Transition to Net Zero: Design Paradigms for Creating Ultra-Efficient Buildings

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Thank you to our sponsors!
Transformation to Net Zero

Buildings

Policy and Code

Design Process

Technologies and Market
Canals ~1840

Railroads ~1880
RiceFergisMiller
Office, Bremerton, WA

Measured EUI <20 kBtu/sf/yr
Energy Code Stringency

- 90.1-2010 (IECC 2012)

Year 2000 Baseline
- A2030 Goals
- Code Stringency

Energy Use Index (1975 Use=100)

Year


100 90-75
80 90.1-1989
70 90.1-2001
60 90.1-2004
50 90.1-2007 (IECC 2009)
40 5% savings
30 11% savings
20 19% savings
10 90.1-2010 (IECC 2012)
Range of Outcome

- 90.1-1989
- 90.1-2001
- 90.1-2004
- 90.1-2007 (IECC 2009)
- 90.1-2010 (IECC 2012)

Year 2000 Baseline
A2030 Goals
Code Stringency

Energy Use Index (1975 Use=100)

Year
Performance Expectations vs. Outcome

![Graph showing Actual / Design EUI (Adj2) vs. Design EUI (Adj2) for LEED levels: Certified, Silver, Gold, and Platinum. The graph illustrates the performance expectations and actual outcomes.](image-url)
Different Players Affect Building Performance

- Tenants
- Design
- Operation

- Computers and Equipment
- Schedule
- Habits
- Staffing
- Controls
- Maintenance
- Commissioning
- Layout
- Integration
- Installation
- Components and Features
Components of energy outcomes
Components of energy outcomes

- Operating Characteristics
- Design Components
Components of energy outcomes

- Tenant Behavior
- Operating Characteristics
- Design Components

Energy Use

2000  2010  2020  2030
## Plug Load Power Density
### Measured Performance (W/SF)

<table>
<thead>
<tr>
<th>Office Location:</th>
<th>Size (SF)</th>
<th>Average Weekday Daytime</th>
<th>Average Weekday Night</th>
<th>Measured Peak</th>
<th>% of total at night</th>
<th>Ratio of Plug Load to Lighting Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irvine, CA 1</td>
<td>8,328</td>
<td>0.8</td>
<td>0.4</td>
<td>1.6</td>
<td>47%</td>
<td>4x</td>
</tr>
<tr>
<td>Irvine, CA 2</td>
<td>1,500</td>
<td>0.8</td>
<td>0.6</td>
<td>1.8</td>
<td>70%</td>
<td>2x</td>
</tr>
<tr>
<td>Rosemead, CA</td>
<td>16,500</td>
<td>0.5</td>
<td>0.3</td>
<td>0.7</td>
<td>63%</td>
<td>equal</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>8,024</td>
<td>1.5</td>
<td>1.46</td>
<td>2.1</td>
<td>97%</td>
<td>5x</td>
</tr>
<tr>
<td>Vancouver, BC</td>
<td>9,000</td>
<td>0.6</td>
<td>0.3</td>
<td>0.8</td>
<td>49%</td>
<td>1.2x</td>
</tr>
</tbody>
</table>

*Source: nbi Office of the Future Pilot Project Monitoring*
End Use in HP Buildings

RFM: Energy End Use based on 16 months

EUI = 20 kBtu/sf/yr

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

Solar PV Production -7%
Elevator 2%
HVAC, DHW, Fans 31%
Lighting 23%
Plugs/Misc 44%
Office of the Future Program

- Single-Fixture Task-ambient (task light provides ambient)
- All building lighting on occupancy sensors
- Private offices 50% auto-on with occupancy sensors, all lights auto-off

Graph showing:
- Title 24 2005 Baseline 1.18 W/SF
- Connected Load 0.83 W/SF
- Controls Credit 0.66 W/SF

Courtesy of Glumac
Efficiency First

[Graph showing the relationship between Construction Cost Premium (% of base) and Advanced Building EUIs (kBtu/sf) for different types and locations of buildings.]

