briefing

Advancing Passive House Policy

NAPHN 2016 policy session 2 presentations

"The building sector offers the largest low-cost potential in world regions to lower emissions."

- Dr. Diana Urge-Vorsatz, Vice Chair, Intergovernmental Panel on Climate Change (IPCC)

be ex

building energy exchange

Dana Schneider
Lang Lasalle

The Empire State Building

Repositioning an Icon as a Model for Energy Efficient Investment

Dana Robbins Schneider
Managing Director
Energy and Sustainability Services

JLL

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
Chairman and CEO, Empire State Realty Trust

2

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 **2.85 million** square feet
4.5 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 including HVAC)
88 kBtu per sf per yr for the office building
CO_2 emissions of **25,000 tons** per year (22 lbs/sqft)

3

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."

4

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

5

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

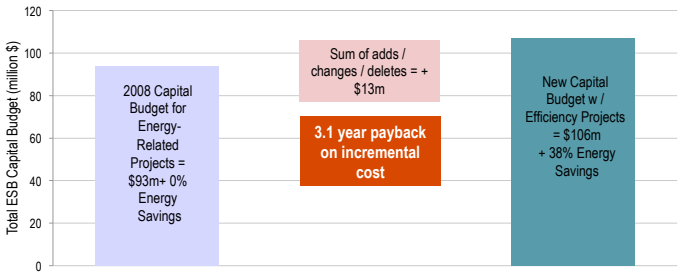
4 Model iteratively

- 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



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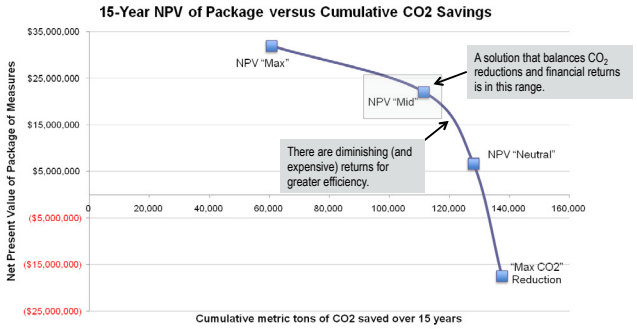
Balance financial return & carbon reduction

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



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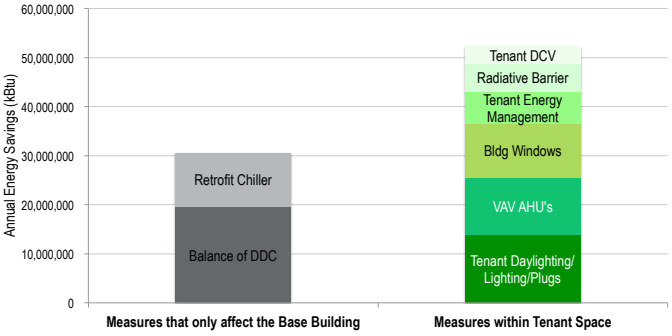
The business case – integrated approach

More than half the savings exist within tenant spaces

Energy Savings: Base Building vs. within Tenant Space

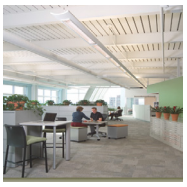


9

Tenant Spaces

Enhanced work environments are created

- Thermal comfort resulting from high performing windows, radiative barriers, HVAC, controls
- Indoor air quality resulting from DCV
- Lighting conditions that coordinate ambient and task lighting.
- High Performance Tenant Design and Construction Guidelines
- Tenant Prebuilt Program
- Positive ROI



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

Measured and Verified Energy Savings

Utility Consumption Comparison

136 Madison Avenue (Class "A" Office)	2008 JAN Actual	FEB Actual	MAR Actual	APR Actual	MAY Actual	Total Annual Actual	Comparison Annual Adjusted*
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 JAN Actual	FEB Actual	MAR Actual	APR Actual	MAY Actual	Total Annual Projected	ESB LEED® Office Annual Adjusted**
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

