Lighting and Workspace Controls

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Many Schools Have NO Energy Control

- When No One is responsible, No One Controls It
  - "It's not my job"; "They don't pay me to do that"; "Who cares? It's government money."
- We can't afford personnel to look after that!
  - Savings in Utility costs could pay for more Teachers and Maintenance Personnel
- **WHO IS IN CONTROL**?

WHO IS IN CONTROL?

What are the opportunities with controls only?

- **HVAC Savings** –up to 40%
  - 24/7 Operation vs. Use as Required
- **Treatment of Outside Air** –up to 50+%
  - 24/7 Operation vs. Use as Required
- **Lighting Savings** – 5 to 50%?
  - Depends on Abuse and Accountability
- **Water Heating and/or Pumps** –up to 25+%
  - 24/7 Operation vs. Use as Required

What are the choices for workspace and lighting controls?

- **Time Clock or Programmable Thermostats**
  - Add Occupancy Sensors for Lights
- **Direct Digital Controls – (PC Based)**
  - Schedule Lights or Add Occupancy Sensors
- **Occupancy Based Controls**
  - Lighting Control Optional

What are the Pros & Cons?

Time Clock

- **PROS**
  - Scheduling for Energy Management
  - Night low limit thermostat, override timer, freeze protection
  - Up to 365 day time clock available
- **CONS**
  - *Requires lots of scheduling*
  - *Requires constant updating*
  - *Harder to install*
  - *Requires Someone to take Ownership*

Programmable Thermostats

- **PROS**
  - Low Installation Cost
  - Time Based Energy Savings
  - Only Minor Complexity to Operate
  - Temporary Override Feature
  - High User Control (can be good or bad)
- **CONS**
  - Program Often Defeated by User
  - All Weeks Operate on Same Schedule Regardless of Occupancy
  - Not Adjustable for Scheduled Holidays, Break, Vacation
  - Occupants *may tamper* with programming
    - Locking covers add a challenge

Direct Digital Control

- **PROS**
  - Energy Savings Based on Programmable Schedule
  - Allows for Scheduled Holidays, Breaks, etc.
  - Allows Manual Override by Operator
  - Reporting / Alarm Capability
  - Off Site Remote Control from computer
- **CONS**
  - High Installation Cost (sometimes as much as HVAC cost)
  - Does not automatically adjust for Unscheduled Vacancy/Occupancy
  - Requires PC Knowledgeable Control Person
  - Limited User Intervention
  - Variation Dependant on Control Person

Occupancy Based Controls (w/Artificial Intelligence)

- **PROS**
  - Minimal Installation Costs
    - **(Comparable to Commercial Grade Program T-Stat + Occupancy Sensor)**
  - *Demand Only* Usage Energy Usage - MAXIMUM SAVINGS
  - Allows for Holidays, Snow Days, Breaks, etc.
  - Automatically Adjusts for Temporary Occupancy
  - Complete User Comfort Control
  - Easy Install & Operation
- **CONS**
  - No Reporting or Remote Monitoring Capability

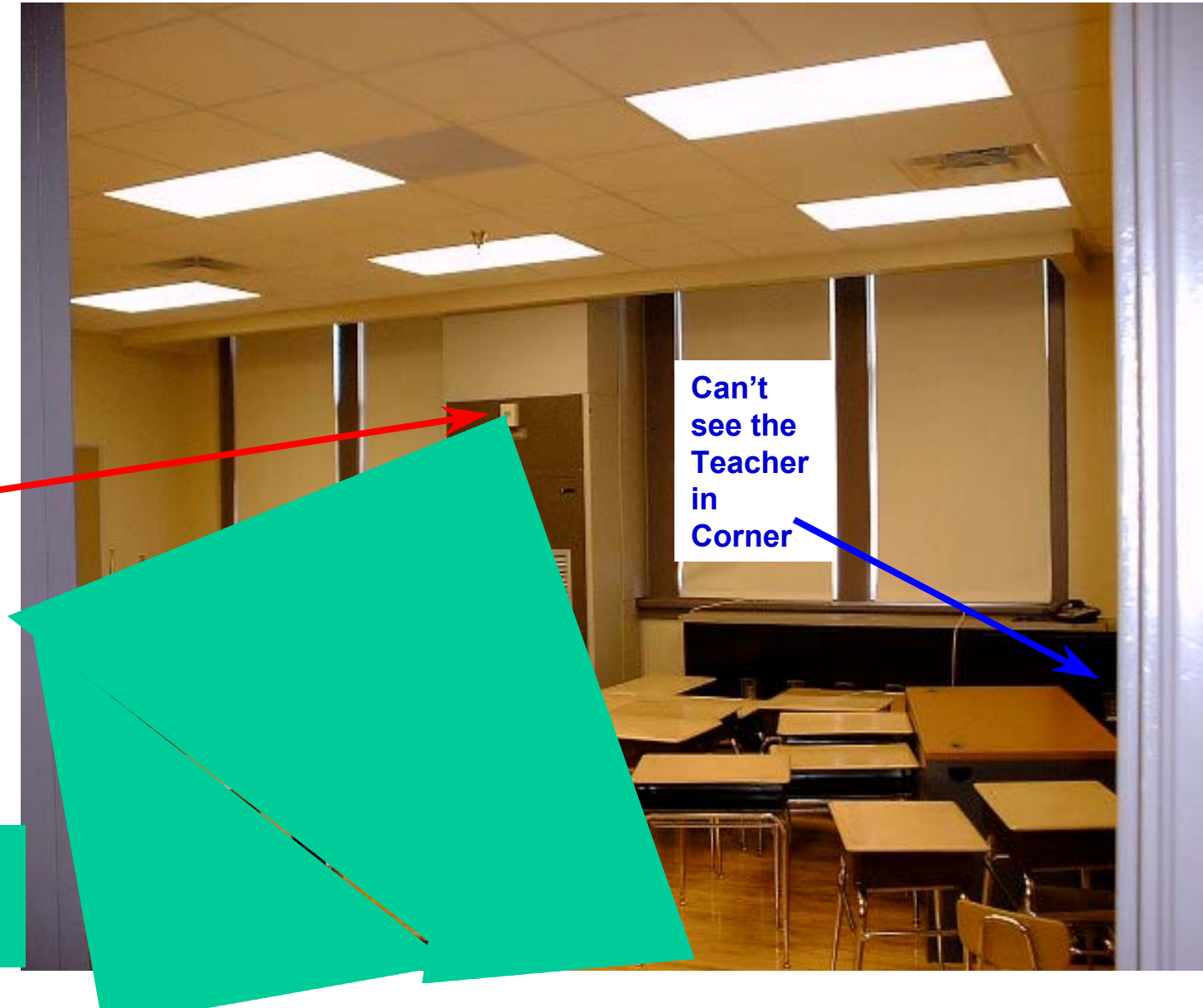
How Occupancy Control *with Artificial Intelligence* Feature Works

