The Empire State Building

Repositioning an Icon as a Model for Energy Efficient Investment

Jones Lang LaSalle®

Real value in a changing world

Clinton Foundation

Clinton Climate Initiative

Rocky Mountain Institute

Johnson Controls

Motivation

"The goal with ESB has been to define intelligent choices which will either save money, spend the same money more efficiently, or spend additional sums for which there is reasonable payback through savings. Addressing these investments correctly creates a competitive advantage for owners through lower costs and better work environment for tenants. Succeeding in these efforts has made a replicable model for others to follow, and a chance to inform policy with good practice."

- Anthony E. Malkin
Malkin Holdings

The Empire State Building

Demonstrate the business case for cost effective energy efficient retrofits through verifiable operating costs reductions and payback analysis

102 stories and 2.8 million square feet
4.0 million visitors per year
$11 million in annual energy costs
Peak electric demand of 9.5 MW down from 11.6 (3.8 W/sf incl. HVAC)
88 kBtu per sf per yr for the office building
CO_2 emissions of 25,000 tons per year (22 lbs/sqft)

Motivation

The retrofit of the Empire State Building was motivated by the building ownership's desire to:

1) Reposition the world's most famous office building into a pre-war trophy asset
2) Prove or disprove energy efficiency retrofits' economic viability
3) Use our work to publicize and differentiate our building and attract tenants
4) Produce a replicable model for energy efficiency retrofits of existing buildings, which will make up 85% of buildings in place in New York City in 2030
5) "If the only place we succeed is ESB, the effort is a failure."

“Green” vs. Energy Efficient Retrofits

Green building practices include energy efficiency.
Energy efficient retrofits focus on quantifiable energy efficiency measures.

Green Building Practices

- Renewable, recycled-content, reused and locally produced materials
- Indoor air quality (voc-free materials, DCV)
- Recycling programs
- Water reduction
- Green cleaning
- Green pest management

Energy Efficient Retrofits

- ✓ Reduce loads
- ✓ Reduce energy usage
- ✓ Optimize systems efficiency
- ✓ Provide controls
- ✓ Integrated, lifecycle approach
- ✓ Quantifiable metrics
- ✓ Guaranteed savings
- ✓ Measurable payback and return on investment

Industry drivers for energy efficient retrofits

Converging forces

Recognition of need to develop more sustainable and efficient business practices

Acceptance of energy supply constraints and national security issues posed by energy dependence

Ongoing federal, state and local legislative action

Corporate trend toward GRI reporting, self regulation and reduction in GHG emissions

Customer, employee and shareholder pressures

Business opportunity

Growing pressure to alter appraisals, values for lending and purchasing based on sustainability

Reduced operating costs through efficiency

Increased marketability, competitiveness

Improved work environments, productivity, recruitment and retention

Positive NPV and ROI

Fund improvements through energy savings

Maintain value

Create a replicable model

Demonstrate how to cost-effectively retrofit a large multi-tenant office building to inspire others to embark on integrated energy efficiency retrofits.

1 Identify opportunities

- 60+ energy efficiency ideas were narrowed to 17 implementable projects
- Team estimated theoretical minimum energy use
- Developed eQUEST energy model

2 Evaluate measures

- Net present value
- Greenhouse gas savings
- Dollar to metric ton of carbon reduced
- Calculated for each measure

3 Create packages

- Maximize net present value
- Balance net present value and CO_2 savings
- Maximize CO_2 savings for a zero net present value
- Maximize CO_2 savings