© New Buildings Institute
Total LEED Projects

![Graph showing LEED project counts by year and certification level]

- Project Count
- Certification Year
- Total LEED Projects
- Certified
- Silver
- Gold
- Platinum

Number of Projects from 2012 to 2014

- 2012:
  - 21 ZNE Verified Buildings and Districts
  - 39 ZNE Emerging Buildings and Districts
  - 39 Ultra-low Energy Buildings

- 2014:
  - 33 ZNE Verified Buildings and Districts
  - 127 ZNE Emerging Buildings and Districts
  - 53 Ultra-low Energy Buildings

*Note: 2012 report used label “ZNE-Capable”*
“That Which Exists Must Be Possible”
Westmont High School Science Education Building
Dreiling Terrones Architects
Grid Neutral
Cooled lab absorbs heat, provides cool radiant surface.
IDeAs Z² Design Facility
EHDD Architecture
First – ILFI certified Net Zero Energy
Reduce Plug Loads

- HVAC
- Plug Loads
- Lighting
- Other

Standard Commercial Building

High Efficiency Design

~50% below standard
Production > Consumption

ENERGY USED: - 43,423 kWh
ENERGY MADE: + 44,543 kWh
NET ENERGY: +1,120 kWh

103%
NREL RSF
RNL Architects
Largest verified Net Zero Energy
Set an Energy Budget

- Set a maximum energy budget to help make design decisions
- Understanding “Best Practices” in the context of the Energy Budget
Cost Transfer

- Total cost same
- Mechanical cost less
- Invest in Architecture
- Active to passive
- Fragile to robust
- Longer life
- Less cost over life
- Simpler
Daylight window redirects light toward ceiling for deeper daylight penetration.

Light shelf reflects light and shades view window.

View window allows views and controls glare and solar gain.

Automatic and manual operable windows allow natural ventilation.

Insulated precast thermal mass wall.

Glazing: Sun light enters, Light Louver, Light reflected up towards ceiling.
435 Indio
RMW Architects
Net Zero Energy Spec Office
Net Zero Energy for Profit

- Performance based lease (carrot and stick for good occupant behaviour)
- Reduced reserve requirements (HVAC, lamp replacement)
- Reduced operating expenses (utilities, maintenance, etc)
- Reduced churn expenses (faster leasing)
- Reduced miscellaneous costs (unanticipated savings – no roof mechanical screen)

- $54/sf added construction cost (including PV array) offset by reduced expenses
- Annual operation savings: $163 K
- Fast lease: LOI in 3 months vs. anticipated 18 mo = $1.5 M
- 16 month payback
Looking Forward
Complex yet Simple
New Technologies for Building Skins
User Involvement

Whoops, desktop on overnight!

YIKES! I use double the average!

average

lowest

Courtesy: Vivian Loftness
Carnegie Mellon University

Courtesy: Brian Orland
Penn State University
The Cost of PV is Dropping

- 2008 - $9.50 a watt installed*
- 2013 - $3.10 a watt installed*

*(Bay Area)
DC Power Distribution
Battery Storage
Microgrids

- Utility-scale Solar Generation
- Utility-scale Energy Storage
- Rooftop PV Solar
- Fuel Cells
- Many new things to manage!
Community Scale

Integrated building systems
Advanced HVAC/lighting, energy management systems, automated load shifting, continuous commissioning

Distributed generation
Onsite (potentially shared) solar PV, fuel cells, biogas, SWH, DG/grid integration, district heat/cooling

Demand programs
Scaled adoption of DR and ADR, advancement of new dynamic pricing models

Electric transport
EV charging infrastructure, smart charging programs, EV grid impacts/integration

Grid infrastructure
Power quality monitoring, advanced distribution automation, self-healing

Storage and backup
Thermal and electric storage, backup, DG/islanding integration, rate arbitrage

Interoperability standards
Building energy management and utility integration standards, DG and storage integration, NIST smart grid standards

Incentives and financing
Development incentives and standards, availability and piloting of PACE, on-bill financing, other commercial structures
More Aggressive Building Codes

- Performance Based Energy Codes
- More aggressive energy efficiency requirements
- Zero energy targets
Assembly Bill No. 1103

CHAPTER 533

An act to add Section 25402.10 to the Public Resources Code, relating to energy.

