Retrofitting Legacy Pneumatic Controls

Overview for Hospitals

6/20/2023

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Healthcare Users of WPT Technology – select examples

- Orlando Health (ORMC)
- AdventHealth
- Prime Healthcare
- Sutter Health (6 sites)
- LifePoint (Conemaugh, Lake Cumberland, Clinch Valley, Danville)
- CommonSpirit (St. Luke's Texas Medical Center)
- Aurora (St. Luke's Milwaukee)
- Advocate (Christ)
- VA Medical Centers (12 sites)
- NYC Health and Human Services (3 sites)
- Yale Medical Center
- Catholic Health – Saint Francis Hospital

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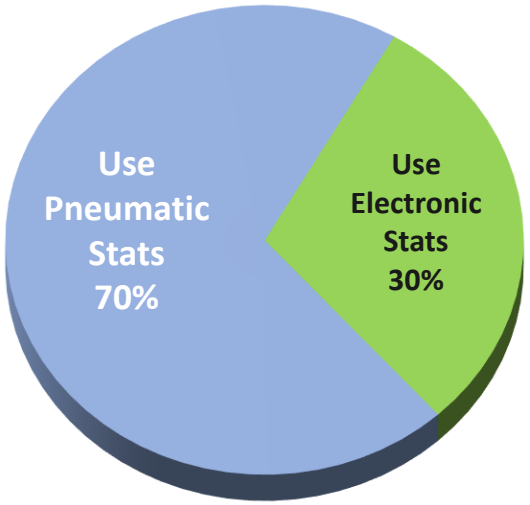
What Problem Are We Solving?

Recognize these thermostats?

- Non-communicating, non-programmable, cannot implement basic energy savings strategies
- No monitoring, no alarming, no fault detection – only irate occupants with hot/cold calls
- Undetected faults (e.g. stuck dampers, uncalibrated thermostats) waste energy and cause discomfort
- No BACnet, cannot integrate with Building Automation Systems

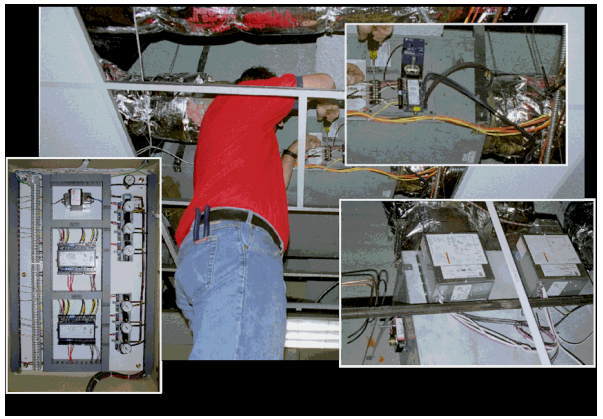
Most Non-Residential Buildings Still Employ Pneumatics

Estimated 60 million pneumatic thermostats still in use for Non-Residential Buildings



Why so many pneumatics still?

- Buildings constructed before 1999
- Conventional DDC retrofit too disruptive to occupants
- Requires opening up walls & ceilings, replacing actuators, running wires
- Very expensive, >$2,500 per stat
- Payback period >10 years . Typically not economical.



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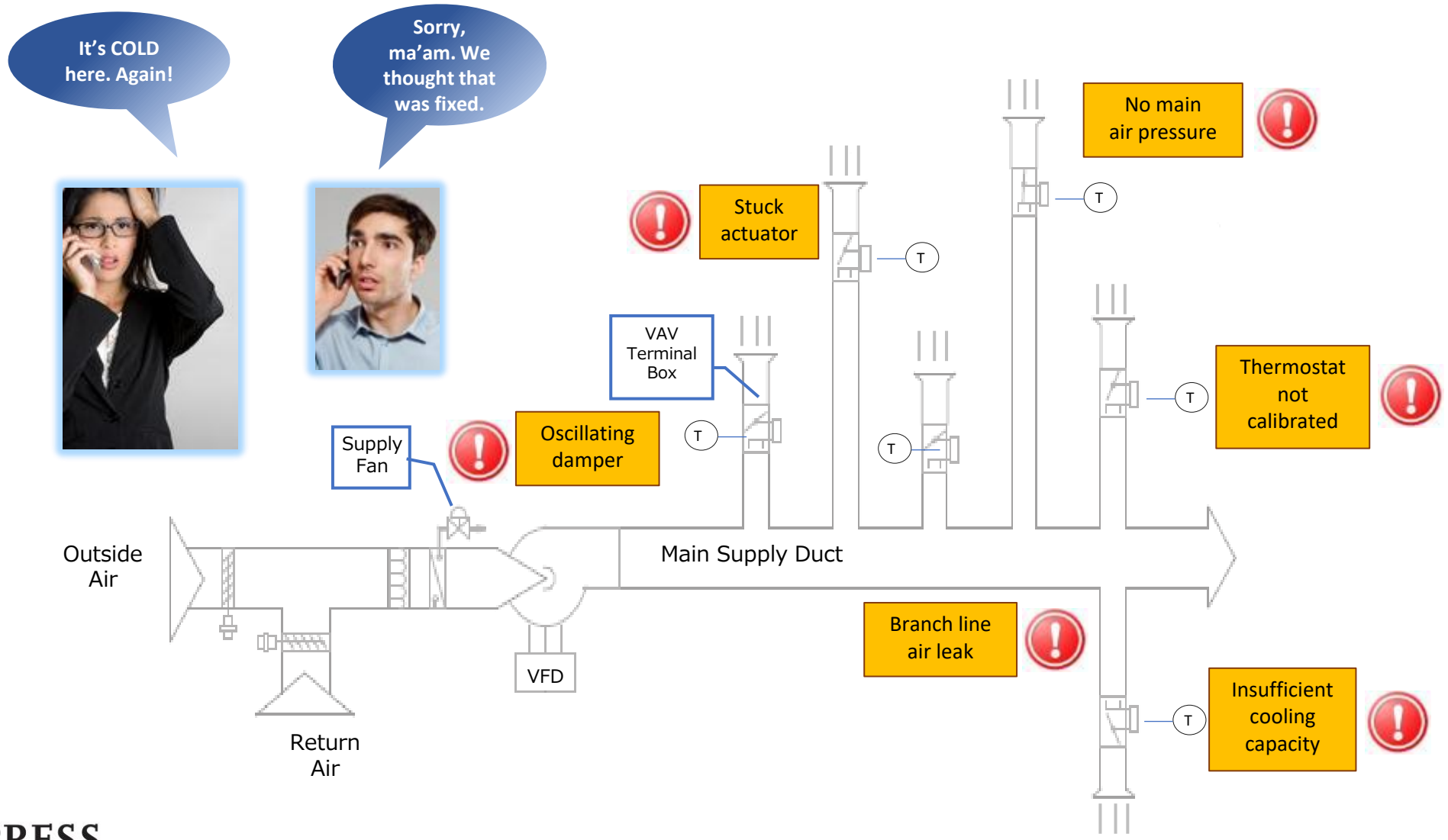
Pneumatic Shortcomings – No Visibility



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Pneumatic Shortcomings – Uses 20-30% More Energy

No remote control
No programmability

- ✘ Temperature Setpoint Enforcement
- ✘ Separate Heating and Cooling Setpoints
- ✘ Programmable Occupancy Schedules
- ✘ Auto Demand Response (zone level)

No/Limited zone sensor data

- ? Duct Static Pressure Control
- ? Supply Air Temperature Resets
- ? Optimal Start/Stop

Pneumatic Controlled Buildings Uses 20-30% More Energy Than DDC Controlled
Energy Savings Strategies We Take For Granted in New Buildings are NOT POSSIBLE

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How to Help Existing Buildings

STEP 1

Non-Invasive retrofit existing thermostats to WPT

Wireless Pneumatic Thermostat (WPT)

STEP 2

Analyze your pneumatic system for faults

SMARTPneumatics

- Stuck actuators?
- Need calibration?
- Supply air leak?
- Oscillating dampers?
- Air system contamination?
- Insufficient cooling?

