Informational Panel: Current Trends and Future of NetZero Building

Panelists:

Kierra DeGrandchamp
President, High Performance Homes

Ellen Larson Vaughan
Policy Director, High Performance Green Buildings
Environmental and Energy Study Institute

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USGBC Nevada, USGBC Western Regional Council
Founding Principal, Humann Building Solutions, LLC
82% of USA citizens live in urban areas

SOURCE: CIA FACTBOOK
PHOTO: STAMETS
BUILDINGS ACCOUNT FOR

70%

OF TOTAL ELECTRICAL USE IN THE USA
BUILDINGS ACCOUNT FOR 39% OF TOTAL CO2 EMISSIONS IN THE USA
BUILDINGS ACCOUNT FOR
65% OF TOTAL WASTE IN
THE USA
A Net Zero Energy Building is proof that it is possible to live within our means.
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A Net Zero Energy Building is uniquely positioned to lead by example.
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A Net Zero Energy Building is deserving of special recognition.
Net Zero Energy is quickly becoming a sought after goal for many buildings around the globe - each relies on exceptional energy conservation and then on-site renewables to meet all of its heating, cooling and electricity needs. Yet the true performance of many developments is overstated – and actual Net Zero Energy buildings are still rare.
CONSIDER THE ALTERNATIVES!

A building designed and built to code is the worst building that you can build without breaking the law!
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A building designed and built to code is the worst building that you can build without breaking the law!

A code minimum building only meets the minimum requirements to keep its builders and developers from being criminally irresponsible!!

Slide Credit: D.A.Huard, LFA, PMP, LEED AP O+M~BD+C
CONSIDER THE ALTERNATIVES!

A building designed and built to code is the worst building that you can build without breaking the law!

A code minimum building only meets the minimum requirements to keep its builders and developers from being criminally irresponsible!!

And for a step in the right direction...

By Executive Order 13514, U.S. President Barack Obama mandated that by 2015, 15% of existing Federal buildings conform to new energy efficiency standards and...

100% of all new Federal buildings be Zero-Net-Energy by 2030.
The Zero Net Energy Building Trend Concept

- Code Allowable Maximum Energy Consumption
- Renewable energy source sufficient to meet building energy demand
- Sustainable Building’s Adoption, Influence and Demand(s)
- Positive Effect on Renewable Energy System Implementations

(Source: Pike Research)
(Source: Humann Building Solutions)

Slide Credit: D.A.Huard, LFA, PMP, LEED AP O+M~BD+C
Existing and Prospective Zero Energy Building Regulation(s) by Country

Asia Pacific
- Japan Public Buildings (2030)
- Massachusetts – All New (2030)
- California – Commercial (2030)
- California – Residential (2020)
- U.S. Federal Buildings (2030)

North America

Europe
- EU Member Countries – Commercial/Residential (2021)
- EU Member Countries – Public Sector (2019)
- United Kingdom – Residential (2016)

(Source: Pike Research)

Slide Credit: D.A.Huard, LFA, PMP, LEED AP O+M BD+C
Predicted Zero Energy Building Revenue by Region, of total World Markets: 2011-2035

(Source: Pike Research)
The Net Zero Energy Building Certification was launched on October 5, 2011 during Day 1 of the 2011 Greenbuild International Conference and Expo in October 2011 (held in Toronto, Ontario Canada), and is tied to the International Living Future Institute’s Living Building Challenge. Certification in both programs is based on actual performance and buildings seeking certification must be operational for at least 12 consecutive months prior to evaluation. To earn Net Zero Energy Building certification, buildings must address the following four LBC Imperatives.
To earn Net Zero Energy Building Certification, the requirements of the following four Living Building Challenge Imperatives must be met:

- **01 Limits to Growth** (in part): Curbs the building’s contribution to the effects of sprawled development, which undermines the positive impact of achieving net zero energy building operation.

- **07 Net Zero Energy**: Serves as the primary focus of Net Zero Energy Building Certification.

