

# Finding the **VALUE** in Deep Energy Retrofits



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Organisers:



International Co-owners:







# RetroFit

## DEPOT

AN RMI INITIATIVE

[www.rmi.org/retrofit\\_depot](http://www.rmi.org/retrofit_depot)

RetroFit 101

How to Retrofit

Case Studies

Value

## Your Premier Resource for Deep Energy Retrofits!

You may be able to find a lot of information and guides on energy retrofits, however none are focused on catalyzing *deep* energy retrofits across the U.S. commercial building stock. To this end, Retrofit Resources offers news, community, and tools for deep energy retrofits that are unbiased by commercial interests. The site shows you how to build the case for a deep energy retrofit and walks you through how to enact a deep energy retrofit from idea to completion.

Whether you're an owner considering the value of deep energy retrofits, a service provider interested in building a skill set, or a sustainability evangelist for your organization, we've got you covered. Dig in.



### Buildings

Residential Energy+

Commercial Energy+

SuperEfficient+

### Tools and Resources

Innovation Center

### THE RETROFIT GUIDES

# RetroFit

## DEPOT

AN RMI RESOURCE

Download the Guides



### DEEP RETROFIT VALUE GUIDE

HOW TO CALCULATE  
AND PRESENT  
DEEP RETROFIT VALUE

A GUIDE FOR OWNER-OCCUPANTS



# What is a **DEEP** Energy Retrofit?

“A deep energy retrofit is a whole-building analysis and construction process that achieves much larger *energy cost savings*—sometimes more than 50% reduction—than those of *conventional* energy retrofits and fundamentally enhances the building value.”

≥ 30%



Organisers:



International Co-owners:





Are there any  
Deep Energy Retrofit  
buildings achieving  
Net Zero?

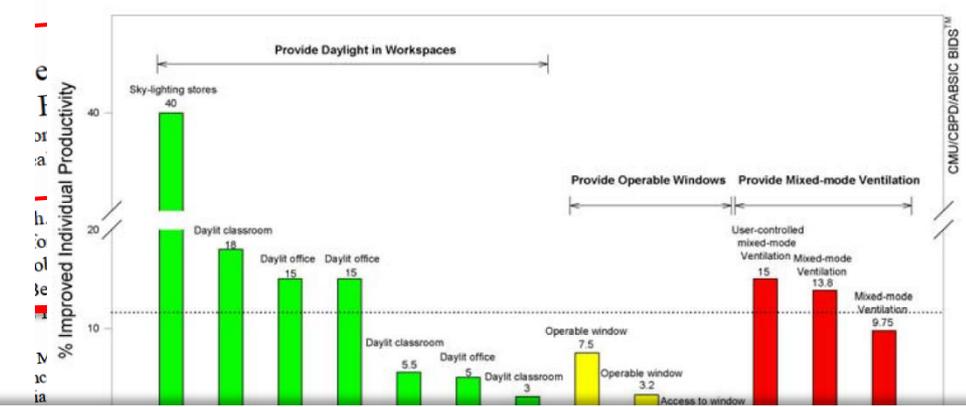
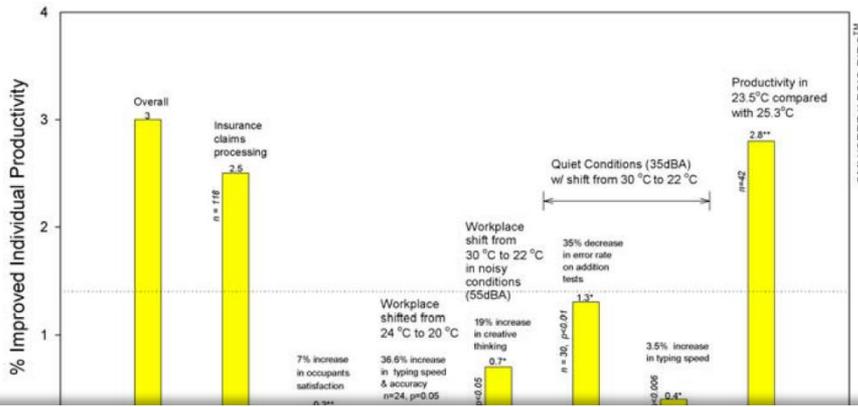
**Yes!**

**What's Next?**

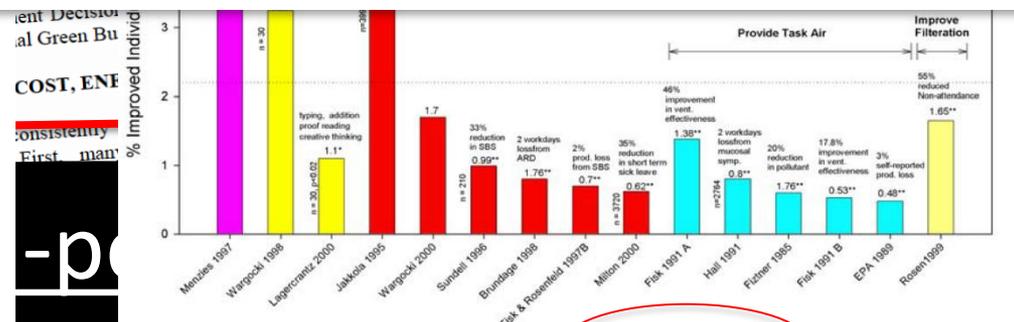
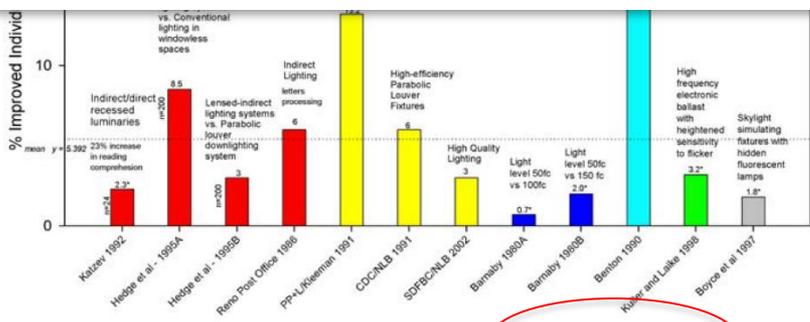