STEP 3

Implement Energy Savings Strategies

- Setpoint Enforcement
- Separate Heat/Cool Setpoints
- Programmable Schedules
- Auto Demand Response
- Duct Static Pressure Reset
- Supply Air Temperature Reset
- Optimal Start/Stop

Our Solution: Wireless Pneumatic Thermostat

EXISTING LEGACY STAT

Minimal Disruption
10 Minute Upgrade

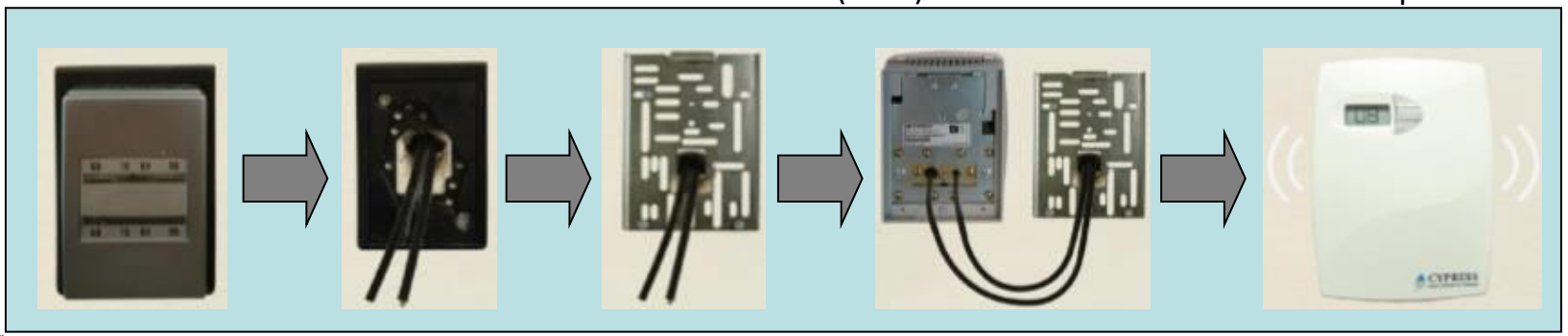
WIRELESS PNEUMATIC THERMOSTAT

Relative Humidity Monitoring Option Available

- Manual control, non-communicating
- No fault detection, no energy savings strategies
- Manual Calibration Required

- Remote Monitoring, Alarming, Control
- BACnet Integration with 3rd party BAS
- Automatic Self-calibration
- Programmable energy savings, demand response strategies

The Wireless Pneumatic Thermostat Provides (WPT) DDC Zone Control without Disruption



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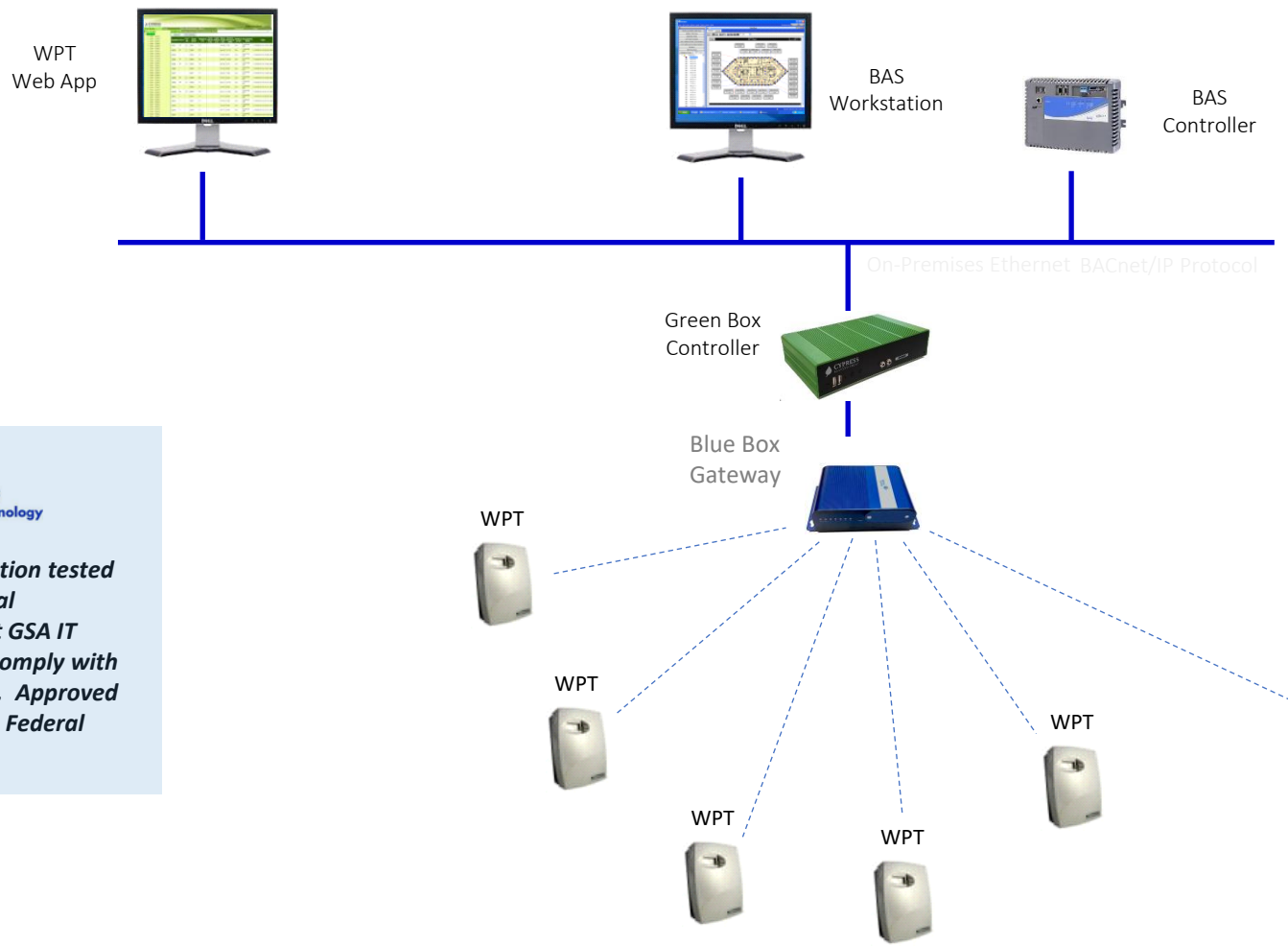
WPT System Components and Architecture



BACnet interface compatible with:

ALERTON · Johnson Controls · AUTOMATEDLOGIC CORPORATION · TRANE · Delta CONTROLS · Schneider Electric · Honeywell · SIEMENS

NIST National Institute of Standards and Technology

Cypress solution tested by US Federal Government GSA IT Security to comply with NIST 800-53. Approved for use in all Federal buildings.

