





BOMA's Energy Efficiency Program

BEEP Course 4

No- and Low Cost Operational Adjustments
to Improve Energy Performance



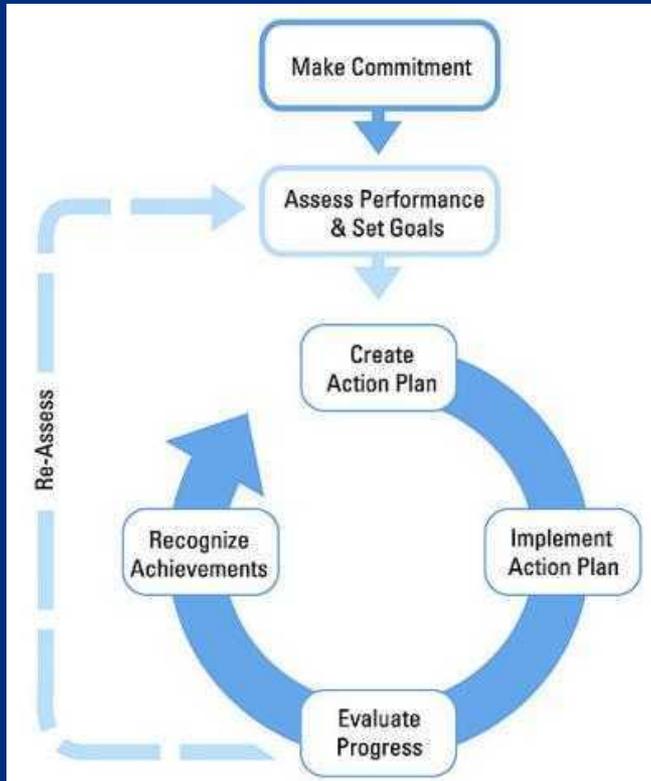
GovEnergy
www.govenergy.gov

Agenda



- **Review ENERGY STAR's Energy Performance Rating System**
- Identify specific areas for improvements
- Set realistic and achievable performance goals
- Create an action plan

ENERGY STAR's Energy Performance Rating System



Based on the successful practices of ENERGY STAR partners, EPA has identified key components for a successful energy management program

Step 1: Benchmark the building to get a baseline Energy Performance Rating between 1 and 100

Step 2: Improve the Energy Performance Rating

Agenda



- Review Energy Performance Rating System
- Identify areas for improvements
- Set realistic and achievable performance goals
- Create an action plan

Sample Building Characteristics



Size	100,000 sf
Occupant density	1 person/250 sf = 400 occupants
Plug load	1.2 PCs/person = 480 PC's
Operating hours	Average = 65 hrs/week
Cost per kWh	\$.09 (Blended rate)

Assume these base building characteristics throughout the training unless otherwise noted.

Identify and Sequence Low Cost Improvements

Low cost opportunities to improve
facility and portfolio-wide energy
performance



O & M



Occupants'
Behavior



Lighting



Controls



Equipment

Use a staged approach

Effective O & M

✓ Reduces the need for ***Unscheduled Maintenance***

Effective O & M Results in:

Decrease

Equipment inefficiencies
and malfunctions

Premature system failures

Unnecessary energy use

Occupants' complaints

Increase

Useful life of systems

Equipment reliability

Indoor air quality (IAQ)

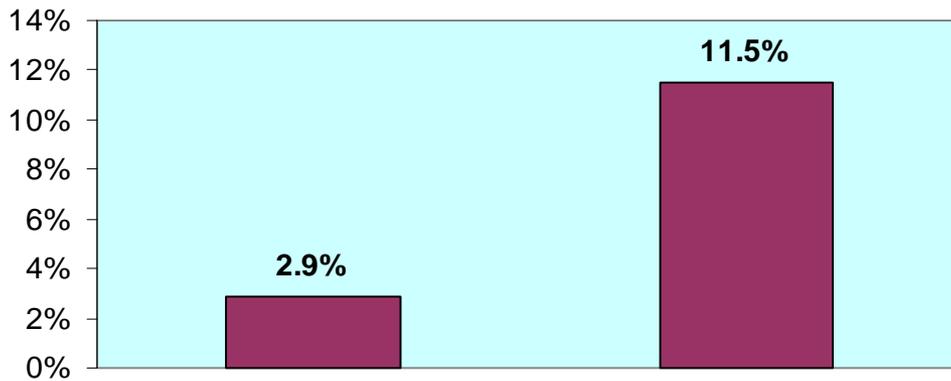
Occupants' comfort level

Tenant retention

Functioning as Designed



**Whole Building Energy Savings Potential
Low Estimate / High Estimate**



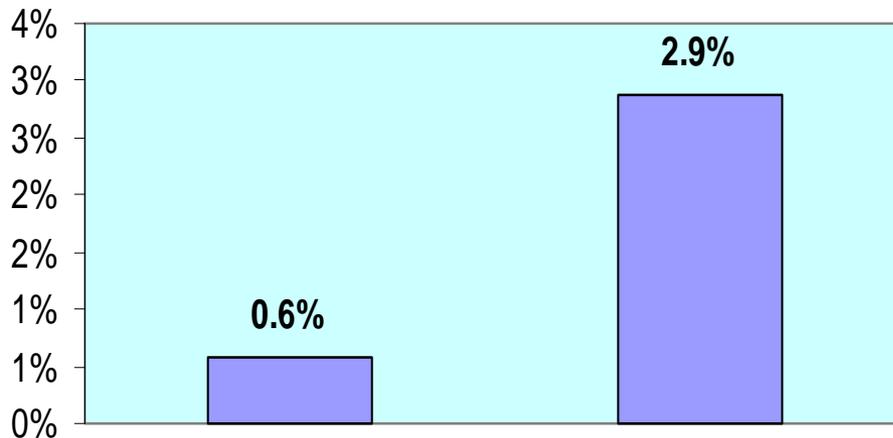
Regularly inspect all equipment and controls to ensure they are functioning as designed

Mini Case Studies	Cost	Annual Savings	Payback	Asset Value Increase	ROI
Located and corrected chilled water pump control issue	\$1,200	\$43,000	7 days	\$537,500	3,583%
Corrected EMS software programming error from AND to OR	\$1	\$3,700	Immediate	\$46,250	370,000%

Calibrate Thermostats



Whole Building Energy Savings Potential
Low Estimate / High Estimate



Periodically, walk through the building and compare the thermostat setting with a hand held digital thermostat (preferably with 2 decimal places)

Ensure thermostat setting equals actual space temperature

Adjust Dampers

Whole Building Energy Savings Potential
Low Estimate / High Estimate

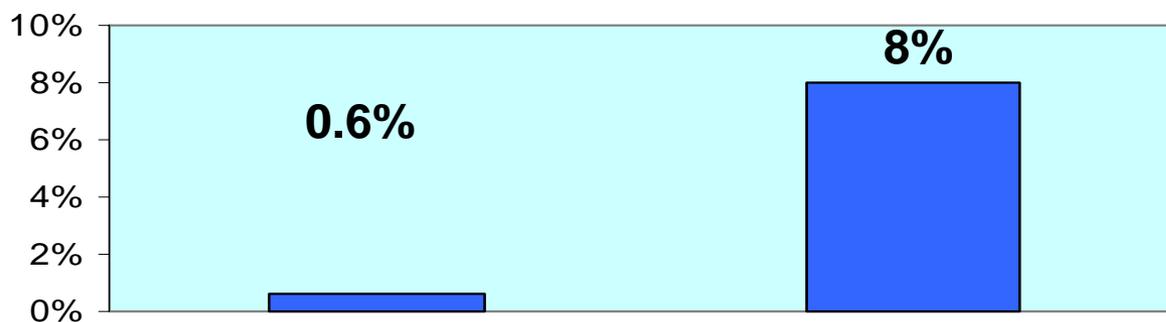


Bring in the least amount of outside air necessary to maintain proper air quality