# Value





# ~3%-30% increase in productivity



Case Studies Introducing Improved Performance with Lighting Control Strategies

(\* Performance improvement for specific tasks multiplied by estimated time at tasks)

Case Studies Introducing Improved Indoor Air Quality

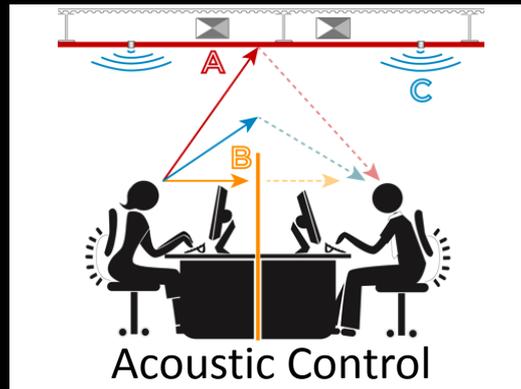
(\* Performance improvement for specific tasks multiplied by estimated time at tasks)  
(\*\* improved ventilation effectiveness calculated relative to productivity gains from other studies)

Lighting System Quality Increases Individual Productivity.

Improved Indoor Air Quality Increases Individual Productivity.



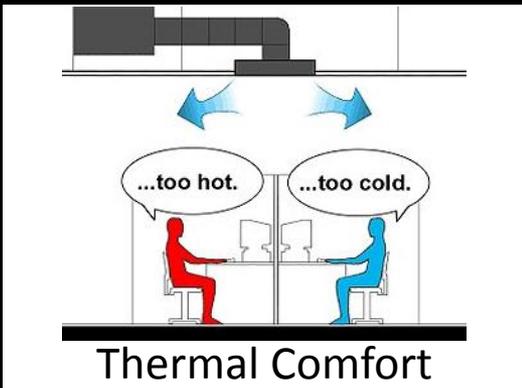
Optimized Lighting



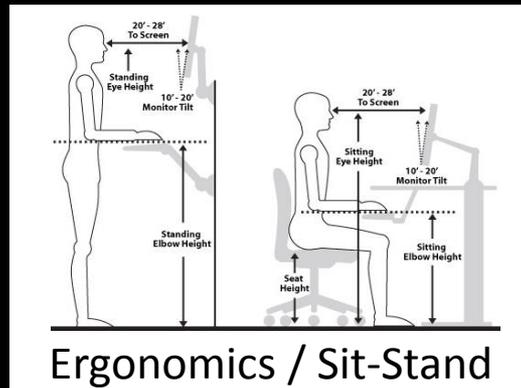
Acoustic Control



No VOC / Chemical Free



Thermal Comfort



Ergonomics / Sit-Stand



High Ventilation /  $\downarrow$  CO<sub>2</sub>



Daylight & Views



Biophilic Design



Work-Life Balance

# Performance: Views, Daylight, Systems

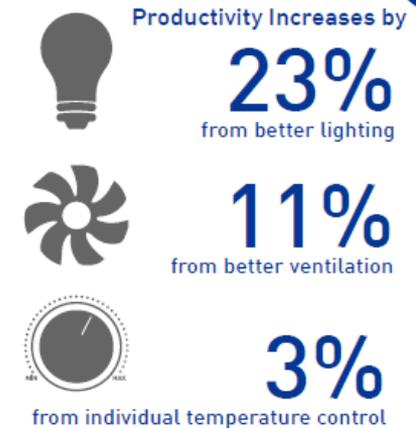
## OUTSIDE VIEWS



## DAYLIGHT



## SYSTEMS



Source: World Green Building Council



Organisers:

