New Buildings Institute

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Research Director

IEA-ECBCS Annex 61
Deep Energy Retrofits of Government and Public Buildings and Building Clusters

Experts Meeting September 9-11, 2013
Darmstadt, Germany
nbi is a driving force behind improved energy performance in commercial buildings.

Deep technical expertise & understanding

- Leadership & Policy
- Design Guidance
- Research, Building Science & Performance
NBI’s Interest in the Annex

1. Expand the dataset of Deep Retrofits
2. Improve the knowledge on technical solutions
3. Create simplified (bundled) solution sets to deep energy savings
4. Address market issues such as fiscal constraints and barriers
NBI Building Performance Database

- Consolidated (internal) data repository from NBI whole-building performance projects
- Used for analysis, benchmarking and integration with new tools
- Primarily anonymous
Topic: US Database on Deep Energy Retrofits – does not exist

Sources, but not consistency on that topic

Address today:

1. Case Studies
2. Energy Performance
<table>
<thead>
<tr>
<th>Sources for Case Studies on Deep Energy Retrofits</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Buildings Institute <em>Gettingto50</em> and Zero Net Energy Databases</td>
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<tr>
<td>US DOE High Performance Buildings Database</td>
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<tr>
<td>AIA Committee on the Environment (COTE) – Top Ten Awards</td>
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<td>Urban Land Institute (ULI)</td>
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<td>US Green Building Council (USGBC) LEED Database</td>
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<td>Cascadia Region Green Building Council</td>
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<td>Rocky Mountain Institute (RMI) Retrofit Depot</td>
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<td>Ashare High Performance Buildings Magazine</td>
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<td>Midwest Regional Green Building Data</td>
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<tr>
<td>NEEA BetterBricks Case Studies</td>
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<tr>
<td>Building Green</td>
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<tr>
<td>Renewable Energy Trust</td>
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<tr>
<td>Advanced Energy Design Guides for Existing Buildings (NREL/DOE)</td>
</tr>
</tbody>
</table>
# NBI Recent Research

## 11 Deep Dives

<table>
<thead>
<tr>
<th>Owner Categories</th>
<th>#</th>
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</thead>
<tbody>
<tr>
<td>Owner Occupied: Private ‘Green’ Firm*</td>
<td>3</td>
</tr>
<tr>
<td>Owner Occupied: Non-profit</td>
<td>2</td>
</tr>
<tr>
<td>Owner Occupied: Non-profit + 80% tenants</td>
<td>1</td>
</tr>
<tr>
<td>Private Investor: Tenant Occupied</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total Projects</strong></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>

*Firms in the business of demonstrating or recommending green design practices.

Energy use for these buildings is **30% - 76%** less than the national average! Half of the buildings have EUIs less than 40 kBtu/ft²/year.

Source: NBI
3 Values of Case Studies:

1. Spotlight on leaders and innovators – creates a pull of interest and replication
2. Demonstrate the technologies and strategies
3. Provide proof of performance – must be measured results
NBI Case Study Examples

Case Study Info:

- Size, use, climate, age
- Owner & design firm
- Energy Use Targets
- Energy Use Actual
- Technologies
- Business Rationale
- Lessons Learned
- Cost
- Split delivery of info:
  a) market = concise
  b) deeper technical

Sept. 9, 2013
The Vance Building
Seattle, WA, USA

134,000 sf
1929 built
2007 remodel
39 EUI

BUSINESS OVERVIEW:
• Building occupied during renovation
• Improvement cost: $26/sq ft
• Increased occupancy by 26% since renovation
• Created TI guidelines for tenant retrofits to guide design decisions for daylighting, ventilation, and finishes.