- **19 Beauty + Spirit (and) 20 Inspiration + Education**: Underscore the notion that renewable energy systems can be incorporated into a building in ways that are attractive and inspiring.
FULL CERTIFICATION
All Imperatives are mandatory
Certification is based on actual performance

PETAL CERTIFICATION
Three Petals or more
One of which must be either Water, Energy or the Materials Petal &
01: Limits to Growth
20: Inspiration + Education

NET ZERO ENERGY BUILDING CERTIFICATION
Four Imperatives
01: Limits to Growth
07: Net Positive Energy (100% only)
19: Beauty + Spirit
20: Inspiration + Education
20 Imperatives

1. LIMITS TO GROWTH
   Projects may only be on greenfield or brownfield – previously developed sites that are not at risk of inadaptation to:
   - sensitive ecological habitats (wetlands, primary dunes, old-growth forest, virgin savannah)
   - existing infrastructure
   - within the 100-year floodplain.

2. URBAN AGRICULTURE
   All projects must integrate opportunities for agriculture appropriate to the scale and density of the project using a ‘House Area Ratio (HAR)’ as the basis for calculation.

3. HABITAT EXCHANGE
   For each hectare of development, an equal amount of land must be set-aside in perpetuity as part of a habitat exchange.

4. CAR FREE LIVING
   Each new project should contribute towards the creation of walkable, pedestrian-oriented communities.

5. NET ZERO WATER
   100% storm water and building water discharge must be managed onsite to feed the project’s internal water demands or released into adjacent sites for management through accessible natural soil surface flow, groundwater recharge, agricultural use or adjacent building needs.

6. ECOLOGICAL WATER FLOW
   100% energy needs must be supplied by on-site renewable energy on an annual basis.

7. NET ZERO ENERGY
   Every occupiable space must have operable windows that provide access to fresh air and daylight.

8. CIVICIZED ENVIRONMENT
   The project must be designed to include elements that nurture the innate human attraction to natural systems and processes.

9. HEALTHY AIR
   To ensure great indoor air quality, buildings, and buildings, completed as part of neighborhood projects, must comply with best practices.

10. BIODIVERSITY
    Contact an accredited health and safety, environmental, or building code compliance officer or project manager to ensure compliance with best practices for building materials and finishes.

11.挪威
    The project must be designed to include elements that nurture the innate human attraction to natural systems and processes.

12. ENERGIZED CARBON CONTAINMENT
    The project must account for the total footprint of embedded carbon (ECF) from its construction and projected replacement costs through a one-time carbon offset tied to the project boundary.

13. RENEWABLE INDUSTRY
    The project must advocate for the creation and adoption of third-party certified standards for sustainable resource extraction and fair labor practices. Aesthetically new materials include stone and rock, metal, and timber.

14. WATER SOURCING
    The project must incorporate place-based solutions and contribute to the expansion of agricultural economy in sustainable practices, products, and services.

15. COMPARE + REUSE
    All projects must strive to reduce or eliminate the production of waste during design, construction, operation, and end-of-life order to conserve natural resources.

16. HUMAN SCALE + HUMAN PLACE
    The project must be designed to create human-centered rather than automobile-centered streets, so that the assistance enhances the aesthetic and aesthetic quality of the project.

17. DEMOCRACY + SOCIAL JUSTICE
    All primary transportation, roads, and non-building infrastructure that are originally designed for car-oriented transportation must be in accordance with the national requirements of background, age, and economic status, along with reasonable steps taken to ensure that all aspects derived from the project’s context.

18. RIGHTS TO NATURE
    The project may not block access to nor diminish the quality of fresh air, sunlight, and nature experiences for any member of society or adjacent ecosystems.

19. BEAUTY + SPIRIT
    The project must include design features intended solely for human delight and the celebration of culture, spirit, and place appropriate to its function.

20. INSPIRATION + EDUCATION
    Educational materials about the performance and operation of the project must be provided to the public to share successful solutions and to mobilize others to make change.

