Toward Zero Energy Commercial Buildings: The Role of the Utility

Ralph DiNola
Chief Executive Officer, NBI

SWEEP Southwest Regional Energy Efficiency Workshop
November 21st, 2014
Tempe, AZ

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Net Zero Energy

Defined...

Zero Net Energy buildings are buildings with greatly reduced energy load such that, averaged over a year, 100% of the buildings energy use can be met with onsite renewable energy technologies. Also known as Zero Net Energy.

Measured Energy Stats

\[ \text{18} - \text{18} = \text{0} \]

BUILDING'S TOTAL EUI  RENEWABLE PRODUCTION EUI  BUILDING'S NET EUI
Market and Policy Context
### National Context

<table>
<thead>
<tr>
<th>National Q4 2013</th>
<th>% of Buildings</th>
<th>% sq. ft of Buildings</th>
</tr>
</thead>
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<tr>
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*Note: Green building adoption in percent until December 31, 2013*

### Green Building Adoption Index 2014

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<tr>
<th>Rank</th>
<th>Market</th>
<th>% of Buildings</th>
<th>% of sq. ft. of Buildings</th>
<th>% of Buildings</th>
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### Total Adoption

- **% of Buildings**
- **% of sq. ft. of Buildings**

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<th>Year</th>
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<td>2012</td>
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*Source: National Building Institute*
Roadmap to 2030

Adopted by:
• US Conference of Mayors
• AIA
• ASHRAE
• Royal Architectural Institute of Canada
• U.S. Green Building Council
• Congress for the New Urbanism

The 2030 Challenge

Source: ©2010 2030, Inc. / Architecture 2030. All Rights Reserved.
*Using no fossil fuel GHG-emitting energy to operate.
“Big Bold” Goals for Net Zero in California

1. All new commercial construction will be ZNE by 2030

2. 50% of existing buildings will be retrofit to ZNE by 2030

3. All new residential construction in California will be ZNE by 2020

The California Efficiency Strategic Plan (Sep 2008)
californiaenergyefficiency.com/docs/EEStrategicPlan.pdf
Code Cycles to Net Zero in CA

Code Cycles to ZNE, Source: SCE & AEC, 2009
Pacific Coast Collaborative

Pacific Coast Action Plan on Climate and Energy

PREAMBLE

The Governments of California, British Columbia, Oregon and Washington,
Pursuant to the Memorandum to Establish the Pacific Coast Collaborative of June 2008, as provided for in Article 6;

existing carbon-pricing programs. Where possible, California, British Columbia, Oregon and Washington will link programs for consistency and predictability and to expand opportunities to grow the region's low-carbon economy.

2) Harmonize 2050 targets for greenhouse gas reductions and develop mid-term targets needed to support long-term reduction goals.
III. Invest in clean energy and climate-resilient infrastructure with actions to:

1) Transform the market for energy efficiency and lead the way to “net-zero” buildings.

Energy efficiency is the lowest cost way to reduce greenhouse gas emissions while creating good local jobs. The governments of California, British Columbia, Oregon and Washington will work to harmonize appliance standards, increase access to affordable financing products, and support policy that ensures that energy efficiency is valued when buildings are bought and sold. Our efforts intend to build a vibrant, growing regional market for energy efficiency products and services.
California

Key Concepts

• California Global Warming Solutions Act of 2006 (Assembly Bill 32)
• California Public Utility Commissions ordered Big Bold Goals for New Construction
• California Energy Efficiency Strategic Plan guides utilities; leads to Path to Zero in Savings by Design
• CEC sets path to ZNE codes in their bi-annual Energy Plan
• Savings by Design Path to Zero program produced at least 30 ZNE or ultra-low energy buildings in 4 years
• CalGreen (stretch code) supports ZNE code path
• Executive order for new state buildings to be ZNE by 2025
Key Concepts

Sec. 5. (1) Except as provided in subsection (2) of this section, residential and nonresidential construction permitted under the 2031 state energy code must achieve a seventy percent reduction in annual net energy consumption, using the adopted 2006 Washington state energy code as a baseline.