Reduce outside air requirements by adjusting dampers to minimize the need to condition outside air (within codes)

Janitorial Best Practices

Whole Building Energy Savings Potential
Low Estimate / High Estimate



Team Cleaning

Clean one floor at a time

Coordinate

Cleaning & security staff

Occupancy Sensors

Energy Star and SEIU study

Day Cleaning

Clean during work hours

Joe Serna, Jr. Building



Day Cleaning



Janitorial Hours
11:00 am – 8:00 pm

Instituted during 2001 energy crisis

Immediate energy saving of 8%

70% reduction in tenant complaints



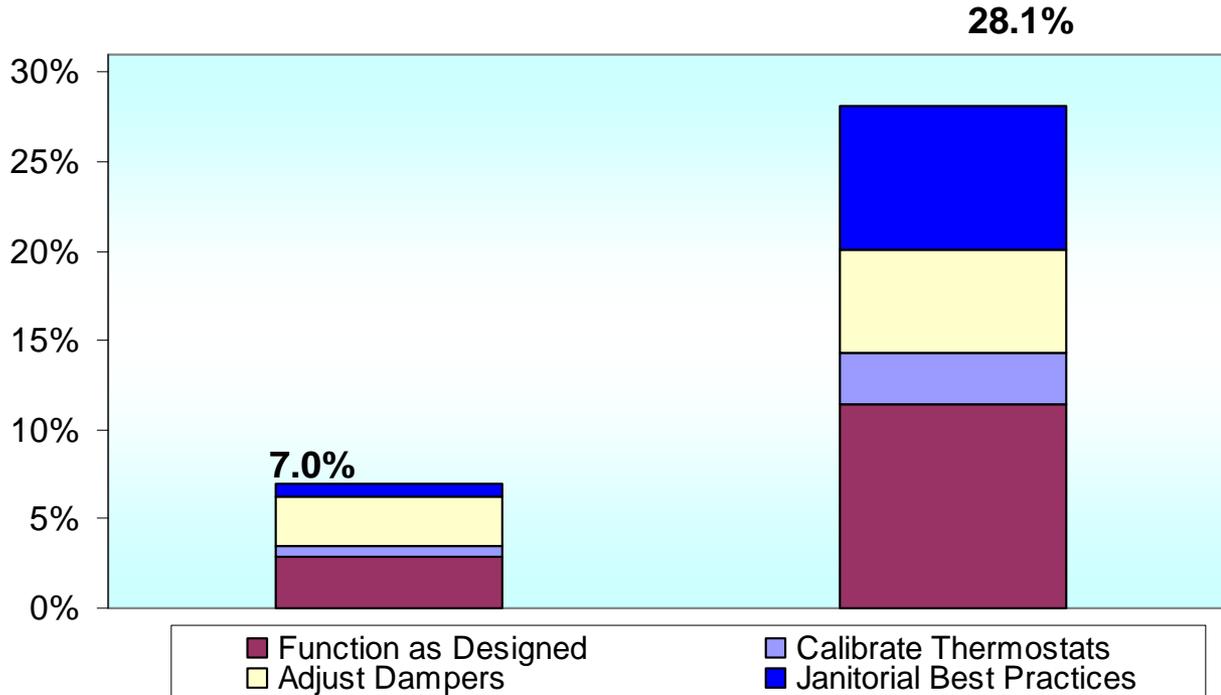
**Managed by
Thomas Properties
Group**

ENERGY STAR Energy Performance Rating = 94

Cost	Cost / sf	Annual Savings	Annual Savings / sf	Payback	Asset Value Increase	Annual Energy Savings
\$0	0¢	\$100,000	11¢	Immediate	\$1.25 mil	8%

Cumulative Effect of Changes to O&M

Whole Building Energy Savings Potential
Low Estimate / High Estimate



Quantifiable Results for Changes to O&M

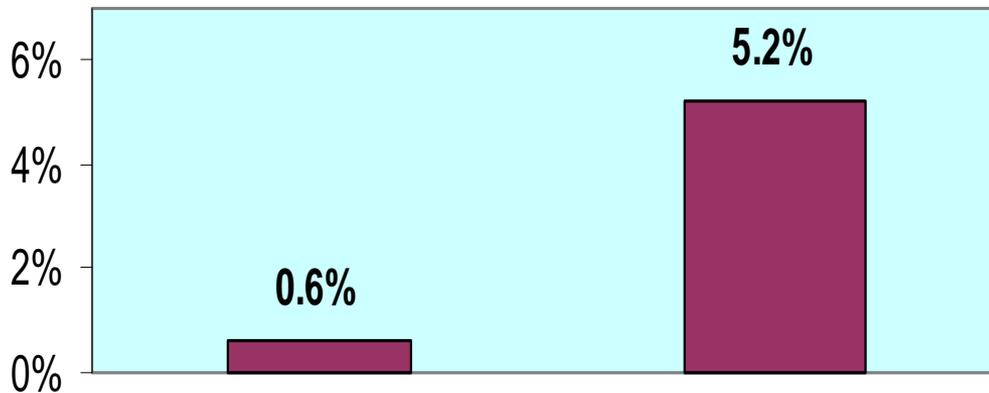


Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Function as Designed	2.9	\$6,285	11.5	\$23,839
Calibrate Thermostats	.6	1,300	2.9	6,285
Adjust Dampers	2.9	6,285	5.7	12,353
Employ Janitorial Practices	.6	1,322	8.0	17,338
CUMULATIVE EFFECT	7.0	\$15,192	28.1	\$59,815

Turn Off Equipment



Whole Building Energy Savings Potential Low Estimate / High Estimate



During off hours, make sure to power down everything – such as copiers, kitchen equipment, and task lights

Use cleaning/security personnel to turn off miscellaneous items such as coffee pots, kitchen equipment, individual office lights

Monitor & Computer Power Management Software



Monitor power management
Save up to \$55 per monitor annually

Whole Building Energy Savings Potential
Low Estimate / High Estimate



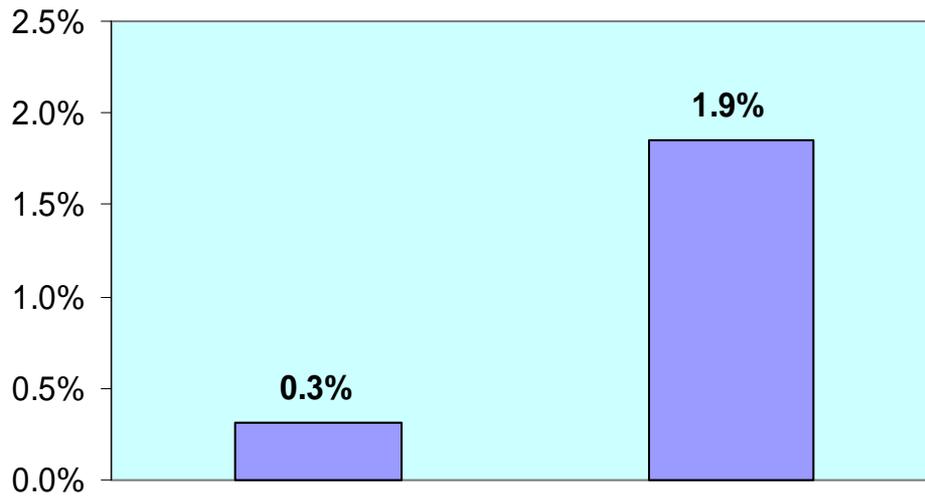
Company	Monitors	Annual Savings	Annual Savings / Monitor
GE	100,000	\$3 mil	\$30
Cisco	20,000	\$528,000	\$26
Pitney Bowes	10,500	\$160,000	\$15

CPU/Hard Drive Power Management
Save up to an additional \$45 per computer annually

