

# Energy Savings Audit

PREPARED FOR  
CB Richard Ellis

ASSESSMENT SITE  
Westmoor Building 2  
10155 Westmoor Drive  
Westminster, CO 80021

ASSESSMENT PERFORMED BY  
Ace Mechanical  
1234 Main Street  
Denver, CO 80021  
(800) 321-1234

ASSESSMENT DATES  
01/22/2009 – 01/29/2009

REPORT ID  
127181



# Executive Summary

This Building Performance Assessment is designed to help key stakeholders understand the building's operation in the following areas:

- Current energy usage and actions you can take to save energy
- Financial analysis of proposed conservation measures
- Comfort and ventilation issues related to mechanical system operations
- Verification of schedules for the operation of temperature and lighting control systems

## Energy Findings



### Proposed Energy Conservation Measures

#### Building Performance

Your Energy Usage Index ranks your building as a **medium** energy user.

#### We Recommend

The recommended energy conservation measures in this report can generate a yearly energy reduction of **434,994 kWh**.

This will reduce your carbon footprint by **386 tons** of carbon dioxide.

View all of the conservation measures on Page 6.

#### The Bottom Line

We recommend investing **\$22,500** on select energy savings measures for a payback of **0.6 years** and an estimated savings of **\$37,626 per year**. This is an **18%** reduction in overall utility cost.

## Comfort & Ventilation



### What we Tested and Found

#### Temperature (T)

8 of 8 spaces measured had excessive deviations from the optimum comfort range.

#### Relative Humidity (RH)

8 of 8 spaces measured had excessive deviations from the optimum comfort range.

#### Carbon Dioxide (CO2)

0 of 4 spaces measured had readings above recommended levels.

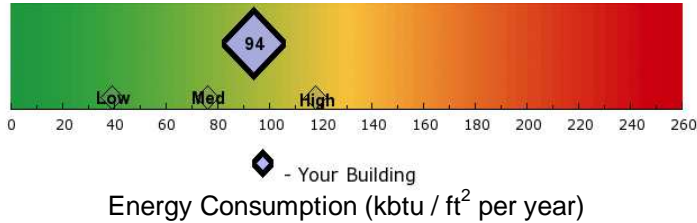
### Areas of Interest

- NE End (RH,T,CO2)
- NW End (RH,T,CO2)
- NE Side Dock (RH,T,CO2)
- E Side (RH,T,CO2)
- V.S. Flr 2 (RH,T)
- Rec Desk (RH,T)
- Ctr of Flr 1 (RH,T)
- S end Flr 1 (RH,T)

# How You Use Energy Today

This page uses the information gathered on your building during the assessment to benchmark your building's performance versus peer buildings of the same type and size across the country. The comparison uses ENERGY STAR® and the Department of Energy's Commercial Buildings Energy Consumption Survey database (CBECS).

## Energy Usage Index



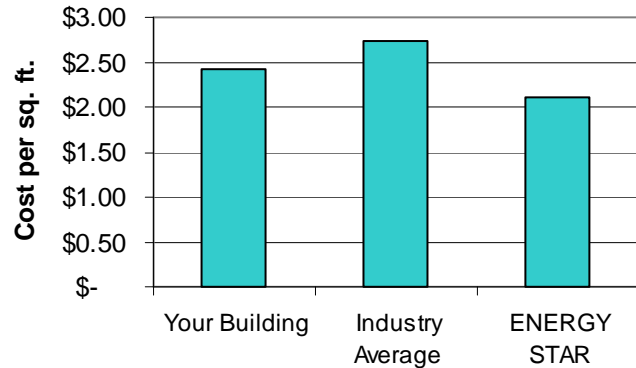
### Explanation

The Energy Usage Index is your building's estimated Energy Consumption (kbtu / ft<sup>2</sup>) in comparison to a range of peer buildings.

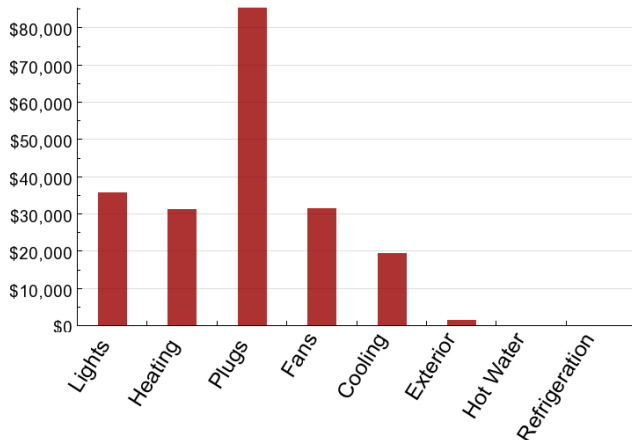
### Summary

The Annual Cost Comparison graph shows your combined cost per square foot for fuel and electricity as indicated by your utility bills over the last year. For comparison, the chart displays peer buildings at the 50<sup>th</sup> (industry average) and the 75<sup>th</sup> (energy-efficient building) percentiles on the ENERGY STAR rating scale.

