Welcome!

Redefining the Rules:
A Deep Energy Retrofit Presentation
for
Architects and Facility Managers

THU., November 5, 2015 1:00 - 2:15 PM EDT
Earn 1.25 HSW LUs
Moderator

Casey Martin, AIA, CEM, LEEP AP

- AIA CAFM Advisory Group
- Program Manager at Stanford Health Care
- Jacobs Strategic Advisory Services group

casey.martin@jacobs.com
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Featured Presenter

Tate Walker, AIA, LEED AP BD+C

- Director of Sustainability at OPN Architects
- AIA Wisconsin - Treasurer 2016
- Technical Team Leader on USDOE’s Commercial Building Partnership Program
- USGBC Energy and Atmosphere Technical Advisory Group 2009-2013

twalker@opnarchitects.com
Course Description

This session will explain how architects & facility managers can use the deep energy retrofit approach to broaden their portfolio to include retrofit projects on a wide scale of building types and sizes.

To complete deep energy retrofit projects successfully, new skills are required such as energy modeling, life cycle cost assessment, commissioning, and measurement and verification.

Additionally, this session will explain the market forces and government regulations that are driving the energy retrofit market and familiarize the audience with financial tools and incentives available to help make the deep energy retrofit market a reality.
Learning Objectives

1. Learn how to identify “retrofit triggers” and how to time energy upgrades to reach deep energy savings economically.
2. Understand financial tools, from incentive programs to tax credits, that can be used to lessen the financial burden of deep energy retrofits.
3. Implement an Integrated Delivery Process to bring key consulting team members to the table earlier in the design process.
4. Understand and evaluate plans to measure and verify performance after occupancy.
Redefining the Rules:
A Deep Energy Retrofit Presentation
for
Architects and Facility Managers
What is a Deep Energy Retrofit?

The design-based, comprehensive approach to evaluating and improving whole building performance.
Role of the architect

- Architects are well-practiced in translating the owner’s project goals into programming and design.
- Architects have experience expressing technical ideas to the owner.
- Although deep energy retrofits require a collaborative project team, there must still be a strong and knowledgeable project leader.
- Architects have experience coordinating an array of professionals to ensure the work meets overall project design and performance goals.
- Architects that include construction administrative services in their practice are well-positioned to oversee the implementation of system upgrades/replacement necessary to achieve performance goals.
Energy Audit - Plan for Efficiency

Based on ASHRAE *Procedures for Commercial Energy Audits, 2 Edition*
Energy Audit – Benchmark

- Energy Use Intensity (EUI) kBtu/sf-yr
- Energy Cost Index (ECI)
- Compare to peer facilities
  - CBECs
  - DOE Buildings Databook
  - Other facilities in your portfolio

Based on ASHRAE Procedures for Commercial Energy Audits, 2 Edition
$\text{SITE} = \text{EU} + \text{ANNUAL ELECTRIC KBtu} + \text{ANNUAL KBtu}$
Set Goals First

Start with the theoretical minimum energy use

Then

Consider project budget, constructability concerns, and other project requirements

Then

Deliver a project with the best energy performance under the given constraints

Annual Energy Use

Theoretical Minimum

Implementable Minimum

55 kBtu/ft²/yr

18 kBtu/ft²/yr

Constraints
RELIGIOUS WORSHIP ENERGY USE INTENSITY
SITE KBTU / SF / YEAR

REGIONAL AVERAGE: 64.6
NATIONAL AVERAGE: 40

2030 CHALLENGE - 70% REDUCTION: 19.4

NET ZERO:
BENCHMARKING

Energy Star Portfolio Manager

Building Performance Database

AIA DDx (Design Data Exchange)
Energy Audit – Level 1

- Brief Walkthrough
- Identify O+M (low/no cost) EEMs
- Identify capital EEMs
- Approximate cost and energy savings potential
- Establish Goals and Targets

Based on ASHRAE Procedures for Commercial Energy Audits, 2 Edition
Common O+M Measures

- Schedule AHU for space
- Economizer OA control
- Duct static pressure reset
- Reduce VAV minimum position
- Supply air temperature reset
- Optimum start for AHU
- Condenser water temperature reset
- Demand control ventilation
Energy Audit – Level 2

- In-depth walkthrough and user/operator interviews
- Develop end-use breakdown of systems
- Detailed analysis of O+M EEMs
- Detailed analysis costs/savings