(2) The council shall adopt state energy codes from 2013 through 2031 that incrementally move towards achieving the seventy percent reduction in annual net energy consumption as specified in subsection (1) of this section. The council shall report its progress by December 31, 2012, and every three years thereafter.
Oregon SB 79 - 2009

• SECTION 5. (1) The Director of the Department of Consumer and Business Services, in consultation with the appropriate advisory boards, shall adopt, amend and administer a code separate from the state building code, to be known as the Reach Code.

• SECTION 6. In reviewing the energy conservation standards, the director shall consider the target standards described in the Architecture 2030 organization’s 2030 Challenge and may consider other available nationally recognized energy conservation standards.
Codes, Policies and Utilities

45 Years of Codes and Programs

Actual Zero

ZNE 20


Reach Code

Program
Given your knowledge of and experience with ZNE buildings, when do you think ZNE will be considered a mainstream approach?

Based on a survey conducted by NBI of 140 leading practitioners in the sustainable buildings industry.
How Can You Lead in the SW?
US Solar Insolation

SWEEP
WHERE WE WORK

NBI © 2014
How will we get to 2030?
New Buildings Institute

NBI’s mission is to promote and accelerate the adoption of next practices for improving energy performance throughout the built environment
NBI...

the virtuous cycle
Research
Solutions
Codes and Policy
Zero Net Energy Buildings

The net zero building movement (where buildings produce as much or more energy than they consume) remains a nascent phenomenon.

As of this time last year, the National Zero Net Energy Buildings Institute -- the organization that tracks such buildings -- had recognized only 13 buildings as net zero structures. Only four of these exceeded 15,000 square feet.

The concept of net zero buildings is spreading. Walgreen, for example, is testing energy-saving ideas. The company will open a 13,000-square-foot store in Chicago that includes a green roof, which is to be

The Bullet Center is a six-story, 50,000-square-foot building that is utilizing never-before-seen technology to be the most sustainable building ever built.

nbi new buildings institute

NBI © 2014
Zero Net Energy Buildings

- **2012**
  - ZNE Verified Buildings and Districts: 21
  - ZNE Emerging Buildings and Districts: 39
  - Ultra-low Energy Buildings (2012 report used label “ZNE-Capable”): 39

- **2014**
  - ZNE Verified Buildings and Districts: 127
  - ZNE Emerging Buildings and Districts: 53
The largest database on ZNE buildings in North America and the only database searchable by ZNE Status & Energy Performance

http://newbuildings.org/getting-to-zero-buildings-database
Existing Building Renovation

- New Construction: 76%
- Renovations: 24%
Ownership Type

- Public: 67%
- Private: 26%
- Non-profits: 7%
Building Types

- 36% Education
- 24% Renovations
- 18 Districts
- 12 Multi-family
18 ZNE Districts

- Campus: 8
- Military: 8
- National Historic Site & Campus: 1
- Neighborhood Mixed Use: 1
Performance Range
(all projects w/ MP data)

National CBECS average for Commercial Buildings

EUI (kBTU/sf/yr)

Avg. EUI 21

ZNE Verified
U-L Verified
ZNE Emerging

n=95

NBI © 2014
DPR Construction San Diego

- San Diego, CA
- 24,500 SF
- Office
- LEED NC Platinum
- ILFI Zero Energy Building Certified
- Callison Architecture
- DPR Construction, Owner, Design/Builder

Photo: DPR Construction
DPR Construction San Diego

**Efficiency Measures:**
- Natural ventilation
- Daylighting
- Roof monitors
- Efficient HVAC
- Solatubes and high performance lighting
- 64 kW PV
Richardsville Elementary School

- Bowling Green, KY
- 72,300 SF
- Education K-12
- Completed in 2010
- LEED Gold
- $206/SF
- Warren County Public Schools
- Sherman Carter Barnhart, Architect
- CMTA, Mechanical and Electrical

