase

Performance Expectations vs. Outcome

LEED level
- Certified
- Silver
- Gold
- Platinum

Actual / Design EUI (Adj2)

Design EUI (Adj2)
Different Players Affect Building Performance

Components of energy outcomes

- Staffing
- Controls
- Maintenance
- Commissioning
- Computers and Equipment
- Schedule
- Habits
- Layout
- Integration
- Installation
- Components and Equipment
Building Operation

Components of energy outcomes

- Operating Characteristics
- Design Components
Occupancy

Components of energy outcomes

- Tenant Behavior
- Operating Characteristics
- Design Components

Energy Use

2000 2010 2020 2030
End Use in HP Buildings

RFM: Energy End Use based on 2 years

EUI = 20 kBtu/sf/yr

- Solar Produced
- Elevator
- Plugs/Misc
- Lighting
- HVAC, DHW, Fans

Net Zero Site Limits

Bullitt Energy Use: Path to Net-Zero
Operator & Occupant Engagement

Performance Analysis Tools
Outcome Project Examples

- Edith Green Wendell Wyatt Federal Building; Portland - SERA
- George Deukmejian Courthouse, Long Beach – AECOM/Clark
- Federal Center South; Seattle - ZGF
It’s High-Performance NOT High-Desires

Ryan M. Colker, J.D.
Director, Consultative Council/Presidential Advisor
National Institute of Building Sciences
1090 Vermont Ave., NW • Suite 700
Washington, DC 20005, USA
202-289-7800 x133
rcolker@nibs.org
@rmcolker

Public Law 93-383, Sect. 809

Congress directed the Institute to “exercise its functions and responsibilities in four general areas………..”

- **Develop and maintain** performance criteria for maintenance of life, safety, health, and public welfare for the built environment
- **Evaluate and prequalify** building technology and products
- **Conduct** related and needed investigations
- **Assemble, store, and disseminate** technical data and related information
High-Performance Buildings

High-Performance building means a building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy [and water] conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

- Energy Independence and Security Act of 2007 §401 (PL 110-140)
Identifying a Path Forward

- Wide-ranging examination of key issues with recommendations
- Follow-on discussions in early 2016
Common Definition for ZEB

- Zero Energy Building (ZEB):
  - An energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

- The designation Zero Energy Building (ZEB) should be used only for buildings that have demonstrated through actual annual measurements that the delivered energy is less than or equal to the on-site renewable exported energy.


Role of Energy Codes

Mark Frankel, NBI
Individual sub-systems have become more efficient, but overall efficiency has been flat

Energy Efficient Buildings Hub/Consortium for Building Energy Innovation

Efficiency Improvements: Building Sector vs. Other Sectors

Energy Efficient Buildings Hub/Consortium for Building Energy Innovation
Driving to Outcomes

- We’ve done the easy stuff
  - Optimized current equipment/methodologies
  - Honed individual disciplines
- Drive for high-performance
  - Integrate and optimize to achieve multiple requirements
- Owners, Occupants, Policymakers demanding results
- Fundamental shift to life-cycle performance
  - Driving new tools, contracts, delivery methods
- Comprehensive strategy, collaborative approach
  - Integrated Design, BIM, Delivery Methods, Contracts, Commissioning
Tackling the Energy Code Challenges

- Bring wider focus to design → construction → operations
- Tie to actual, measured results
- Limit burdens on code departments
- Incent smooth handover
- Move beyond prescriptive and component-by-component approach
- All energy uses covered
- Compliance through most cost-effective means

Outcome-based Pathway in the International Green Construction Code

- Sets targets
  - Table based on CBECS
  - Ratio of actual performance to table reference
- Compliance
  - Issue Temporary Certificate of Occupancy or Post Occupancy Verification Permit
  - Owner bears burden of reporting to resolve TCO/POVP
    - 12 months compliant data within 3 years
    - Certified by registered design professional
    - Could hinder financing, insurance, leasing, sale, permitting, etc.
  - Penalties/resolution up to AHJ
  - Requires links with other policies/departments
**Seattle Target Performance Path**

- Outcome-based pathway
- Establishes energy use targets
- Requires demonstration of operational energy use
- Financial security to be used as penalty ($4sqft)
  - Proportion eligible for mitigation