Harvest Daylight



Whole Building Energy Savings Potential
Low Estimate / High Estimate



Locate work stations requiring high illumination adjacent to windows

Switch off lights when daylight is sufficient

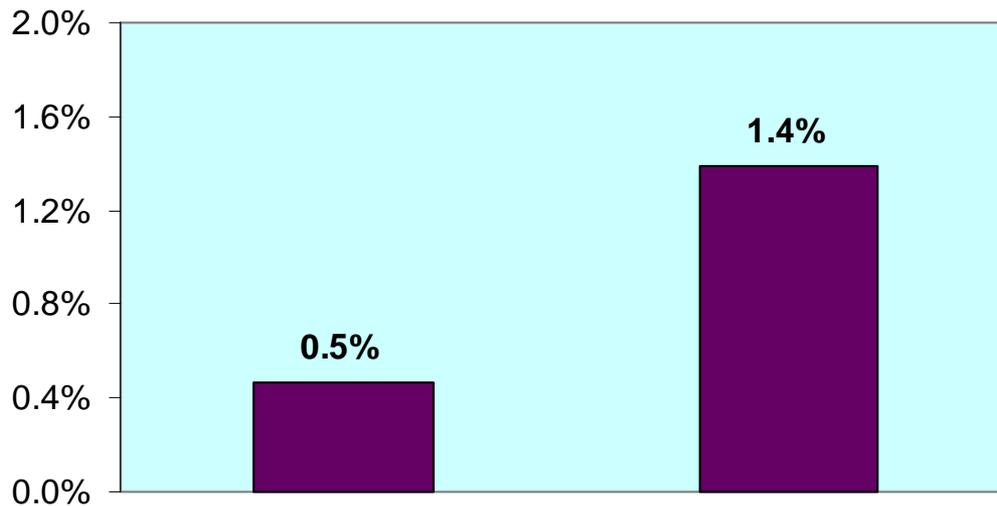
Clean windows and skylights

Turn off lights where natural light is sufficient

Work Station Task Lighting



Whole Building Energy Savings Potential
Low Estimate / High Estimate

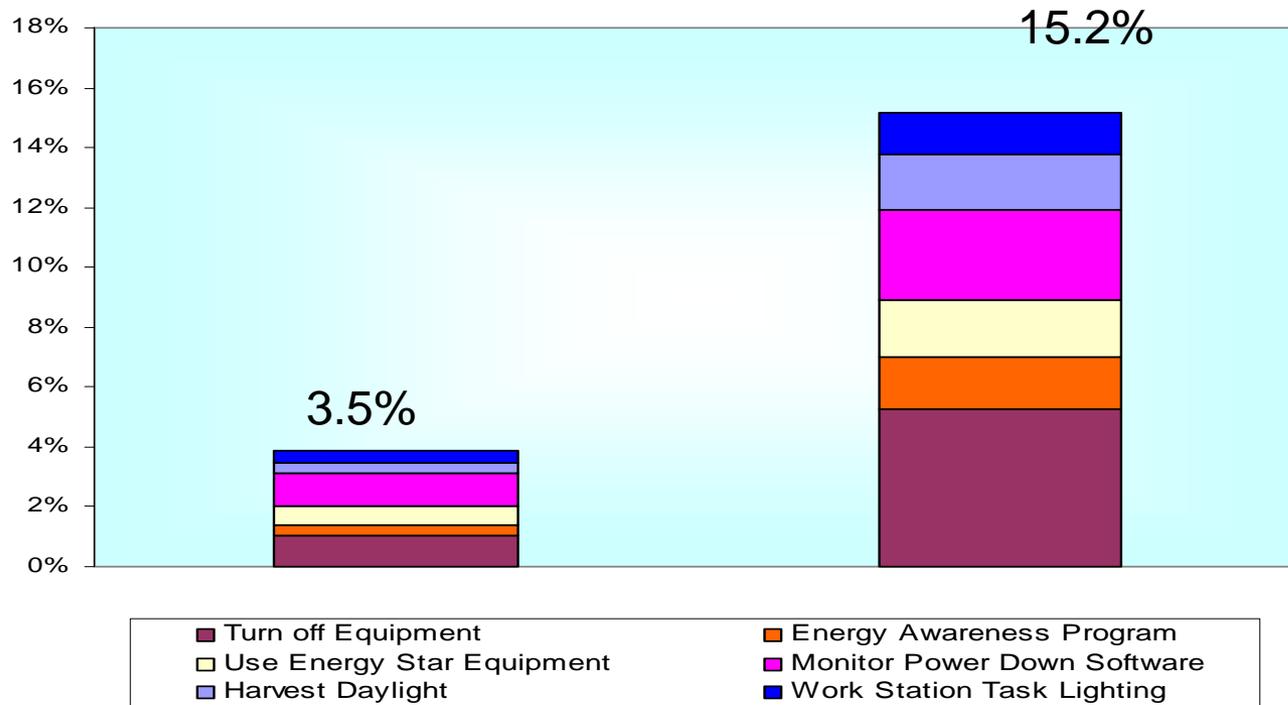


Direct light at areas where tasks are being performed and use lower wattage for overhead ambient lighting

Consider combining with motion-controlled power strips

Cumulative Effect to Changes in Occupants' Behaviors

Whole Building Energy Savings Potential
Low Estimate / High Estimate



Quantifiable Results for Changes to Occupants' Behaviors



Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Turn off Equipment	0.6	\$1,322	5.3	\$11,486
Energy Awareness Program	0.4	759	1.7	3,684
ENERGY STAR Equipment	0.6	1,300	1.9	4,118
Power Management Software	1.1	2,384	3.0	6,502
Harvest Daylight	0.3	650	1.9	4,009
Work Station Task Lighting	0.5	997	1.4	3,034
CUMULATIVE EFFECT	3.5	\$7,412	15.2	\$32,833

Boston Edison Corporate Office



Over 70% of total energy use was consumed during non-occupied periods!

Tenants lost their dial-in codes to activate lighting during off hours. Upon request, security would turn on entire floors of lighting for one person.

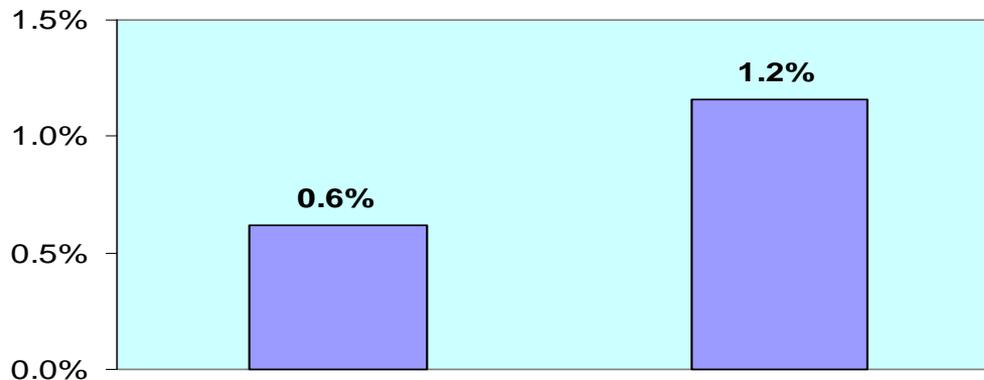


Cost	Cost / sf	Annual Savings	Annual Savings / sf	Payback	ROI Increase	Asset Value Increase	Annual Energy Savings
\$2,000	1¢	\$121,200	53¢	2 mos.	6,050%	\$1.5 mil	6.5%