Legend

- Wired Ethernet
- LoRaWAN Wireless
- WPT — Wireless Pneumatic Thermostat

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Tchnology Vetted by U.S. DOE GSA Proving Ground

"Our wireless pneumatic thermostats are easy to use and cost-effective, and they provide access to energy-saving control strategies that weren't available through our old pneumatic system."

—Greg Dix
Building Manager, Ronald Reagan Building
Washington, D.C.
National Capital Region
U.S. General Services Administration

GSA

OAK RIDGE National Laboratory

U.S. DEPARTMENT OF ENERGY

Finalist – 2016 Federal Energy Management Program JUMP Award

Link to GSA/DOE Report:
https://www.gsa.gov/governmentwide-initiatives/climate-action-and-sustainability/emerging-building-technologies/published-findings/energy-management/wireless-thermostats-for-pneumatic-systems

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Implement Energy Savings Strategies

- Setpoint Enforcement
- Separate Heat/Cool Setpoints
- Programmable Schedules
- Auto Demand Response
- Duct Static Pressure Reset
- Supply Air Temperature Reset
- Optimal Start/Stop

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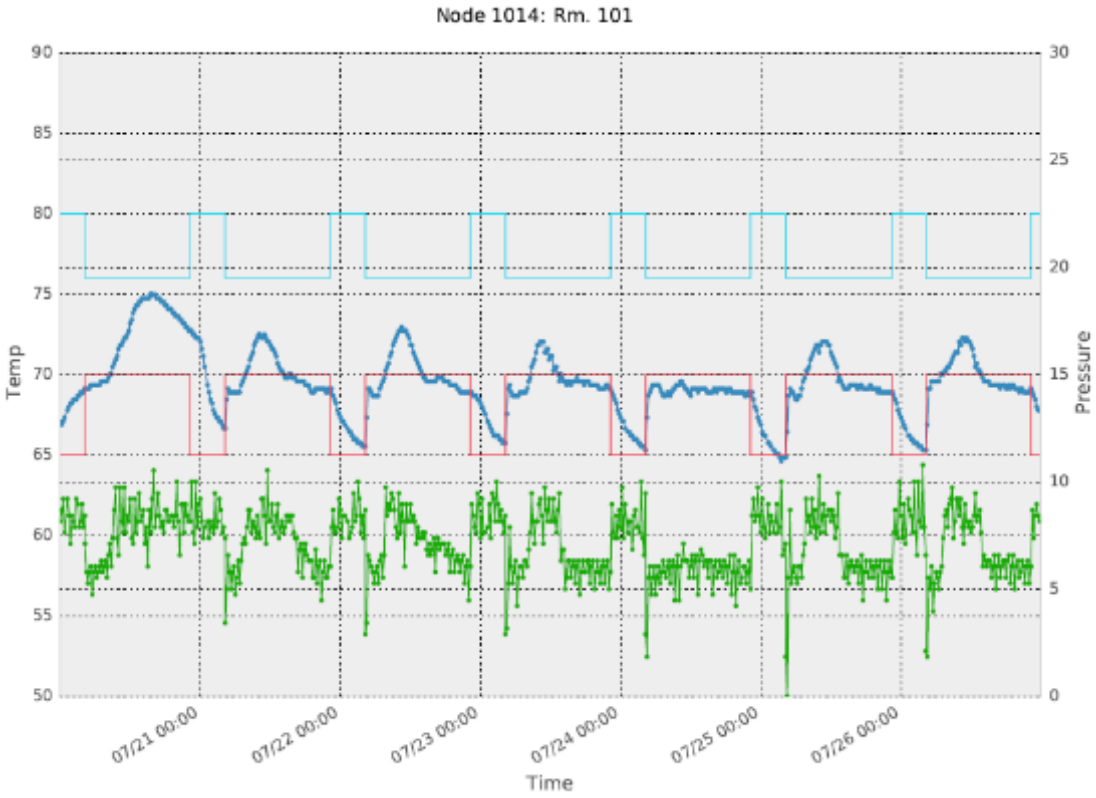
Enables Trending of Key Pneumatic Parameters

- Monitor, Trend, Alarm, Notify on Zone Temperatures, Setpoint Temperature(s), Branch Pressure, and Relative Humidity.
- BACNet Integration – control and view via BAS, or directly via GBC Controller.
- Know who is uncomfortable before they complain.



Green Line = Branch Pressure
Dark Blue Line = Room Temperature
Light Blue Line = Cooling Setpoint
Red Line = Heating Setpoint

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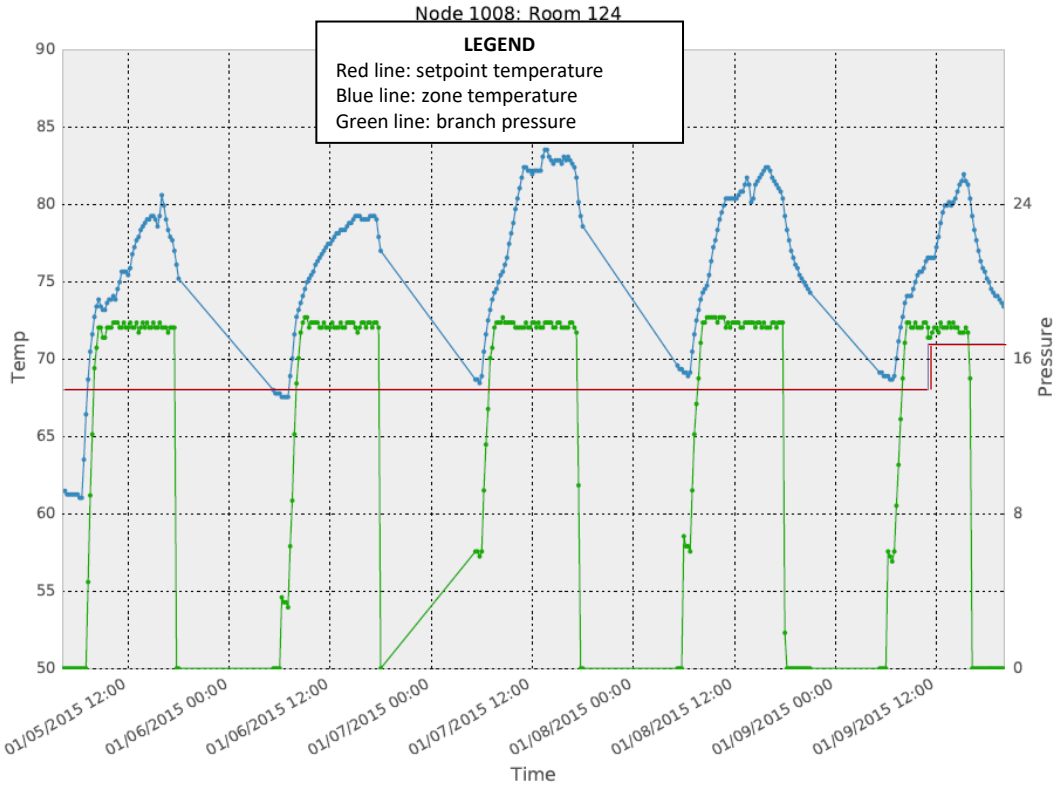
Example of Fault Detection: Zone Temperature Always Hotter than Setpoint



- Hot water valve for reheat was broken and stuck open.
- Terminal unit was always in maximum heat, even though thermostat commanded maximum cooling for that zone.
- Corrective Action: Repair/replace faulty valve actuator.

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SMARTPneumatics – AI for Pneumatics

1

Wireless Pneumatic Thermostat collects extensive sensor and operational data on zone temperatures, setpoints, occupancy modes, air pressure etc.