**Setting the Stage**

- Link with comprehensive policy approaches to performance goals
- Coupled with benchmarking & reporting can begin to develop localized targets
- Supports movement beyond one time demonstration to ongoing compliance
- Allows future focus on regulating performance of existing buildings
- Create feedback loops within & between AEC, O+M, government
- Drive improvements in performance data, modeling, turnover, integrated design and operations
A Pathway for Outcome-Based Performance

Contract Types
- IPD w/targets
- DBOM
- PPP
- Energy Saving Agreement
- Energy Saving Purchase Agreement
- Design-Build Plus

Establish Building Team

Set Targets

Collaborative Design

Construction

Operations

Commissioning

Owner/Team Policies

Feedback

Codes + Regulation (benchmark & reporting, etc.)
Incentives (utility, tax, permitting, etc.)

Incentives

Penalties

Checkpoints

Data collection

It’s Not Just Codes. . .

- Emergence of Performance Contracting
  - GSA
  - Washington
  - California

- Advancing past Design-Bid-Build

- New AIA Guide on PPP

- Commission on Environmental Cooperation

  Integrated Design & Delivery Guide
Procurement methods

Design / Build → Operate

Design → Bid/Build → Operate

Re-examine Procurement Methods

Design / Build → Operate/Maintain
Governor Deukmejian Courthouse, Long Beach

- Public-Private Partnership/DBFOM
- The performance-based contract allowed the courthouse to be constructed without any public funding and provides for the ongoing maintenance and performance of the facility. Under the terms of the agreement, the Judicial Council can deduct a specific amount from the availability payment if components of the building do not work. For example, there is a $5,000 deduct for every two hours that certain elevators are inoperable.

GSA Federal Center South

7. CLIN 0005 – M&V and Warranty Period Verification. The Government will retain a predetermined amount of dollars from the overall contract award during performance evaluation. Release of payment for this withheld amount will be contingent upon final confirmation that the energy performance standards for the facility (i.e. actual BTU/GSF saved) have been achieved as verified by the M&V and Warranty Period testing to be conducted within 365 days from final completion. The basis for the pre-determined amount shall be equal to .5% of the proposed construction price.
Olympia, Washington Government Project

1063 Block Replacement Project

Click on the images above for a larger version.

The 2013 Legislature authorized, with some conditions, Enterprise Services to replace the 1063 Capital Way S. block with:

- a 200,000-225,000 square foot;
- high-performance multi-tenant office building;
- using the design-build procurement process (RCW 39.10);
- with a five-year performance guarantee on energy, operations and maintenance.
- tenant lease cost of no more than $25 per gross square foot.

Project Updates/Announcements

Saken Construction Co. of Seattle and ZGF Architects of Portland have been selected as the apparent successful design team. Read the press release.

Subscribe for Updates

Just having the map doesn’t mean you get the treasure...

- Need leaders to step up and lead the way
- Share your experiences/Educate peers
- Demand results/Deliver results
- Participate in development of tools, policies
Overall Needs for Effective Outcomes

- Education across industry
  - AEC
  - Code Officials
  - Government
- Guidance documents
  - Modeling
  - Benchmarking
  - Policy Frameworks
- Insurance Markets
- Contracting Tools

Overall Needs for Effective Outcomes

- Procurement guides
- Data protocols
- Links with 111(d) programs as measurable, verified reductions in energy/GHG
- Shifts in processes, design fees, risk profiles, project scope, attitudes
- Case studies
Shifting Perceptions on the Cost of High Performance

**High Performance Buildings**
- Operationally Cost effective
- Sustainable / Green / Energy Efficient
- Resilient / DR-COOP
- Supports Productivity / Mission
- Functional / Operational
- Preserve historical value
- Safe to work in
- Secure from threats
- Accessible
- Aesthetically pleasing

**Improved Facility Delivery**
- Reduce product waste
- Prefabrication
- Improve supply chain
- Process optimization
- Systems analysis
- Performance analysis
- Commissioning
- Improve product selection
- Common information base
- Coordinate decision making
- Integrate scheduling
- Optimize design
- Design to sustain

**Results**
- Achieve net zero energy
- Reduce water consumption
- Protect environment
- Reduced carbon footprint
- Meet LEED goals
- Meet Energy Star Goals
- Asset optimization