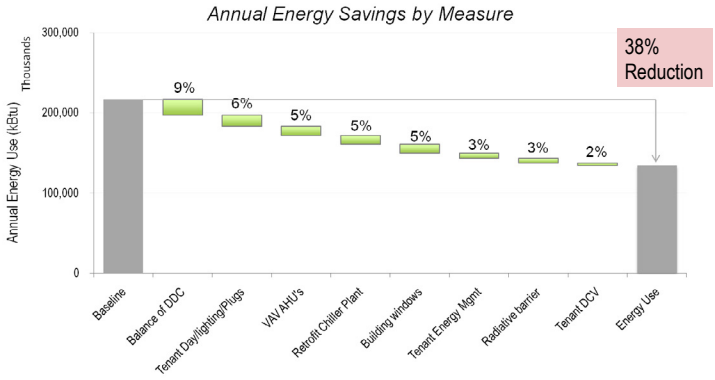
**Madison rate utilized

57%
Energy Savings

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

Implementing recommended measures

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



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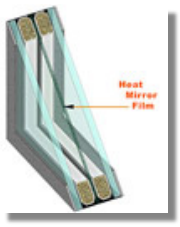
Measures

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.



14

Measures

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

15

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.

16

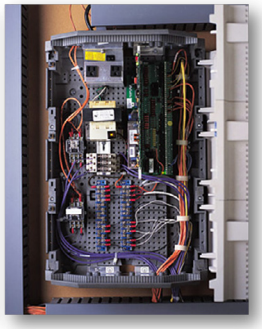
Measures

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.

17

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).



18

Measures

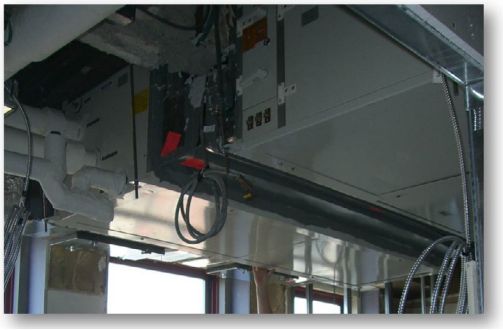
DDC CONTROLS: The measure involves upgrading the existing control systems at the Empire State Building becoming ***one of the largest wireless networks ever installed***.

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

19

Measures

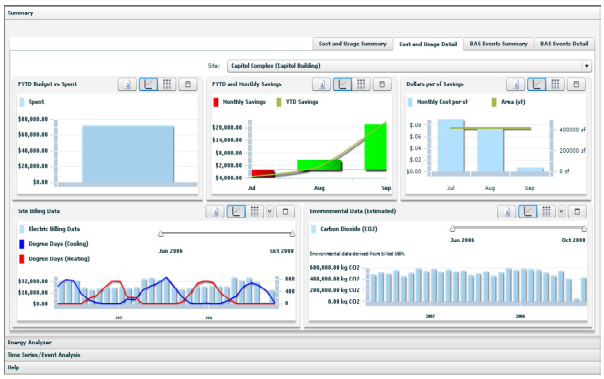
DEMAND CONTROL VENTILATION: This project involves the installation of CO2 sensors for control of outside air introduction to chiller water and DX Air Handling Units.



20

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.