Based on ASHRAE *Procedures for Commercial Energy Audits, 2 Edition*
Energy Audit – Level 3

- Most refined analysis
- Additional measurements
- O+M and Capital EEMs
- Detailed LCC/LCA
- Energy modeling (simulation)

Based on ASHRAE Procedures for Commercial Energy Audits, 2 Edition
<table>
<thead>
<tr>
<th>Energy Efficiency Measures</th>
<th>Energy Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Install a new condensing HW boiler and controls</td>
<td>$11,006</td>
</tr>
<tr>
<td>2. Control OA dampers on AHUs to close at night</td>
<td>$3,305</td>
</tr>
<tr>
<td>3. Install DDC system on AHUs</td>
<td>$6,897</td>
</tr>
<tr>
<td>4. Control exhaust fans (not pool) off at night</td>
<td>$1,356</td>
</tr>
<tr>
<td>5. Control DHW pump using an aquastat</td>
<td>$26</td>
</tr>
<tr>
<td>6. Install VFDs on all pumps (HW &amp; CHW loops; pool)</td>
<td>$1,761</td>
</tr>
<tr>
<td>7. Replace cooling tower with new HE tower w/VFD</td>
<td>$148</td>
</tr>
<tr>
<td>8. Replace T12s, high watt T8s, and pool MHs</td>
<td>$9,802</td>
</tr>
<tr>
<td>9. Replace all incandescent light bulbs (incl. exit signs)</td>
<td>$3,923</td>
</tr>
<tr>
<td>10. Install occupancy sensors in all enclosed spaces</td>
<td>$1,089</td>
</tr>
<tr>
<td>11. Install R30 of roof insul. on underside of tower roof</td>
<td>$1,567</td>
</tr>
<tr>
<td>12. Replace showerheads with low flow (&lt;= 1.5 gpm)</td>
<td>$711</td>
</tr>
<tr>
<td>13. Add sensors to boiler on residential space</td>
<td>$157</td>
</tr>
<tr>
<td><strong>Totals (1-13)</strong></td>
<td><strong>$41,745</strong></td>
</tr>
</tbody>
</table>

**Energy Savings**

- Electricity Savings: 43%
- Natural Gas Savings: 29%
- Annual Energy Savings: $41,745
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<tr>
<td>(see page 3 for detailed descriptions)</td>
<td>$/yr</td>
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START ENERGY ANALYSIS EARLY!

- RS Means
- “Shoebox” energy model
- Cost estimate
- DD energy model
- GC cost estimate
- CD energy model

Greater data accuracy
Energy Audit – Level of Effort

Level 3: Investment grade

Level 2: LEED v4 O+M EA Cx Analysis option 2

Level 1: LEED v4 O+M EA Prerequisite Minimum Energy Performance

Benchmark: Energy Star Portfolio Manager

Based on ASHRAE Procedures for Commercial Energy Audits, 2 Edition
LIFE CYCLE ANALYSIS

• LCCA is in **iterative process**

• LCCA is best done by a combination of the owner, architect engineer, cost estimators and financier

• One party needs to take ownership of the analysis
SIMPLE PAYBACK VS. LIFE CYCLE

**Simple Payback**
1. Cost of Measures
2. Incentives
3. Energy Savings

**LCCA**
1. Cost of Measure
2. Incremental Cost of Measures
3. O&M costs
4. Credit for Downsized Equipment
5. Value Beyond Energy Cost Savings
6. Salvage and Disposal
7. Inflation
8. Incentives
9. Energy Cost Savings
COMPONENTS OF AN LCCA

Initial Costs
- Fee Costs
- Construction Costs
- Other Upfront Costs

Annual Costs
- Financing Costs
- Energy & Water Costs
- Maintenance Costs

Owners Total Costs
- Salvage & Disposal
- Associated Costs & Benefits
- Incentives & Rebates
- Alteration & Replacement Costs

Adapted from Kirk and Dell’isola Life Cycle Costing for Design Professionals (1995)
LCCA TOOLS

DOE: Life Cycle Cost Analysis for Sustainable Buildings - (BLCC 5.3-14)
RETROFIT VALUE BEYOND ENERGY COST SAVINGS

• Transition Energy Efficiency and Renewable Energy away from being talked about in simplistic terms like “payback”