Source: NBI
Photo Credit: Lara Swimmer

Sept. 9, 2013
The Vance Building
Seattle, WA, USA

EFFICIENCY MEASURES
- Removed ducted heating systems
- Recalibrated steam heating system
- Localized thermostats
- Operable windows
- Automated sunshades
- Lighting retrofit with automated controls
- Light shelves
- CO2 sensors
- Re-commissioning
The Vance Building
Seattle, WA, USA

Source: NBI
Photo Credit: William Wright Photography
The Alliance Center
Denver, CO, USA

PROJECT OVERVIEW
• Multi-tenant non-profit office
• 6-story, 38,000 ft²
• Constructed: 1908
• Retrofit: 2006
• EUI: 42 kBtu/ft²/year
• EnergyStar rating: 85
• LEED EB Gold, CI Silver,
  EnergyStar Champion Award
• Owner: Alliance for Sustainable Colorado

Source: NBI
Photo Credit: Alliance for Sustainable Colorado
The Alliance Center
Denver, CO, USA

EFFICIENCY MEASURES
- Direct Digital HVAC Control system
- Occupancy sensors
- Photocells for daylight harvesting (fifth floor only)
- High-Efficiency glazing
- Commissioning
- T8 fixtures with dimmable ballasts
- Commissioning
- Photovoltaics
- Translucent Wall Panels
- Increased insulation
- Sun Shades (sixth floor only)
- Un-refrigerated water fountains

Source: NBI
Photo Credit: Alliance for Sustainable Colorado
The Alliance Center
Denver, CO, USA

BUSINESS HIGHLIGHTS
• Total project cost: $3.07/ft²
• Average annual energy savings: $8,800
• 35 tenants focused on advancing sustainability
• Serves as public demonstration project for advanced design strategies

Source: NBI
Photo Credit: Slaternaul, Architects
The Alliance Center
Denver, CO, USA

Source: NBI
Photo Credit: Alliance for Sustainable Colorado

SITE EUI

Your Building

160
140
120
100
80
60
40
20
ZERO

Comparative Building

National Average EUI
Portfolio Manager EUI
Best Practice Existing Building
The Alliance Center Office Building
Denver, CO USA

ALTERNATIVE VIEW OF ENERGY COMPARISON

kBtu/ft²/year

Alliance Center Measured Energy
Use - 42

Average for comparable office buildings - 69

Average for all U.S. Office Buildings - 93

Source: NBI, 2011

Sept. 9, 2013
The Aventine Office Building
La Jolla, CA, USA

HIGH PERFORMANCE RESULTS:
• 23 kBtu/ft² - Site Energy Use Intensity
• EnergyStar Rating of 100 for over 3 straight years

Source: Glenborough Properties

Sept. 9, 2013
The Aventine Office Building
La Jolla, CA, USA

ENERGY MANAGEMENT STRATEGIES:

- Chiller plant identified as energy load with single biggest savings opportunities
- Glenborough installs Optimum Energy’s Software Solution / “OptimumLOOP”
- Improved plant efficiency from a 1.4 KW/per/ton to a .40 -.60 KW/per/ton plant efficiency range
- The Aventine reduced over 501,745 kilowatts of energy, saving $75,763
Actual Energy Performance and Comparisons

- LEED
- CEUS
- CBECs

Small CA Office Retrofit

- Thru 6/09
- Thru 8/11
- Thru 1/12

Sept. 9, 2013
## Cost of Deep Energy Savings

<table>
<thead>
<tr>
<th>STANDARD U.S. OFFICE BUILDING SYSTEM</th>
<th>KBTU/FT²/YEAR REDUCTION</th>
<th>COST/FT²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug Load</td>
<td>6 - 15</td>
<td>$0</td>
</tr>
<tr>
<td>Lighting</td>
<td>6 - 8</td>
<td>$3 - $5</td>
</tr>
<tr>
<td>Ventilation</td>
<td>4 - 5</td>
<td>$2 - $5</td>
</tr>
<tr>
<td>Cooling</td>
<td>10 - 15</td>
<td>$3 - $7</td>
</tr>
<tr>
<td>Heating</td>
<td>3 - 10</td>
<td>$1 - $2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30 - 50</td>
<td>$10 - $20</td>
</tr>
</tbody>
</table>

Source: Kok, Nils, Norm Miller, and Peter Morris, 2011: “The Economics of Renovation”
PLUG LOADS

Operations and Occupancy are Critical

NIGHT ENERGY USE AS A KEY PERFORMANCE INDICATOR (KPI)

PLUGS:
- Often 2-5 times lighting loads!
- Typically approximately 50-90% of day use still used at night

Source: NBI CEC PIER Research
Thank you
Annex 61

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www.newbuildings.org