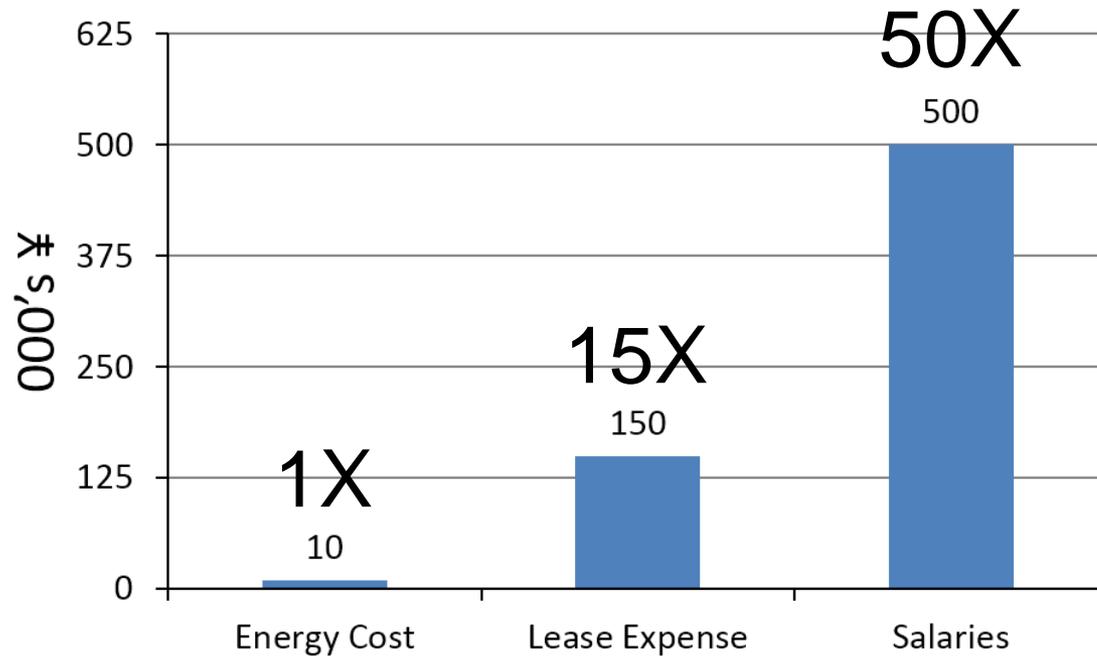


International Co-owners:



# Why Productivity Matters

Relative Office Costs (¥/m<sup>2</sup>/Year)  
Tokyo, Japan



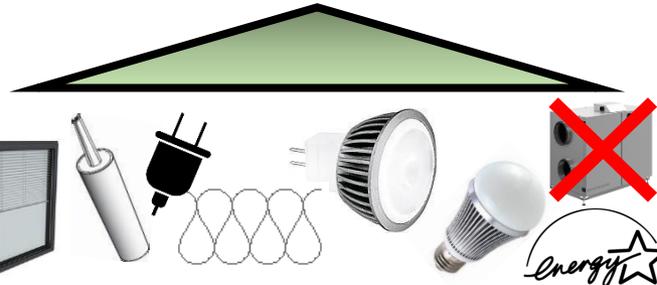
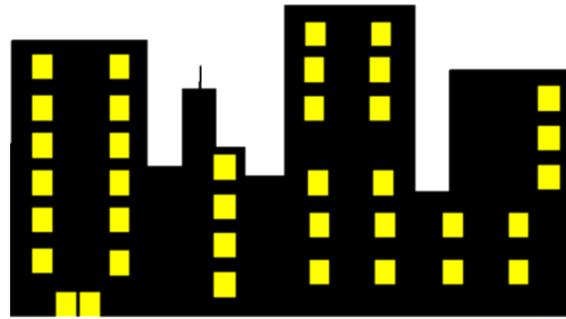
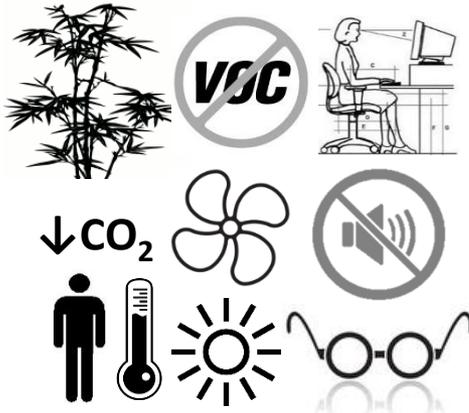
# Implementation Timing and Results

## 1 PLANNED CAPITAL IMPROVEMENTS



**Data Sources:**  
 RMI, Deep Retrofit Value, 2014  
 Eichholtz et al, 2010  
 Wiley et al, 2010  
 Feurst and McAllister, 2011  
 Pogue et al, 2011  
 Bernstein and Russo, 2012  
 Kok et al, 2012

## 3 VALUE BEYOND ENERGY SAVINGS



## 2 BUILD ON PLANNED IMPROVEMENTS

## 4 CAPTURING REAL VALUE

**CO<sub>2</sub>** 30-60% ↓  
**Rent** 4-16% ↑  
**Occupancy** 3-17% ↑  
**Productivity** 3-15% ↑  
**Turnover** ↓  
**Engagement** ↑