## Annual Cost Comparison (\$ / ft<sup>2</sup>)



## Current Annual Energy Costs



### Findings

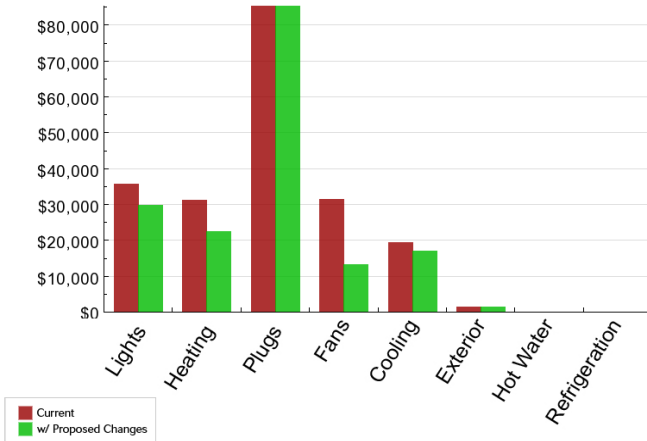
The Current Annual Energy Costs graph shows the estimated cost of each of these typical operations for your building.



# Energy Savings Analysis

The Energy Savings Analysis for your building is outlined on this page. The analysis is based on a sophisticated set of energy modeling algorithms and actual building performance data. It shows the current usage and potential energy and cost savings opportunities from the proposed changes highlighted.

## Annual Energy Comparison



### Explanation

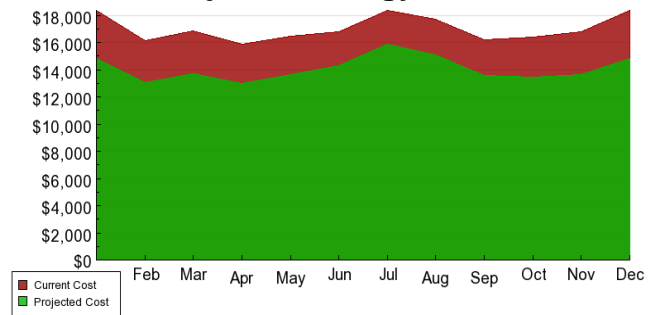
The Annual Energy Comparison chart compares your current energy use against energy use after implementing the proposed energy conservation measures. Energy savings are for a typical weather year.

The current average monthly demand is **343 kW**.

### Explanation

The Projected Energy Cost chart compares the current monthly costs against projected monthly costs after implementing the proposed energy conservation measures. Projected savings are for a typical weather year.

## Projected Energy Cost



## Return on Investment

Cost to Implement	\$22,500
Program Rebates	\$1,500
Payback Period	0.6 Years
Est. Annual Savings	\$37,626

### Summary

The Return on Investment information gives a high-level view of the costs associated with the proposed energy conservation measures, the resulting savings, and a simple payback estimate.

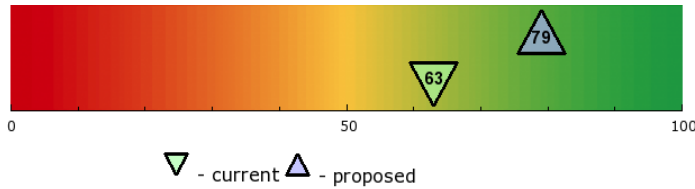
The estimated annual savings represents an **18%** reduction in your annual energy cost.



# ENERGY STAR® and Sustainability

The ENERGY STAR Energy Performance Rating is a great way to benchmark a building against peer buildings. Other metrics included on this page are the carbon footprint of the building (using EPA's utility emission data), the estimated energy reduction of the recommended energy conservation measures, and the equivalent carbon footprint reduction.

## Estimated ENERGYSTAR® Rating



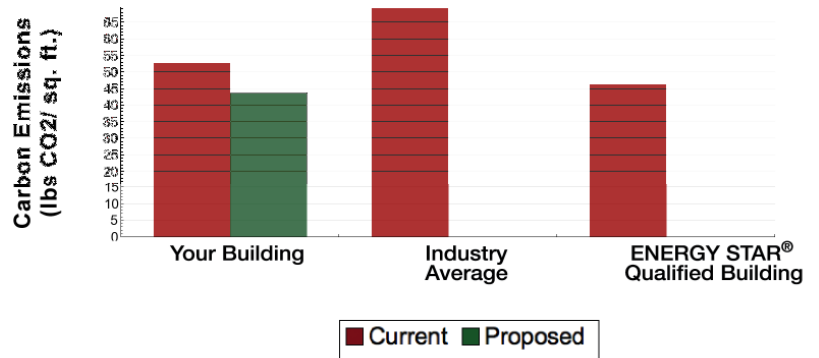
### Explanation

The ENERGY STAR® Energy Performance Rating for your building is the estimated percentile ranking on a 0-100 scale using the Department of Energy's Commercial Buildings Energy Consumption Survey database (CBECS). To qualify for ENERGY STAR certification, your building must have a rating of 75 or greater.

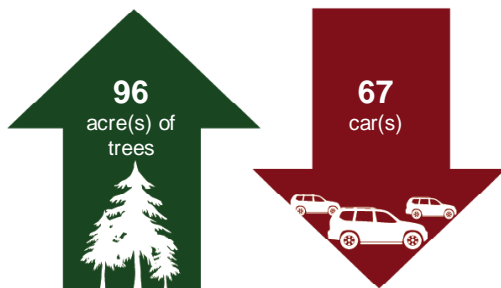
### Summary

The carbon footprint of a building measures the building's impact on the environment through its greenhouse gas emissions. This chart shows your building's current carbon footprint, the potential reduction associated with our recommendations, and how your building compares to similar buildings across the country.