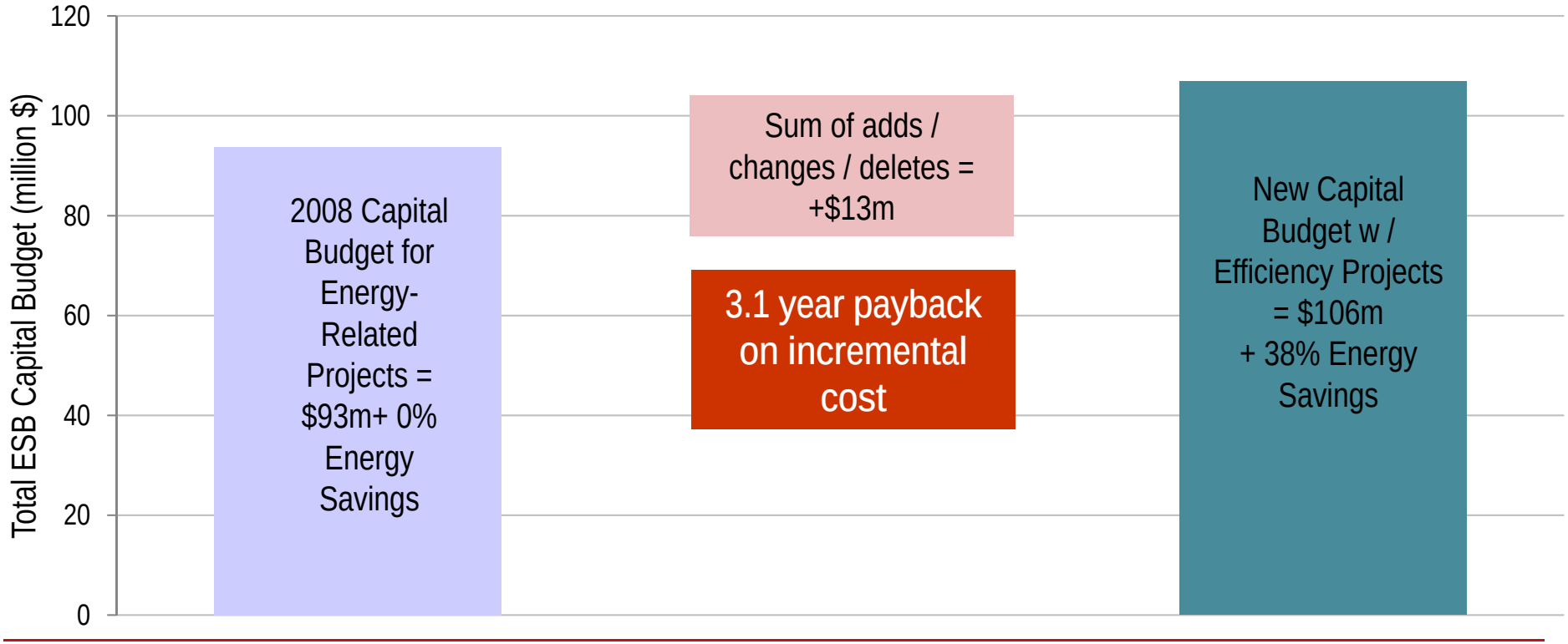
4 Model iteratively

- Iterative energy and financial modeling process to identify final eighht recommendations

Demonstrate business case through verifiable operating costs reductions and payback analysis