# Empire State Building

New York City, USA

Opened – 1931

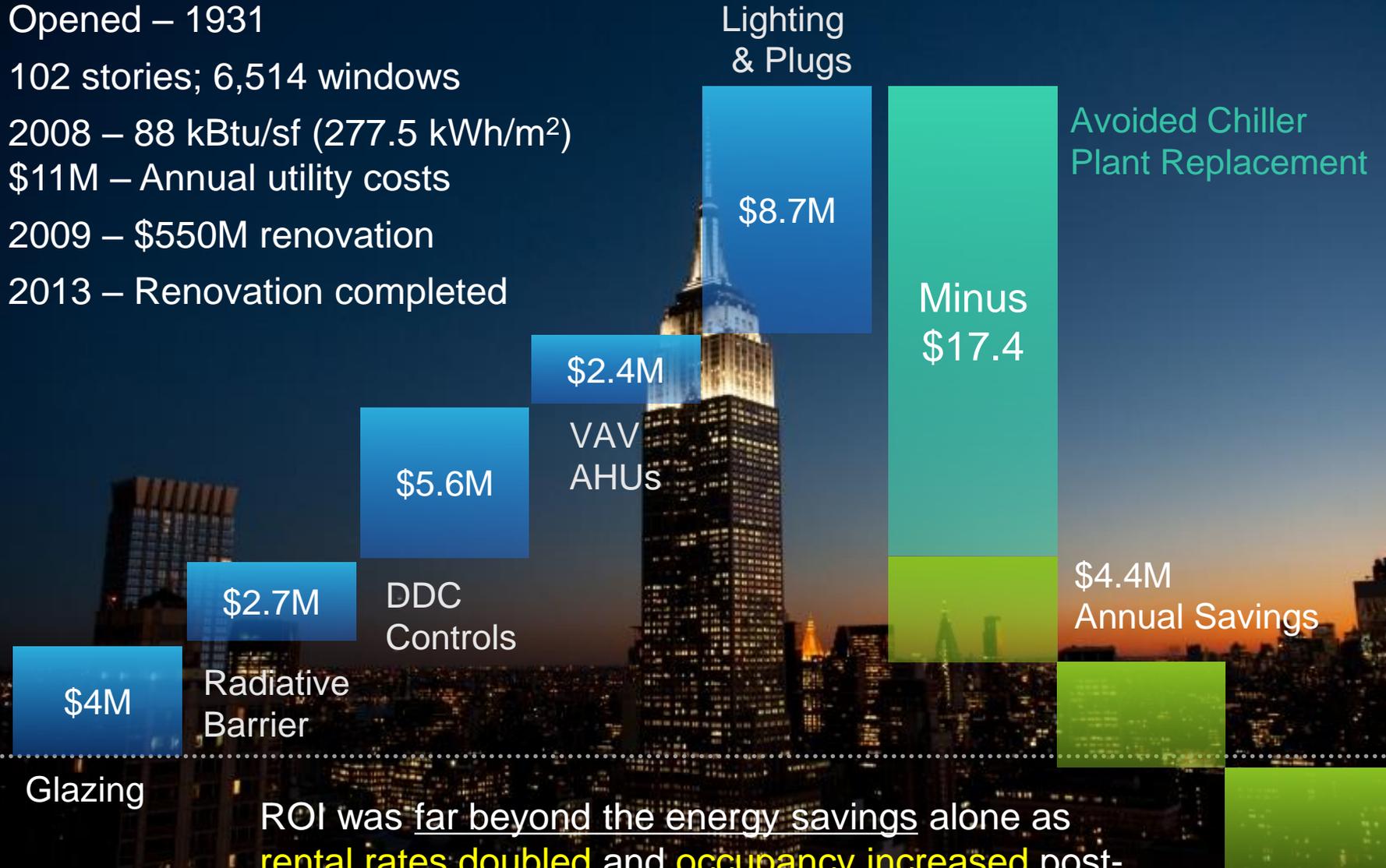
102 stories; 6,514 windows

2008 – 88 kBtu/sf (277.5 kWh/m<sup>2</sup>)

\$11M – Annual utility costs

2009 – \$550M renovation

2013 – Renovation completed



ROI was far beyond the energy savings alone as **rental rates doubled** and **occupancy increased** post-renovation. And the **property value increased**.

# Deutsche Bank HQ

Frankfurt, Germany

Opened – 1984

1,250,000 SF (116,171m<sup>2</sup>)

Renovation – 2007-11

Cost - \$290,000,000

\$232/SF (\$2,496 m<sup>2</sup>)

	<b>Resources</b> Recycling: 98 %	Recycling of 30,500 tons + fit-out of 15,000 m <sup>2</sup> office space with reused construction elements
	<b>Heating energy</b> Reduction: 67 %	67% savings per year = heating energy for approx. 750 households
	<b>Electrical power</b> Reduction: 55 %	Savings of 55% power = annual consumption of approx. 1,900 households
	<b>Water</b> Reduction: 74 %	74% saved water per year = filling of 22 Olympic-sized pools
	<b>CO<sub>2</sub> Emissions</b> Reduction: 89 % <sup>1)</sup>	Reduction of 89% per year = 6,000 cars driving 12,000 km