## Carbon Emissions Benchmark

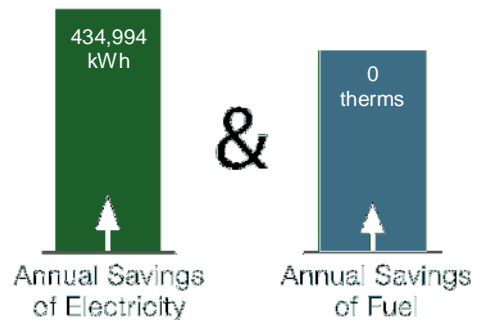


## Equivalent Carbon Footprint Reduction



Implementing the proposed energy conservation measures will reduce greenhouse gas emissions by **386 tons** of carbon dioxide per year, equivalent to removing **67 cars** from the road or reforesting **96 acres of trees**.

## Estimated Annual Savings



The Estimated Annual Savings from the reduction in energy usage is based on the energy conservation opportunities proposed in this report.



# How to Achieve Energy and Cost Savings

After evaluating the building's actual performance we propose the following actions for lowering energy use and costs:

## Energy Savings Opportunities:

Recommended Energy Conservation Measures	Estimated Savings			Estimated Cost	Simple Payback w/o Rebate	Estimated Rebate Amount	Simple Payback w/ Rebate
	Electricity (kWh)	Fuel (therms)	Total Yearly Savings				
<b>Temperature Control</b>							
Adjust heating / cooling setpoint by 2 degrees to 71 / 75				\$0		\$0	
<b>SubTotal</b>	22,032	0	\$1,906	\$0	0.0 Years	\$0	0.0 Year
<b>Ventilation Control</b>							
Reduce base ventilation rate by 30%. Check economizer and tune as needed.				\$2,000		\$0	
<b>SubTotal</b>	101,253	0	\$8,758	\$2,000	0.2 Years	\$0	0.2 Year
<b>Lighting Schedule</b>							
Adjust lighting schedule to turn off at 10:00 pm				\$500		\$0	
<b>SubTotal</b>	73,225	0	\$6,334	\$500	0.1 Years	\$0	0.1 Year
<b>HVAC Controls</b>							
Install VFDs on air handlers				\$20,000		\$1,500	
<b>SubTotal</b>	238,484	0	\$20,628	\$20,000	1.0 Years	\$1,500	0.9 Year
<b>Sum Total*</b>	434,994	0	\$37,626	\$22,500	0.6 Years	\$1,500	0.6 Year

\*The sum total does not reflect the order of implementation of the proposed energy conservation measures and therefore does not reflect any interactive effects this sequence would have on realizing the full savings potential.

# Building Comfort and Ventilation Analysis

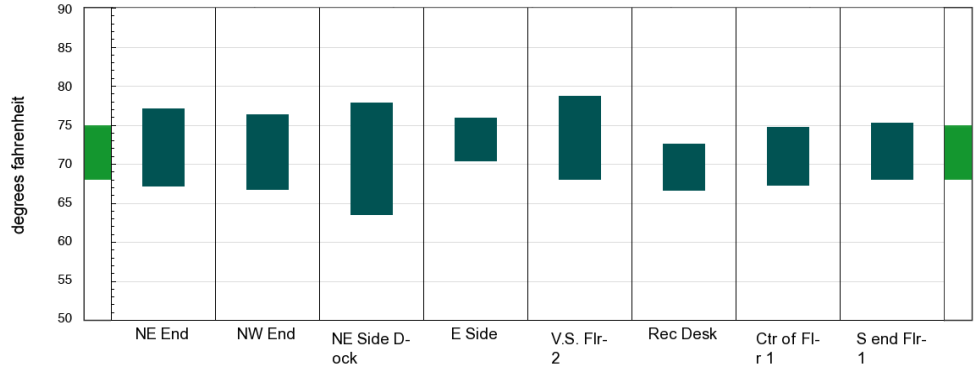
This page shows the min/max range of temperature, humidity, and carbon dioxide levels measured during occupied periods. Reducing the range is critical to achieving a building under control that is properly ventilated which allows tenants to be comfortable and productive. The action ratings are based on the worst case found when comparing measured data during occupied hours against established industry guidelines (ENERGY STAR, BOMA, ASHRAE, DOE).

## Temperature Findings



Your building is out of control with ample opportunity to save energy.

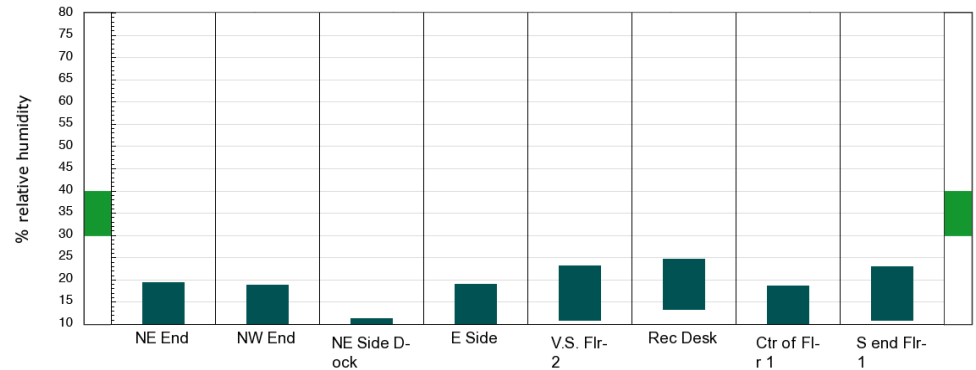
- 7 space(s) were too warm at times
- 5 space(s) were too cool at times
- 8 space(s) had excessive temperature variation