• Simple payback example:
  – $1,000,000 total project cost
  – $250,000 annual savings
  – No utility rebate included
  – “Payback” of 4.0 years

• But… the value of energy efficiency extends far beyond cost savings.
ADDRESSING THE BENEFITS BEYOND ANNUAL SAVINGS

For LEED-certified buildings:

- Occupancy rates 4% higher
- Lease Rates 7.4% higher

© Institute for Market Transformation, 2011.
*These studies only tracked two of the listed indicators. All studies controlled for multiple factors, including building size and location. For more information, please contact David Leipziger at david@imt.org.
STRENGTHEN THE CASE FOR DEEP RETROFITS

What **owner-occupants** likely value most:

- Improved Employee Productivity  
  - 1-10%
- Greater Occupant Satisfaction  
  - 27-76%
- Fewer Employee Sick Days  
  - 0-40%
- Lower Maintenance Costs  
  - 9-14%
- Greater Property Value  
  - 11-26%

RETROFIT MANAGEMENT EXAMPLE:

SELECTING TEAM EXPERIENCED WITH INTEGRATIVE DESIGN

RESULTS IN

 UP FORCAST RELIABILITY CHANGE ORDERS

GENERATE

 DECREASE COST RISKS OPERATING COST RISKS

CREATE

 RETROFIT RISK
STRENGTHEN THE CASE FOR DEEP RETROFITS

What **building investors** likely value most = NOI

- Lower Maintenance Costs  ➔ 9-14%
- Improved Occupancy Rates  ➔ 3-18%
- Greater Rental Rates  ➔ 2-17%
- Higher Property Value  ➔ 11-26%

**DESIGN OPPORTUNITY EXAMPLE:**

- **Creating Sealed Building Envelope** ➔ **Results In**
  - Thermo-comfort ➔ **Generate**
  - Building Rating ➔ Energy Needs ➔ **Create**
  - Energy Costs ➔ Occupant Demand For Space ➔ Rentable-Based Revenues ➔ Sales Revenues
NET OPERATING INCOME

Potential Rental Income – Vacancy Losses

Effective Rental Income + Other Income (parking etc.)

Gross Operating Income - Operating Expenses (repairs and maintenance, utilities, taxes, insurance, management fees etc.)
CATEGORIZING VALUE BEYOND ENERGY

Value Elements:

1. Retrofit Capital Costs
2. Non-Energy Operating Costs
3. Risk Mitigation
4. Health Costs
5. Employee Costs
6. Tenant Revenue
7. Sales Revenue

Source: Adopted from How To Calculate and Present Deep Retrofit Value for Owner-Occupants, Rocky Mountain Institute, January 2014 and How To Calculate and Present Deep Retrofit Value: A Guide for Investors, Rocky Mountain Institute, April 2015

Photo of CBRE's new HQ in Los Angeles, a retrofitted building; Source: ArchDaily
INCLUDING ADDED VALUE IN EVALUATION

WHERE CONVENTIONAL EVALUATION STOPS

NET PRESENT VALUE

$0

DOES NOT PASS TEST

PASSES TEST

TOTAL ADDED VALUE

Source: How To Calculate and Present Deep Retrofit Value: A Guide for Investors, Rocky Mountain Institute, April 2015
HUMAN ASPECT OF RETROFITS THAT ‘GREEN’

<table>
<thead>
<tr>
<th>Financial Benefits of Green Schools ($/ft^2)</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>$9</td>
</tr>
<tr>
<td>Emissions</td>
<td>$1</td>
</tr>
<tr>
<td>Water and Wastewater</td>
<td>$1</td>
</tr>
<tr>
<td>Increased Earnings</td>
<td>$49</td>
</tr>
<tr>
<td>Asthma Reduction</td>
<td>$3</td>
</tr>
<tr>
<td>Cold and Flu Reduction</td>
<td>$5</td>
</tr>
<tr>
<td>Teacher Retention</td>
<td>$4</td>
</tr>
<tr>
<td>Employment Impact</td>
<td>$2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$74</strong></td>
</tr>
<tr>
<td><strong>Cost of Greening</strong></td>
<td><strong>($3)</strong></td>
</tr>
<tr>
<td><strong>Net Financial Benefits</strong></td>
<td><strong>$71</strong></td>
</tr>
</tbody>
</table>

THE ECONOMICS OF BIOPHILIA

By providing views of nature:

- $2,000 annually per employee
- $93 million annually in industry healthcare costs

WHY DESIGNING WITH NATURE IN MIND MAKES FINANCIAL SENSE
TWO TYPES OF PROJECTS: CASH OR NO CASH

Available Capital

- Compare risk and value of efficiency to other investments
- Convince CFO to invest in efficiency

Lack of Available Capital

- Pursue various funding/financing options
- Consider incentives, public/private options, and foundation investments
Deep retrofits are feasible and can be cost-effective.