Time	NodeID	Node Name	Type	Setpoint (F)	Zone Temp (F)	Pitch Pressure (PSI)	Battery (PSI)	Occupancy Mode	Hop-1	Hop-2	Hop-3	Hop-4	Hop-5	Hop-6	RSSI-1	RSSI-2	RSSI-3	RSSI-4	RSSI-5	RSSI-6
11/27/2015 0:04	101	Barnes Cor	Rm2	62	69.8	18.95	OK	Occupied	15	14	13	12	11	1	5.38	5.21	3	2.5	3	4
11/27/2015 0:19	101	Barnes Cor	Rm2	62	69.8	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	1.86	3.33	3.67
11/27/2015 0:34	101	Barnes Cor	Rm2	62	69.8	18.42	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2.5	3	4
11/27/2015 0:49	101	Barnes Cor	Rm2	62	69.8	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.25	3	2.5	3.33	3.67
11/27/2015 1:04	101	Barnes Cor	Rm2	62	69.8	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2	3.33	3.67
11/27/2015 1:19	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2.5	3.33	3.67
11/27/2015 1:34	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2.5	3.33	4
11/27/2015 1:49	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2	3	3.67
11/27/2015 2:04	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2	1.86	3	3.67
11/27/2015 2:19	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.25	2.5	2	3	4
11/27/2015 2:34	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2	2.5	3	3.67
11/27/2015 2:49	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.38	5.21	2.5	2	3.33	4
11/27/2015 3:04	101	Barnes Cor	Rm2	62	69.58	18.16	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2.5	3.33	3.67
11/27/2015 3:19	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2.5	3	3.67
11/27/2015 3:34	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2	3	3.67
11/27/2015 3:49	101	Barnes Cor	Rm2	62	69.58	18.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3.33	2.5	3	3.67
11/27/2015 4:04	101	Barnes Cor	Rm2	62	69.58	18.42	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3.67	2.5	3.33	4
11/27/2015 4:19	101	Barnes Cor	Rm2	70	69.8	4.21	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2	3	3.67
11/27/2015 4:34	101	Barnes Cor	Rm2	70	70.03	3.95	OK	Occupied	15	14	13	12	11	1	5.42	5.25	3	1.86	3	3.67
11/27/2015 4:49	101	Barnes Cor	Rm2	70	70.7	5	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2	3.33	3.67
11/27/2015 5:04	101	Barnes Cor	Rm2	70	70.7	5.53	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2	3	4
11/27/2015 5:19	101	Barnes Cor	Rm2	70	70.93	5.79	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2	2.5	3.67
11/27/2015 5:34	101	Barnes Cor	Rm2	70	71.15	6.32	OK	Occupied	15	14	13	12	11	1	5.42	5.25	2.5	1.86	3	4
11/27/2015 5:49	101	Barnes Cor	Rm2	70	71.15	6.58	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2	3	4
11/27/2015 6:04	101	Barnes Cor	Rm2	70	71.38	6.58	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2	3	4
11/27/2015 6:19	101	Barnes Cor	Rm2	70	71.38	6.84	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2.5	3	3.67
11/27/2015 6:34	101	Barnes Cor	Rm2	70	71.6	6.84	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2	3	3.67
11/27/2015 6:49	101	Barnes Cor	Rm2	70	71.6	7.11	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2	3.33	3.67
11/27/2015 7:04	101	Barnes Cor	Rm2	70	71.6	7.11	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2	3	3.67
11/27/2015 7:19	101	Barnes Cor	Rm2	70	71.6	7.11	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2	3	4
11/27/2015 7:34	101	Barnes Cor	Rm2	70	71.83	7.37	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2	3.33	3.67
11/27/2015 7:49	101	Barnes Cor	Rm2	70	71.83	7.37	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	1.71	2.5	4
11/27/2015 8:04	101	Barnes Cor	Rm2	70	72.05	7.63	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2.5	3.33	3.67
11/27/2015 8:19	101	Barnes Cor	Rm2	70	72.05	7.89	OK	Occupied	15	14	13	12	11	1	5.42	5.21	2.5	2	3	3.67
11/27/2015 8:34	101	Barnes Cor	Rm2	70	72.05	7.89	OK	Occupied	15	14	13	12	11	1	5.38	5.21	3	2	3.33	3.67
11/27/2015 8:49	101	Barnes Cor	Rm2	70	71.83	8.42	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2	3.33	3.67
11/27/2015 9:04	101	Barnes Cor	Rm2	70	71.6	8.68	OK	Occupied	15	14	13	12	11	1	5.42	5.21	3	2	3	3.67

Adjust Setpoint(s) to More "Reasonable" Temperature

NodeID	Description	Recommended Action
118	O'Brien Rm 25	Cool Above Setpoint is too low (63F). Try adjusting.
119	O'Brien Rm 27	Cool Above Setpoint is too low (63F). Try adjusting.

Check for Oil in Pneumatic Lines

NodeID	Description	Recommended Action
113	O'Brien Rm23	May need to clean system, install new filter/dryers, replace WPT.

Actuators May be Stuck

NodeID	Description	Recommended Action
118	O'Brien Rm 25	Check Heating Actuator - may be stuck open
117	O'Brien Rm 30	Check Heating Actuator - may be stuck open

Check Thermostat Calibration

NodeID	Description	Recommended Action
116	O'Brien Rm 28	Check thermostat calibration - 4.1 deg F offset

2

Advanced patented analytics software perform fault detection diagnostics and produces easy to read actionable report.

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See the big picture and drill down on problems

Zones not able to maintain setpoint

Cooling setpoints too low

Heating valve may be stuck open

Worst performing Zones sorted at top

Node	Type of WPT	WPT Action	Sample Rate (min)	Maintain Setpoint? (ABS DeltaT)	Heating Setpoint Suspect? (deg F)	Cooling Setpoint Suspect? (deg F)	WPT Calibrated? (psi error)	Main Pressure OK? (psi)	Oil in Line? (sticking psi)	Heating Actuator Stuck Open/Uncal?	Cooling Actuator Stuck Open/Uncal?	Insufficient Heating Capacity?	Insufficient Cooling Capacity?	Low Batt?	Wire-less Missed Comm?
0118	1.0	Direct	0.0	7.9	65	65	1.7	14.2	1.8	TRUE	FALSE	FALSE	FALSE	OK	1.9%
0119	1.0	Direct	0.0	6.9	63	63	2.5	14.0	0.0	FALSE	FALSE	FALSE	FALSE	OK	0.5%
0113	1.0	Direct	0.0	4.3	68	72	0.9	15.3	4.0	FALSE	FALSE	FALSE	FALSE	OK	5.1%
0117	1.0	Direct	0.1	4.1	68	70	1.2	15.3	1.5	TRUE	FALSE	FALSE	FALSE	OK	0.5%
0116	1.0	Direct	0.0	3.9	70	74	4.1	15.3	1.8	FALSE	FALSE	FALSE	FALSE	OK	0.7%
011A	1.0	Reverse	0.0	0.5	71	71	2.4	11.3	0.0	FALSE	FALSE	FALSE	FALSE	OK	1.1%