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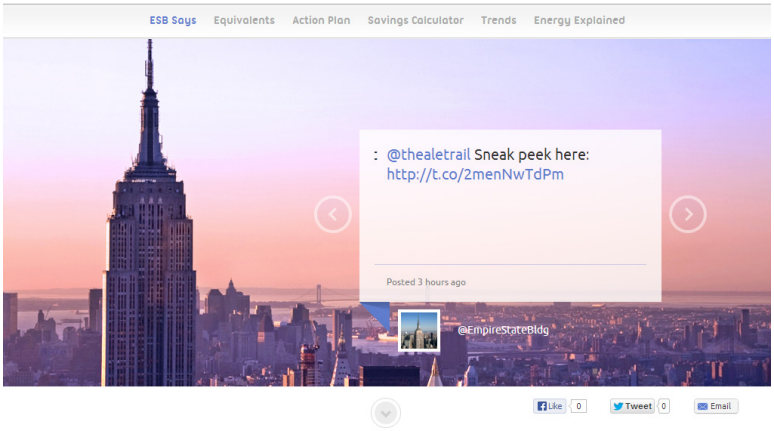
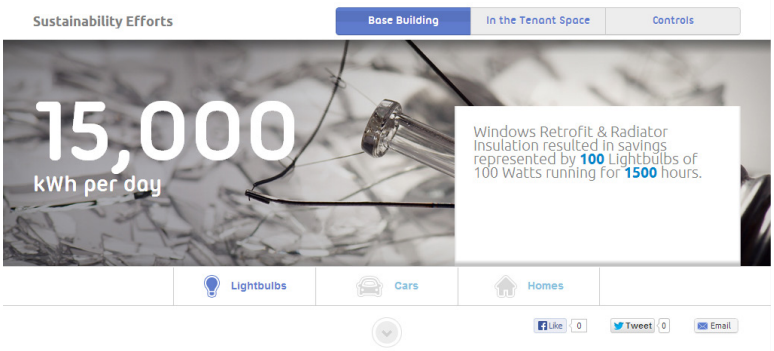
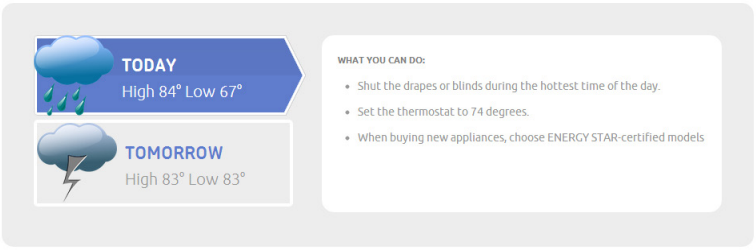
Empire State Building - Tenant Energy Portal

Educate and Engage on Energy Efficiency and Sustainability

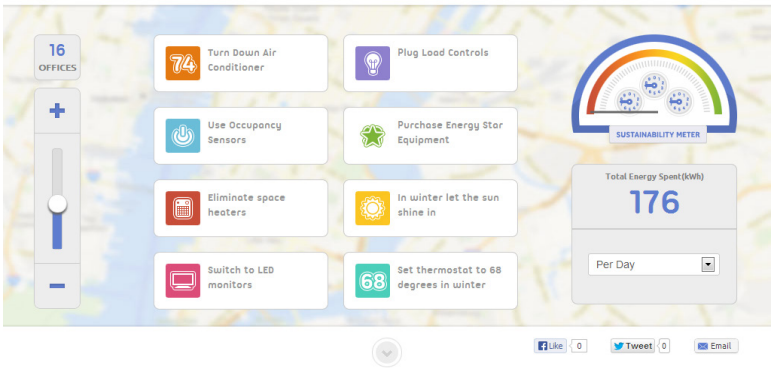




Weather Action Plan



Savings You Can Measure



Sustainability Trends

Blogs | Twitter

2012 EEI: China Results
June 11, 2012 via Institute for Building Efficie...

Warm Weather and the Daily Commute
May 07, 2013 via Energy Saver Blog

Measurement and Verification: How Technology Can Change the Game
November 07, 2011 via Institute for Building Efficie...

Hot New Advances in Water Heating Technology
April 18, 2013 via Energy Saver Blog

Energy Performance Requirements for European Buildings: Cost Optimality
March 07, 2011 via Institute for Building Efficie...

Spring Home Maintenance: Windows, Windows, Windows!
April 26, 2013 via Energy Saver Blog

Charging Your Plug-in Electric Vehicle at Home
May 13, 2013 via Energy Saver Blog

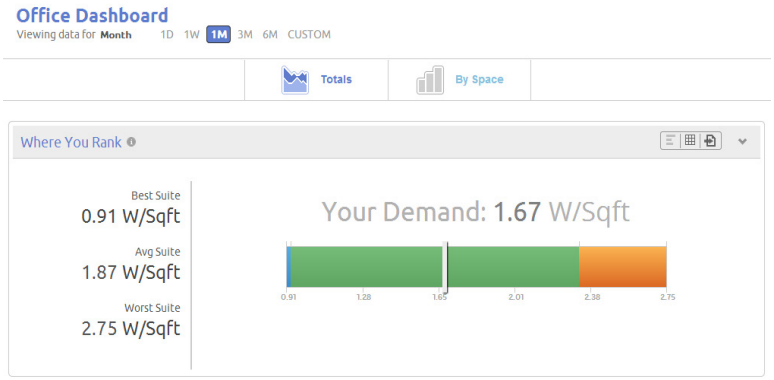
Energy Efficiency for All: Clean Energy Financing in Developing Nations
April 16, 2010 via Institute for Building Efficie...