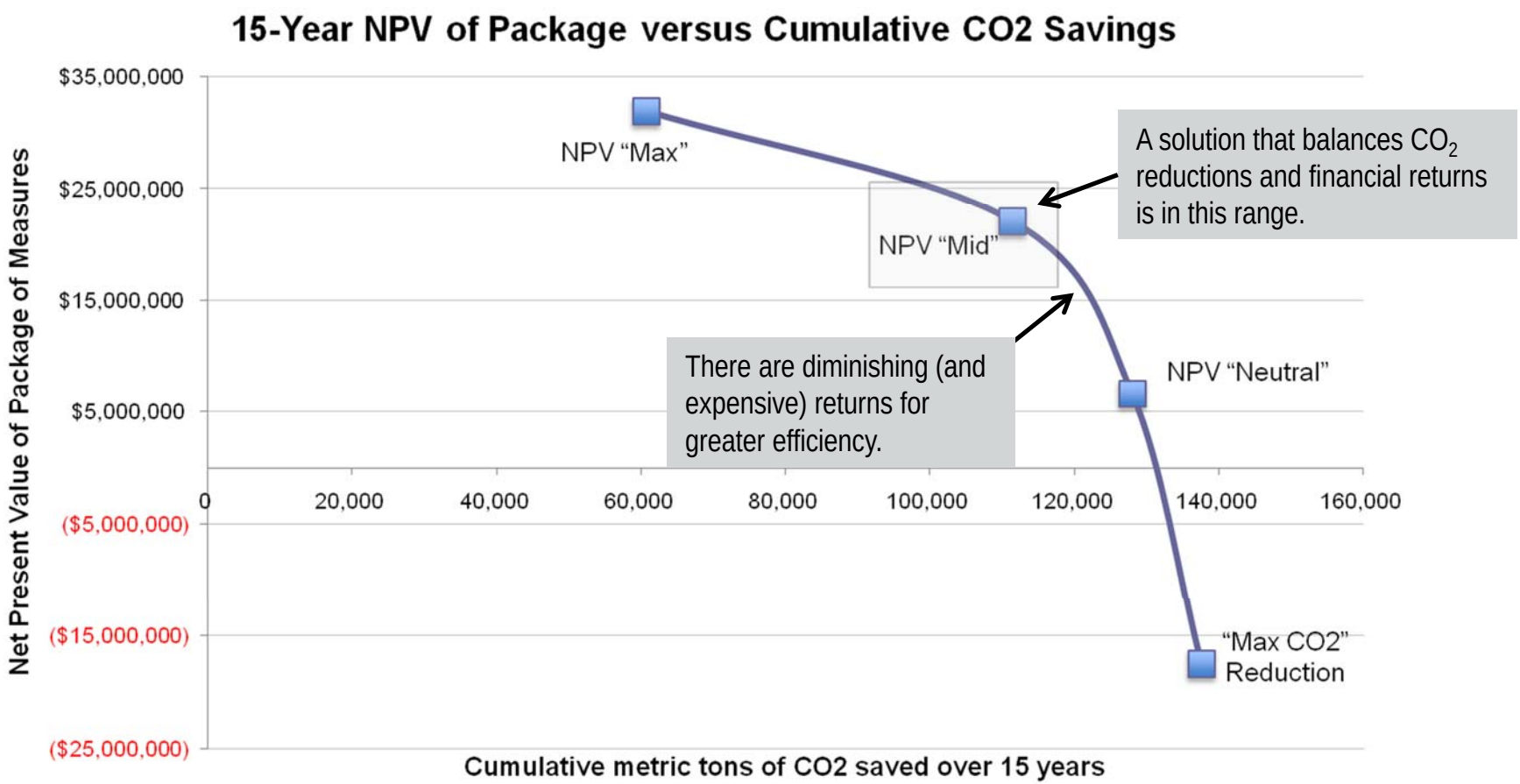
With a $550 million capital improvement program underway, ownership decided to re-evaluate certain projects with cost-effective energy efficiency and sustainability opportunities in mind.

Capital Budget Adjustments for Energy Efficiency Projects



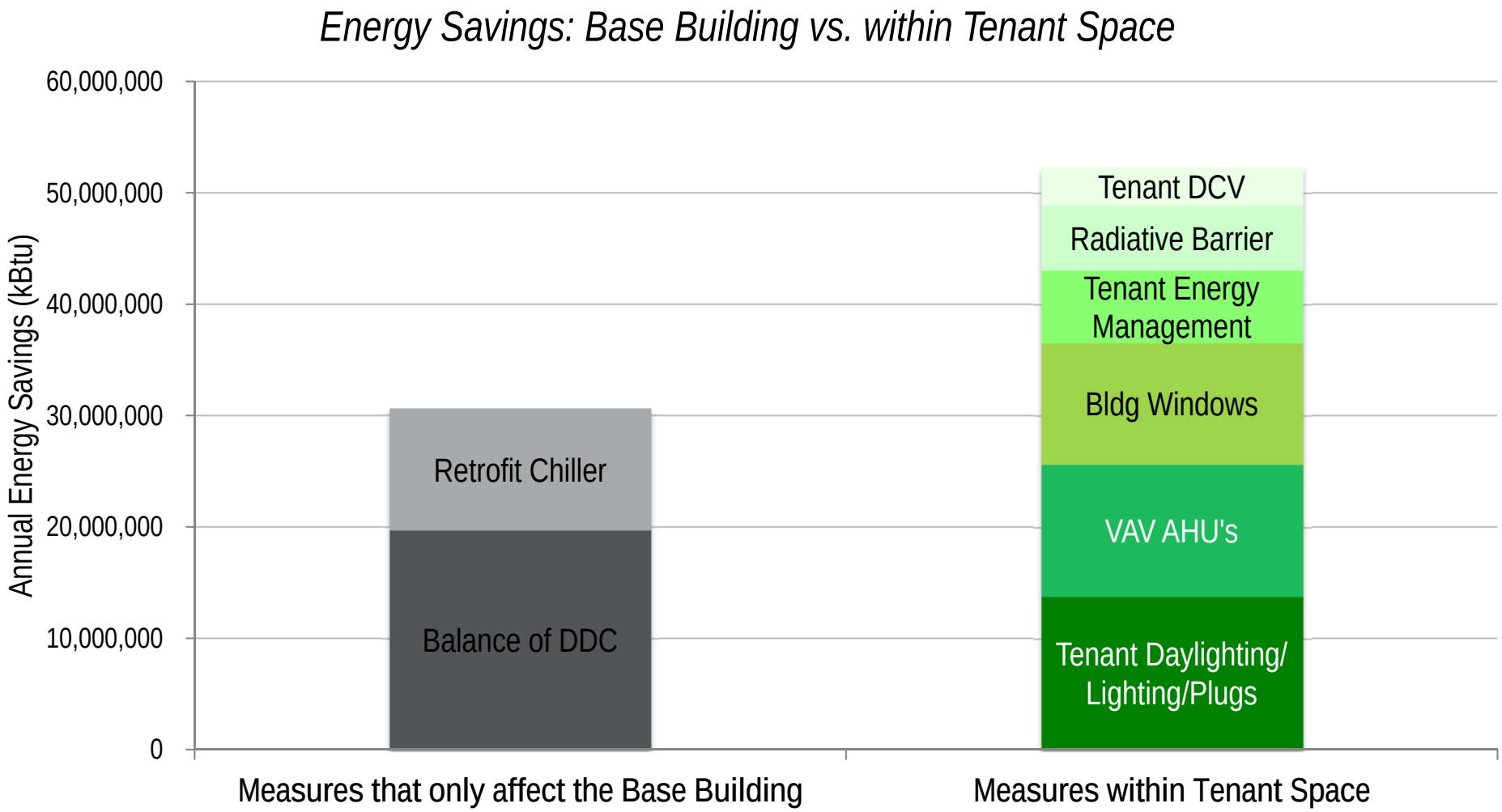
Balance financial return & carbon reduction