## Relative Humidity Findings



- 0 space(s) had high relative humidity at times
- 8 space(s) had low relative humidity at times

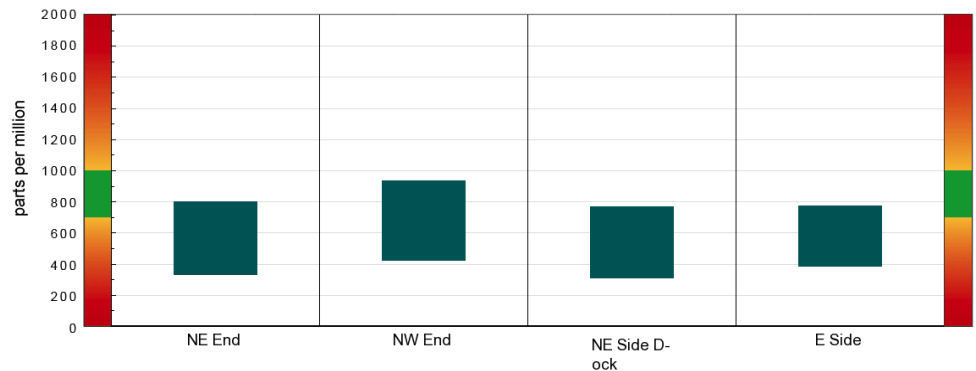


## Carbon Dioxide Findings



Your building is over-ventilated and can save energy by reducing the overall amount of outside air ventilation

- 0 space(s) had elevated carbon dioxide levels
- 4 space(s) had low carbon dioxide levels



# Outdoor Conditions

Outdoor conditions recorded during the test period are included as part of this report.

The outdoor data included in this report was recorded at: Broomfield, CO 80021

## Outdoor Temperature

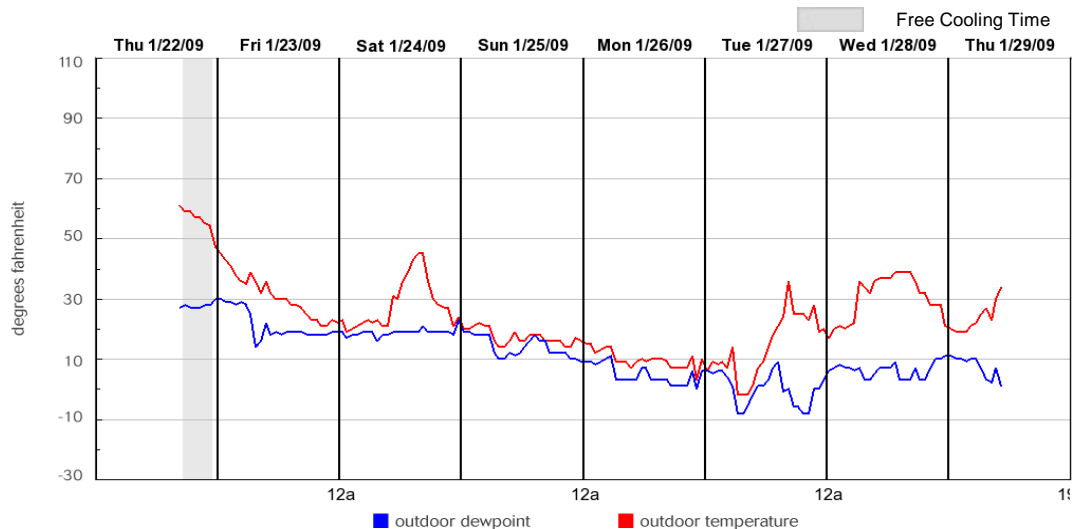
Test Period Avg: 1/22/09 – 1/29/09	Heating Degree Days	Cooling Degree Days
23 °F	42	0

## Outdoor Temperature and Dewpoint

A major factor in the total cost of heating and cooling a building is the heat lost (during heating season) or gained (during cooling season) due to the difference between indoor and outdoor temperatures. The amount of energy consumed to compensate for the difference between outdoor temperature and the desired indoor temperature is driven by three primary factors:

- Heat lost or gained due to conduction through walls, ceilings, and windows.
- Energy required to heat, cool, and dehumidify outside air entering the building, either through infiltration or mechanical ventilation.
- Heat gain due to solar load.

This chart shows the outdoor temperature and dewpoint during the test period at the test location.



More aggressive temperature setbacks during unoccupied periods may provide energy savings with no impact on occupant comfort. Proper ventilation control and use of an economizer for free cooling may also contribute significantly to energy savings.

# Temperature

[Sensor Range: 32 to 100 °F; Resolution: 0.1 °F; Calibration Accuracy: ± 1°F]



The ideal temperature is between 68 °F and 75 °F during the heating season and 72 °F and 78 °F during the cooling season, with variation of less than 3 °F. Lowering the heating setpoint and raising the cooling setpoint can save significant energy while maintaining a comfortable and productive working environment.