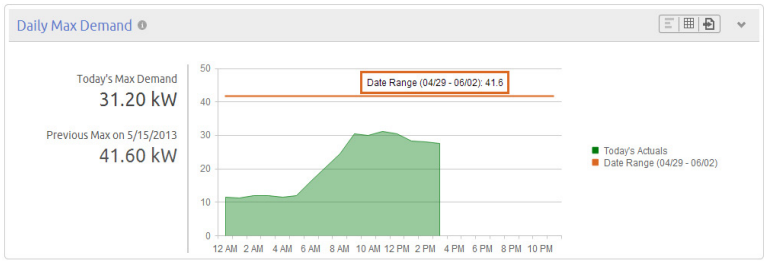
Think Spring, Think Local...
April 25, 2013 via Energy Saver Blog

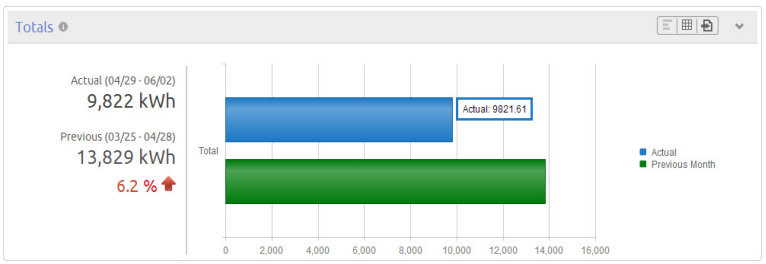
Energy Explained

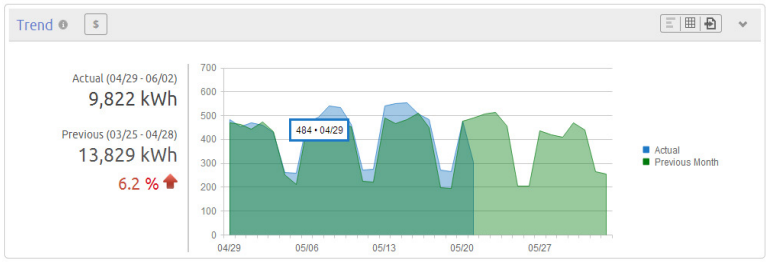
DEFINITIONS:

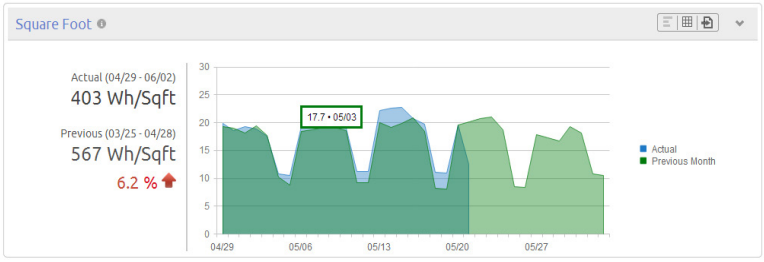
- Energy is a measure of how much fuel is contained within something, or used by something over a specific period of time.
- The kilowatt hour (kWh) is a unit/measure of energy. The term kWh is used to express energy consumption, or how much energy is used.
- Power is the rate at which energy is generated or used.
- The watt (W) is a unit/measure of power. A watt is the same thing as Joules per second (J/s).
- The kilowatt (kW) is a unit/measure of power. One kW is a measure of power equal to 1000 W.
- The equation that connects energy and power is: energy = power * time, for example, kWh = kW * h
- Cost is usually expressed in terms of $/kWh. The more energy you use, the more it costs.
- Maximum demand, or peak load, across a period, is based on the highest average kW across that period. The higher the peak load, the higher the peak load charge, or maximum demand charge.