ESB can achieve a high level of CO_2 and energy reduction cost-effectively



The business case – integrated approach

More than half the savings exist within tenant spaces



Tenant Spaces

Enhanced work environments are created

- Better thermal comfort resulting from better windows, radiative barrier, and better controls;
- Improved indoor air quality resulting from DCV; and
- Better lighting conditions that coordinate ambient and task lighting.
- Positive ROI
- Tenant Prebuilt Program and Design Guidelines

Savings in Tenant Spaces

Investments based on incremental cost and projected savings

	Total Project Cost	Total Cost ($/rsf)	Construction Cost ($/rsf)
Class 'A' Office Budget	$4,413,404	$180.88	$121.45
Actual Costs	$4,624,262	$189.52	$132.95
LEED Premium & Energy Efficiency*	**$210,858**	**$8.64**	**$11.50**
*Total LEED Premium – 4.7%			
Energy Saving (NPV for 15 Yrs)	$593,496		
NYSERDA Grant (Approx.)	$22,802		
Net Positive**	**$405,440**		
**Total Savings – 9.2%			

Data provided by Skanska based on performance of their 32nd floor office at the ESB, 2009

Measured and Verified Energy Savings

Utility Consumption Comparison

136 Madison Avenue (Class "A" Office)	2008					Total Annual Actual	Comparison Annual Adjusted*
	JAN Actual	FEB Actual	MAR Actual	APR Actual	MAY Actual		
Cost	$3,677	$3,921	$4,209	$3,721	$4,905	**$57,506**	**$85,039**
Consumption (KWH)	13,760	15,520	17,920	14,880	19,893	**220,853**	**326,595**
Avg. Cost per KWH	0.27	0.25	0.23	0.25	0.25	**0.26**	**0.26**
Energy Cost (Per Rentable Square Feet)	0.22	0.24	0.26	0.23	0.30	**3.49**	**3.49**

*Adjust Class "A" office to the same RSF as ESB

Empire State Building (LEED Platinum)	2009					Total Annual Projected	ESB LEED® Office Annual Adjusted**
	JAN Actual	FEB Actual	MAR Actual	APR Actual	MAY Actual		
Cost	$1,989	$1,987	$2,500	$2,151	$2,525	**$32,015**	**$43,099**
Consumption (KWH)	10,516	10,506	11,686	10,523	12,220	**165,764**	**165,764**
Avg. Cost per KWH	0.19	0.19	0.21	0.20	0.21	**0.19**	**0.26**
Energy Cost (Per Rentable Square Feet)	0.08	0.08	0.10	0.09	0.10	**1.31**	**1.77**