Change Incandescents to CFL & HID



Whole Building Energy Savings Potential
Low Estimate / High Estimate

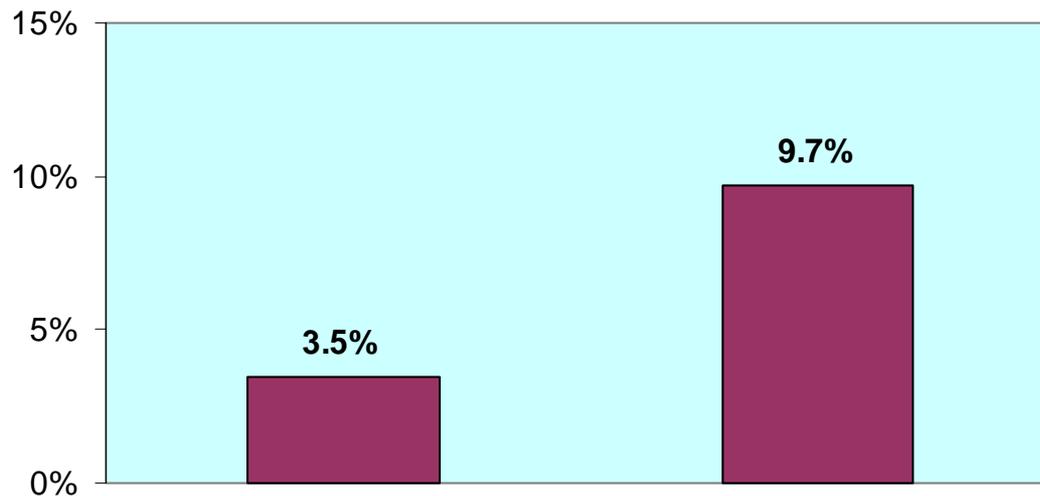


Mini Case Study	Cost	Annual Savings	Payback	ROI
Convert 75 W incandescent high-ceiling lobby lights to 16 W fluorescent floods	\$2,161	\$4,834	5-6 mos.	224%

Convert T12 to T8 & T5 and Electronic Ballasts



Whole Building Energy Savings Potential
Low Estimate / High Estimate



Re-Lamping?
Consider

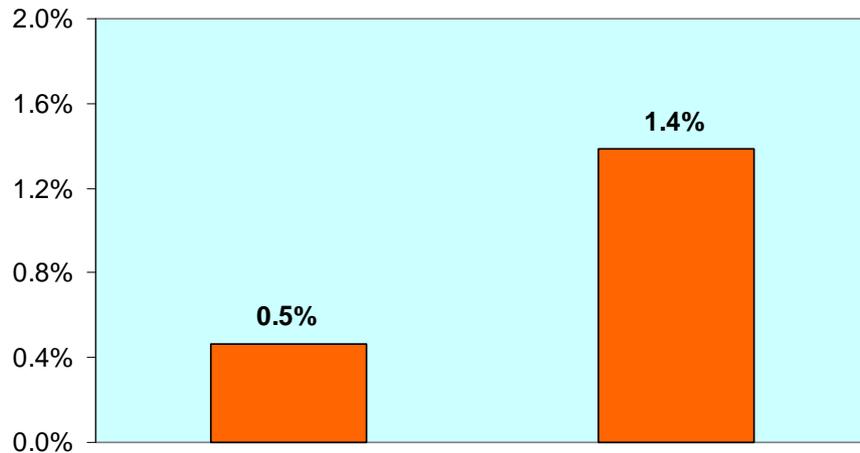
Luminaire Dirt Depreciation
Light loss factor resulting from dirt and dust accumulated on light fixtures and lamps.

Convert T12s to T8s / T5s and electronic ballasts
Eliminate magnetic ballasts

Full Floor Lighting Sweeps



Whole Building Energy Savings Potential
Low Estimate / High Estimate



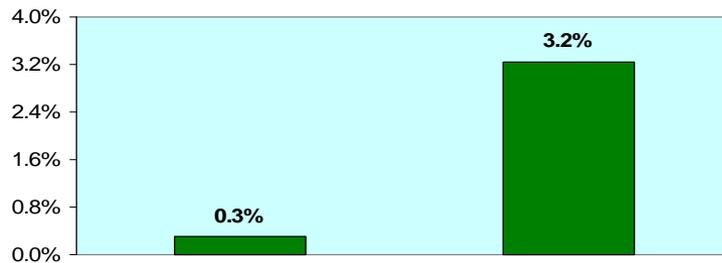
Program and periodically verify that the EMS system is performing full floor lighting sweeps

Mini Case Study	Cost	Cost/sf	Annual Savings	Payback	ROI
Programmed lighting sweep controls	\$5,000	1 ¢	\$17,901	3 mo.	358%

Occupancy Sensors



Whole Building Energy Savings Potential
Low Estimate / High Estimate

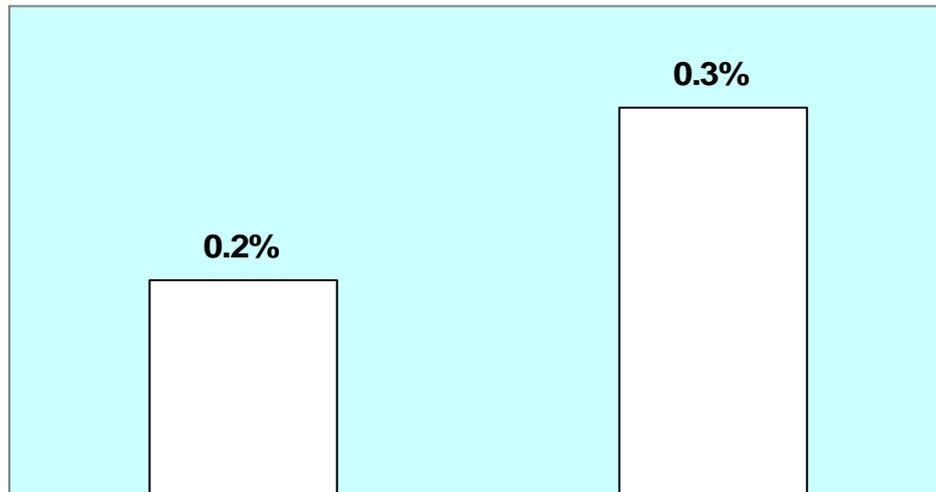


Install occupancy sensors to automatically turn off lights when physical movement stops

Mini Case Studies	Cost	Rebate	Annual Savings	Payback	ROI
Installed motion sensors for HVAC controls in conference rooms	\$37,500	\$8,714	\$40,357	8 -9 mos.	108%
Installed motion sensors in storerooms	\$10,212	\$888	\$5,800	1.6 yrs	57%
Adjusted motion sensors from 18 minutes to 5-7 minutes	\$2,750	N/A	\$750	3.7 yrs.	27%

High Efficiency LED Exit Signs

Whole Building Energy Savings Potential
Low Estimate / High Estimate



Operate 24/7

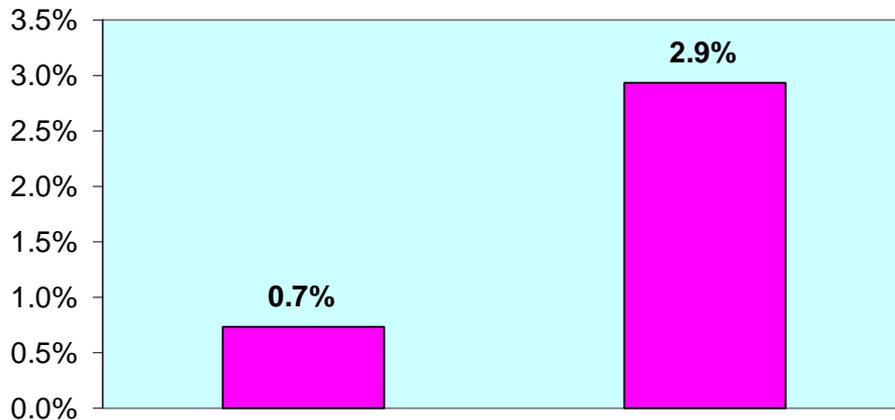
Lower maintenance costs due to extended life

