THE FULL VALUE OF DEEP ENERGY RETROFITS

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Rocky Mountain Institute

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Deep Energy Retrofit Forum
Washington D.C.
Its about the people!

It’s about enhancing mission effectiveness

It's about federal leadership

Sources:
http://www.reconomy.org/wp-content/uploads/2013/12/Energy4All_Kids_at_Fens_site_Pure_Leapfrog-352x198.jpg,
Its about energy security and resilience

People cost far more than energy

- Productive Salaries & Benefits: 86.3%
- Rent: 8.9%
- Absenteeism: 2.7%
- Presenteeism: 1.3%
- Energy: 0.8%

Sources: US Department of Labor 2010, BLS 2011; BOMA 2010
Occupant engagement is critical

As we move toward more efficient and net zero energy buildings, plug loads play a big role in energy use, between 30% - 60% of a buildings energy use.

7.4% reduction in energy use due to behavioral strategies.²
- Energy kiosk and educational signage
- Certifications and awards
- Training programs and fact sheets
- Energy competitions

Source: [http://www.aiatopten.org/](http://www.aiatopten.org/)
What next?

We need a better way to **quantify** and **monetize** these benefits.

Resources
RMI’s DRV Report:
- Published Spring 2015
- Provides guidance for calculation methodologies
- Compiles industry studies and research
- Case studies
- Free at [www.rmi.org](http://www.rmi.org)

Additional resources:
- IREM Courses
- Carnegie Mellon BIDS database
- Green Building Finance Consortium
Deep Retrofit Value Categories – Private Sector

- Net Present Value
  - $0
  - Retrofit cost
  - Energy cost savings
  - Development cost reductions
  - Operating cost savings
  - Tenant based revenues
  - Sales proceeds

Where conventional analysis stops

Risk Reduction

5

1

2

3

4

5

Does not pass test

Passes the test
Deep Retrofit Value Categories – Public Sector

- Net Present Value
  - $0
  - Retrofit cost
  - Energy cost savings
  - Development cost reductions
  - Operating cost savings
  - Tenant Occupant based revenues
  - Sales proceeds

Where conventional analysis stops:
- Risk Reduction (5)
- Does not pass test

Passes the test
# Deep Retrofit Value Categories – Public sector (Part 1)

<table>
<thead>
<tr>
<th>Category</th>
<th>Private Sector - Leased buildings</th>
<th>Public Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Capital cost savings through integrative design</td>
<td>• Capital cost savings through integrative design</td>
</tr>
<tr>
<td>1. Development Cost Savings</td>
<td>• Subsidies and incentives (i.e. tax credits, rebates, grants, expedited permitting, site density bonuses, fee waivers, subsidized lending, PACE)</td>
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<tr>
<td></td>
<td></td>
<td>• Alternative financing (ESPC, UESC, ENABLE, PPA’s, ESA’s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Portfolio approach – targeting ripe buildings, sharing lessons learned</td>
</tr>
<tr>
<td>2. Operating Cost Savings</td>
<td>• Insurance savings – premium reductions and improved technologies can prevent losses</td>
<td>• Insurance savings</td>
</tr>
<tr>
<td>(non-energy)</td>
<td>• Space Optimization – smaller mechanical equipment increases usable floor area</td>
<td>• Space Optimization</td>
</tr>
<tr>
<td></td>
<td>• Maintenance cost savings (9-14%)(^1)</td>
<td>• Maintenance cost savings</td>
</tr>
<tr>
<td></td>
<td>• Better loan rates due to lower mortgage default rates on green buildings (20%)(^2)</td>
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</tbody>
</table>

Deep Retrofit Value Categories – Public sector (Part 2)

<table>
<thead>
<tr>
<th>Category</th>
<th>Private Sector – Leased buildings</th>
<th>Public Sector</th>
</tr>
</thead>
</table>
| 3. Tenant/Occupant based revenues | • Faster lease up time (i.e. Sharp Development leased up in 3 months vs. expected 18 months)  
  • Higher rent rates (2-17%)¹  
  • Increased tenant retention, reduced vacancy (4%)²  
  • More positive negotiations and longer lasting relationships | • Productivity increases (1-11%)³  
  • Increased occupant satisfaction (27-76%)⁴  
  • Increased occupant health, reduction in sick days (0-40%)⁵  
  • Increased employee attraction and retention  
  • Increased brand and leadership value |

<table>
<thead>
<tr>
<th>Absenteeism</th>
<th>Annual Absenteeism rate</th>
<th>Equivalent hours lost work</th>
<th>Annual cost to employer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Sector</td>
<td>1.7%</td>
<td>35</td>
<td>$765</td>
</tr>
<tr>
<td>Public sector</td>
<td>2.2%</td>
<td>42</td>
<td>$1,100</td>
</tr>
</tbody>
</table>