Deep retrofits are not cost-effective for every project.

New financing strategies are emerging.

- Retrofit financing has not been figured out.
- U.S. Government, largest landlord & tenant, has taken the lead in financing retrofits.
RETROFIT FINANCING OPTIONS

**Commercial Loan**
- Can be Non-Energy or Project Specific Financing

**Utility**
- Utility provides low-interest loan
- Paid through utility bills

**Municipality**
- Payment through Property Taxes / Lien with Building
- City or County must Have Adopted Program

**Energy Service Company**
- One-Stop-Shop – Architect Acts as Advisor to Owner
- May Include Maintenance Contract

**3rd Party**
- Fixed Terms, Monthly Payment, No Upfront $$$
- Can be Outside of Operating Budget, i.e. Off-Balance Sheet
RETROFIT REBATE AND CREDIT OPTIONS

**Utility Incentives**
- Energy Modeling
- Enrollment in Utility Rebate Program(s)

**Historic Tax Credit**
- 20% of Construction Cost
- 20% from State or Local Gov’t (ex. WI)

**179D Tax Deduction**
- Allocation letter
- Energy Model
- Verification by 3rd Party

**Innovation Tax Credits**
- Development or Improvement
- Process of “Experimentation”
- Technological in Nature
ENERGY SAVINGS PERFORMANCE CONTRACTING (ESPC)

ECM’s implemented in Fed ESPC’s by investment

- Lighting: 16%
- HVAC: 13%
- EMCS: 15%
- Chiller: 11%
- Piping dist: 8%
- Renewable heat: 8%
- GHP: 7%
- Cogen: 5%
- Boiler: 5%
- Water: 3%
- Renewable elec: 3%
- Motors: 2%
- Envelope: 1%
- Process: 1%
- Other: 1%

Key observations:

1. Apart from lighting, little/no load reductions

2. 60% ECM’s are HVAC related

1. Envelope, occupant related upgrades are rare (<1% of projects)

- Architects can recommend or incorporate ESPCs into their existing projects

Source: Oak Ridge National Lab, John Shonder, 2013
MEETS

Metered Energy efficiency transaction structure

• Cutting Edge finance mechanism intended to break down all conflicts between landlords, tenants, investors, and utilities

• 20 year contract that is beneficial to all parties
IMPLEMENTATION
OPTIMIZE THE WHOLE
DEEP TRIGGERS

1. Adaptive Reuse, Market Repositioning or Modernization
2. Roof, Window or other Major Envelope work
3. Deferred Maintenance / Replacement for HVAC and Similar Equipment
4. Code-Required Updates
5. New Acquisition and Refinancing Announcements of Utility Rate Hikes or other Related News
6. Major Occupancy Change
7. Significant Comfort or Maintenance Issues
8. Owner-Initiated Energy Management Planning
Deep Retrofit = Integrative Design + Economic Triggers + Existing Operation Evaluation
DEFINING A COMPREHENSIVE ENERGY SAVINGS PLAN

Building Infrastructure Investment Phases

- Independent ECMs (low cost/no cost)
- Load Reduction ECMs (dependent on tunneling through the cost barrier)
- HVAC ECMs (dependent on a deep retrofit trigger)
- Maintain Performance
Kirkwood - Linn Hall
‘Retrofit’ Relationship Diagram
‘Deep Retrofit’ Relationship Diagram
EE Tools for Existing Buildings

<table>
<thead>
<tr>
<th>Activity</th>
<th>% Savings Range</th>
<th>Cost/ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCx</td>
<td>16%</td>
<td>$0.30</td>
</tr>
<tr>
<td>Capital Improvement</td>
<td>20-40%</td>
<td>Varies</td>
</tr>
<tr>
<td>M+V</td>
<td>1-3%</td>
<td>1-10% project</td>
</tr>
<tr>
<td>Total</td>
<td>37-59%</td>
<td>Varies</td>
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