- Passive Infrared Sensor detects *Motion* & *Change in Temperature* (body heat)
- "Utilizes Artificial Intelligence" & "Fuzzy Logic" to <u>Memorize Occupancy Patterns</u>
- Programs based on 7ea – 24 hr periods
- Anticipates Occupancy and allows Std Thermostat control to pre-condition to comfort level prior to arrival of occupants

LOCATION, LOCATION, LOCATION

...

Locate Occupancy Sensor where it will see most activity



See Line of Sight

Automatic Climate Control

- Memorizes Occupant Usage Patterns With No Programming
- Recognizes Room Usage
  - Delays, Snow Days, Field Trips, and Holidays
- Automatic System Operation For Unscheduled Room Usage
  - After Work Hours, Meetings and Maintenance

Use Outside Air ONLY as Needed

- **Occupancy Ventilation Control**
  - Occupied Periods
    - Motorized Ventilation Is Activated
    - Additional OPTION – CO_2 Detector (pants and suspenders)
  - Unoccupied Periods
    - Motorized Ventilation Is Deactivated
      - **Reduced Cost Of Operation During Unoccupied Periods**

Lighting Control

- **Occupancy Lighting Control**
  - Automatic Turn *OFF When Room Is Not Occupied*
    - *Incorporates 30-60 minute Delay*
  - Automatic Turn *ON When Occupancy Is Sensed*
  - *Manual Override During Occupied Mode w/Light Switch*
    - *Use N/C Contactor for Fail ON control*

A Simple Solution to A Complex Problem

- **Hassle-Free Energy Management**
  - No Programming (only Dip Switch set up on Install)
  - Eliminates Occupant Complaints
    - During Occupied Times Thermostat Provides Temperature Adjustments Within Set Temperature Clamps
  - Maximizes Energy Savings
    - Room-By- Room
- ***Best with Electronic Digital Auto Changeover T-stat***
  - Works with Std (non prg) T-Stat w/e-prom memory or mercury bulb
    - **(no battery dependant or volatile memory)**
  - Suggest *Auto Changeover* T-Stat
  - Programmable Max Temp Settings (ie: Honeywell T8511)

Typical Setback/up Options

- Six Setback And Four Set Up Temperatures
- Temperature Ranges
  - **Cooling78-90 Degrees F**
  - **Heating48-68 Degrees F**
- Pre-Conditioned Input To Initiate Pre-Heating Or Cooling
  - Gymnasiums, Play Rooms, Auditoriums

Other Features Available

- Compressor Protection To Prevent Short Cycling
- HVAC Malfunction and High Temperature Alarm Output
- Remote Sensor Input For Additional Motion Detectors
  - **Used When Multiple Rooms On One HVAC Unit**
- Fire Sensing Protection - Shuts Down HVAC System And Ventilation System In Case Of Fire
- Boiler or Hot Water Heater Control based on Occupancy
  - 1 Hour Preheat Option may be utilized.