**Madison rate utilized

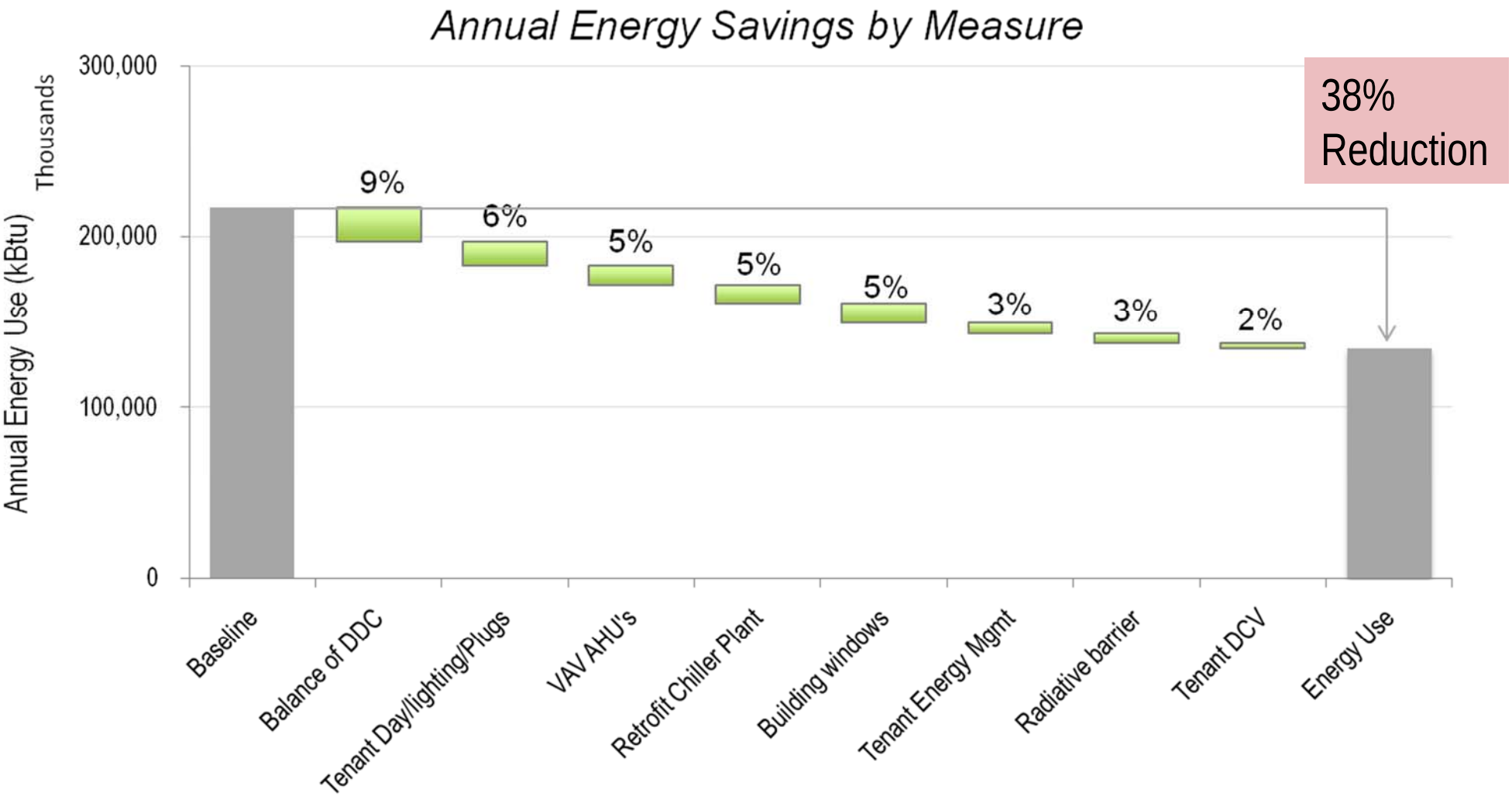
49%

Energy Savings

Data provided by Skanska based on performance of their 32nd floor office at the ESB, 2009