> $500M Value

## Deep Retrofit Value Categories – Public sector (Part 3)

<table>
<thead>
<tr>
<th>Category</th>
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</tr>
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</table>
| 4. Sales proceeds        | • Increased sale proceeds (11-26%)\(^1\)  
• Higher NOI  
• Increased liquidity                                           | N/A                                               |
|                           |                                                                                                 | DOE Asset Rating, ASHRAE EQ                        |
| 5. Risk Reduction         | • Reduced exposure to utility price volatility  
• Reduced risk of business interruption due to critical equipment failure  
• Increased flexibility and adaptability                          | • Reduced exposure to utility price volatility  
• Reduced risk of business interruption due to critical equipment failure  
• Increased flexibility and adaptability  
• Increased energy security and resiliency                        |

WorkPlace 20·20 Projects Evaluation Study

### Daylight
- **New**: 75% (75 people)
- **Old**: 51% (51 people)

### Window View
- **New**: 69% (69 people)
- **Old**: 47% (47 people)

### Air Quality
- **New**: 65% (65 people)
- **Old**: 36% (36 people)

### Temperature
- **New**: 43% (43 people)
- **Old**: 34% (34 people)

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**Figure 6: Effect of Office Space on Stress Level**
- **33%** (The same as before)
- **49%** (Better than before)

**Figure 4: Improved Individual Work Effectiveness**
- **55%** of those surveyed said the new space is better for individual productivity (32% neutral)
- **49%** of those surveyed said the new space is better for concentration (26% neutral)

Source: GSA The New Federal Workplace (2009)
Rocky Mountain Institute Innovation Center

**Type:** Commercial office building.

**Use:** Headquarters of Rocky Mountain Institute, accommodating 50 staff and 80 in convening center

**Location:** Basalt, Colorado

**Size:** 15,610 sq. Ft

**Completed:** Dec 2015
RMI Innovation Center Highlights

**Achieves net-positive energy** (<200 NZE buildings)

The **highest performing** building in the **coldest climate zone** in the US, even before PV

74% more efficient than the average office building in its climate

LEED Platinum certified, Passive House Certified, and PHIUS+ Source Net Zero Project

**No cooling system and a small, distributed heating** system with equivalent capacity of 1 mid sized home
This building serves as a model

The Innovation Center is right in the ‘sweet spot’ to move the market

90% / 78% of commercial / government buildings are under 25,000 SF

Offices are the biggest use of commercial buildings, 2nd biggest in government buildings

Half of commercial and government buildings are owner occupied

By 2035, about three-fourths of U.S. floor space will be new or renovated.

Source: CBECS 2003 and 2012
RMI Innovation Center Costs

The incremental cost associated with achieving net zero energy for the Innovation Center was **10.8%** and will deliver a simple payback in just under **4 years**.

Our net zero energy building delivers significantly more long-term value than a typical building. Increased productivity, reduced energy costs and reduced maintenance costs contribute >$2.5 M over a 10 year period.
< 4 year payback on NZE

<table>
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<tr>
<th>Premium for net zero energy</th>
<th>$86/SF</th>
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<table>
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<tr>
<th>Annual operating costs</th>
<th>Annual Savings</th>
</tr>
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<tr>
<td>Energy</td>
<td>$8,100</td>
</tr>
<tr>
<td>(Compared against a LEED baseline building, includes annual PPA expenses for building related PV, not for PV dedicated to EV charging)</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>$3,000</td>
</tr>
<tr>
<td>(reduced exterior repainting, lower HVAC equipment maintenance, reduced lighting bulb replacement)</td>
<td></td>
</tr>
<tr>
<td>Productivity and Satisfaction</td>
<td>$334,100</td>
</tr>
<tr>
<td>(3% gain in revenue per employee due to productivity increase from <em>individualized temperature controls, natural ventilation</em> and <em>increased daylight availability.</em>)</td>
<td></td>
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<th>Total</th>
<th>$345,200/year or $22/SF</th>
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<td>Simple payback</td>
<td>3.9 years</td>
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</table>
3% productivity increase is conservative

34 studies compiled and analyzed by Carnegie Mellon’s Center for Building Performance and Diagnostics show...

- **3.6% average productivity gain** for individualized temperature control
- **5.5% average productivity gain** for maximized daylighting
- **9% average productivity gain** for mixed-mode or all-natural ventilation.

10 year present value for productivity increases:

- **18.1%** cumulative productivity gain: $15,560,000
- **9.0%** natural ventilation: $7,740,000
- **8.5%** daylighting: $4,730,000
- **3.6%** temperature control: $3,100,000
- **RMI at 3%**: $2,580,000
Several additional likely sources of value were considered but they are less significant and some are related to aspects of the building other than its energy performance (i.e. high-end finishes, modular design, etc.)

- Value of convening
- Recruiting and Retention
- Building Longevity
- Flood Insurance
- Employee Churn
- Landscape Maintenance
- Grid Resilience
- Carbon Offsets
- Natural Gas Cost Certainty

> 7X value from productivity
What next?

1. Every building should have an informational energy display in the lobby
2. Every major renovation should do a pre and post occupant productivity and satisfaction survey
3. Building owners can advertise the full value and help educate occupants
4. Building occupants can study and publish the results
5. Policy makers can support programs that illustrate and communicate the quantitative link between cost and value
6. Cohort to document calculation methodologies and bound values for the federal government to increase adoption