Photo: Sherman Carter Barnhart
Richardsville Elementary School

Efficiency Measures:
- Ground source heat pump
- DOAS
- CO2 sensors
- Daylighting
- High performance lighting system with controls
- EMS & Energy Dashboard

Photo: Sherman Carter Barnhart
Walgreens Evanston Store
14,000 sf - Opened April 2014

Efficiency Measures:
• Building massing (geometry and orientation)
• Excellent insulation and windows
• Exterior shading, automated interior shades & operable windows
• Dedicated outside air ventilation system
• Demand ventilation controls
• All LED lighting and daylight harvesting controls
• Refrigerated case doors
• Heat recovery from refrigeration systems
• Ground source (geothermal) heat pump heating and cooling
• Natural \((\text{CO}_2)\) refrigerant
• Solar PV & Wind turbine
How Can Utilities Support ZNE?
Support Code Innovation

Four important concepts in this standard are:

1) The development of a primary metric called Energy Use Intensity (EUI) to measure the predicted and actual energy use. This is analogous to miles per gallon for a car.

2) The embedded energy to deliver water to the building must be offset by on-site energy production to achieve net-zero status.

3) The development of an energy budget and the net-zero potential is defined by the ability of the building to generate on-site energy with the energy producing area limited to the building roof (and covered parking in commercial buildings). This requires that buildings be energy efficient.

4) The net-zero certification will be issued after one year of performance demonstrates net-zero achievement. Meeting the requirements in either the prescriptive path or performance path shall be deemed to be in compliance with the requirement of the IECC without regard to the issuance of the net-zero certificate.
Implement Whole Building Programs
Advanced Buildings New Construction Guide

Commercial Buildings under 100,000 sf

• Office
• Retail
• Elementary & private schools
• Town Halls, Fire & Police Stations

NBI © 2014
## Approximate Range of Savings from Advanced Buildings Requirements

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<th>Base Code and Year</th>
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<td>&gt;30%</td>
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C401.1 Scope. The requirements contained in this chapter are applicable to new commercial buildings and additions to or remodels of commercial buildings. Commercial buildings shall exceed the energy efficiency requirements of ASHRAE/IESNA Standard 90.1 Energy Standard for Buildings Except for Low-Rise Residential Buildings by at least 30 percent or other approved equivalent design criteria.

30% Better ASHRAE/IESNA Standard 90.1
C401.1.1 Alternative approaches for compliance. The following methods of compliance may be used in place of the requirements of Chapters 4, 5, and 6. This section shall not apply to: any building not designated as an institutional building; any building that is not a new construction; or any building that is not a commercial building. The methods of compliance shall be:

City of Boulder Commercial Energy Code
A Prescriptive Pathway to Compliance for Buildings Less Than 20,000 Square Feet Using the Advanced Buildings: New Construction Guide

nbi new buildings institute
NBI © 2014
New Construction Guide: Tier 3

30%
Deploy Integrated DSM

Code hearings: 2015 IgCC supports greater DR participation by **simplifying** and **standardizing** the Auto-DR HVAC

- Energy Management Systems
- Direct Digital Control
- Smart Thermostats
- Distributed Generation
- Energy Storage
- Demand Response

**The Water Heater as Grid Battery, Version 2.0**

Could a simple redesign turn basement water tanks into real-time utility assets?

Jeff St. John  
November 8, 2013

http://www.greentechmedia.com/
Develop a NZE Pilot Program

Pilot structure

Eligibility requirements:
- At least 60% energy savings beyond 2007 Oregon code
- At least 50% through energy efficiency alone

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<td>Design</td>
<td>Energy modeling and energy-related technical studies</td>
<td>$10,000 - $50,000</td>
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<tr>
<td>Construction</td>
<td>Install and commission energy efficiency measures</td>
<td>Double incentive rate, up to $500,000</td>
</tr>
<tr>
<td>Post-Occupancy</td>
<td>Whole building or subsystem monitoring</td>
<td>$5,000 - $30,000</td>
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Projects