[Approved by Governor October 12, 2007. Filed with Secretary of State October 12, 2007.]

AB 1103, Saldana. Energy: commercial buildings: consumption. Existing law declares that electrical energy is essential to the health, safety, and welfare of the people and the economy of this state, and it is the state’s policy to promote all feasible means of energy conservation. This bill would require electric and gas utilities, as defined, on and after January 1, 2009, to maintain records of the energy consumption data of all nonresidential buildings to which they provide service, in a format compatible for uploading to the United States Environmental Protection Agency’s Energy Star Portfolio Manager (Energy Star Portfolio Manager), for at least the most recent 12 months. Upon written or secured electronic request, these records would be made available to the building owner, as defined, upon request.

[Concise description of bill content]

[Concise description of bill content]
New Standards

LIVING BUILDING CHALLENGE℠

Stir the pot.
Infuse with inspiration and poetry.
Embrace the psychology of the end game.
Lead the market forward.
Create models for the future.

Achieve the Living Building Challenge℠
DESIGN PARADIGMS FOR CREATING ULTRA-EFFICIENT BUILDINGS
PORTLAND
OREGON

POPULATION: 603,106 (METRO: 2,226,009)
LATITUDE: 45.5236° N
METRO LAND AREA: ~770 Square Miles
CLIMATE
PORTLAND - TEMPERATURE / HUMIDITY

Data Source: TMY3 726980 WMO Station Number
Location: Portland Intl. Airport
CLIMATE
PORTLAND TEMPERATURE BINS (6AM-7PM, M-F)
ENERGY USE
PREDICTED vs. ACTUAL (121 LEED BUILDINGS)

“ESSENTIALLY, ALL MODELS ARE WRONG, BUT SOME ARE USEFUL”
- George E.P. Box
Gravesend, Kent, U.K.

ENERGY USE
REALITY

REMEMBER,
BUILDINGS DON’T
USE ENERGY,
PEOPLE DO.
ENERGY USE
PREDICTED vs. ACTUAL

PREDICTED EUI

ACTUAL EUI

ENERGY MODELLER
ENGINEER
ARCHITECT
OWNER
OCCUPANT
# ENERGY MODEL TRACKING LOG

## INTERNAL LOADS

<table>
<thead>
<tr>
<th>Description</th>
<th>Owner and Design Team Provided Data</th>
<th>Energy Model Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupant Density (SF/Person unless otherwise indicated)</td>
<td></td>
<td>OWNER</td>
</tr>
<tr>
<td>Total Building FTE (# people)</td>
<td></td>
<td>OWNER</td>
</tr>
<tr>
<td>Short-term visitors &lt;1 hour (average #people/day)</td>
<td></td>
<td>OWNER</td>
</tr>
<tr>
<td>Long-term visitors &gt;1 hour (average #people/day)</td>
<td></td>
<td>OWNER</td>
</tr>
<tr>
<td>Occupied office sf</td>
<td></td>
<td>OWNER</td>
</tr>
<tr>
<td>Occupied office sf/ program occupants</td>
<td></td>
<td>OWNER</td>
</tr>
<tr>
<td>by Space type</td>
<td></td>
<td>OWNER</td>
</tr>
<tr>
<td>Sample space type - Office</td>
<td></td>
<td>OWNER</td>
</tr>
</tbody>
</table>