	<b>Utilisation ratio</b> Increase: 20 %	Up to 600 additional employees benefit from the new work environment



LEED <sup>2)</sup>  
Platinum  
Certificate

World's first major  
refurbishment of a  
skyscraper to achieve a  
LEED Platinum  
certificate



DGNB <sup>3)</sup>  
Gold  
Certificate

First major renovation  
which was awarded a  
DGNB certificate in Gold

<sup>1)</sup>With reference to the Primary Energy | 55% through reduced consumption | 34% through green power

<sup>2)</sup>LEED: Leadership in Energy and Environmental Design

<sup>3)</sup>DGNB: Deutsche Gesellschaft für Nachhaltiges Bauen

# Health, Wellness and Productivity Calculation Methodologies

**Office Productivity and Human Performance Calculation Methodology**

Average Office Worker Salaries (Tokyo)  
 ¥4,670,000 (annual, including "bonus") 2014: <http://doda.jp/guide/heimin/2014/area/data.html>  
 ¥1,401,000 (benefits @ 30%)  
 ¥6,071,000.....Use: **¥6,000,000/person, including benefits**

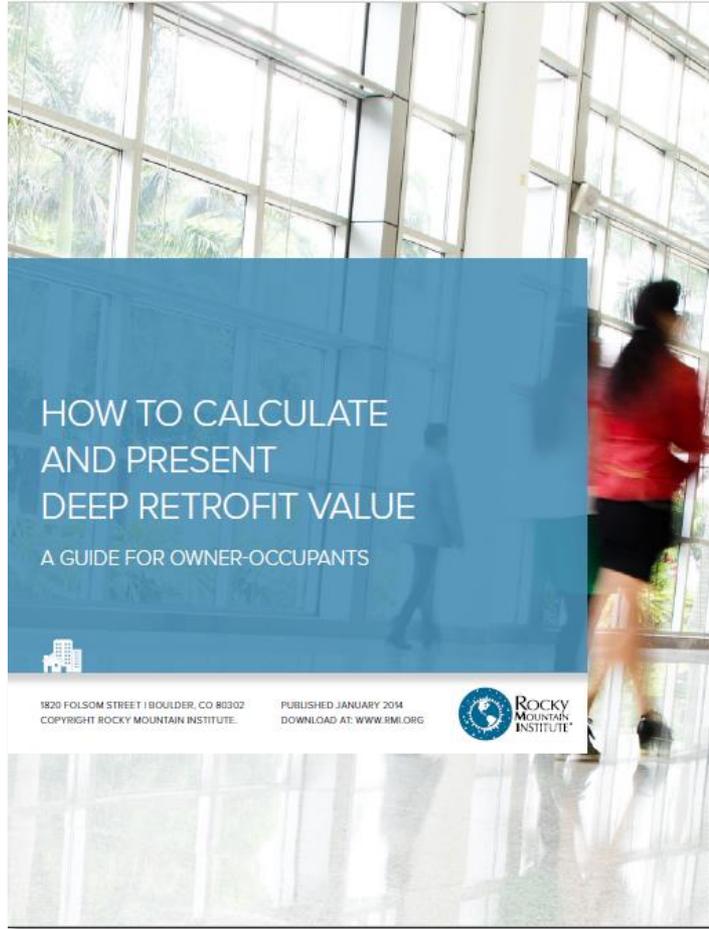
Number of Workers / m<sup>2</sup>  
 Median office: 3.92 **tsuba/person** (2014 **Yoroku report**). 1 **tsuba** = 3.306 m<sup>2</sup> = **13 m<sup>2</sup>/person**