- ecoFLATS
- June Key Delta
- Hood River Middle School
- PCC Newberg

Photo courtesy of Hennebery Eddy Architects; Photographer: Stephen Miller
Support, Convene and Recognize Leadership

ZNE EARLY ADOPTERS LEADERSHIP NETWORK

CPUC-NBI-DGS public sector workshops to support:

- Local governments
- State agencies
- K-12 schools
- Higher Education
ZNE Communication Toolkit

1. **ZNE Action Bulletin**
   News, case studies, policy, research, events and trainings

2. **Message Platform**
   Key target audience messages

3. **Intro to ZNE Presentation**
   ZNE What, Why & How

4. **Case Studies**
   California project examples, including design strategies, planning, cost, and lessons learned

5. **ZNE Companion Guide/Fact Sheets**
   General info, key audiences messages

[www.newbuildings.org/zne-communications-toolkit](http://www.newbuildings.org/zne-communications-toolkit)
Start Design with a 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

Bullitt Center

Courtesy: PAE Consulting Engineers
Use Energy Modeling Early and Often

CA Title 24 EUI = 50

54% reduction

65% reduction

24 - 28 = -4

BUILDING'S TOTAL EUI

RENEWABLE PRODUCTION EUI

BUILDING'S NET EUI

kBtu/sf/yr

kWh/sf/yr

Courtesy: EHDD
Focus on Operations and Occupancy – related Loads

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.

Courtesy of PAE Consulting Engineers
Keep the Big Picture in Focus

- Set the zero net energy **goal** and build the **team**
- **Go Passive** first: optimize passive design solutions
- Invest in the **envelope** and **glazing**
- Get control of **lighting** and **HVAC** with integrated control strategies
- **Separate ventilation** from space conditioning
- Prioritize People: **occupants and operators** drive energy use

✓ **Zero Net Energy is achievable through readily available technologies and design.**

✓ **Price range is broad and less about zero than choices.**
  **Cost can be at or approaching standard budgets.**
Deploy Ultra-low Energy Strategies

- Ground Source Heat Pumps
- Ventilation: Natural, Dedicated Outdoor Air Systems (DOAS), Demand Control Ventilation (DCV)
- Highly Efficient Thermal Envelope
- Building Orientation & Glazing ratio
- Solar Control - shading
- Daylighting Access and Controls
- Energy Management Systems
- Building Dashboards
- Radiant Heating / Cooling & Chilled Beams
- Plug load Reductions
- Energy Recover Systems

NASA Sustainability Base, CA
Courtesy: Cesar Rubio Photography, McDonough & Partners
“The prevailing industry perception is that zero energy is cost prohibitive and suitable only for showcase projects with atypical, large budgets; however, there is mounting evidence that zero energy can, in many cases, be achieved within typical construction budgets.”

www.nrel.gov/docs/fy14osti/62752.pdf
How Can Utilities Support ZNE?

• Develop an Energy Code Roadmap to ZNE by 2030 and foster adoption of advanced codes
• Align Incentives with ZNE and Whole Building Solutions
• Develop and Run ZNE Pilot Programs
• Define Effective Technologies and Strategies for ZNE
• Take ZNE to scale with District and Community approach
On the horizon?
The future of buildings is coming. What part will you play?

Zero net energy (ZNE) is an ultra-efficiency building performance goal that owners can define, design teams can reach for and occupants desire.

Join the nation’s leading policymakers, design professionals, building owners and commercial real estate representatives at the 2015 Getting to Zero National Forum to share perspectives on the growth of ZNE, learn about best practices for successful projects and collaborate on opportunities for ZNE to transform the built environment.

Join us to help lead the advancement of ZNE and the transformation of the built environment.

2015 Getting to Zero National Forum
February 1-3
Washington, DC

goingtozeroforum.org/
Learn more about NBI

http://newbuildings.org/support-nbi
Thank You!

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