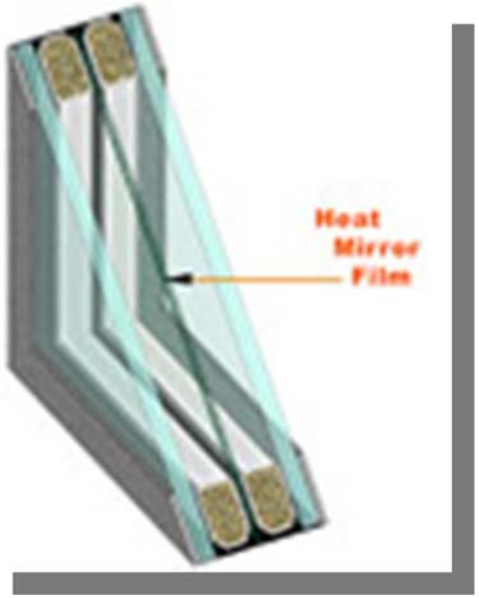
Implementing recommended measures

Eight interactive levers chosen iteratively from more than 60 options ranging from base building measures to tenant engagement deliver these results



Measures

WINDOWS: Remanufacture existing insulated glass units (IGU) within the Empire State Building's approximately 6,500 double-hung windows to include suspended coated film and gas fill.

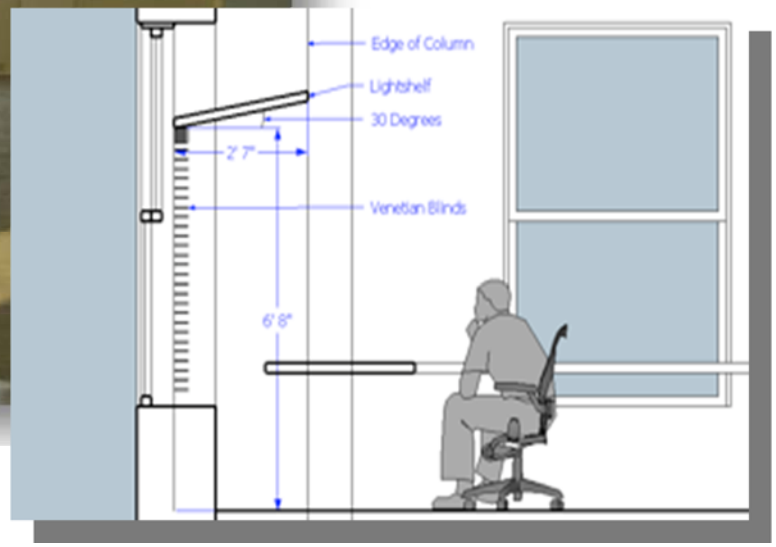


Measures

RADIATIVE BARRIER: Install more than six-thousand insulated reflective barriers behind radiator units located on the perimeter of the building.

Measures

TENANT DAYLIGHTING / LIGHTING / PLUGS: This measure involves reducing lighting power density in tenant spaces, installing dimmable ballasts and photosensors for perimeter spaces, and providing occupants with a plug load occupancy sensor for their personal workstation.



Measures

CHILLER PLANT RETROFIT: The chiller plant retrofit project includes the retrofit of four industrial electric chillers in addition to upgrades to controls, variable speed drives, and primary loop bypasses.

Measures

VAV AIR HANDLING UNITS: Replace existing constant volume units with variable air volume units using a new air handling layout (two floor-mounted units per floor instead of four ceiling-hung units).

Measures

DDC CONTROLS: The measure involves upgrading the existing control systems at the Empire State Building becoming *one of the largest wireless networks ever installed*.