## LIGHTING DESIGNER

<table>
<thead>
<tr>
<th>Description</th>
<th>Owner and Design Team Provided Data</th>
<th>Energy Model Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting Power Density (Watts/SF)</td>
<td>LIGHTING DESIGNER</td>
<td>OWNER</td>
</tr>
<tr>
<td>by Space type</td>
<td></td>
<td>OWNER</td>
</tr>
<tr>
<td>Sample space type - Office</td>
<td></td>
<td>OWNER</td>
</tr>
</tbody>
</table>

## OWNER

<table>
<thead>
<tr>
<th>Description</th>
<th>Owner and Design Team Provided Data</th>
<th>Energy Model Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug Load Power Density (Watts/SF)</td>
<td>OWNER</td>
<td>OWNER</td>
</tr>
<tr>
<td>by Space type</td>
<td></td>
<td>OWNER</td>
</tr>
<tr>
<td>Sample space type - Office</td>
<td></td>
<td>OWNER</td>
</tr>
</tbody>
</table>

## ALL TEAM

<table>
<thead>
<tr>
<th>Description</th>
<th>Owner and Design Team Provided Data</th>
<th>Energy Model Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misc Load Assumptions</td>
<td>ALL TEAM</td>
<td>ALL TEAM</td>
</tr>
<tr>
<td>by Space type</td>
<td></td>
<td>ALL TEAM</td>
</tr>
</tbody>
</table>

## ELEVATOR CONSULTANT

<table>
<thead>
<tr>
<th>Description</th>
<th>Owner and Design Team Provided Data</th>
<th>Energy Model Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevator energy and usage assumptions (kWh)</td>
<td>ELEVATOR CONSULTANT</td>
<td>ELEVATOR CONSULTANT</td>
</tr>
<tr>
<td>Power Demand (kW or hp)</td>
<td></td>
<td>ELEVATOR CONSULTANT</td>
</tr>
<tr>
<td>Energy Use (kWh/yr)</td>
<td></td>
<td>ELEVATOR CONSULTANT</td>
</tr>
<tr>
<td>Quantity</td>
<td></td>
<td>ELEVATOR CONSULTANT</td>
</tr>
</tbody>
</table>
OUTCOME BASED CODES
FOCUSED ON ACTUAL PERFORMANCE

2030 CHALLENGE

ENERGY INDEPENDENCE AND SECURITY ACT (EISA)

OUTCOME BASED CODES
MEET PERFORMANCE REQUIREMENTS

CURRENT CODES
MEET PRESCRIPTIVE REQUIREMENTS

NET ZERO ENERGY CERTIFICATION

LIVING BUILDING CHALLENGE

LEED

LAW BREAKING BUILDINGS

RESTORATIVE BUILDINGS

SERA ARCHITECTS, INC. © 2013
ARCHITECTURE 2030
REDUCTIONS IN BUILDING FOSSIL FUEL USE

Source: Architecture 2030, based on statistics from Energy Information Administration

* USING NO FOSSIL FUEL GHG-EMITTING ENERGY TO OPERATE
http://architecture2030.org/the_solution/solution_energy
Owner: GSA

A/E Team:
SERA ARCHITECTS
CUTLER ANDERSON ASSOCIATES
STANTEC
INTERFACE
PAE
KPFF
ATELIER DREISEITL

CMc Team:
HOWARD S WRIGHT
BENSON
McKINSTRY
DYNALECTRIC
OTIS
NUPRECON
### ARRA and EISA

#### Minimum Performance Criteria

<table>
<thead>
<tr>
<th>Energy Star Requirements</th>
<th>Water Conservation Requirements</th>
<th>Energy Conservation Requirements</th>
<th>LEED Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score goal: <strong>97</strong></td>
<td><strong>20%</strong> Indoor potable water reduction</td>
<td><strong>55%</strong> Fossil fuel reduction</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>50%</strong> Outdoor potable water reduction</td>
<td><strong>30%</strong> Energy usage reduction</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>30%</strong> Solar thermal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Gold Required</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Platinum Goal</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ENERGY GOAL

77 – 83 Existing EGWW building (437,777 sf)