Replace inefficient Exit signs with high efficiency LED Exit signs

Install Timer Controls or Photocell for Exterior Lighting



Whole Building Energy Savings Potential
Low Estimate / High Estimate



Automatically controls lights in response to daylight

Install timer controls or photocell for exterior lighting

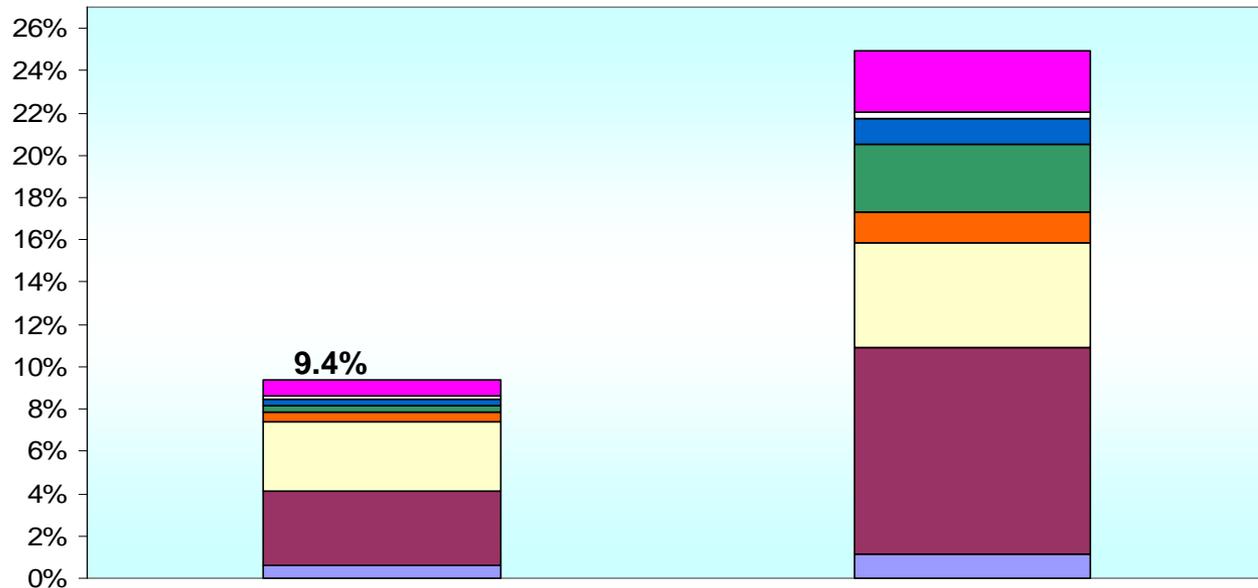
Mini Case Study

Mini Case Study	Cost	Rebate	Annual Savings	Payback	ROI
Installed photocells for exterior lighting	\$2,300	\$400	\$700	2.7 yrs.	37%

Summary Energy Savings for Lighting



Whole Building Energy Savings Potential
Low Estimate / High Estimate **25%**



- Change incandescent to CFL and HID
- Delamp
- Occupancy Sensors
- High efficiency LED Exit signs
- Convert T12 to T8 & T5 and electronic ballasts
- Full floor lighting sweeps
- Bi-level local switches
- Timer controls for exterior lighting

Quantifiable Results for Changes to the Lighting Systems

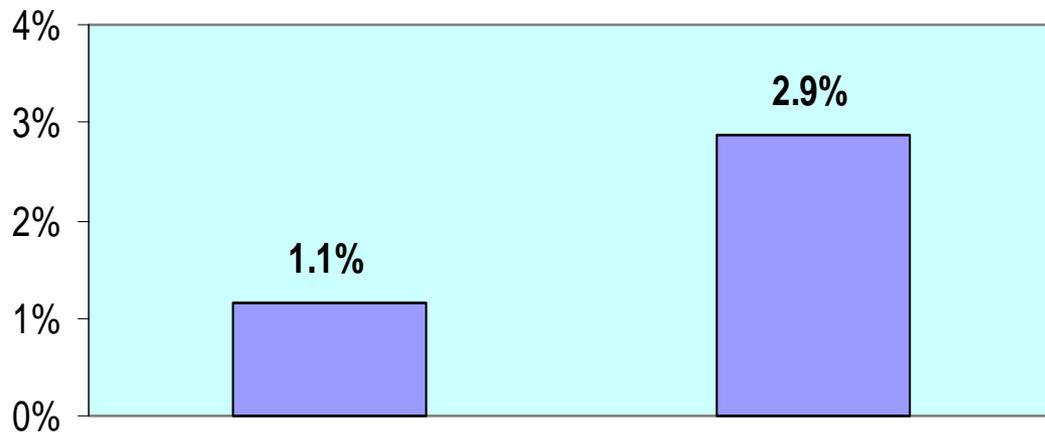


Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Change ICL to CFL & HID	0.6	\$1,300	1.2	\$2,601
Convert T12 to T8 & T5	3.5	7,585	9.7	21,022
Delamp	3.3	7,152	5.0	10,836
Full floor lighting sweeps	0.5	997	1.4	3,034
Occupancy Sensors	0.3	672	3.2	6,935
Bi-Level Local Switches	0.3	672	1.2	2,601
High efficiency LED Exit Signs	0.2	325	0.3	607
Timer controls and photo cells	0.7	1,582	2.9	6,285
CUMULATIVE EFFECT	9.4	\$20,372	25.0	\$54,180

Adjust Temperature



Whole Building Energy Savings Potential
Low Estimate / High Estimate

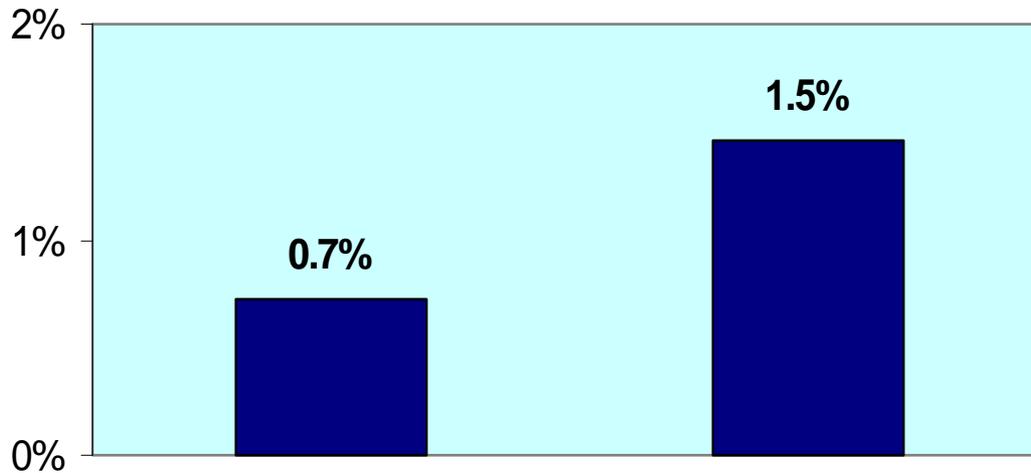


Physically walk through the building and talk with tenants to determine if the actual temperature is comfortable.

Operating Hours



Whole Building Energy Savings Potential
Low Estimate / High Estimate



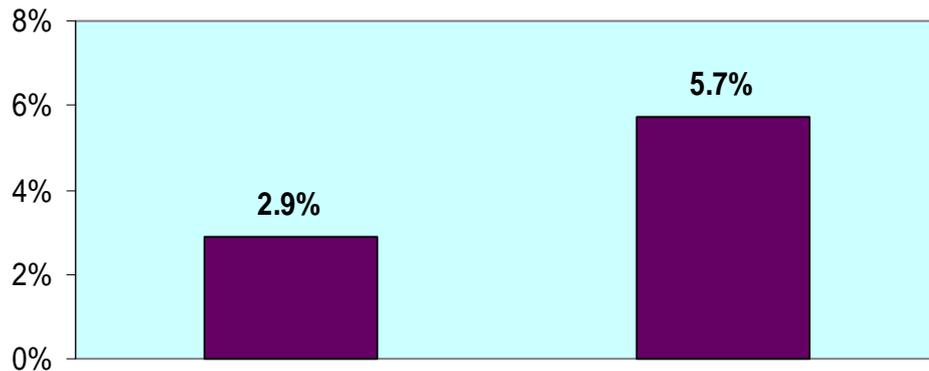
Are you conditioning space when no one is there?