Additional Features:

- **Service Override**
  - **Automatic Return Of Control To The Occupancy Control, If System Is Not Switched Back After Service**
- **Adaptive Freeze Protection**
  - **Checks For Excessive Heat Loss And Prevents Pipes From Freezing In Excessively Cold Weather**

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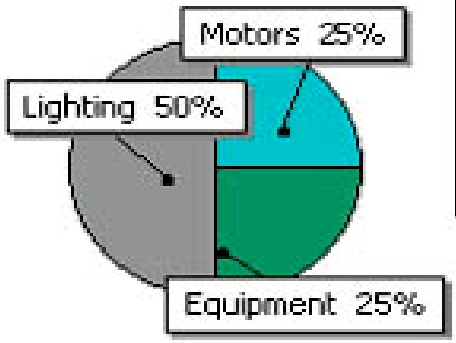
Case Study
Educational Institutions

Cost of your Utility Electric Supply

$80,000



Typical breakdown by area of savings		% Savings by Solution	Lost Opportunity Dollars
$20,000	Motors •Exhaust fans •Pumps •Compressors	50% Air Movement & cooling	(Useful work)
		25% Efficiency Losses	$ 5,000
		25% Ineffectual operating times	$ 5,000
$20,000	Office Equipment •Computers, Printers •Fax, Copiers •Phone system etc.	50% Business Applications	(Useful work)
		25% Power Quality Losses	$ 5,000
		25% Ineffectual operating times	$ 5,000
$40,000	Lighting •Overhead •Architectural •Outdoor •Signage	10% Useful Light	(Useful work)
		40% Efficiency Losses	$16,000
		40% Ineffectual operating times	$16,000
		10% Power quality losses	$ 4,000
		Total Dollars	**$ 56,000**

This case study is an example based on averages developed from many energy consumers. Your savings may vary.
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Assumed Calculated Savings

Following is a hypothetical evaluation of installing occupancy based energy management controls on a typical school with 30 classrooms.

24hr x 7day operation (3.5 Ton 10 SEER Heat Pump = 5.98kWh)

Assumptions:

- ***During Occupied*** times the HVAC unit operates an average 40% of time
  - 6:30A – 4:30P = 10 hours x .40 duty time = 4 hours operation
- ***During UNoccupied*** times the HVAC operates an average 25% of time.
  - 4:30P – 6:30A = 14 hours x .25 duty time = 3.5 hours operation
- ***If a 10 degree set back/up during Unoccupied is incurred it is estimated that operation time may be reduced to 5% duty time.***
  - 4:30P – 6:30A = 14 hours x .05 duty time = 0.7 hours operation avg.

Considering the previous, following is a comparison of costs for 30 typical classrooms with *NO control (24x7) operation* versus *Occupancy Based* set back control.

(*Note: If school is out for the summer, this difference will also improve*.)

IF *NO SET BACK*

Occupied Operation = 30 classes x 5.98kWh = 119.6kWh x 4.0 Hours Duty = 478kW

Unoccupied Operation = 30 classes x 5.98kWh = 119.6kWh x 3.5 Hours Duty = 419kW

Total 897kW x $.06*/kWh = $53.82/day x 365 days

= $19,644.30 per year

* Actual Utility Costs Will Vary

OCCUPANCY BASED SET BACK

Occupied Use **= 30 rooms x 5.98kWh= 119.6kWh x 4.0 Hrs. Duty=478kW**

Unoccupied Use **= 30 rooms x 5.98kWh= 119.6kWh x 0.7 Hrs. Duty= 84kW**

Total 562kW x $0.06/kWh = $33.72/day X 365 days = $12,307.80 per yr

SAVINGS CALCULATION:

Normal $19,644.00 - $12,308.00 = $ 7,336.00* per yr (or 37% savings)

@only 25% savings = $4,911.00; @ only 15% savings = $2,047.00

Note: Calculations and savings dollars will vary with utility rates

- **If school is out for summer or holidays, these calculations increase!**
- **Additional savings for Outside Air totally off during unoccupied periods.**
- **Also, lights that are not turned off, will be with occupancy controls for added savings**

Comparison of systems

System Attribute	Programmable T-Stat	*DDC Control*	Occupancy Based w/Artificial Intelligence
Automatically Learn Schedule & Changes	None	None	Yes
Anticipates Arrival	By Schedule	By Schedule	Yes - Automatically
Flexibility To Occupancy	Manual Override	Master Override	Automatically Detects and Adjusts
User Interaction	With Instruction	Limited	None Required
Economy Of Operation	Medium	High	Very High
Comfort To Occupants	Medium	Medium	High
Difficulty Of Programming	Medium	High	None
Maintenance	Minimum	Medium	None

Occupancy Based Controls Have Become a Preferred Control System in Nashville Metro Schools

Comments from David Gilpen – Project Manager

- Mr. Gilpen states:
  - the (Occupancy Control) is a No Brainer"
  - "It is the most Simple and Low Cost way to control HVAC in classrooms."
  - "I like the (Occupancy Control) because you put it in, and forget about it. It does it's job."

The Choice depends on what you want

- Lowest Up Front Cost?
- Ability to monitor operation off site?
  - OR let occupants tell you.
- Maximum Energy Savings vs Installed Costs?
  - Consider return on investment
- Ease of Installation & Maintenance?
  - Simplicity vs Technology & added skills required

THANK YOU FOR LISTENING

QUESTIONS?