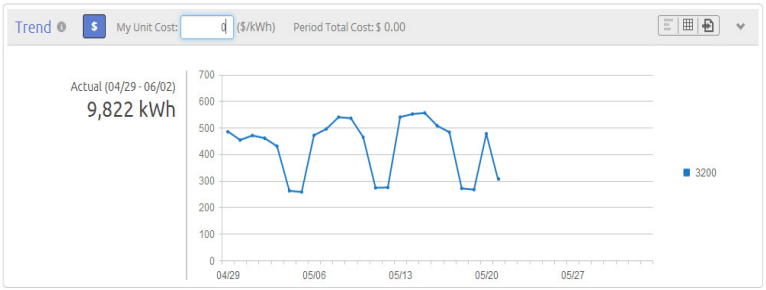

Office Dashboard
Viewing data for Month
1D 1W 1M 3M 6M CUSTOM
Totals
By Space
Where You Rank
Best Suite
0.91 W/Sqft
Avg Suite
1.87 W/Sqft
Worst Suite
2.75 W/Sqft
Your Demand: 1.67 W/Sqft
0.91
1.28
1.65
2.01
2.38
2.75


Daily Max Demand
Today's Max Demand
31.20 kW
Previous Max on 5/15/2013
41.60 kW
Date Range (04/29 - 06/02): 41.6
50
40
30
20
10
0
12 AM 2 AM 4 AM 6 AM 8 AM 10 AM 12 PM 2 PM 4 PM 6 PM 8 PM 10 PM
Today's Actuals
Date Range (04/29 - 06/02)

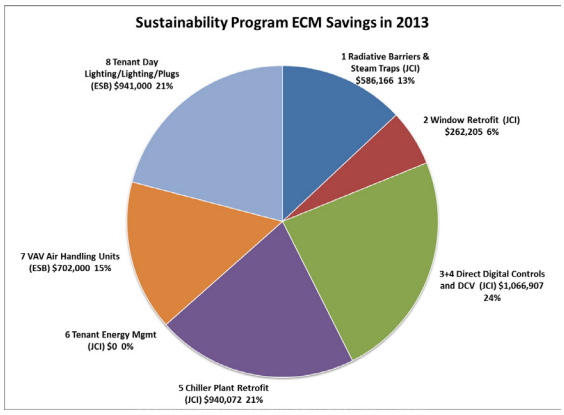

Totals
Actual (04/29 - 06/02)
9,822 kWh
Previous (03/25 - 04/28)
13,829 kWh
6.2 %
Actual: 9821.61
Total
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
Actual
Previous Month


Trend
$
Actual (04/29 - 06/02)
9,822 kWh
Previous (03/25 - 04/28)
13,829 kWh
6.2 %
700
600
500
400
300
200
100
0
484 • 04/29
04/29
05/06
05/13
05/20
05/27
Actual
Previous Month


Square Foot
Actual (04/29 - 06/02)
403 Wh/Sqft
Previous (03/25 - 04/28)
567 Wh/Sqft
6.2 %
30
25
20
15
10
5
0
17.7 • 05/03
04/29
05/06
05/13
05/20
05/27
Actual
Previous Month


Trend
$
My Unit Cost:
0
($/kWh)
Period Total Cost: $ 0.00
Actual (04/29 - 06/02)
9,822 kWh
700
600
500
400
300
200
100
0
04/29
05/06
05/13
05/20
05/27
3200

Measurement & Verification



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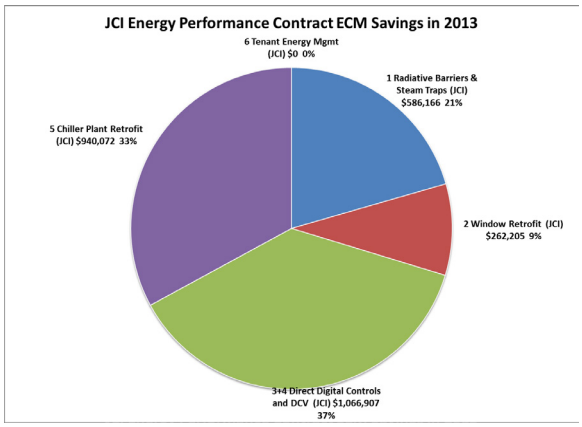
Measurement & Verification

2013 Performance: Energy Performance Contract



Measurement & Verification

2013 Project Savings

No.	ECM	Contract Guaranteed Savings (Unadjusted, from Contract)	PY Target Guaranteed Savings (Using 2013 Baseline Adjustments)	PY ECM Performance Savings (Using 2013 Measurements)	PY Actual Operation Savings (Using 2013 Actual Operations Data)
[A]	[B]	[C]	[D]	[E]	[F]
1	Windows Retrofit	$338,508	$304,101	$262,205	$262,205
2	Radiator Insulation and Steam Traps	$491,191	$521,519	$586,166	$586,166
3	BMS Retrofit	$774,388	$786,660	$1,066,907	$1,066,907
4	Chiller Plant Retrofit	$611,641	$730,649	$940,072	$915,895
5	Tenant Energy Management	$25,000	$26,533	$0	$0
	TOTAL	**$2,240,728**	**$2,369,462**	**$2,855,350**	**$2,831,173**