Talk to the tenants to see if they are actually using their space during the lease required operating hours. Do they really need the air until 7 pm? Or on weekends?

Adjust Ventilation in Low Density or Vacant Space



Whole Building Energy Savings Potential
Low Estimate / High Estimate



Adjust ventilation in low or unoccupied spaces

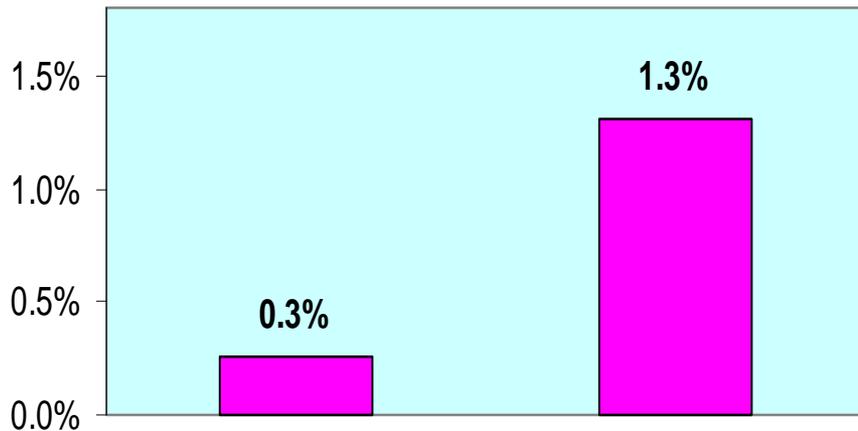
Reduce exhaust and outdoor-air ventilation rates within codes

Mini Case Study	Cost	Rebate	Annual Savings	Payback	ROI
Motion sensor controls for HVAC in file storage rooms	\$2,100	\$1,084	\$2,820	4 months	278%

Limit Access to Thermostats



Whole Building Energy Savings Potential
Low Estimate / High Estimate



Your job is to protect the thermostats from unauthorized adjustment

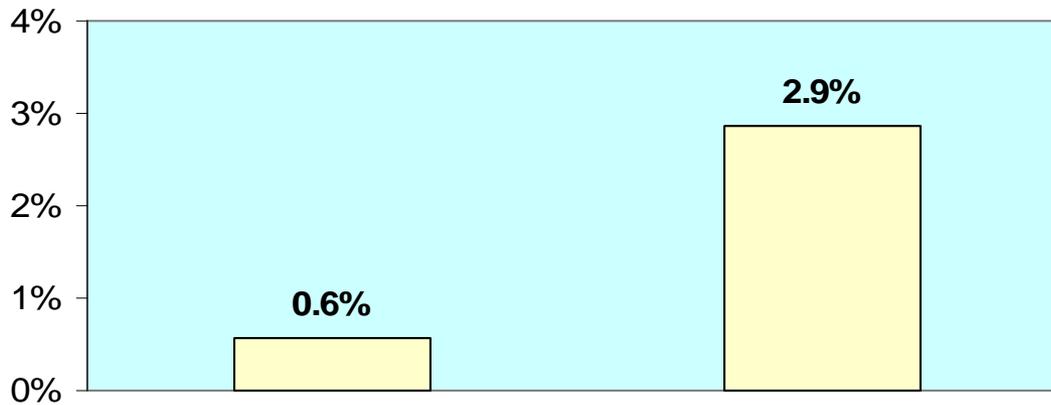
- EMS controls
- Tamper-proof locking covers on thermostats
- Locking screws to prevent tampering

Eliminate or minimize tenants' access to thermostats

Optimize Start Up Time & Equipment Sequencing



Whole Building Energy Savings Potential
Low Estimate / High Estimate



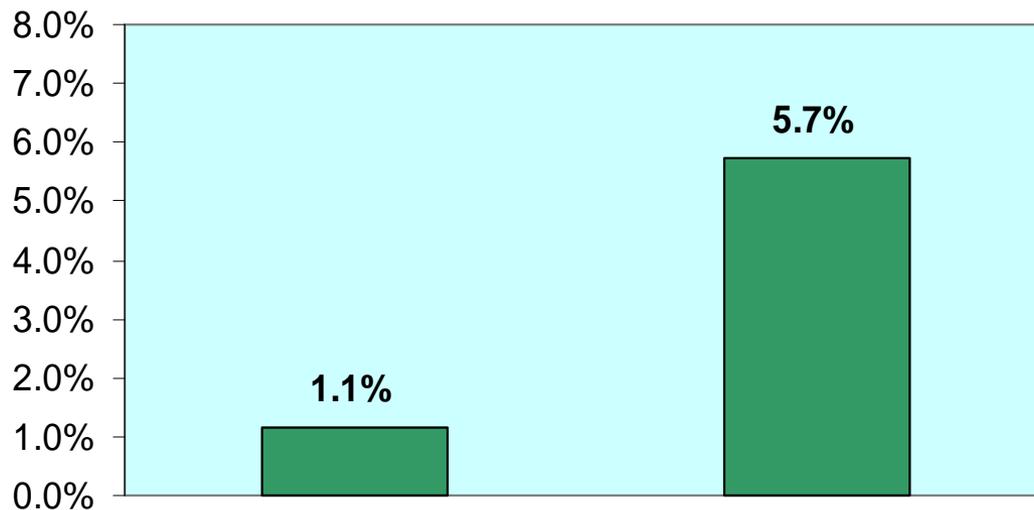
Experiment to determine the latest possible start up time

Mini Case Study	Cost	Annual Savings	Payback	ROI
Changed cooling tower staging and sequencing—50% reduction	\$575	\$12,272	17 days	2,134%

Seasonal Changes



**Whole Building Energy Savings Potential
Low Estimate / High Estimate**



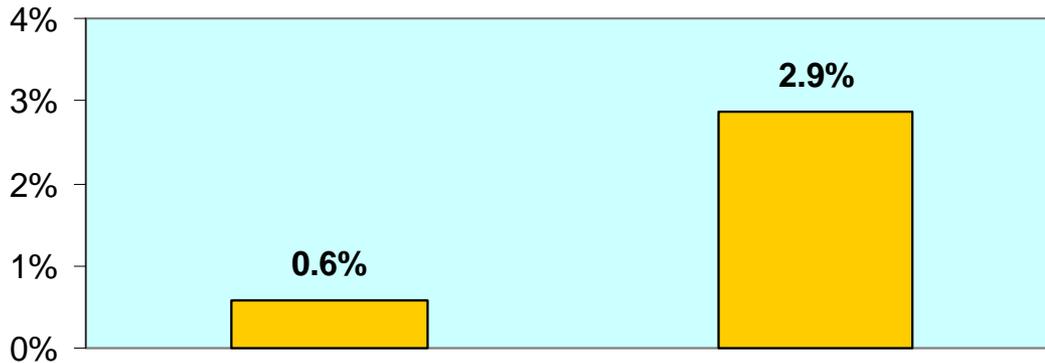
Consider a lower set point in the winter months and a higher set point in the summer months, if your system will allow it