Slide Credit: Norman Strong, FAIA; DAHuard, LFA; ILFI
INTRODUCTION TO THE LIVING BUILDING CHALLENGE 3.0

A Visionary Path to a Regenerative Future

INTERNATIONAL LIVING FUTURE INSTITUTE™
THE METAPHOR OF THE FLOWER

ROOTED IN PLACE AND YET:
Harvests all energy + water
Is adapted to climate and site
Operates pollution free
Is comprised of integrated systems
Is beautiful

LIVING BUILDING CHALLENGE™
Why a challenge?
Infusing inspiration and poetry
Rewarding early adopters
Creating new models
Stirring the pot
Pulling the market forward
Projects may only be built on greyfields or brownfields: previously developed sites that are not classified as on or adjacent to any of the following sensitive ecological habitats:

- Wetlands: maintain at least 15 meters, and up to 70 meters of separation
- Primary dunes: maintain at least 40 meters of separation
- Old-growth forest: maintain at least 60 meters of separation
- Virgin prairie: maintain at least 30 meters of separation
- Prime farmland
- Within the 100-year flood plain

Project teams must document site conditions prior to the start of work. On-site landscape must be designed so that as it matures and evolves it increasingly emulates the functionality of indigenous ecosystems with regard to density, biodiversity, plant succession, water use, and nutrient needs. It shall also provide wildlife and avian habitat appropriate to the project’s transect through the use of native and naturalized plants and topsoil. No petrochemical fertilizers or pesticides can be used for the operation and maintenance of the on-site landscape.
LANDSCAPING

Emulate functionality of indigenous ecosystems
Provide wildlife and avian habitat
Use native and native-like plants and native topsoil
The project must contain design features intended solely for human delight and the celebration of culture, spirit and place appropriate to its function and meaningfully integrate public art.
Educational materials about the operation and performance of the project must be provided to the public to share successful solutions and to motivate others to make change.

Projects must provide:

- An annual open day for the public.
- An educational web site that shares information about the design, construction, and operation of the project.
- A simple brochure describing the design and environmental features of the project, as well as ways for occupants to optimize project function.
- Interpretive signage that teaches visitors and occupants about the project.
- A Living Building Case Study to be posted on the Institute website.
06: NET POSITIVE ENERGY
One hundred and five percent of the project’s energy needs must be supplied by on-site renewable energy on a net annual basis, without the use of on-site combustion. Projects must provide on-site energy storage for resiliency.
United States Photovoltaic Solar Resource: Flat Plate Tilted at Latitude

This map illustrates the annual average solar resource data for the United States, showing the potential for photovoltaic solar energy at various locations. The data is represented by color gradients, with darker shades indicating higher solar potential. The map includes states and major bodies of water, providing a comprehensive overview of solar resource distribution across the country.
“Our desire is to open a wedge into the future so that we, and others can see what is possible in a contemporary office building.”

Denis Hayes
Bullitt Foundation, President
THE BULLITT CENTER

Seattle, WA

ENERGY SYSTEMS

- PV
- Solar Hot Water
- Geothermal
- Biomass
- Wind
- Constructed Wetlands

16 EUI
Net Zero

ENERGY

75% Saved

100% Saved

WATER

- Rainwater
- Greywater
- Composting Toilets
- Blackwater

SYSTEMS

- LEED
- Living Building
- Architecture 2030

75% Saved

16 EUI

100% Saved

Rainwater
Greywater
Composting Toilets
Blackwater

Courtesy: Miller Hull

Slide Credit: Norman Strong, FAIA; DAHuard
SITE ENERGY CONSUMPTION

Note: Existing condition EUI normalized to new construction conditioned floorspace.

Credit: Norman Strong, FAIA Miller Hull; Interface Engineering; DAHuard
EUI – Energy Use Index

92
850,000 kWh
19,000 Therms

52
769,000 kWh

32
484,000 kWh

16
230,000 kWh

15
225,000 kWh

83% SAVINGS
Energy Efficiency Measures

- **Annual Energy Use (kWh)**

Bar chart illustrating energy use across various categories including:

- Solar
- Domestic Hot Water
- Elevator
- Ventilation
- Fans
- Pumps & Auxiliary
- Space Cooling
- Space Heating
- Miscellaneous Equipment
- IT Server
- Lights

**Net Zero** line indicating the target energy efficiency level.
Energy Consumption

**Typical Building**
- Heat: 40%
- Plug Loads: 25%
- Cooling: 7%
- Fans: 5%
- Dom Hot Water: 4%
- Lights: 15%
- Pumps/Aux: 4%
- Elevator: 1%

**Proposed Building**
- Total Savings: 75%
- Plug Loads: 13%
- Lights: 5%
- Space Heating: 2%
- Dom Hot Water: 1%
- Pumps/Aux: 3%
- Fans: 0%
- Tenant Savings: 10%
- Elevator: 1%