Initial Investment Costs + Lifetime Cost Reductions = Zero or Net Positive
Utilizing BIM to Optimize Operations

• UK Government leading the way
  – Soft Landings
    As stated in the Government Construction Strategy, May 2011, Soft Landing objectives:
    Aligning the interests of those who design and construct an asset with those who subsequently use it
    Specific action: Trial introduction of a period (say 3 to 5 years) of post completion proving of the asset by contractors. Note connection with BIM and its potential to connect design and construction information to asset management.
    Outcome sought: Project designed and delivered to required operational standards and to allow asset to operate to the required standard for the whole of its life.

  – Focus on the “Golden Thread”
    • Why we build the building in the first place

• BIM is not just a design tool, but a life-cycle management tool

---

The Facility Lifecycle

[Image of the Facility Lifecycle diagram]

Courtesy of Autodesk
http://www.wbdg.org/resources/outcomebasedpathways.php

http://newbuildings.org/outcome-based-energy-codes
National Performance Based Design Guide

Go to http://npbdg.wbdg.org for latest version

National Performance Based Design Guide

Table of Contents

Introduction
1. Whole Building Performance
2. Site
3. Structural Engineering
4. Facade
5. HVAC Systems
6. Mechanical Engineering
7. Lighting Design
8. Energy Engineering

Go to http://npbdg.wbdg.org for latest version
**Owner’s Performance Requirements Tool**

- Assists the design community to plan new building designs and retrofit projects by analyzing different performance scenarios and producing cost effective strategies as outputs.

- Allows decision makers to make judgments in terms of how much exposure and cost is acceptable for:
  - Resilience performance
  - Overall Risk levels
  - Seismic risk
  - Flood risk
  - Tornado risk
  - Blast range threat
  - Ballistic threat
  - CBR exposure
  - Exterior glazing
  - Air tightness/leakage
  - Unit energy cost
  - Natural ventilation
  - Solar energy
  - Noise control

Available at www.oprtool.org

**OPR Enables Owner ROI Analysis**

**Planning Process**

- New Construction
- OPR
- Fire, Safety
- Security
- Energy Environment
- Owner Prioritized HP A&D
- HP Considerations HP Materials Multi-Hazards
- Owner Prioritized Engineering

**Performance Improvements**

- Illustrates how the OPR tool can show the ROI when increasing performance.
- Based on a realistic example of an office building. Performance was increased for all safety and security attributes – CBR not included

<table>
<thead>
<tr>
<th>Highest Improved Performance Scenario</th>
<th>Moderate Improved Performance Scenario</th>
<th>Lowest Improved Performance Scenario (Life Safety)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible damage, minor repairs required to the envelope, no disruption in operations</td>
<td>Repairable damage to envelope, some disruption in operations</td>
<td>Building destroyed but does not collapse</td>
</tr>
<tr>
<td>70% Increase in CapEx</td>
<td>57% Increase in CapEx</td>
<td>20% Increase in CapEx</td>
</tr>
<tr>
<td>1200% Decrease in Exposure</td>
<td>230% Decrease in Exposure</td>
<td>0 % Decrease in Exposure</td>
</tr>
</tbody>
</table>

**Cost vs. Resilience (Return on Investment)**

OPR also evaluates ROI from operational improvements (energy savings, and durability)
Occupant Inputs = Zero Energy Output

Paul A. Torcellini, Ph.D., P.E.
Principal Engineer, NREL

November 4, 2015

- RSF uses 50% less energy than if it were built to current commercial codes at no extra capital cost
- RSF increases space at NREL by 60% but only increases energy use by 6%
RSF Built for “No Additional Cost”

The PV system is sized for an annual EUI of 35.1 kBtu/ft².

Measured Versus Modeled Monthly and Cumulative EUI

Note: The annual EUI values are demand side values and do not include the...
Buildings Are For Occupants!