Schedule seasonal changes to thermostats

Coast Last Hour of Operations



Whole Building Energy Savings Potential
Low Estimate / High Estimate

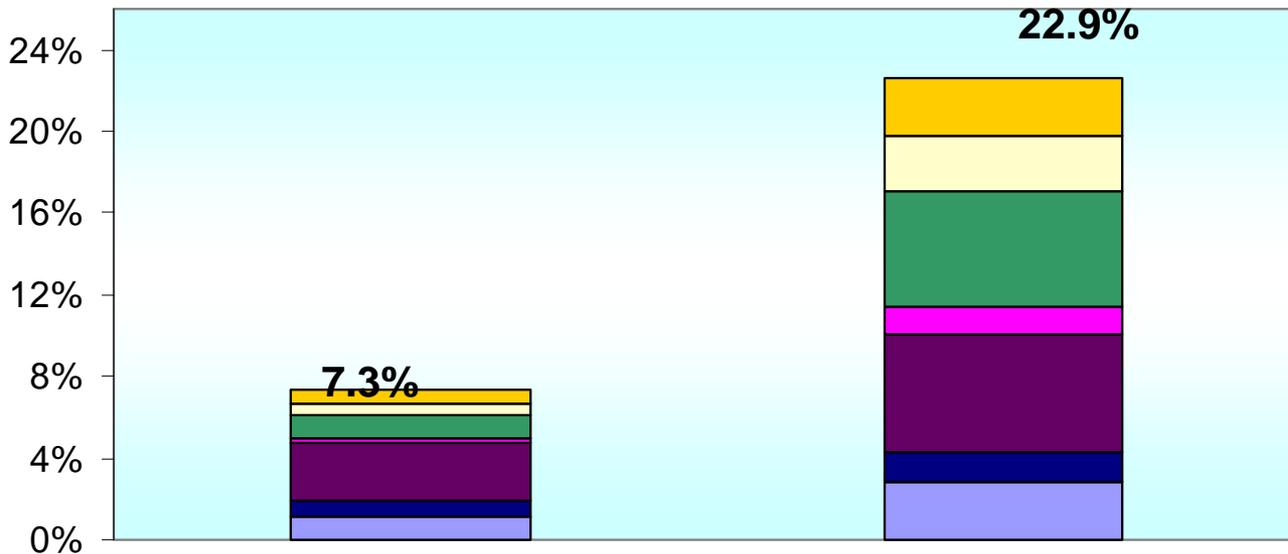


Experiment to determine the EARLIEST possible time the systems can be powered down while maintaining comfort

Mini Case Study	Cost	Rebate	Payback	Annual Savings
Reduced operating hours on a fountain from 119 to 60 hrs/week	Negligible	\$926	Immediate	\$6,706

Summary Energy Savings for Control Measures

Whole Building Energy Savings Potential
Low Estimate / High Estimate



Adjust Temperature
Adjust Ventilation
Seasonal Changes

After-hours Usage
Limit Access to Thermostats
Optimize Start Up Time

Quantifiable Results for Changes to Controls



Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Adjust Temperature	1.1	\$2,384	2.9	6,285
After Hours Usage	0.7	1,517	1.5	3,251
Adjust Ventilation	2.9	6,285	5.7	12,353
Limit Access to Thermostats	0.3	563	1.3	2,817
Optimize Start-up Times	0.6	1,300	2.9	6,285
Seasonal Changes to Thermostats	1.1	2,384	5.7	12,353
Coast Last Hour of Operation	0.6	1,300	2.9	6,285
CUMULATIVE EFFECT	7.3	\$15,821	22.9	\$49,846

2040 Main Street



Installed new control sequence programming to control:

- Variable frequency drives (VFD)
- Chiller and tower optimization
- Air handler points for static pressure
- Supply/return resets
- Local/global lockouts for strip heaters

*ENERGY STAR Energy Performance Rating
Before Upgrades = 74 Current Rating = 82*



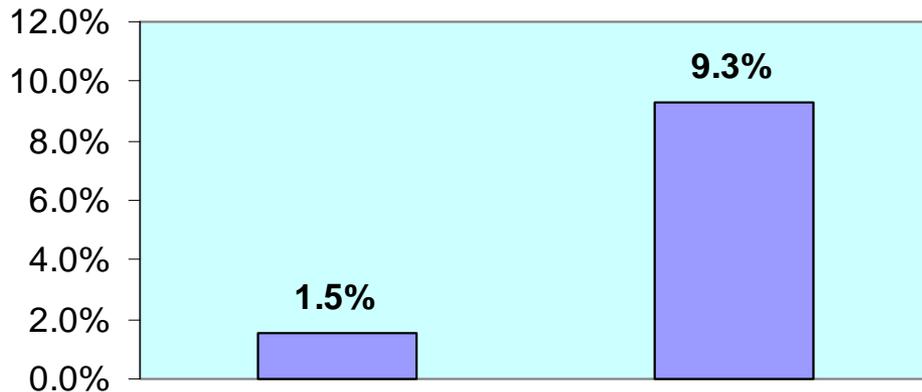
**Managed by Transwestern
Commercial Services**

Cost	Cost / sf	Annual Savings	Annual Savings / sf	Payback	ROI	Asset Value Increase	Annual Energy Savings
\$56,000	17¢	\$47,000	14¢	1.2 yrs	\$84%	\$587,500	40%

Install Variable Frequency Drives & Variable Air Volume Systems



**Whole Building Energy Savings Potential
Low Estimate / High Estimate**

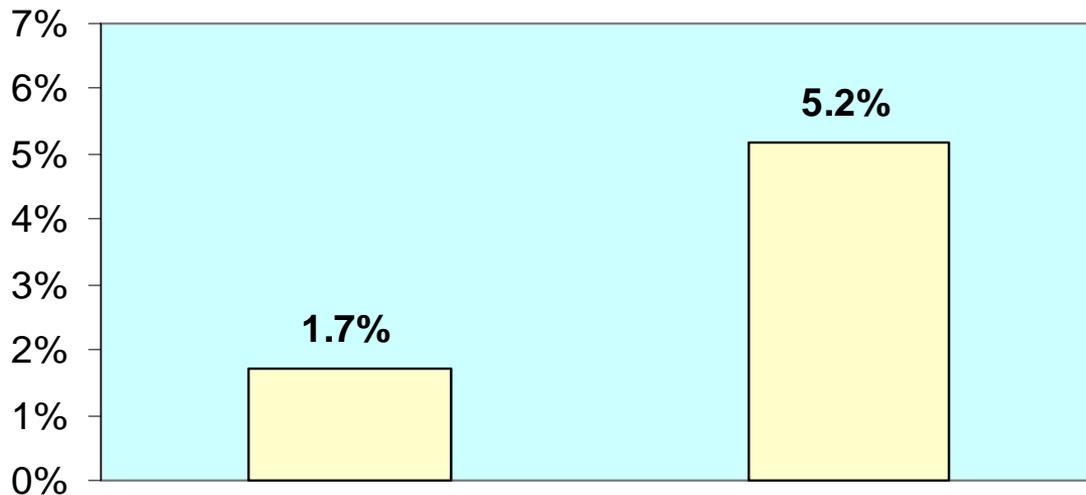


Motors and fans may not need to run at full speed at all times, due to varying levels of demand placed on the system at different points throughout the day.

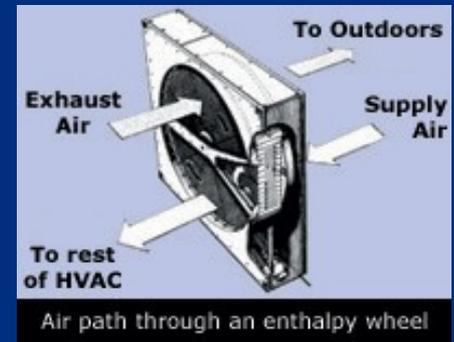
Mini Case Study	Cost	Annual Savings	Payback	ROI
Install VFDs	\$31,000	\$16,000	2 yrs.	52%