34 – 36 +/- 15% Renovated EGWW target range

NATIONAL AVERAGE FACILITY
CHESAPEAKE BAY FOUNDATION MARYLAND 30,600 SF
NREL (WITH DATA CENTER) COLORADO 218,000 SF
SCHLITZ AUDUBON NATURE CENTER WISCONSIN 39,000 SF
ALDO LEOPOLD LEGACY CENTER WISCONSIN 11,900 SF
PROJECT DELIVERY

GSA STANDARD (P-100) VS. COLLABORATIVE

EST. SAVINGS
$940,000
44,000 HRS in 15 MONTHS VS. 53,000 HRS in 24 MONTHS FOR PROJECT DOCUMENT PRODUCTION

MONEY SAVED

INTEGRATED DELIVERY
COST OF DESIGN CHANGES
ABILITY TO IMPACT COST AND FUNCTION

DESIGN EFFORT
TIME
DESIGN PROCESS
14 MONTHS
CONSTRUCTION START
21 - 24 MONTHS
P-100 BIDDING
COST OF DESIGN CHANGES
P-100
Transform a 512,400 square foot, 18-story, 1974 office building into a LEED Platinum cornerstone of GSA’s green building portfolio.

BUDGET: $141,000,000
ENVELOPE STUDY
SURROUNDING BUILDINGS

June 21
8 am
ENVELOPE STUDY
SHADING FROM ADJACENT BUILDINGS

East Elevation
10 am

South Elevation
2 pm

West Elevation
4 pm

North Elevation
8 am

Shaded Area
- March / September
- June
- December
SHADING STUDY
HELIDON TESTING

% annual shading, south facade
DAYLIGHT STUDY
ARTIFICIAL SKY

Daylight Factor  min/max ratio  16 ft perimeter zone
STUDY RESULTS
A HYBRID SOLUTION

Thermal analysis
• Percentage glazing
• Shading

Daylight analysis
• Surrounding buildings shading
• Building integrated shading
• Interior light quality
• Energy savings

Ongoing Studies
• Energy Sensitivity Analysis

East 80%
South 85%
3.2 ave. daylight factor

East 72%
South 72%
6.4 ave. daylight factor

East 82%
South 80%
5.2 ave. daylight factor
DATA DRIVEN DESIGN
FROM STUDY TO DESIGN TO CONSTRUCTION

REEDS ON EAST FAÇADE
Low Glazing to Wall Ratio
40% glazing

Low Infiltration Rate
0.06 CFM

Well-Insulated Wall

Daylighting
Light shelves bounce light 16ft. into interior

Summer mid-day sun (high angle)

Equinox morning sun (lower angle)
DESIGN/ANALYSIS

WEST ELEVATION SHADING STRATEGY

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

**West Facade**
Reeds provide avg. 50% shading

**South & East Facades**
Combination vertical + horizontal shades

**North Facade**
No shading
AFTERCARE
TUNING PERFORMANCE

- Commissioning
- Post Occupancy Evaluation
- Measurement & Verification
- Energy Modeling
- Corrective Action Plan

Substantial Completion
Tenant Agency Move-In and Orientation
LEED Certification
TENANT DESIGN PROCESS

PROJECT KICK-OFF:
- INTRODUCTION
- PROJECT GOALS
- DESIGN PROCESS

PROJECT GUIDELINES:
- SHARED AMENITIES
- MODEL UNIT
- 51 STANDARDS

CHECK-IN:
- COMMITTEES
- OCCUPANT BEHAVIOR

WALK-THROUGH:
- CONFIRM ELEC/DATA

ORIENTATION SYMPOSIUM:
- GEOGRAPHY
- SYSTEMS
- GOALS
- INVOLVEMENT

TRAINING AND MILESTONES
KNOW YOUR BUILDING
• Design History
• Systems and Strategies
• Sustainability Goals