Check thermostat calibration

Check for oil or water in pneumatic line

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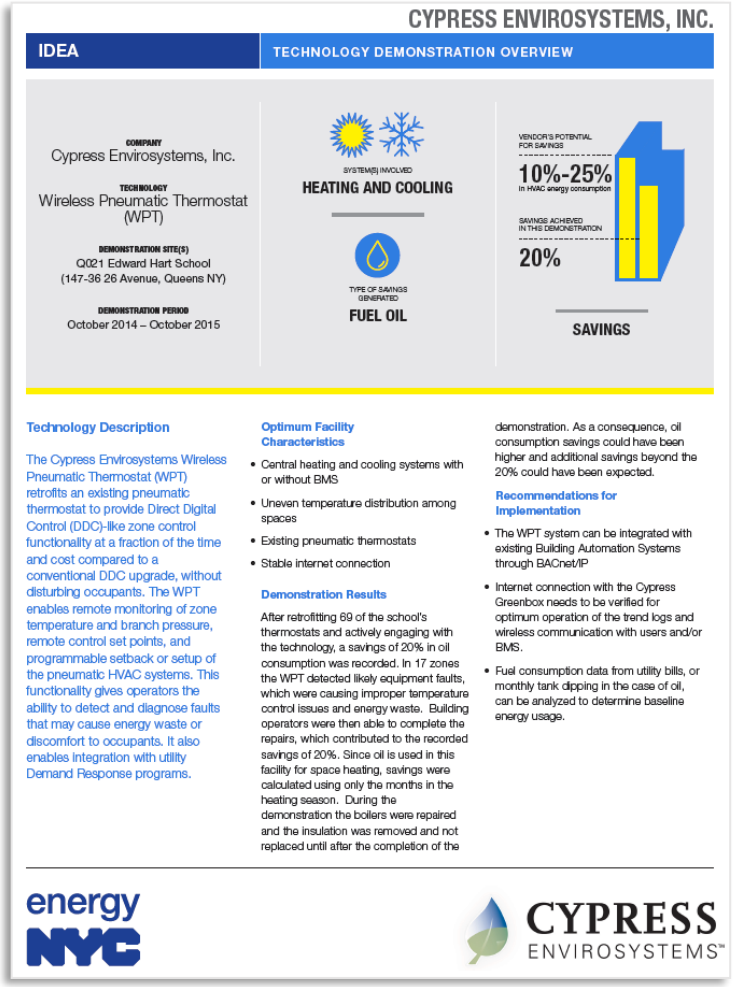
NYC Case Study - M&V Validated 20% Savings



CYPRESS ENVIROSYSTEMS, INC.

IDEA | TECHNOLOGY DEMONSTRATION OVERVIEW

COMPANY
Cypress Envirosystems, Inc.

TECHNOLOGY
Wireless Pneumatic Thermostat (WPT)

DEMONSTRATION SITE(S)
Q021 Edward Hart School
(147-36 26 Avenue, Queens NY)

DEMONSTRATION PERIOD
October 2014 – October 2015

SYSTEM(S) INVOLVED
HEATING AND COOLING

TYPE OF SAVINGS GENERATED
FUEL OIL

VENDOR'S POTENTIAL FOR SAVINGS
10%-25%
in HVAC energy consumption

SAVINGS ACHIEVED IN THIS DEMONSTRATION
20%

SAVINGS

Technology Description

The Cypress Envirosystems Wireless Pneumatic Thermostat (WPT) retrofits an existing pneumatic thermostat to provide Direct Digital Control (DDC)-like zone control functionality at a fraction of the time and cost compared to a conventional DDC upgrade, without disturbing occupants. The WPT enables remote monitoring of zone temperature and branch pressure, remote control set points, and programmable setback or setup of the pneumatic HVAC systems. This functionality gives operators the ability to detect and diagnose faults that may cause energy waste or discomfort to occupants. It also enables integration with utility Demand Response programs.

Optimum Facility Characteristics

- Central heating and cooling systems with or without BMS
- Uneven temperature distribution among spaces
- Existing pneumatic thermostats
- Stable internet connection

Demonstration Results

After retrofitting 69 of the school's thermostats and actively engaging with the technology, a savings of 20% in oil consumption was recorded. In 17 zones the WPT detected likely equipment faults, which were causing improper temperature control issues and energy waste. Building operators were then able to complete the repairs, which contributed to the recorded savings of 20%. Since oil is used in this facility for space heating, savings were calculated using only the months in the heating season. During the demonstration the boilers were repaired and the insulation was removed and not replaced until after the completion of the demonstration. As a consequence, oil consumption savings could have been higher and additional savings beyond the 20% could have been expected.

Recommendations for Implementation

- The WPT system can be integrated with existing Building Automation Systems through BACnet/IP
- Internet connection with the Cypress Greenbox needs to be verified for optimum operation of the trend logs and wireless communication with users and/or BMS.
- Fuel consumption data from utility bills, or monthly tank dipping in the case of oil, can be analyzed to determine baseline energy usage.

energy NYC

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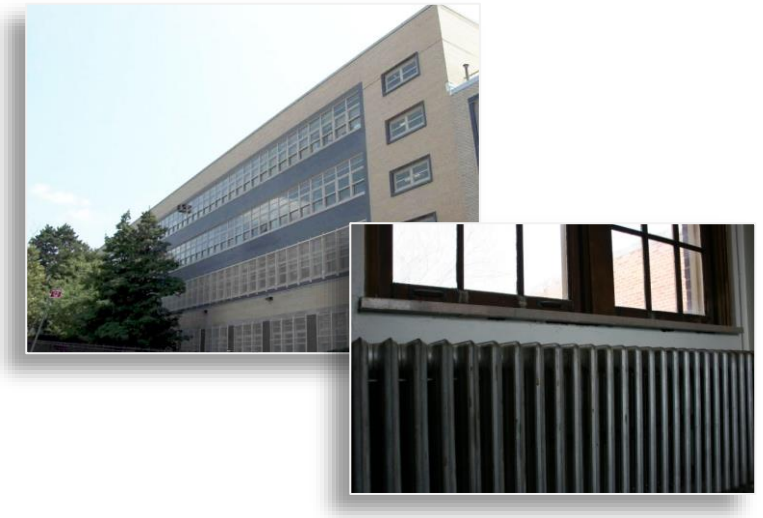
- Edward Hart Middle school Queens, NYC
- Uses Oil Fired Boilers, hot water radiators
- Fault detection, example:
  - Radiator hot water valve stuck open
  - Undetected probably many years
  - Occupants open window to compensate
  - Maintenance staff stretched thin, no data, not aware of situation



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Reduced Hot/Cold Calls – 345 California St, San Francisco

- 17,000 sq-ft Class A Office Space, 31st Floor
- 48 Story Hi-Rise, managed by Cushman & Wakefield
- San Francisco Financial District
- Tenant: Private Equity Firm