- Occupants and Operators ultimately control all the energy loads
- Frustration when Occupants are expected to “perform” but have no levers to control
- Plug loads
- Design elements for the Occupants
- Occupant training

RSF Energy Modeling

NREL RSF Energy Use Breakdown

<table>
<thead>
<tr>
<th>End Use</th>
<th>kBtu/ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Heating</td>
<td>8.58</td>
</tr>
<tr>
<td>Space Cooling</td>
<td>0.85</td>
</tr>
<tr>
<td>Pumps</td>
<td>0.48</td>
</tr>
<tr>
<td>Ventilation Fans</td>
<td>1.88</td>
</tr>
<tr>
<td>Domestic Hot Water</td>
<td>0.90</td>
</tr>
<tr>
<td>Exterior Lights</td>
<td>0.12</td>
</tr>
<tr>
<td>Lights</td>
<td>2.07</td>
</tr>
<tr>
<td>Office Plug Loads</td>
<td>7.87</td>
</tr>
<tr>
<td>Task Lights</td>
<td>0.10</td>
</tr>
<tr>
<td>Data Center</td>
<td>12.11</td>
</tr>
<tr>
<td>Data Center Cooling</td>
<td>0.02</td>
</tr>
<tr>
<td>Data Center Fans</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Credit: Chad Lobato/NREL
Day vs. Night Plug and Process Loads

Only occupied about ⅓ of the time
- Nights Unoccupied
- Weekends Unoccupied
- Holidays Unoccupied

<table>
<thead>
<tr>
<th>Occupied Hours Power Density (W/ft²)</th>
<th>0.10</th>
<th>0.20</th>
<th>0.30</th>
<th>0.40</th>
<th>0.50</th>
<th>0.60</th>
<th>0.70</th>
<th>0.80</th>
<th>0.90</th>
<th>1.00</th>
<th>1.10</th>
<th>1.20</th>
<th>1.30</th>
<th>1.40</th>
<th>1.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>0.20</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>0.30</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>0.40</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>0.50</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>0.60</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>0.70</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>0.80</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>0.90</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>1.00</td>
<td>3.0</td>
<td>5.0</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>13.0</td>
<td>15.0</td>
<td>17.0</td>
<td>19.0</td>
<td>21.0</td>
<td>23.0</td>
<td>25.0</td>
<td>27.0</td>
<td>29.0</td>
<td>31.0</td>
</tr>
</tbody>
</table>

Plug Loads

- 4 Quads—20% of commercial building energy use
- Office equipment is 7% of total electrical use
- Very diverse and diffuse making them hard to manage and control
- Evaluated current plug loads
- Developed a process to reduce
  - Unused equipment
  - Space conditioning
  - Lighting needs
RSF Plug Load Reduction Strategies

- Elevators
  - Use energy efficient traction elevators
  - Change elevator lighting to energy efficient fluorescent lighting
  - Turn off elevator lighting when the elevator is unoccupied
- Break Rooms
  - Increase the number of people that use each break room from approximately 40 to 60
  - Eliminate the cooler on the drinking fountain
- Task Lights
  - Move from 35W fluorescent task lights to 6W LED task lights
- Phones
  - Go from 100 standard phones to 1000 VOIP phone that consumes 2W each
- Copiers, Printers, Fax Machines
  - Decrease the number people that use individual copiers, printers and fax machines
  - Increase the number of people that use common, or group, copiers, printers and fax machines from 15 to 20
  - Increase the use of all-in-one machines
- Computers
  - Go from approximately 260 laptops, 33% of staff, to 720, 90% of staff, ensure standby mode works for all workstations
- Data Center
  - Blade Servers with Virtualization
  - High efficiency UPS
  - EoW/employee current to 48W/employee in RSF

The result of these strategies is a 47% reduction in plug loads.

Baseline vs RSF Plug Load EUI

Graphics and Technical Resources

Technical Resources

- Utility Incentives Spreadsheet
- “How To” 1-Pager for Office Desk
- Decision Trees
October 2010 – August 2011 Plug Load Power Density

![Graph showing power density over time]

Credit: Chad Lobato/NREL

Tools Deployed

- **Effective break rooms**
  - Water
  - Refrigeration
  - Thermal comfort
- **Advanced Power Strips**

Note: The elevators are included in the plug loads.
Lighting Control

- Must look like an on/off switch
- Give the users control
- Vacancy control strategy

Is this photo significant?