KNOW YOUR IMPACT
• Occupant Behavior
• Shared Resources

KNOW YOUR NEIGHBORS
• Property Manager
• Green Team / Tenant Agencies
BEFORE & AFTER MOVE

Survey 3 largest agencies in their Existing Office spaces:

• First & Main Building
  2010 Class-A office building
  LEED-C&S Platinum
  One block away from EGWW

• Robert Duncan Plaza
  1991 office building
  Downtown Portland
**INDOOR ENVIRONMENTAL QUALITY (IEQ)**

- Thermal Comfort
- Lighting / Daylighting
- Indoor Air Quality
- Acoustics
+ Office Layout, Furnishings & General Satisfaction

<table>
<thead>
<tr>
<th><strong>Thermal Comfort</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>How satisfied are you with the temperature in your workspace?</td>
</tr>
<tr>
<td>Very Satisfied</td>
</tr>
</tbody>
</table>

| Overall, does your thermal comfort in your workspace enhance or interfere with your ability to get your job done? |
| Enhances | | | | | | Interferes |

<table>
<thead>
<tr>
<th><strong>Air Quality</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>How satisfied are you with the air quality in your workspace (i.e. stuffy/stale air, cleanliness, odors)?</td>
</tr>
<tr>
<td>Very Satisfied</td>
</tr>
</tbody>
</table>

| Overall, does the air quality in your workspace enhance or interfere with your ability to get your job done? |
| Enhances | | | | | | Interferes |

*University of California, Berkeley – Center for the Built Environment (CBE)*
POST OCC STUDIES
CBE, LBNL, M+V, MODELS and more...

TRACK 1: LEED
3/21/2013 - 3/28/2013 LIGHTING MEASUREMENT
4/1/2013 SUMMARY REPORT
6/1/2013 SEASONAL TESTING - COOLING
8/16/2013 - 10/1/2013 SEASONAL TESTING - HEATING
12/15/2013 - 1/31/2014 10 MONTH CX REVIEW
4/30/2014
11/1/2014 - 11/30/2014 EXAMINE ACTUAL PERFORMANCE
12/31/2014

TRACK 2: POST OCCUPANCY EVALUATION
3/1/2013 - 4/1/2013 EVALUATE EXISTING FACILITIES (Survey Planning)
4/1/2013 - 4/15/2013 Survey Execution
5/1/2013 SUMMARY REPORT
6/2/2013
9/25/2014 - 10/25/2014 CONDUCT 2ND ROUND SURVEY (EG-WW)
11/1/2014 - 12/18/2014 CORRELATE 2ND ROUND AND ACTUAL PERFORMANCE
1/15/2015 ISSUE CORRECTIVE ACTION PLAN
2/1/2015

TRACK 3: LEED M&V
8/5/2013 - 9/9/2013 DRAFT FINAL
11/21/2014 - 2/2/2014 DATA COLLECTION
11/30/2014 - 1/1/2015 DATA ANALYSIS
1/4/2015 - 2/2/2015 MODEL CALIBRATION
2/18/2015 - 3/14/2015 DEVELOP REVISED CODE BASELINE ENERGY MODEL
3/15/2015 - 3/30/2015 WHITE PAPER SUMMARY OF M&V
5/1/2015

TRACK 4: ENERGY MODELING
5/1/2014

Energy Analysis Report (FINAL)
INDOOR ENVIRONMENTAL QUALITY (IEQ)

- Thermal Comfort
- Electric Lighting
- Daylighting
- Indoor Air Quality
- Acoustics

CORRELATE TO DESIGN

- IEQ parameters
  Lighting & Daylighting Studies
  Acoustics expectations
  Thermal Comfort Study
- Energy model assumptions

Figure 20. East interior zone stratification pole and example hourly temperature profiles, 9/14/2011.

Figure 21. East perimeter zone stratification pole and example hourly temperature profiles, 9/14/2011.