[76.pdf](#)  
 work stations, increased ventilation  
 liability, daylighting/views **biophilia**...  
 with the most common studies reporting  
 a **study range for our modeling**.

Japan (14.4% annually (2011) across  
 Assumption: in the office sector it's  
**baseline, minus whatever reduction we**

this is a detailed example:  
**Employee-turnover**/ Ranges reported by  
 calculator might be useful:  
**benefits**

not working long hours, has negative  
 prevalent. One large US study estimated  
 USD (¥26,144). Another detailed 2013 study  
[1740/pdf/indhealth-51-482.pdf](#) across various  
 per 100 workers over prior 4 week period  
 environment) and hours of productivity lost  
 meters (per 100 workers, prior 4 weeks).  
**(-\$200 per person or ¥20,608) rate = 0.1%**  
**lost (-¥450 per person or ¥45,136) rate =**  
**using designers sense of how bad the old space**



HOW TO CALCULATE  
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Organisers:



International Co-owners:



Sustainable Buildings and Climate Initiative  
 Promoting Policies and Practices for Sustainability



Global Alliance for Buildings and Construction



# YKK Headquarters

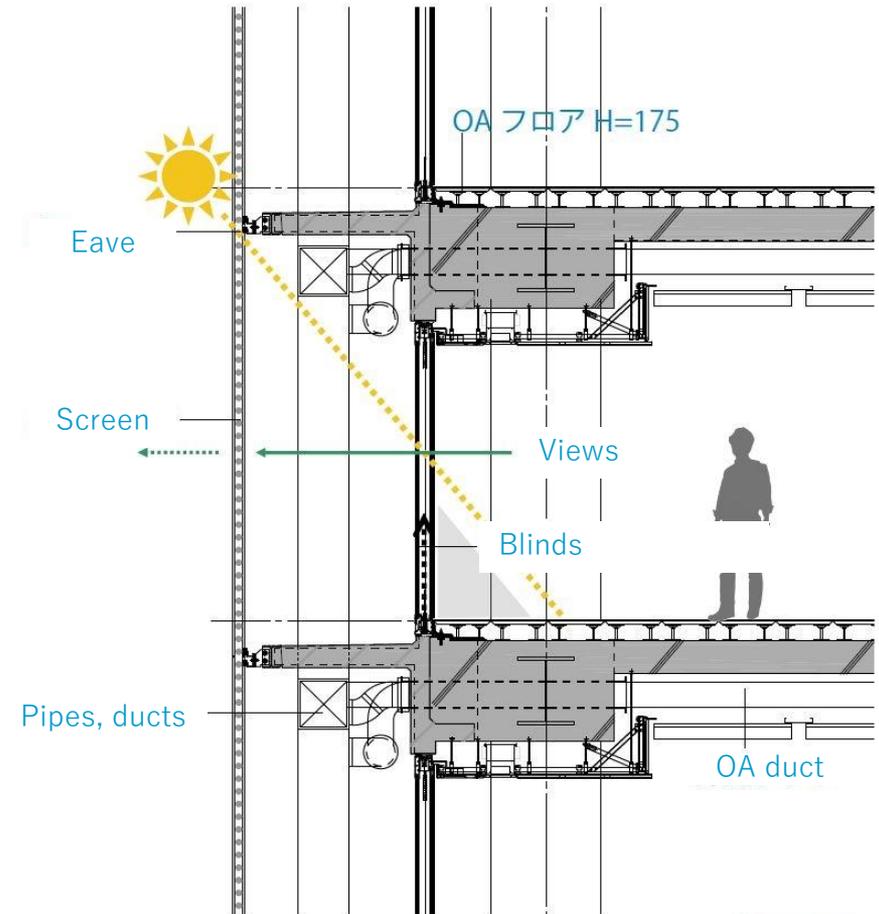
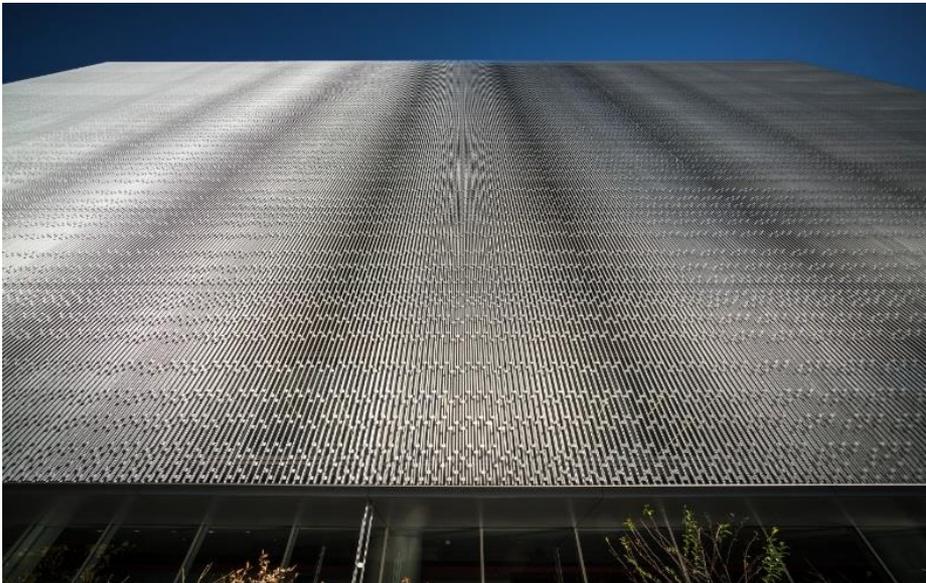
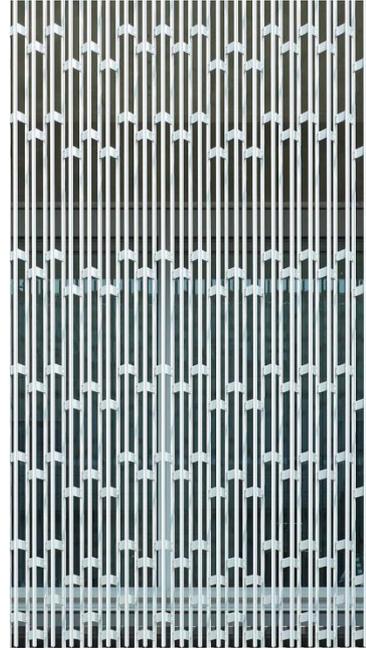
Tokyo, Japan (Akihabara)