Credit: Jennifer Scheib/NREL
Radiant Ceilings
Underfloor Ventilation
Thermal Mass Walls
Operable Windows
Daylight
Ambient lighting with daylight sensors for 25 fc
Hallway Glare Control
6 watt task light 50 fc
Space Layout

- Inviting stairwells
- Hallways with bright ends
- Elevators only in the center spline
## Summary

- Keep the building simple
- Let the occupants help with the controls—engage them
- Default is maximum energy savings
- Make the user interface SIMPLE
- Design the building to be robust and to work with the occupants, not ignore the occupants
- Occupants can be your biggest ally.

---

**www.nrel.gov/rsf**
**Buildingdata.energy.gov/cbrd**
**Paul Torcellini**
**Paul.Torcellini@nrel.gov**
Results from a Living Building

The Bullitt Center Turns Two

Presented By: Ruwan Jayaweera, PE, LEED AP, Senior Associate
So, Did We Hit the Mark?

✅ Certified March 2015

Bullitt Center
HVAC System Overview
Proposed Building Energy Use

Actual Performance
Bullitt Center Performance

Net positive building

EUI under 10 in 2014 | Predicted EUI of 16

85% occupied
**Bullitt Center Energy**
Predicted vs. Actual Energy Production & Consumption

**Performance**
Predicted Weather

---

**Bullitt Center Energy**

Predicted vs. Actual Energy Production & Consumption

**Performance**

Predicted Weather
Performance
Actual Weather

Actual Values (from Bullitt DDC)
Temperature and Humidity Plot, Seattle, WA
All Hours

Performance
Thermal Comfort

North Zone Summer Temperature Profile

ZONE 1 SLAB TEMPERATURE  ZONE 1 SPACE TEMPERATURE  OUTSIDE AIR TEMPERATURE
Performance
Thermal Comfort

South Zone Shoulder Temperature Profile

- ZONE 1 SLAB TEMPERATURE
- ZONE 1 SPACE TEMPERATURE
- OUTSIDE AIR TEMPERATURE

North Zone Winter Temperature Profile

- ZONE 1 SLAB TEMPERATURE
- ZONE 1 SPACE TEMPERATURE
- OUTSIDE AIR TEMPERATURE
Performance
Thermal Comfort

South Zone Winter Temperature Profile

Living in a Living Building
Building Culture
Modes of Arrival to the 6th Floor by Week

Research by: Heather Burpee, University of Washington Integrated Design Lab
Living in a Living Building
Thermal Comfort

Living in a Living Building
Daylighting
Living in a Living Building
Indoor Air Quality

Living in a Living Building
The Restroom Experience
Grrrrrrrrr...

Living in a Living Building
Composting Toilet System
First Compost Removal
No odors, just dry compost
Lessons Learned

Living in a Living Building
Tenant Buy-In
Living in a Living Building
Issues

Living In A Living Building
Solutions
Post Occupancy Adjustments

Building Operation

Ensuring energy performance

Metering challenges

3rd party option
Tenant Budgets

What Metering Tells Us
M&V at PAE’s Portland Office
What Metering Tells Us
M&V at PAE’s Portland Office

Lighting Power Density

What Metering Tells Us
M&V at PAE’s Portland Office

Plug Loads
What Metering Tells Us
M&V at PAE’s Portland Office

Financial Considerations
Comparisons

- 52,000 sf  900,000 sf  120,000 sf
- $32.5 M  $500 M  $70.1 M
- $625/sf  $556/sf  $584/sf
- Seattle, WA  Seattle, WA  Seattle, WA
- **Living Building, Net Zero**  **Gates Foundation HQ**  **Stone 34**
- **LEED Platinum**  **LEED Platinum**  **LEED Platinum**
What Would You Like to Know?

Ruwan Jayaweera, PE, LEED AP
Ruwan.Jayaweera@pae-engineers.com
503-542-0521

Interested in Sponsoring?

We are actively seeking sponsors for these sessions. Are you interested in promoting your business while helping provide leading edge information on zero net energy?

Contact Stacey@newbuildings.org
Thank you for joining us!

Slides will be available tomorrow on our website:
newbuildings.org/demand-webinars

A survey will open as you exit the webinar, please help us make the best webinars possible by answering the survey. Your opportunity to enter your AIA member number for credits is in the survey.