University of California, Berkeley – Center for the Built Environment (CBE)
SEASONAL TUNING

CALIBRATE ENERGY MODEL

CONNECT TO MEASUREMENT & VERIFICATION

- Tie into M&V and energy modeling cross-walk

TIE-IN WITH POST OCCUPANCY EVALUATIONS

- Involvement in corrective Action plan from occupant satisfaction
**ONGOING M&V**

**ENERGY & WATER PERFORMANCE**

**ENERGY END USE METERS**
- Major systems submetered

**CORRELATE ACTUAL PERFORMANCE TO DESIGN**
- Cross walk to early design energy model

**CALIBRATED MODEL FOR ONGOING OPTIMIZATION**

**WATER CALCULATOR**
- Potable Water Use
- Rainwater catchment & Reuse
SHADES OF GREEN

TYPICAL “CODE” BUILDINGS

BETTER BUILDING PRACTICES

HIGH PERFORMANCE GREEN BUILDINGS

PURSUING SUSTAINABILITY

RESTORATIVE BUILDINGS

Current Technologies and Services

Current Technologies and Services

The Living Building Challenge

Other Standards

LEED Certified

LEED Silver + Gold

LEED Platinum

Net Zero

The Natural Step

Evolving Technologies and Services
LIVING BUILDING CHALLENGE®
3.0
A Visionary Path to a Regenerative Future

http://living-future.org/
Oregon Sustainability Center
Living Building Challenge
PUBLIC / PRIVATE PARTNERSHIPS

OSC Board:
- City of Portland Bureau of Planning and Sustainability
- Oregon University System
- Portland State University
- Portland Development Commission
- Oregon Living Building Initiative

- Plus dozens of other organizations, researchers, companies and others
SITE PLAN

GRID ALIGNED
20º W OF S
SECTION PERSPECTIVES
ENERGY USE
BEFORE TENANT ENGAGEMENT

TYPICAL BUILDING ENERGY USAGE

POTENTIAL ASHRAE SAVINGS
Without Tenant ECMS
ENERGY DISTRIBUTION
WITH TENANT ENGAGEMENT

POTENTIAL ENERGY SAVINGS
Without Tenant ECMS

ENERGY SAVINGS
GOAL
With Tenant ECMS
FEEDBACK MECHANISMS
“FRACTAL DASHBOARDS”

BUILDING FAÇADE
Compare to other buildings

BUILDING LOBBY
Compare floors within the building

DEPARTMENT/OFFICE
Create inter-office competition

INDIVIDUAL
Understand personal contribution
FEEDBACK MECHANISMS

INFORMATION SOURCES

BUILDING FAÇADE
Smart Grid Connections

BUILDING LOBBY
Building Management System

DEPARTMENT/OFFICE
Utility Submetering

INDIVIDUAL
Plug Load Monitors
(Enmetric Systems Power Port shown)
Welcome to the Seattle 2030 District, a ground-breaking, high-performance building district in downtown Seattle. By targeting a district-wide reduction in energy and water use in buildings and CO2 emissions from commute trips, we will work collaboratively to meet a 50% energy reduction by the year 2030. The progress below represents actual data tracking of these three metrics in the Seattle 2030 District member base:

- 23.6 million Square Feet of Building Space
- 73 Buildings - Office, City, County, Hotel, and Healthcare
OPTIMAL SCALES

![Graph showing optimal scales for different technologies across various scales from room to region.](image-url)
CONTRIBUTIONS

EcoDistricts Institute:  http://ecodistricts.org/

Arup:  http://www.arup.com/

Sherwood Design Engineers:  http://www.sherwoodengineers.com/

International Living Future Institute:  http://living-future.org/

Living Building Challenge:  http://living-future.org/node/24

Living Building Challenge Financial Study:  http://living-future.org/node/265


Center for the Built Environment
http://www.cbe.berkeley.edu/


AIA 2030 Challenge:  http://network.aia.org/2030Commitment/Home
THANK YOU!

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http://newbuildings.org/zero-energy

http://newbuildings.org/webinars