Sources: ASHRAE Standard 55 – 1992, BOMA, ENERGY STAR, DOE

Alert Lvl	
	Occupied/Unoccupied Heating Setpoint is 73 / 64
	Occupied/Unoccupied Cooling Setpoint is 73 / 80

## Energy Savings Opportunities

Our findings indicate there are several ways to save money by operating your building differently:

### Energy Recommendations Based on Measurements

- Calibrate thermostat(s) to reduce temperature variation
- Verify the control system is shutting the heating & cooling equipment off during unoccupied periods
- Move thermostat(s) to reduce temperature variation
- Balance air flow within duct system to reduce temperature variation

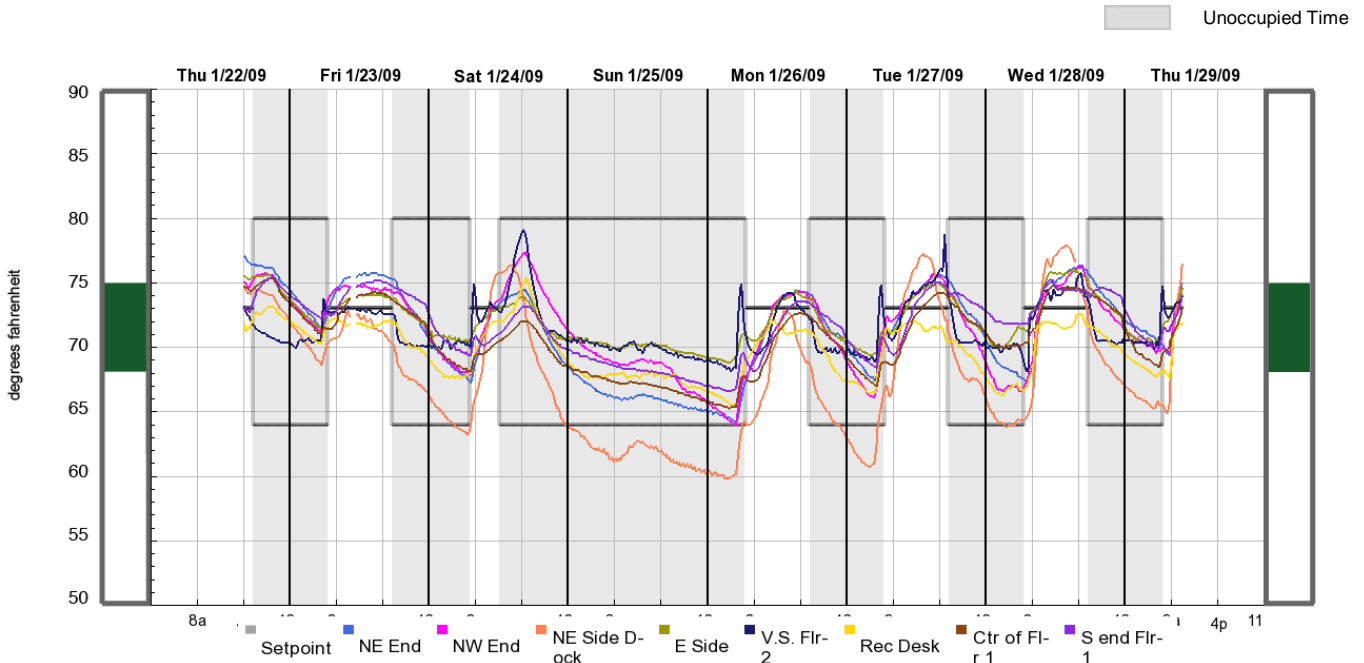
### Further Comfort & Energy Recommendations

- Raise the cooling set point
- Lower the heating set point
- Increase the amount of cooling set back possible during unoccupied periods

## Monitor Statistics

Monitor	Alert Lvl	Min °F	Max °F	Avg °F	%ToR*	SV†
NE End		67	77	73	47%	10
NW End		67	76	73	21%	10
NE Side Dock		64	78	72	40%	14
E Side		70	76	73	25%	5
V.S. Flr 2		68	79	73	6%	11
Rec Desk		67	73	71	7%	6
Ctr of Flr 1		67	75	72	14%	7
S end Flr 1		68	75	73	4%	7

These statistics are for occupied times only.  
\* % Time out of Range † Spread Value



# Relative Humidity

[Sensor Range: 10 to 95 %; Resolution: 1%; Calibration Accuracy: ± 5%]



Optimum comfort and health is achieved when relative humidity is maintained between 30% and 55%. Readings outside these boundaries may indicate ventilation issues which contribute to an increase of energy used to condition the space.

Sources: ASHRAE Standard 55 – 1992, American Lung Association, Indoor Air Quality Association, BOMA, ENERGY STAR, DOE

## Analysis and Recommendations

Our findings indicate areas in your building that may have issues worth investigating for possible energy savings, and especially if there are comfort complaints.