Total Floor Area - 22,574m<sup>2</sup> (242,985 sf)

Floors - B2F-10F

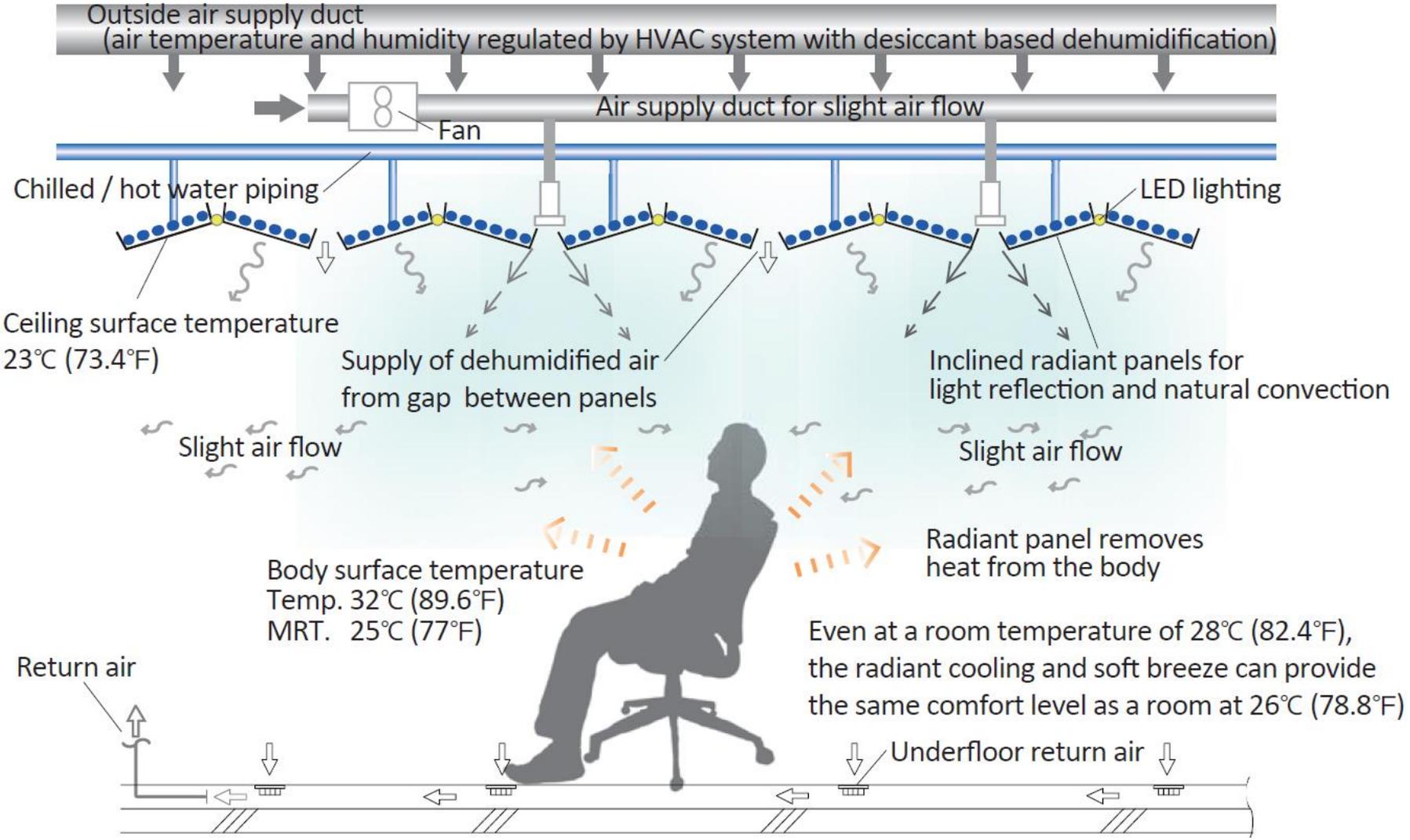
Completed - 2015 June

# Daylight, Views and Glare Control





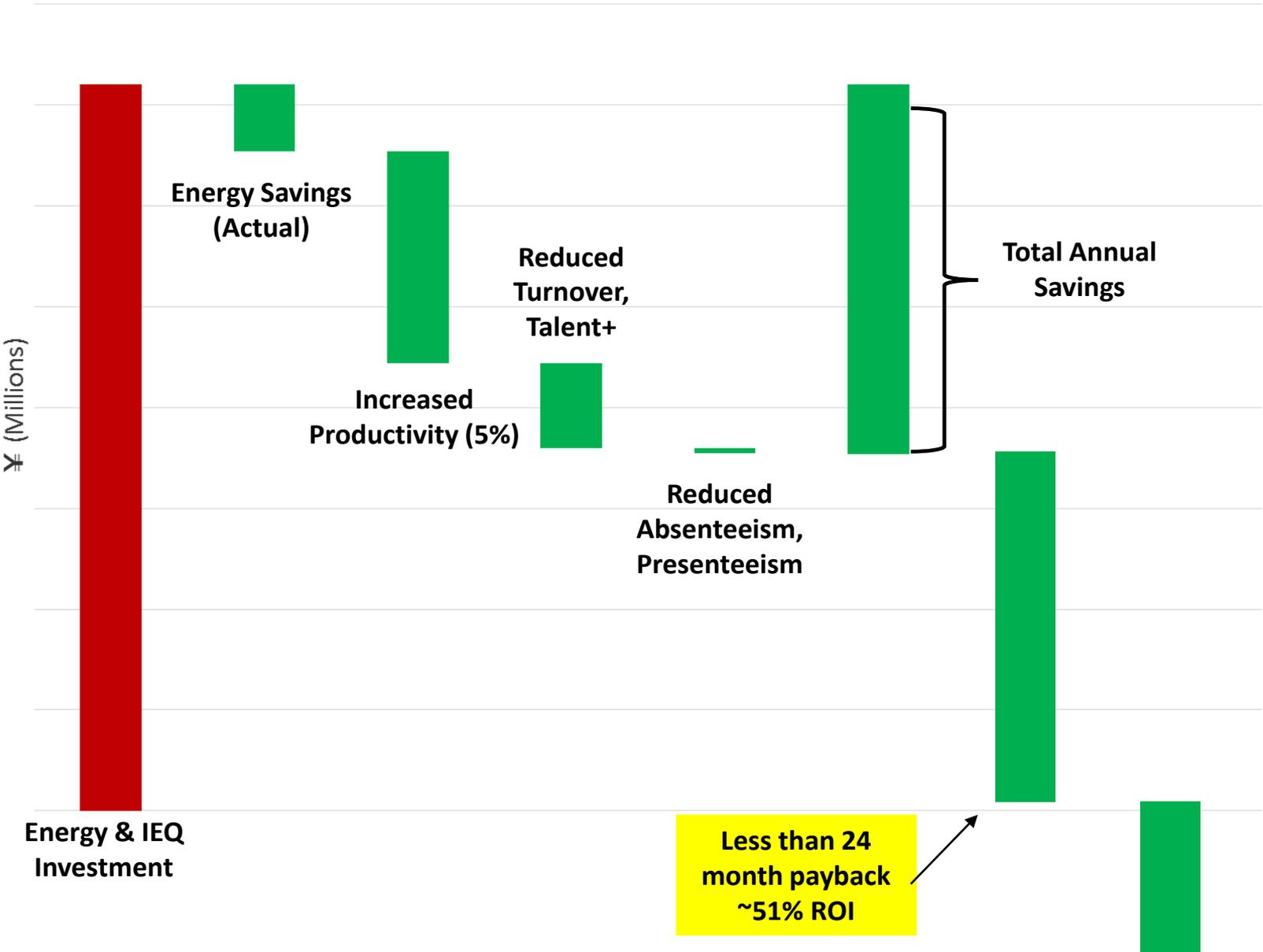
# Thermal & Visual Comfort / Low VOC, CO<sub>2</sub>