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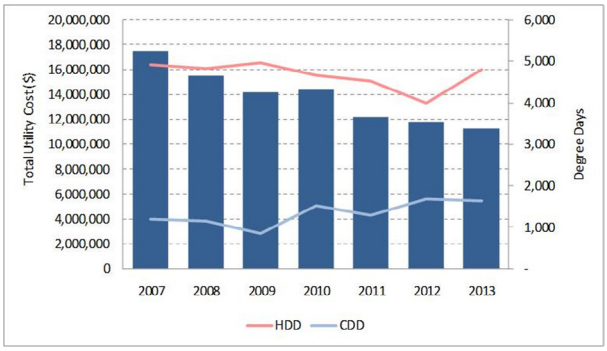
Measurement & Verification

Reduction in ESB's 2007 Total Utility Costs During Performance Period



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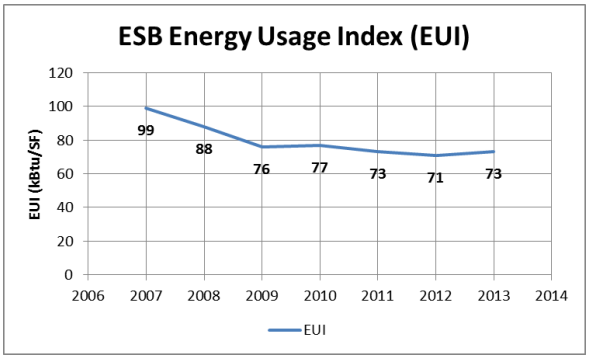
Results that matter



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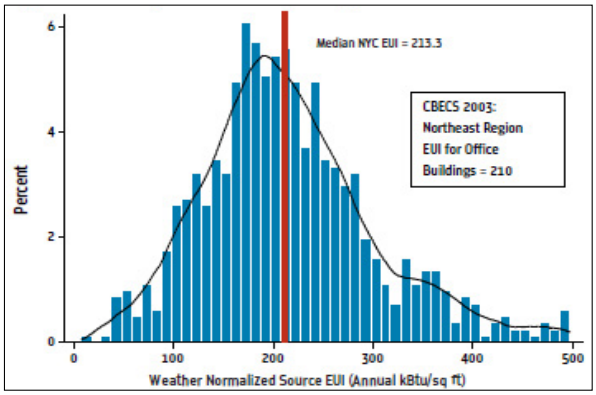
Median NYC Office Building EUI = 213
ESB EUI = 73



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ESB Model for Energy Retrofits

- Replicating this process in over 100 buildings nationally
- Below is a summary of the results we project in buildings where we have replicated this process:

	Capital cost	Energy reduction	Annual savings	Payback period
Bldg. A	$4,000,024	50%	$2,501,756	1.6 years
Bldg. B	$1,763,280	23%	$321,805	5.5 years
Bldg. C	$1,625,469	20%	$463,055	3.5 years
Bldg. D	$1,509,064	42%	$398,169	3.9 years
Bldg. E	$1,269,885	29%	$314,460	4.0 years
Bldg. F	$700,225	26%	$242,426	2.9 years

The Empire State Building: A groundbreaking energy and sustainability program

- Reduce energy use by 38 percent
- Annual savings of $4.4M
- 3.1 year payback
- Reduce carbon emissions 105,000 metric tons
- Energy Star 90
- LEED EBOM Gold
- Energy Performance Contract
- Quantifiable transparent results
- Serve as a model for owners of existing buildings

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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

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For more information…

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esbsustainability.com

The Building Energy Exchange connects the Manhattan real estate communities to energy and lighting efficiency solutions through exhibitions, education, technology demonstrations, and research. We identify opportunities, navigate barriers to adoption, broker relationships, and showcase best practices at our resource center in the Surrogate's Courthouse in Manhattan.

be-exchange.org