### Possible Causes

- No humidification system present
- Excessive ventilation during some periods

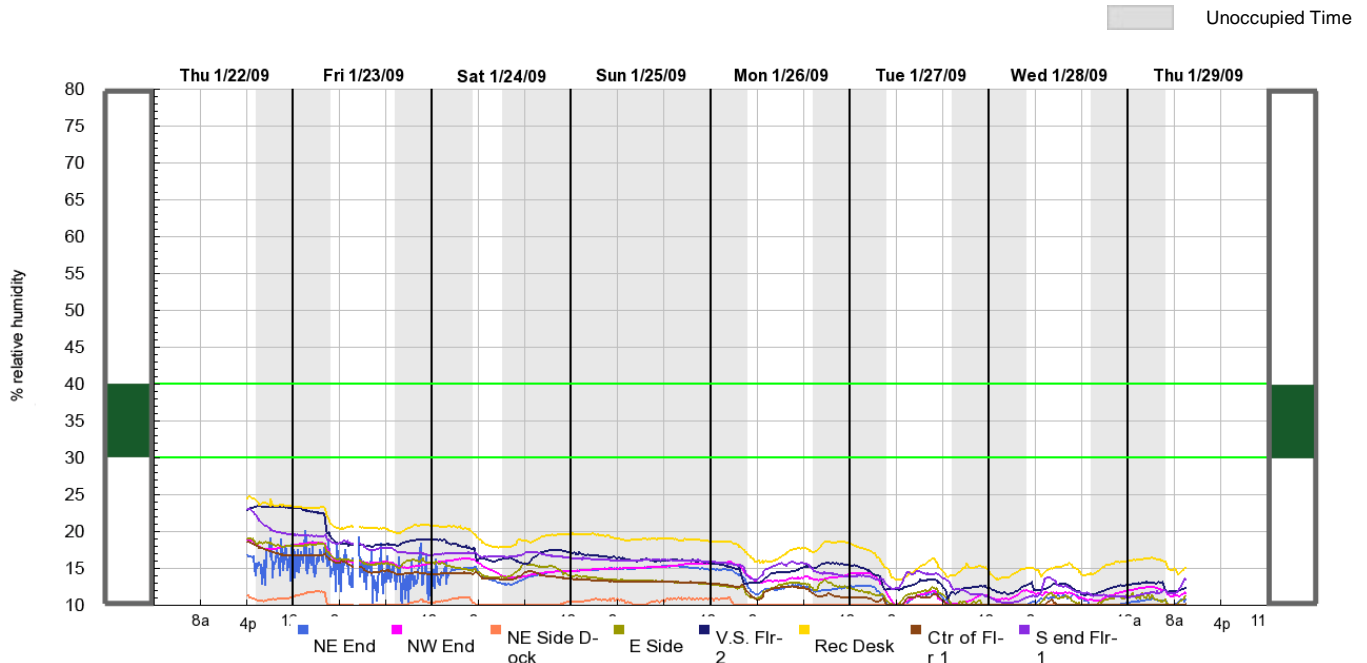
### Recommended Actions

- Add humidification system
- Improve ventilation control

## Monitor Statistics

Monitor	Alert Lvl	Min	Max	Avg	% ToR*
NE End		9	19	12	100%
NW End		10	19	13	100%
NE Side Dock		1	11	5	100%
E Side		10	19	13	100%
V.S. Flr 2		11	23	15	100%
Rec Desk		13	25	17	100%
Ctr of Flr 1		8	19	12	100%
S end Flr 1		11	23	15	100%

These statistics are for occupied times only.  
\* % Time out of Range



## Carbon Dioxide

[Sensor Range: 0 to 2000 ppm; Resolution: 10 ppm; Calibration Accuracy: ± 100 ppm]



Monitoring carbon dioxide levels is an important aspect of ensuring a comfortable, healthy and energy efficient indoor environment. At levels above 1000 ppm, air becomes stale and less comfortable to breathe. Levels well below 1000 ppm may indicate excessive outside air, resulting in higher than necessary energy costs due to the need for conditioning of this additional outside air.

Sources: ASHRAE Standard 62-2001, U.S. Green Building Council, Indoor Air Quality Association, Health Canada, BOMA, ENERGY STAR, DOE

### Monitor Statistics

Monitor	Alert Lvl	Min	Max	Avg	% ToR*
NE End		335	803	571	82%
NW End		427	935	628	74%
NE Side Dock		312	767	512	94%
E Side		387	775	562	85%

These statistics are for occupied times only.  
\* % Time out of Range

### Energy Savings Opportunities

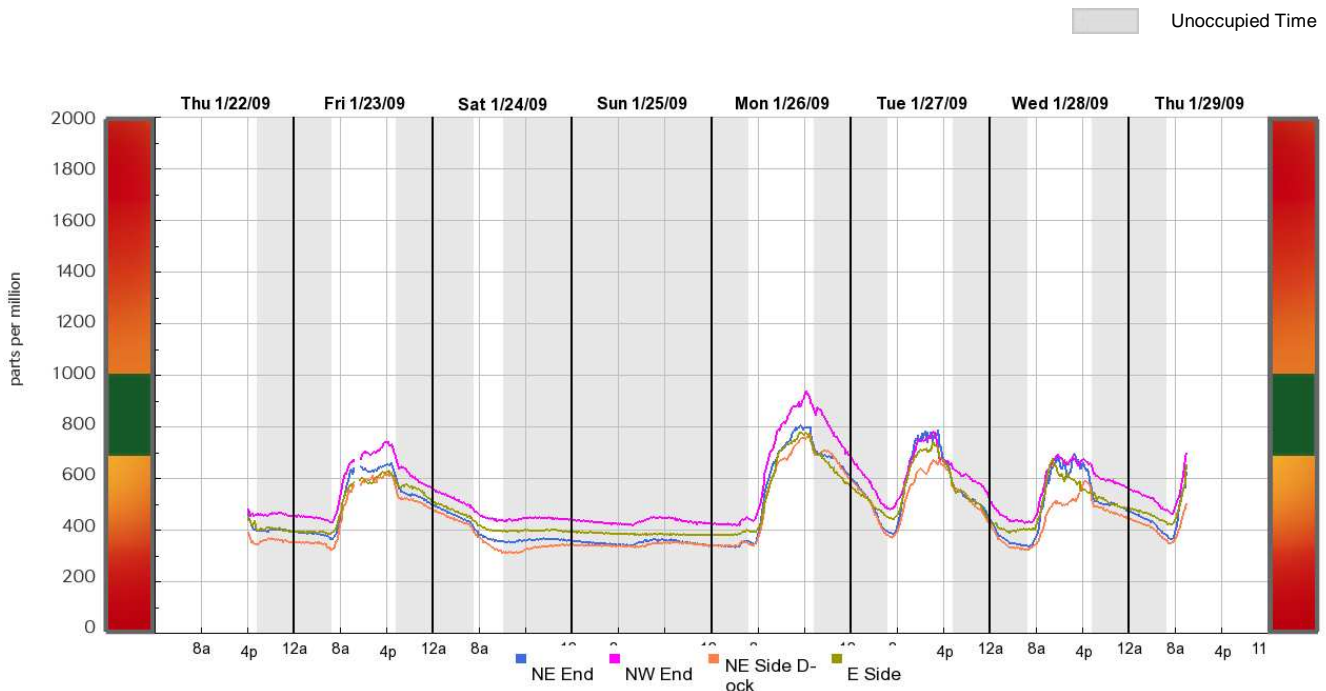
Our findings indicate there are several ways to save money by operating your building differently:

#### Energy Recommendations Based on Measurements

- Verify dampers are not stuck open or leaky
- Reduce the amount of outside air ventilation
- Install demand control ventilation

#### Comfort & Health Recommendations

- None.



# Lighting



Lighting controls and scheduling are some of the easiest low and no cost investments in energy efficiency. Controlling the artificial lights with occupancy or daylight controls and replacing inefficient bulbs can significantly reduce your electrical energy spend. In the graph below, artificial lights are represented by the sharp on/off of the curve, natural daylight by a gradual increase, and direct sunlight by the large spikes.

Sources: BOMA, ENERGY STAR, DOE

Stated Schedule: 13.2 average occupied hours

## Energy Savings Opportunities

Our findings indicate there are several ways to save money by operating your building differently:

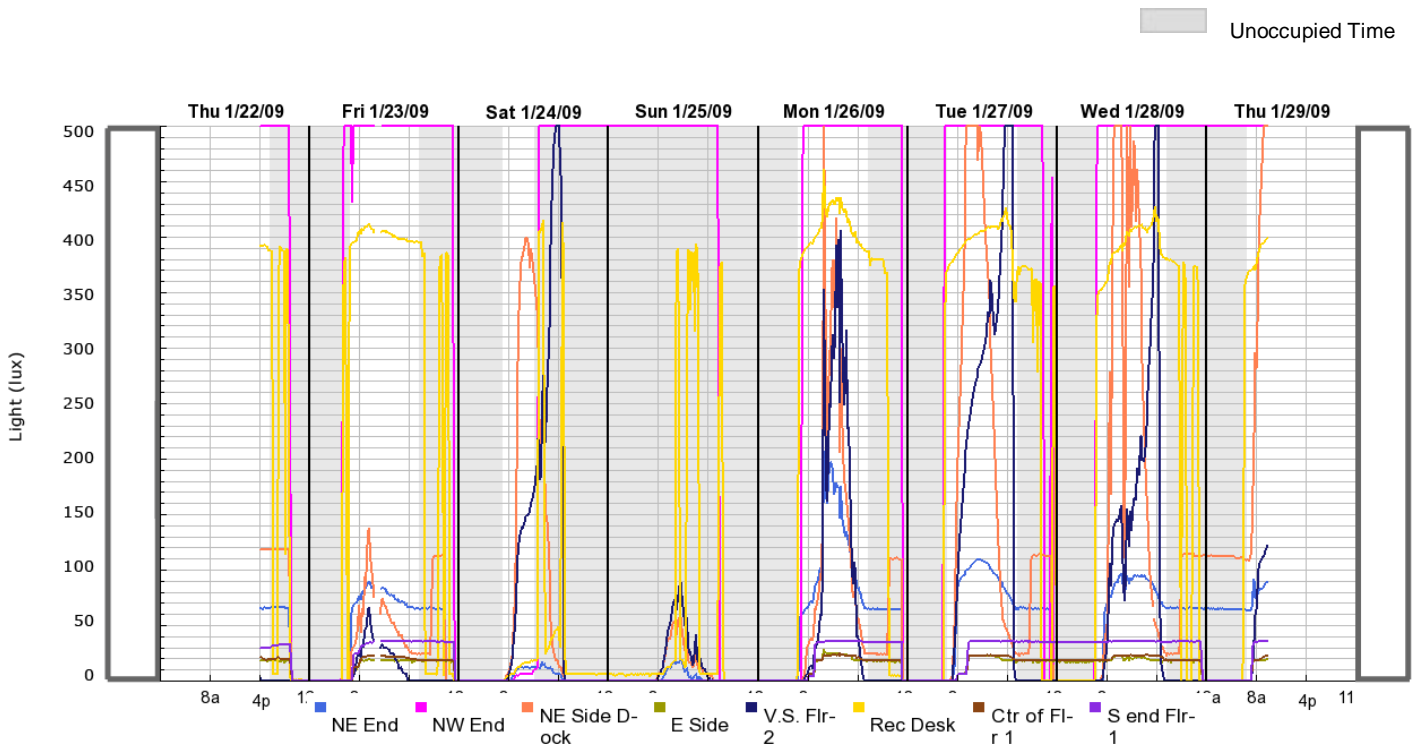
### Energy Recommendations Based on Measurements