CUSHMAN & WAKEFIELD

Pre-WPT Installation
Mar - Nov

W.O #	DATE	TENANT	FLOOR	OFFICE #	REQUEST	TEMP.	WORK PERFORMED	BY	#
148516	9-Mar-09		31	3115	COLD		FOUND STAT PUTTING OUT 1#	JIM	1
150125	6-Apr-09		31	LARGE CONF.	PRE COOL		PUT STAT INTO COOLING FOR MTNG.	TIM	2
150195	8-Apr-09		31	CONF ROOM	COLD		CAL. T-STAT AND SET TO 70-74	PAUL	3
150500	15-Apr-09		31	3146	COLD	70	OFFICE TEMP. WAS 70	PAUL	4
151016	27-Apr-09		31	3155	COLD	71	TEMP. WAS 71	FRAZER	5
153307	15-Jun-09		31	CONF ROOM	HOT	73	AMBIENT 73 LOWERED STAT TO 65/70	PAUL	6
153976	26-Jun-09		31	EAST CORNER	COLD	73	RM TEMP 73 RAISED STAT TO 74	JIM	7
153991	26-Jun-09		31	PINE SIDE	COLD	73	AREA TEMP. 73, RAISED STAT TO 74	JIM	8
N/A	6-Jul-09		31	3156	COLD	71	OFFICE TEMP. WAS 71	PAUL	9
154347	7-Jul-09		31	S. ADMIN	COLD	72	AREA TEMP WAS 72	C.W/ PF	10
155020	22-Jul-09		31	3115	COLD	71	AREA TEMP AT 71 F, T'STAT AT 75 F	ART	11
155582	5-Aug-09		31	3134-A	COLD	73	AREA TEMP WAS 73.	CRAIG	12
155597	5-Aug-09		31	N CONF RM.	COLD		T'STAT SET TO 65-69, RESET TO 70-73	ARTURO	13
155597	5-Aug-09		31	NORTH CONF RM	COLD	68	TEMP. WAS 68 RESET TO70-73	ART	14
155808	12-Aug-09		31	3104	HOT		RE-SET STAT TO 71-74, FROM 70-74	CRAIG	15
157113	8-Sep-09		31	3127	HOT		CAL. STAT AND SET TO 71-74	CRAIG	16
157849	30-Sep-09		31	CAL. ST. SIDE	COLD		CAL. AND SET STAT TO 75	CRAIG	17
158278	6-Oct-09		31	3134A	COLD		REDUCED CFM, REDIRECTED AIR FLOW	C.W./S.T.	18
158192	7-Oct-09		31	3134A	COLD	74	TEMP.IS 74 ADJUSTED TWO STATS IN AREA	ART	19
158563	16-Oct-09		31	EAST CORNER	HOT	73	SET STAT TO 73	GRAIG	20
159030	27-Oct-09		31	3152	HOT	71	OFFICE TEMP. WAS 71	PAUL	21
159095	29-Oct-09		31	EAST CORNER	COLD	72.5	AREA TEMP WAS 72.5	ARTURO	22
159113	29-Oct-09		31	3146	HOT		DECREASED STPT TO 71-74 FROM 71-75	ARTURO	23
159222	2-Nov-09		31	3146A	HOT		CHILLER STARTED AT 10:45	ARTURO	24
159222	2-Nov-09		31	3146A	WARM	73	AREA TEMP WAS 73. MADE NO ADJ.	ARTURO	25
159240	2-Nov-09		31	WEST ADMIN	WARM	71.5	AREA TEMP. WAS 71.5 MADE NO ADJ.	PAUL	26
159321	3-Nov-09		31	3143/3140	WARM	72.5	AREA TEMP. WAS 72.5 MADE NO ADJ.	PAUL	27
159759	13-Nov-09		31	N CONF RM.	COLD	69	INCREASED SPT TO 71-74, FROM 69-73	ARTURO	28
159854	17-Nov-09		31	N CONF RM.	COLD	69	CAL. AND SET STAT TO 71-74	CRAIG	29

Post-WPT Installation
Mar – Nov

W.O #	DATE	TENANT	FLOOR	OFFICE #	REQUEST	TEMP.	WORK PERFORMED	BY	#
164055	1-Mar-10		31	3155	COLD	69	NEW W.P.T. WAS SET AT 71, SET TO 74	PAUL	1
164473	5-Mar-10		31	3113	COLD	71	FOUND COAT HANGING OVER T-STAT	PHIL	2
164916	12-Mar-10		31	3134A	COLD	72	SUPPLY AIR AT 68F STAT SET @ 72, RAISED TO 73	ART	3
165486	25-Mar-10		31	3120A & B	COLD	72	RAISED SPT. TO 73	CRAIG	4
166825	27-Apr-10		31	3120A & B	COLD	72	WPT WAS SET TO 73, RAISED TO 74	PAUL	5
166853	27-Apr-10		31	3121	HOT	77	UNABLE TO CALIBRATE WPT WILL FOLLOW-UP	PHIL	6
166994	3-May-10		31	3121	HOT	76	FOLLOW-UP TO REPLACEMENT OF WPT BY	CRAIG	7
169919	28-Jun-10		31	3155	COLD	70	RESET STAT TO 72	CRAIG	8
174033	27-Sep-10		31	PINE SIDE	HOT	80	CALIBRATED (3X) STATS AND SET AT 70 F.	CRAIG	9
176108	17-Nov-10		31	3155	COLD	70	STAT WAS SET @ 71 RAISED TO 73	PAUL	10

- ✓66% reduction in hot/cold calls
- ✓25 avoided calls/year
- ✓7-10¢/sq-ft/year savings

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Benefits of SMARTPneumatics

- Save energy
- Enhance occupant comfort
- Reduce maintenance labor and hot/cold calls
- Avoid damage to equipment
- Meet LEED ongoing commissioning requirements

How to Help Existing Buildings

STEP 1

Non-Invasive retrofit existing thermostats to WPT

Wireless Pneumatic Thermostat (WPT)

STEP 2

Analyze your pneumatic system for faults

SMARTPneumatics

- Stuck actuators?
- Need calibration?
- Supply air leak?
- Oscillating dampers?
- Air system contamination?
- Insufficient cooling?

STEP 3

Implement Energy Savings Strategies

- Setpoint Enforcement
- Separate Heat/Cool Setpoints
- Programmable Schedules
- Auto Demand Response
- Duct Static Pressure Reset
- Supply Air Temperature Reset
- Optimal Start/Stop

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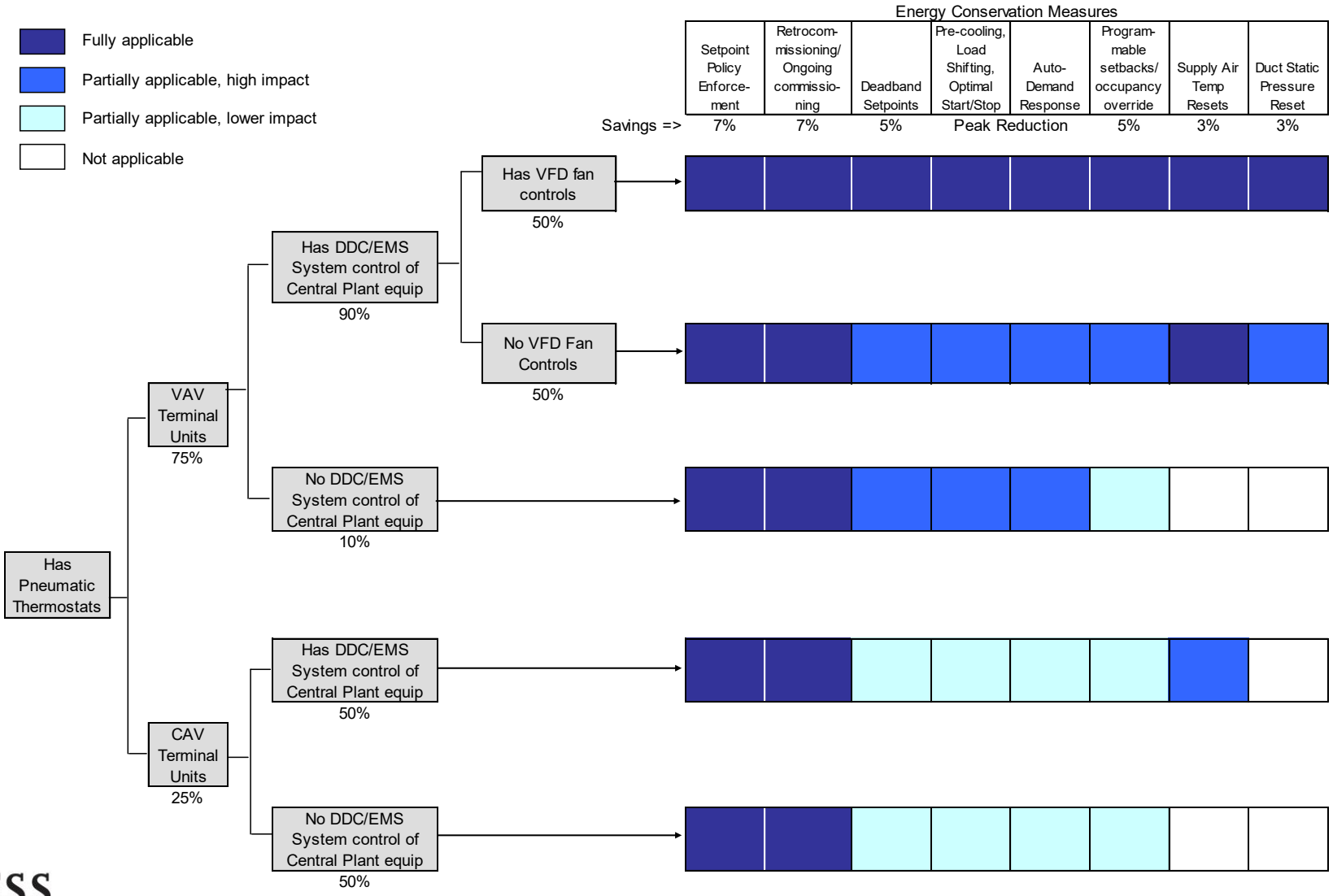
What Control Strategies are Applicable for this Building?