*Slide Credit: Norman Strong, FAIA; DAHuard, LFA*
Proposed Building Energy Use

Slide Credit: Norman Strong, FAIA; DAHuard, LFA
PLUG LOADS 2007

75 watts 75 watts 300 watts

20” CFL-LCD 20” CFL-LCD CPU

450 watts
PLUG LOADS 2010

14 watts  
22” LED-LCD

14 watts  
22” LED-LCD

62 watts  
LAPTOP

90 watts
PLUG LOADS 2011

SERVER BASED APPLICATIONS

42 watts

14 watts

22” LED-LCD

14 watts

22” LED-LCD

14 watts

Slide Credit: Norman Strong, FAIA; DAHuard, LFA
**Current (-39%)**
Server Virtualization and Consolidation nets a 28% reduction across all servers.
Replacing a 1/3rd of our workstations with new highly efficient units nets a 36% savings for all workstations. Additionally we eliminated 15 shared computers by utilizing Virtual Desktop Infrastructure, totalling a net savings of 47% across all workstations.

**Future (-73%)**
Power management strategies to reduce consumption by 73% across all workstations.

Retire Laser Printers

Replacing monitors with higher efficient models will net a 41% savings across all monitors

Migrate additional users over to laptops and Zero Clients
NET ZERO
ENERGY BUILDING CERTIFICATION™

12 MONTHS OF OPERATION
INITIATE CERTIFICATION PROCESS

1. SUMBIT DATA FOR AUDIT
   - APPROX. TIMELINE: 2 WKS
   - INSTITUTE PERFORMS DOCUMENT COMPLETION CHECK
     - 2 WKS
     - (SCHEDULE DELAY) IF DOCUMENTATION IS INCOMPLETE, INSTITUTE SENDS REQUEST FOR INFORMATION TO TEAM.
     - IF A SECOND ROUND IS NECESSARY, ADDITIONAL FEES APPLY.
   - SCHEDULE SITE VISIT
     - 4 WKS
     - AUDITOR PERFORMS CONTENT REVIEW
       - 2 WKS
       - (SCHEDULE DELAY) IF DOCUMENTATION IS UNCLEAR, AUDITOR SENDS CLARIFICATION REQUEST TO TEAM. THE INSTITUTE DOES NOT PERFORM A SECOND 'COMPLETION CHECK'. IF A SECOND ROUND IS NECESSARY, ADDITIONAL FEES APPLY.
   - AUDITOR PERFORMS SITE VISIT
     - 1-2 WKS

Slide Credit: ILFI, DAHuard, LFA
Slide Credit: ILFI, DAHuard, LFA
1. BAINBRIDGE ISLAND, WA
   Ordinance 2009-06
2. SEATTLE, WA
   Living Building Pilot
   Green Q
3. CLARK COUNTY, WA
   Sustainable Communities Pilot Program
4. PORTLAND, OR
   Green Building Policy (proposed)
5. STATE OF OREGON
   House Bill 2080
6. EUGENE, OR
   Guide 2 Green

REGULATORY INCENTIVES + ORDINANCES

© 2010 ILBI

Slide Credit: ILFI, DAHuard, LFA
Canada Mortgage and Housing Corporation
1992  Healthy Housing Design Award

A 1,700 square foot, semi-detached, three-bedroom family dwelling, located on a small infill lot. The site has no existing water and sewer systems or hydro and gas utilities. As a result, the house harvests its own energy, purifies rainwater for drinking, and treats its own waste and is designed to have a total operating cost not to exceed $300 per year.

Toronto Healthy House,
Toronto, Ontario (1993)
Martin Liefhebber

Slide Credit: D.A.Huard, LFA, PMP, LEED AP O+M BD+C
The Green Dream Home, Kamloops, British Columbia

Predicted Annual Energy Consumption

<table>
<thead>
<tr>
<th>Category</th>
<th>Consumption (kWh/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heating</td>
<td>7.46</td>
</tr>
<tr>
<td>Domestic water heating</td>
<td>12.55</td>
</tr>
<tr>
<td>Appliances/lighting</td>
<td>14.74</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>2.93</td>
</tr>
<tr>
<td>Space cooling</td>
<td>1.16</td>
</tr>
<tr>
<td><strong>Total predicted consumption</strong></td>
<td><strong>38.84</strong></td>
</tr>
</tbody>
</table>

Predicted Annual On-site Renewable Energy Production

- Solar (photovoltaic) electricity: 35.08 kWh/m²
- Active solar domestic water heating: 7.39 kWh/m²

**Total predicted production**: 42.47 kWh/m²

Predicted Annual Energy Balance: +3.63 kWh/m²

Note: All values are based on heated floor area of 284 m². The space heating value does not include the contribution from passive solar gain and internal gains.