Install Heat Recovery Equipment

Whole Building Energy Savings Potential
Low Low Estimate / High Estimate



Enthalpy Wheel



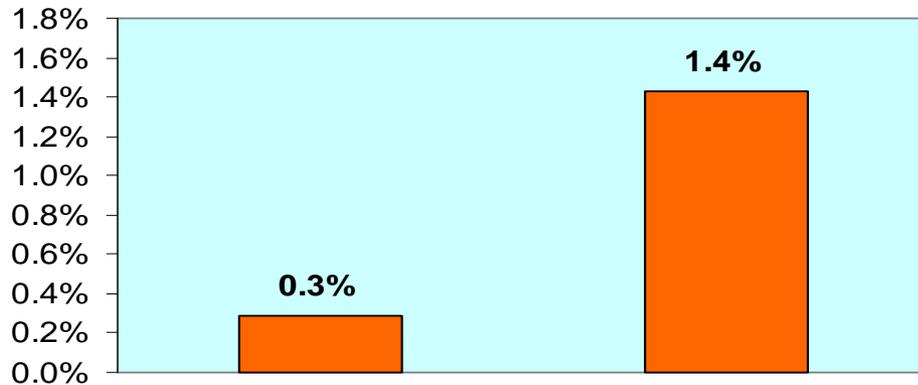
Source: Queen's University, School of Applied Science

Install heat recovery equipment (enthalpy wheels, heat pipes)
to optimize conditioning of ventilated air

Relocate Thermostats to Optimal Locations



**Whole Building Energy Savings Potential
Low Estimate / High Estimate**

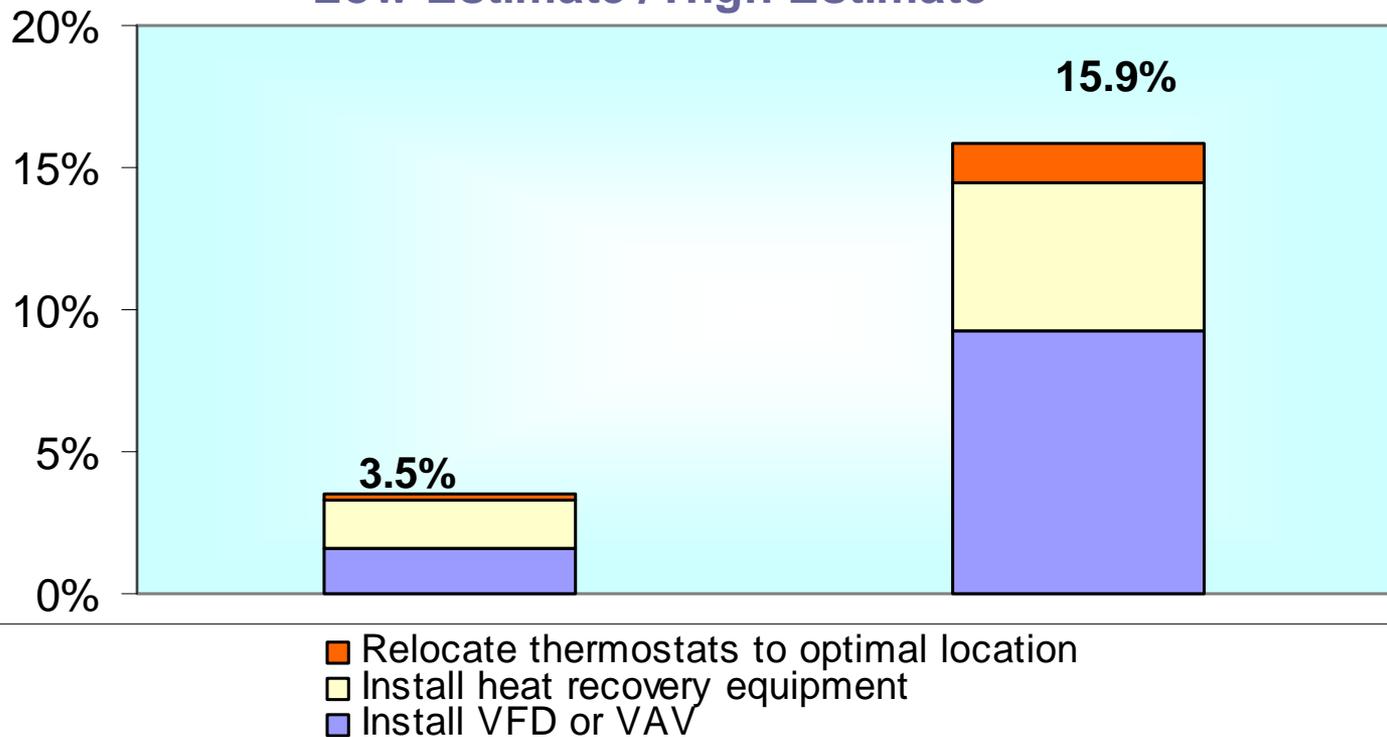


Install or relocate
thermostats near return air
ducts

Mini Case Study	Cost	Annual Savings	Payback	ROI
Relocate thermostats	\$3,230	\$2,519	1.3 yrs	78%

Summary Energy Savings for Equipment Changes

Whole Building Energy Savings Potential
Low Estimate / High Estimate



Quantifiable Results for Changes to Equipment



Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Install VFD or VAV	1.5	\$3,251	9.3	\$20,155
Install Heat Recovery Equipment	1.7	3,684	5.2	11,269
Relocate Thermostats	0.3	650	1.4	3,034
CUMULATIVE EFFECT	3.5	\$7,585	15.9	\$34,675

Agenda



- Review Energy Performance Rating System
- Identify areas for improvements
- Set realistic and achievable performance goals
- Create an action plan

Set Energy Performance Goals



Upon completing the benchmarking process you can set performance goals by setting a:

1. Target rating
2. Target energy reduction

Reduce Consumption Increase Savings



100,000 sf
 Operating hours = 65
 # of Occupants = 400
 # of PC's = 480
 Cost of energy =
 \$.09/kWh

Cost Savings at Various Levels of Energy Reduction

Initial Rating	1% Energy Reduction	3% Energy Reduction	5 % Energy Reduction	10% Energy Reduction
50	\$2,167	\$6,502	\$10,836	\$21,672
70	\$1,620	\$4,860	\$8,100	\$16,200
90	\$1,187	\$3,561	\$5,936	\$11,871

Agenda



- Review Energy Performance Rating System
- Identify areas for improvements
- Set realistic and achievable performance goals
- Create an action plan

Create an Action Plan



Download the
ENERGY STAR
*Guidelines for Energy
Management*

for ideas to incorporate into
your organization's
Energy Management Plan

Best Practices Checklist for Improved Energy Performance



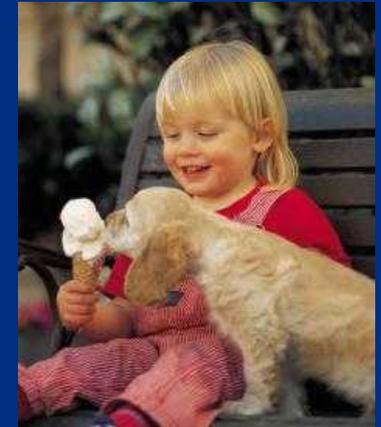
	High % Est	Opportunity Exists?	Target % Reduction	Who?	Target Date to Complete	Actual Date	Notes
Operations & Maintenance							
Functioning as designed	11.5	Yes	4	Wes	9/30/07		
Calibrate thermostats	2.9	Yes	1	Jack	12/01/07		
Adjust dampers	5.7	No	N/A	N/A	N/A	N/A	N/A
Janitorial best practices	8.0	No	N/A	N/A	N/A	N/A	N/A
Occupants' Behaviors							
Turn off equipment	5.2	Yes	1	Lea	12/31/06		
Energy awareness prg	1.7	No	N/A	N/A	N/A	N/A	N/A

Reminder to Share Your Data



**Sharing your benchmarked data benefits the entire industry!
And it's as easy as 1, 2, 3!**

1. Establish a user account in Portfolio Manager
2. From the My Portfolio page, choose "*Share Facilities*"
 - From the drop down menu labeled "*Select a Portfolio Manager Master Account*", look for *BOMA International-BOMABEEP* and select it from the Master Account Registry.
3. Follow the directions and click SAVE





Questions?

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Would you like to know more about this session?

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Don't forget to fill out and drop off your session evaluations.