EMPIRE STATE BUILDING CASE STUDY

Cost-Effective Greenhouse Gas Reductions via Whole-Building Retrofits:
Process, Outcomes, and What is Needed Next

Jones Lang LaSalle
Real value in a changing world

Clinton Foundation | Clinton Climate Initiative

Rocky Mountain Institute

Johnson Controls

I. MOTIVATION

1) Prove or disprove the economic viability of whole-building energy efficiency retrofits.

Prior to 2008, the Empire State Building's performance was average compared to most U.S. office buildings.

Annual utility costs:

- $11 million ($4/sq. ft.)

Annual CO2 emissions:

- 25,000 metric tons (22 lbs/sq. ft.)

Annual energy use:

- 88 kBtu/sq. ft.

Peak electric demand:

- 9.5 MW (3.8 W/sq. ft. inc. HVAC)

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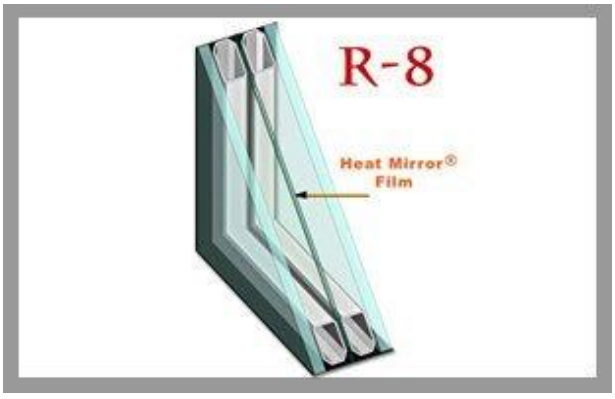


WINDOWS
Remanufacture 6,500 existing dual glazed windows
Add suspended film between panes, fill with argon gas
R-2 to R-8

RADIANT BARRIERS
Install more than 6,000radiant barriers behind existing radiators at perimeter of building

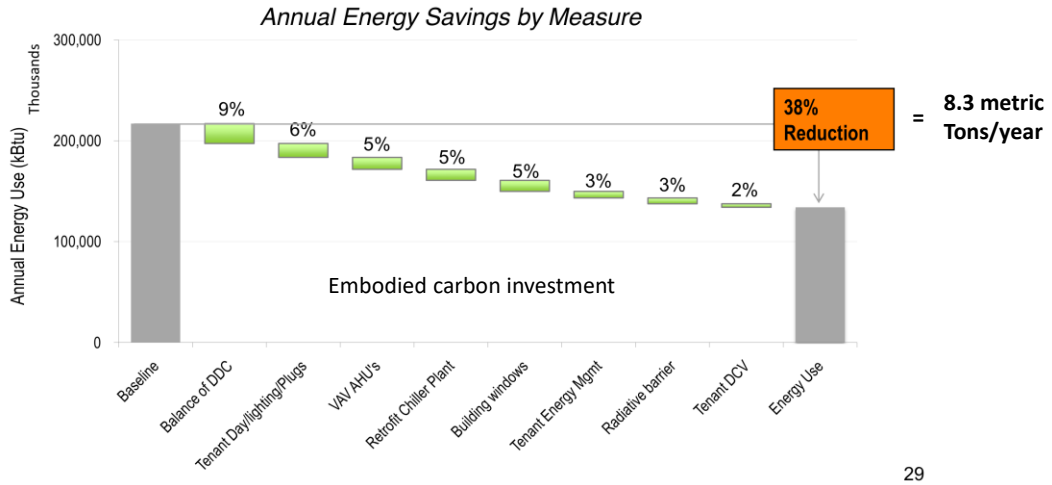
CHILLER PLANT RETROFIT
Retrofit + controls, variable speed drives and primary loop bypass

VAV AIR HANDLING UNITS
Replace existing constant volume units with Variable Air Volume units using 2 floor mounted instead of 4 ceiling mounted

III. KEY FINDINGS

1) Eight interactive levers ranging from base building measures to tenant engagement deliver these results.

Energy and CO2 savings in the optimal package result from 8 key projects.



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Though it is more informative to look at financials for the package of measures, capital costs and energy savings were determined for each individual measure.

Project Description	*Projected Capital Cost*	*2008 Capital Budget*	*Incremental Cost*	*EstimatedAnnual Energy Savings**
Windows	$4.5m	$455k	$4m	$410k
Radiative Barrier	$2.7m	$0	$2.7m	$190k
DDC Controls	$7.6m	$2m	$5.6m	$741k
Demand Control Vent	Inc. above	$0	Inc. above	$117k
Chiller Plant Retrofit	$5.1m	$22.4m	-$17.3m	$675k
VAV AHUs	$47.2m	$44.8m	$2.4m	$702k
Tenant Day/Lighting/Plugs	$24.5m	$16.1m	$8.4m	$941k
Tenant Energy Mgmt.	$365k	$0	$365k	$396k
Power Generation (optional)	$15m	$7.8m	$7m	$320k
TOTAL (ex. Power Gen)	$106.9m	$93.7m	$13.2m	$4.4m

***Note that energy savings are also incremental to the original capital budget.**

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Consider Carbon Payback

Embodied carbon “investment”

Reduced operational carbon “savings” or “return”

Energy efficiency measures can have
short or long “payback”
high or low ROI

Panelists

Larry Strain,
Siegel & Strain Architects

Bruce King,
Ecological Building Network

Nick Dirr,
Association for Energy Affordability

BAYREN