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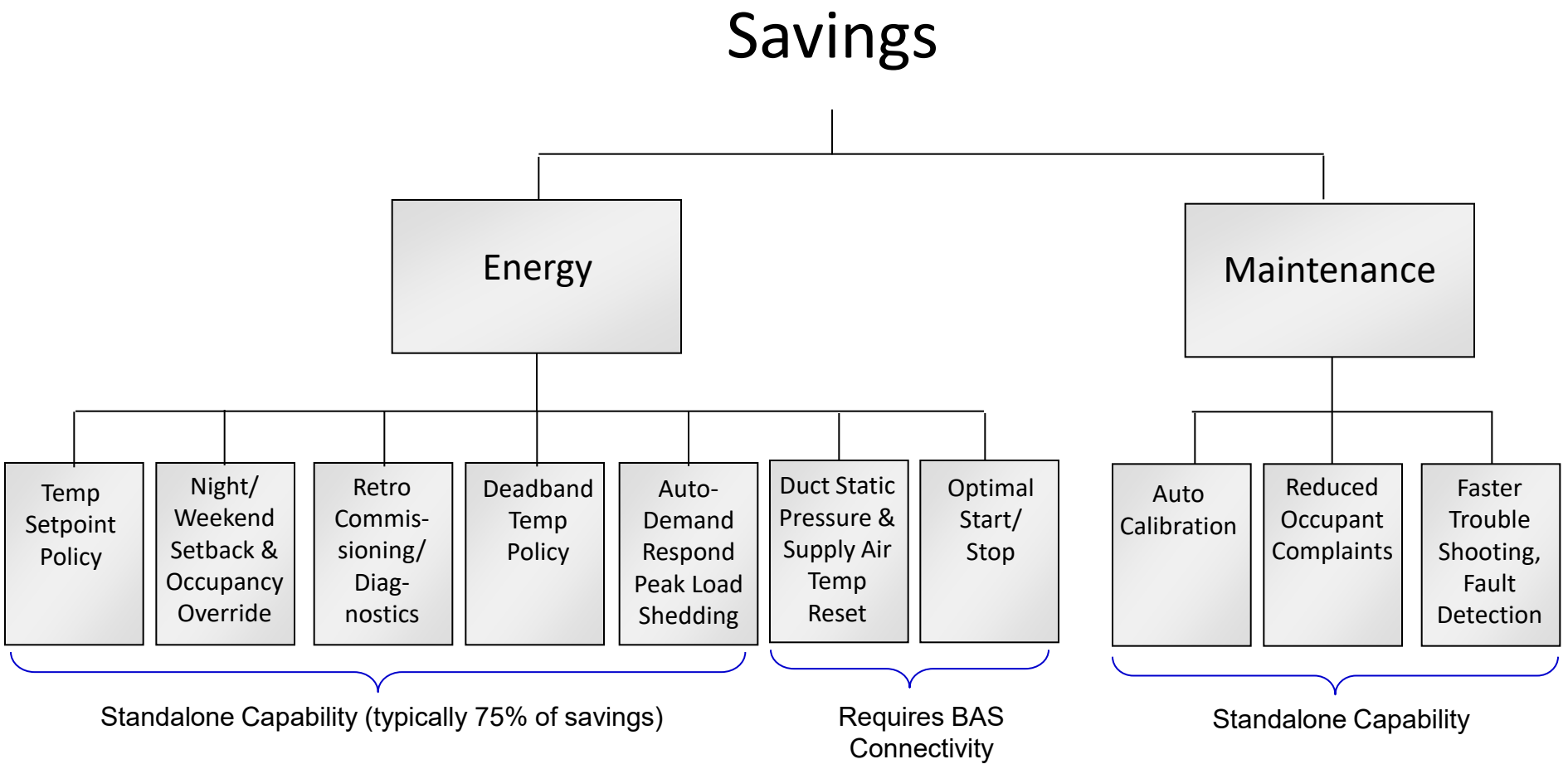
Enable Energy Savings Strategies – 20-30% reduction



Same Benefits as Direct Digital Control –
but at a Fraction of the Price and Disruption

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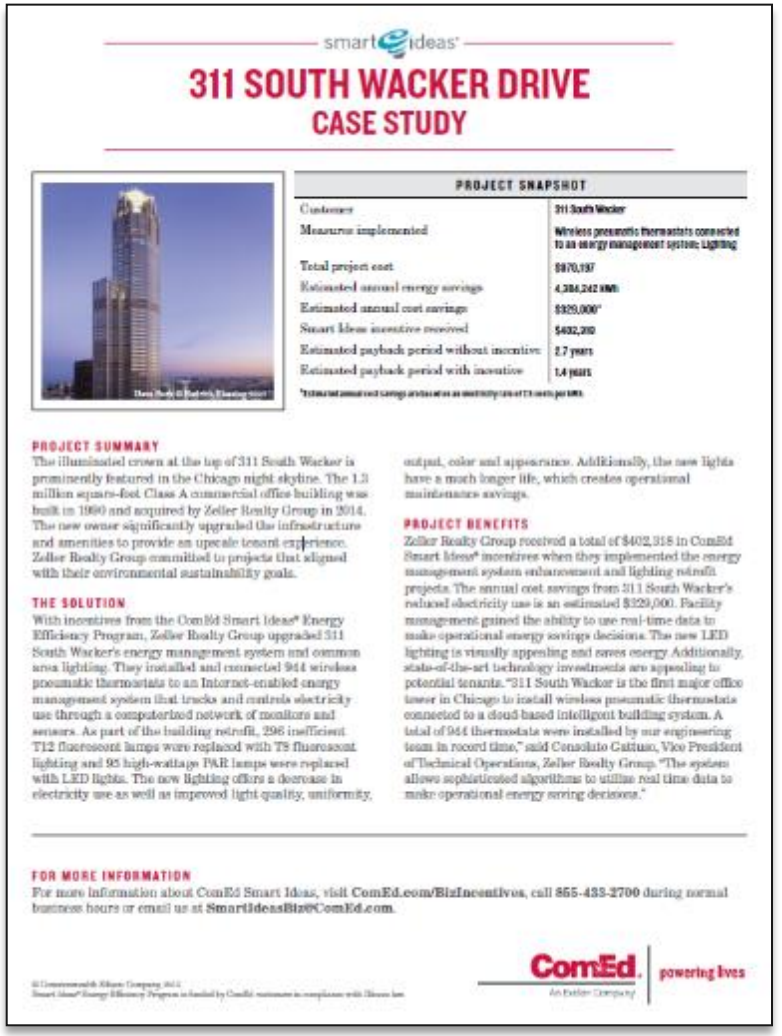
ComEd Case Study - Chicago