- Verify the light schedule & reduce unoccupied hours operation

### Further Energy Recommendations

- Replace inefficient lamps with new high efficiency lamps
- Install occupancy sensors for individual zones
- Install daylight controls on the perimeter
- Reduce after hours use through coordination with the cleaning crews

Monitor	Alert Lvl	Measured On-Time
NE End		11. hrs
NW End		15. hrs
NE Side Dock		7.9 hrs
E Side		11. hrs
V.S. Flr 2		1.6 hrs
Rec Desk		11. hrs
Ctr of Flr 1		10. hrs
S end Flr 1		9.3 hrs



# Building and Monitor Placement Information

## General Information

Contact Information	
Building Name	Westmoor Building 2
Contact	John Hagen
Address	10155 Westmoor Drive Westminster, CO 80021
Building Information	
Building Background	Building Usage: <b>Office</b> Building Size (sq ft): <b>85502</b> # of Stories: <b>2</b> Building Status: <b>New Construction</b> Construction type: <b>Cement Block</b> LEED Cert.: <b>None</b> Heating System: <b>Electric Resistance</b> Domestic Hot Water: <b>Gas or Other Fuel (Low Usage)</b> Economizer: <b>Yes</b> Cooling System: <b>DX / Packaged Unit</b>
Additional Systems	Humidification: <b>No</b> Demand Control Ventilation: <b>No</b> Dehumidification: <b>No</b>

## Monitor Placement

Building Area	Monitor Serial #
NE End	17200
NW End	17177
NE Side Dock	17171
E Side	17124
V.S. Flr 2	16239
Rec Desk	16140
Ctr of Flr 1	16081
S end Flr 1	16001

## Space Description

Office			
Gross Floor Area	<b>83238</b>	Weekly Operating Hours	<b>70</b>
Number of Workers on Main Shift	<b>375</b>	Number of PCs	<b>500</b>
Office Air-Conditioned	<b>50% or more</b>	Office Heated	<b>50% or more</b>

Computer Data Center			
Gross Floor Area	<b>2264</b>	Weekly Operating Hours	<b>168</b>

Parking			
Enclosed Floor Area	<b>0</b>	Non-Enclosed Floor Area (w/roof)	<b>0</b>
Open Floor Area (w/o roof)	<b>154950</b>	Weekly Hours of Access	<b>168</b>

## Building Utility Information

### Electric Utility Information

Date	Electric Usage		Electric Demand	
	kWh	Cost	KW	Cost
1/26/08	210182	\$14,809		\$0
2/26/08	193941	\$13,794		\$0
3/26/08	187475	\$13,734		\$0
4/26/08	177309	\$15,413		\$0
5/26/08	196792	\$16,840		\$0
6/26/08	178438	\$16,960		\$0
7/24/08	199046	\$21,001		\$0
8/24/08	202000	\$21,459		\$0
9/24/08	184489	\$19,633		\$0
10/23/08	185006	\$16,200		\$0
11/23/08	208667	\$16,276		\$0
12/28/08	239039	\$18,221		\$0
<b>TOTAL:</b>	2362384	\$204,341		\$0

### Fuel Utility Information

Date	Fuel Usage	
	Usage	Cost
1/29/08	458	\$428
2/29/08	623	\$622
3/29/08	450	\$484
4/29/08	97	\$122
5/29/08	35	\$65
6/29/08	20	\$50
7/28/08	23	\$50
8/27/08	18	\$48
9/29/08	34	\$48
10/28/08	84	\$90
11/26/08	217	\$196
12/28/08	652	\$590
<b>TOTAL:</b>	2711	\$2,792

## Roles and Responsibilities for an Effective Assessment

This assessment was conducted using a combination of on-site visual inspections, input generated through conversations with building maintenance personnel, and measurements made with the BuildingAdvice system. The overall accuracy of this assessment is enhanced by ensuring that accurate input is provided through each step.

Due to potential changes in occupancy, operations, and variable weather conditions, implementation of the proposed energy conservation measures does not guarantee a reduction in energy usage.

Key participants in this process – the building owner / maintenance personnel, the firm conducting the assessment, and AirAdvice all play a critical role in an effective assessment.

### The building owner / maintenance personnel are responsible for providing:



1. Knowledgeable and accurate input as to the physical and operating parameters of the building under evaluation
2. Honest responses to questions about complaints and/or knowledge of issues
3. Commitment to provide resources necessary to address issues identified and correct problems noted in the visual inspection and monitoring

### The firm conducting this assessment is responsible for:



1. Conducting a thorough interview of individuals knowledgeable about the building's performance
2. Following appropriate industry standards for inspection techniques, measurement techniques, and recommendations
3. Maintaining BuildingAdvice and other test equipment used in the assessment within calibration specifications recommended by manufacturers

### AirAdvice is responsible for providing:



1. Monitoring equipment that performs within stated specifications
2. Web-based systems with a high degree of reliability and availability
3. Systems that ensure users are notified when calibration of units is necessary

Confidentiality of the data is preserved on behalf of the user of the BuildingAdvice system and their clients. AirAdvice will not disclose individual building information or test data without the client's written permission. AirAdvice may use aggregated data from the multiple buildings for reporting on industry findings and trends.