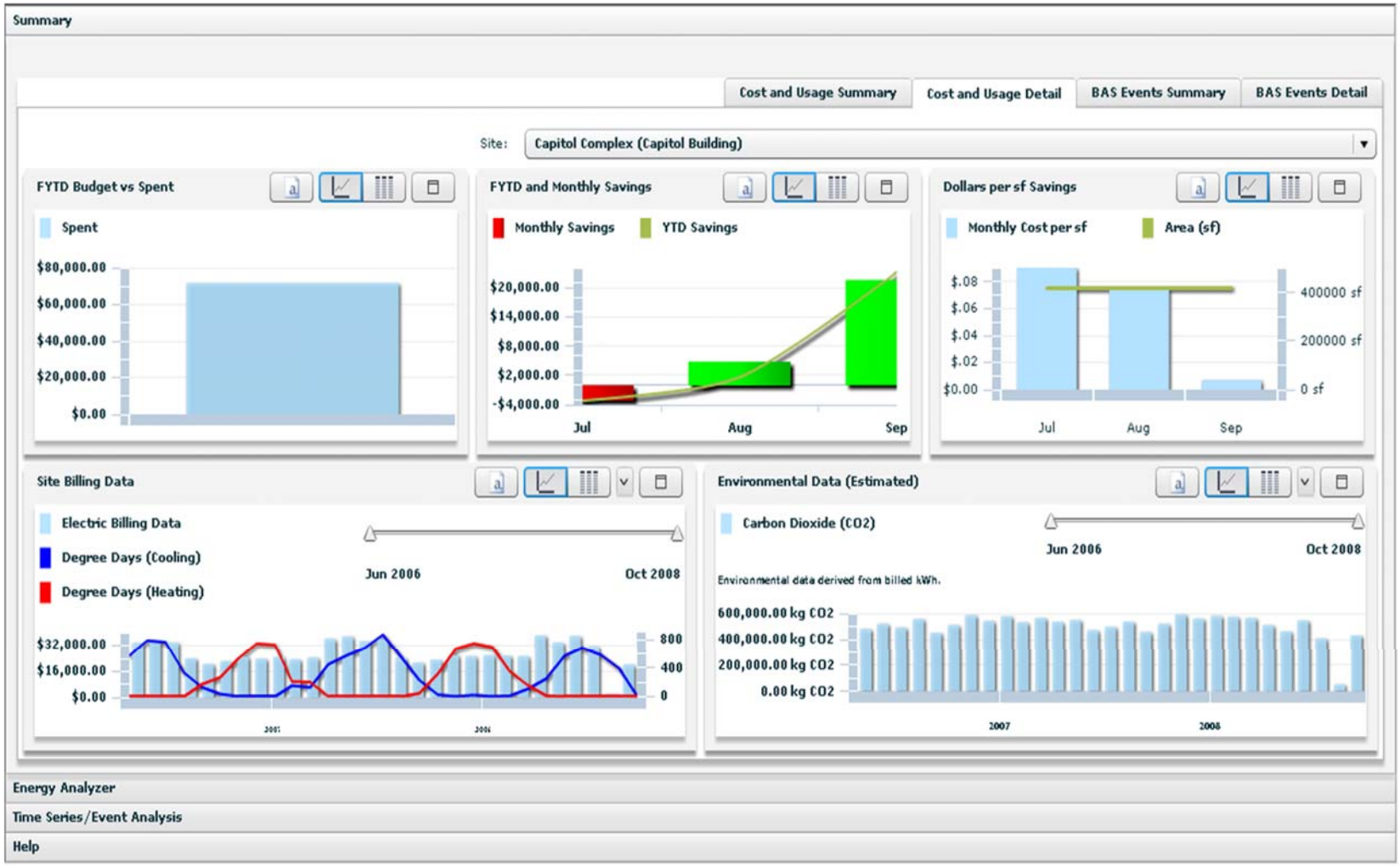
Real-time *facilities performance index monitoring* used for continuous commissioning of HVAC systems.

Measures

DEMAND CONTROL VENTILATION: This project involves the installation of CO2 sensors for control of outside air introduction to chiller water and DX Air Handling Units.

Measures

TENANT ENERGY MANAGEMENT: This project will provide tenants with access to online energy consumption and benchmarking information as well as sustainability tips and updates.



Challenges

- Full exploration of all energy efficiency measure can be time consuming and resource intensive
- Realizing maximum impact requires the engagement and participation of all of the building stakeholders and skilled execution
- Important energy efficiency measures had to be passed over to maintain a sub-five year payback
- Financing should be a combination of financing savings and incentives which take into account expenditures avoided due to reductions in energy consumption
- Many buildings are subscale for large ESCO programs
- Resource limitations are a governor of speed and breadth

Practical Next steps

What you can do to take action

1) Triage your building portfolio based on renovation cycle
2) Create a sustainability master plan including retrofit projects, design standards, lease structure changes, tenant energy management programs, and marketing initiatives
3) Commit to an integrated, whole-building retrofit approach: Conduct whole-building audits rather than single measure projects
4) Require performance guarantees with ongoing measurement and verification of savings to reduce risk and maintain performance
5) Engage tenants, employees, and building occupants in energy savings efforts through training, tools, technology
6) Create concrete successes at the building and pre-built level to build momentum and enthusiasm

www.esbsustainability.com

Contact Information

- Dana Robbins Schneider
  Jones Lang LaSalle
  dana.schneider@am.jll.com
  917.882.5646

- Paul Rode
  Johnson Controls, Inc.
  paul.rode@jci.com
  914.419.5032