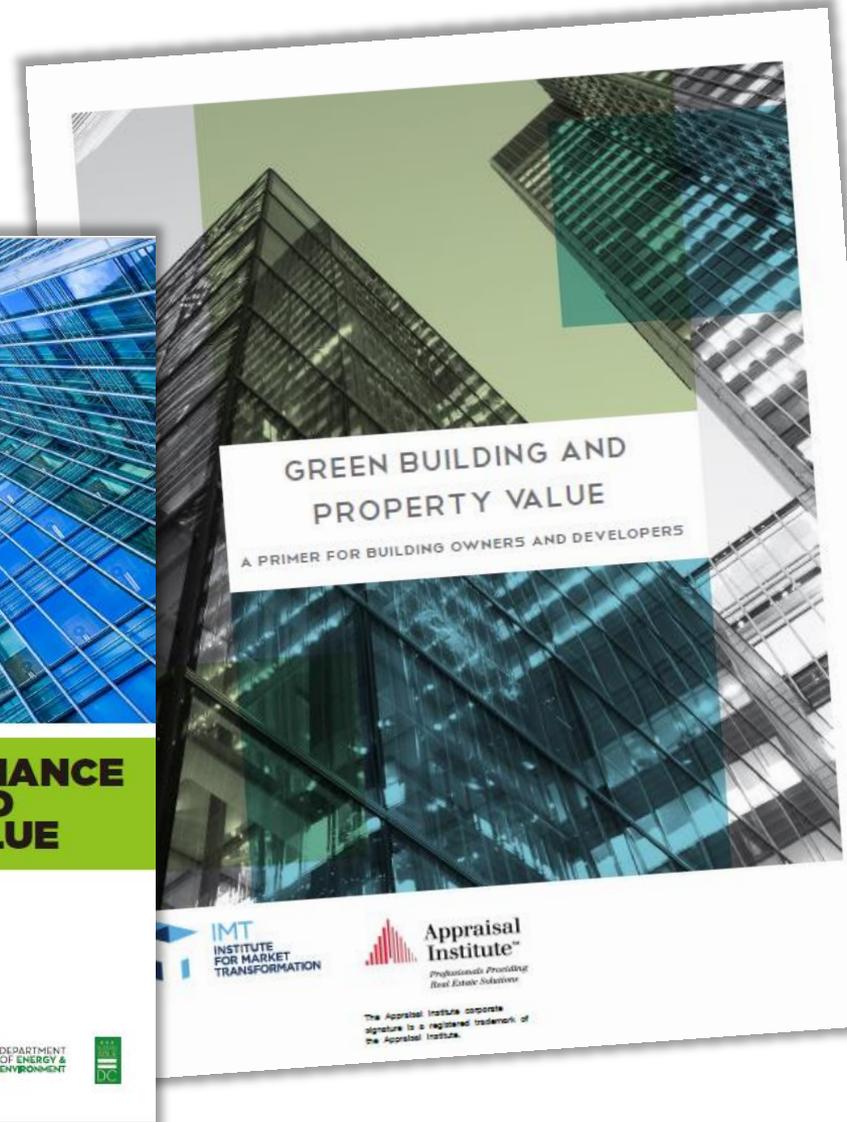
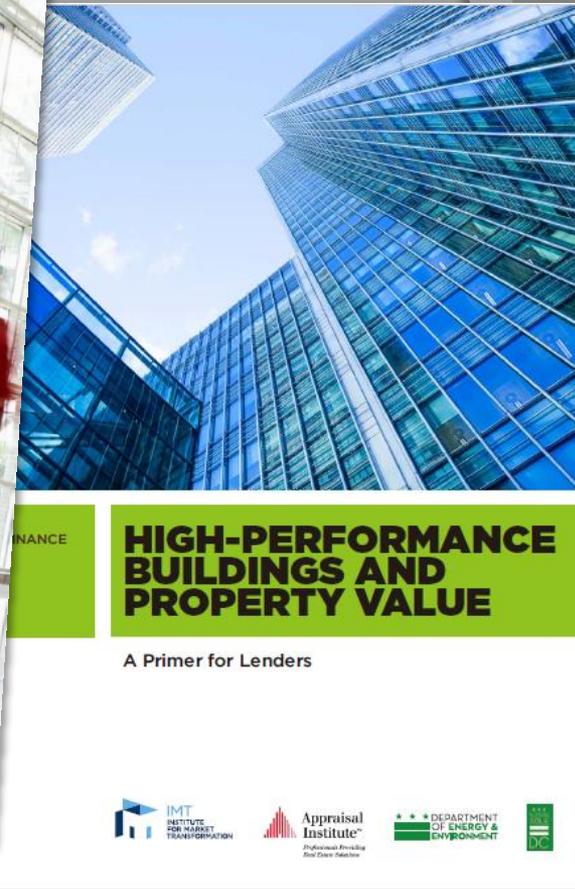
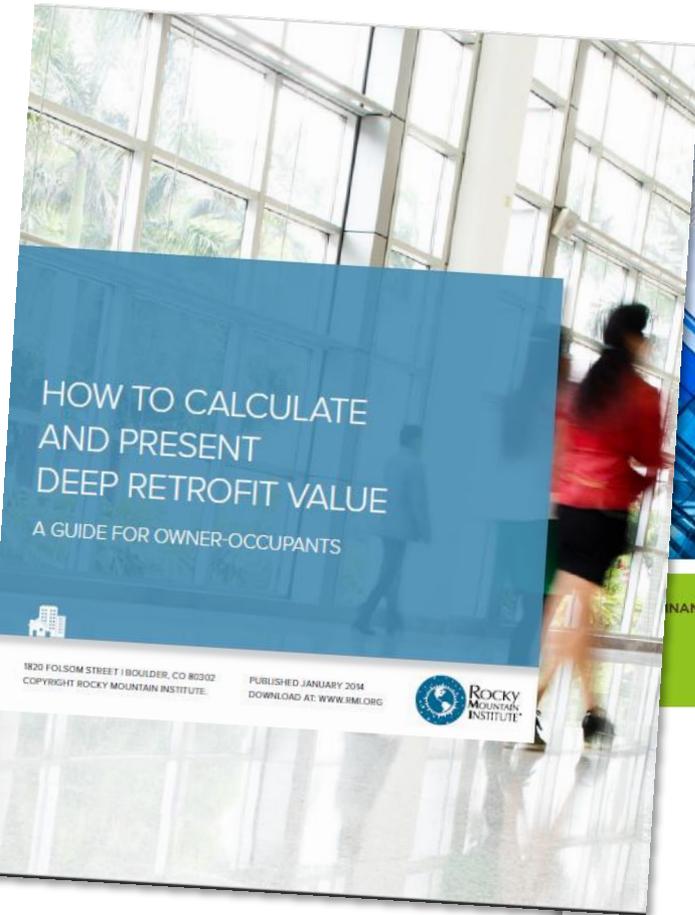




# Value Beyond Energy Savings



# References



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# Thank you



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