Slide Credit: D.A.Huard, LFA, PMP, LEED AP O+M™BD+C
First Two Projects Obtain Net Zero Energy Building Certification !!

PROJECT
Painters Hall
Status: Petal Recognition, Net Zero Energy Building
Date Certified: April 1, 2012
Version of Program: 2.0
Location: Salem, OR
Bioregion: Cascadia
Living Transect: L4
Typology: Building
Occupant Type: Office, Cafe, Assembly

DETAILS
Project Area: 10,580 gsf
Building Area: 3,250 sf // Building Footprint: 3,250 sf
Start of construction: 04/2009
Start of Occupancy Period: 04/2010
Owner occupied: Yes
Number of occupants: 3 FTE // Number of visitors: 30 per day
Typical hours of operation: Office: M-F 8am-5pm;
Cafe: M-F 9am-2pm; Community Center;
frequent night & weekend use
Painters Hall Obtains Net Zero Energy Building Certification

- Painters Hall, is part of Pringle Creek Community, a 32-acre mixed-use development in Salem.
- The development is the first project to receive the NAHB Green Land Development of the Year award in 2007.
- Painters Hall converted an 80-year-old existing building into a community center.
- LEED Platinum-certified, ILFI Net Zero Energy Building Certified
- 20.2 kilowatt rooftop solar array exceeds the power required to meet the Building’s energy needs
  - GSHP for highly efficient heating and air conditioning.
  - Simple low-cost solutions for energy reduction, such as natural daylighting and passive cooling save money and increase comfort
  - Materials reuse prominently featured
  - Zero Waste Initiative significantly reduces garbage produced by events and activities.
IDeAs Z² Design Facility Obtains Net Zero Energy Building Certification

- In 2007, when green building typically meant incremental improvements in design and performance
- A net zero energy building that emits no carbon dioxide.
- Integrated Design approach focused on plug load reduction, plentiful daylighting and continuous energy metering
- A vibrant, inspiring environment for IDeAs employees.
First Two Projects Obtain Net Zero Energy Building Certification!!

**PROJECT**
IDEAs Z² Design Facility
Status: Net Zero Energy Building
Date Certified: April 4, 2012
Location: San Jose, CA
Bioregion: California
Living Transect: L4
Typology: Renovation
Occupant Type: Office

**DETAILS**
Project Area: 34,000 sf
Building Area: 7,200 sf
Building Footprint: 3,250 sf
Start of construction: 01/2007
Start of Occupancy Period: 10/2007
Owner occupied: Yes
Number of occupants: 15

Slide Credit: D.A. Huard, LFA, PMP, LEED AP O+M® BD+C
ECO-SENSE
Victoria, BC, Canada

PAINTERS HALL
Salem, OR

EXAMPLES OF COMPLETED PROJECTS
PETAL CERTIFIED
EXAMPLES OF COMPLETED PROJECTS
NET ZERO ENERGY (NZEB) CERTIFIED
PACKARD FOUNDATION HEADQUARTERS
Los Altos, CA
Photo Credit: Terry Lorant

HOOD RIVER MIDDLE SCHOOL
Portland, OR

DPR REGIONAL OFFICE
Phoenix, AZ

EXAMPLES OF COMPLETED PROJECTS
NET ZERO ENERGY (NZEB) CERTIFIED
PHIPPS CENTER FOR SUSTAINABLE LANDSCAPES
Pittsburgh, PA
Photo Credit: Paul G. Weigman

WILLOWBROOK HOUSE
Austin, TX

IDEAS 22 DESIGN FOUNDATION
San Jose, CA

EXAMPLES OF COMPLETED PROJECTS
NET ZERO ENERGY (NZEB) CERTIFIED
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