- 65 story tower, built in 1990
- 1.4 million sq-ft
- Utility validated energy savings of 30% per year
- Payback period of 1.8 years with ComEd incentive (3.6 years without incentive).



smart ideas

311 SOUTH WACKER DRIVE
CASE STUDY

PROJECT SNAPSHOT

Customer	311 South Wacker
Measures implemented	Wireless pneumatic thermostats connected to an energy management system; Lighting
Total project cost	$870,197
Estimated annual energy savings	4,384,242 kWh
Estimated annual cost savings	$329,000*
Smart Ideas incentive received	$402,318
Estimated payback period without incentive	2.7 years
Estimated payback period with incentive	1.4 years

*Estimated annual cost savings are based on an electricity rate of 7.5 cents per kWh.

PROJECT SUMMARY

The illuminated crown at the top of 311 South Wacker is prominently featured in the Chicago night skyline. The 1.3 million square-foot Class A commercial office building was built in 1990 and acquired by Zeller Realty Group in 2014. The new owner significantly upgraded the infrastructure and amenities to provide an upscale tenant experience. Zeller Realty Group committed to projects that aligned with their environmental sustainability goals.

THE SOLUTION

With incentives from the ComEd Smart Ideas® Energy Efficiency Program, Zeller Realty Group upgraded 311 South Wacker's energy management system and common area lighting. They installed and connected 944 wireless pneumatic thermostats to an Internet-enabled energy management system that tracks and controls electricity use through a computerized network of monitors and sensors. As part of the building retrofit, 296 inefficient T12 fluorescent lamps were replaced with T8 fluorescent lighting and 95 high-wattage PAR lamps were replaced with LED lights. The new lighting offers a decrease in electricity use as well as improved light quality, uniformity, output, color and appearance. Additionally, the new lights have a much longer life, which creates operational maintenance savings.

PROJECT BENEFITS

Zeller Realty Group received a total of $402,318 in ComEd Smart Ideas® incentives when they implemented the energy management system enhancement and lighting retrofit projects. The annual cost savings from 311 South Wacker's reduced electricity use is an estimated $329,000. Facility management gained the ability to use real-time data to make operational energy savings decisions. The new LED lighting is visually appealing and saves energy. Additionally, state-of-the-art technology investments are appealing to potential tenants. "311 South Wacker is the first major office tower in Chicago to install wireless pneumatic thermostats connected to a cloud-based intelligent building system. A total of 944 thermostats were installed by our engineering team in record time," said Consolato Gaitano, Vice President of Technical Operations, Zeller Realty Group. "The system allows sophisticated algorithms to utilize real time data to make operational energy saving decisions."

FOR MORE INFORMATION

For more information about ComEd Smart Ideas, visit **ComEd.com/BizIncentives**, call **855-433-2700** during normal business hours or email us at **SmartIdeasBiz@ComEd.com**.

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311 S. Wacker Drive ECM's

	Applicability for 311 South Wacker Dr.	Typical Savings based DDC and WPT experience	Est. Savings for 311 Wacker Dr.
Programmable Setbacks	Setback for about 60% of zones for heating only. (Cooling setback already in place at central plant level).	5-10%	9%
Duct Static Pressure Reset	Fans have variable pitch blades which can be modulated based on WPT branch pressure readings	5-10%	6%
Setpoint Enforcement, auto-calibration, continuous commissioning	Enforce setpoints to reasonable levels (i.e. between 65 and 75 degrees) to avoid simultaneous heating/cooling. Only apply to perimeter reheat zones.	5-10%	3%
Supply Air Temp Reset	Use WPT temperature sensors to optimize supply air temp at AHU's	2-4%	3%
Deadband Setpoints	Deadband setpoints may be applicable for some areas - verify tenant service level agreement	3-5%	3%
Optimal Start/Stop	AHU's on set schedule - can introduce optimal start/stop for cooling only	5-10%	2%
Potential Energy Savings via Applicable ECM's			26%

ECM Fully Applicable ECM Partially Applicable ECM Not Applicable

Projected Savings: 26%
Actual Measured Savings: 30% (over 18 month period post retrofit)

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MUSH Customers - Examples

Government

- Federal GSA (7 sites)
- NASA (JPL, Ames)
- Architect of the Capitol – Library of Congress
- City of New York (20+ muni buildings)
- City of Winnipeg (6 buildings)
- New Hampshire State Legislative Office Building
- Park Ridge IL Library
- LA County Courthouses

Higher Education

- Notre Dame (12+ buildings)
- CalPoly San Luis Obispo (5 buildings)
- Texas A&M
- University of Toronto (Green Ribbon Award)
- Illinois State University
- UNC Charlotte and UNC Wilmington
- CUNY (2 campuses) and SUNY (2 campuses)

K-12

- New York City DoE (100+ schools)
- North Rockland NY SD (6 schools)
- Hackensack NJ SD (3 schools)
- Rockford IL SD (6 schools)
- Spring TX SD
- Monroe Woodbury Central SD (4 schools)
- Northbridge SD

Hospitals

- Sutter Health (6 sites)
- Advocate/Atrium
- VA Medical Centers (12 sites)
- NYC Health and Human Services (3 sites)
- Ascension
- Etobicoke, Trillium - Toronto
- LifePoint (14 sites, in progress)

WPT Partners

Johnson Controls

WTL Series Digital Pneumatic Thermostats

Affordable digital control for pneumatic HVAC systems

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Case Study:

Conemaugh Memorial Medical Center

Duke LifePoint Healthcare System

April 2025

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Conemaugh Memorial Medical Center - Overview

Facility Type	540 bed hospital, Level 1 trauma center
Location:	Johnstown, PA
Building:	Multiple Connected Buildings Built From 1962-2021
Total Hospital Area:	855,000 Sq-ft
Project Areas:	93,200 Sq-ft (patient wings and vascular support)
New Wireless Thermostats	156 Total: Patient wing, P Building - 128 stats Vascular support, M Building - 28 stats
Terminal Unit Type:	Pneumatic Constant Air Volume w/hot water reheat
AHU's	7 AHU's with VFD Fans
Central Plant:	Electric Chiller, Gas Boiler
BAS:	JCI Metasys
Utility:	Penelac

Energy Source:	Consumption
Electricity HVAC:	25,455,000 kWh per year $0.085 Per kWh $2,189,000 Total per year
Gas HVAC:	185,300 MMBTU $5.175 Per MMBTU $ 960,000 Total per year
TOTAL HVAC Energy Use:	**$ 3,149,000** **$ 3.68 / Sq-ft**

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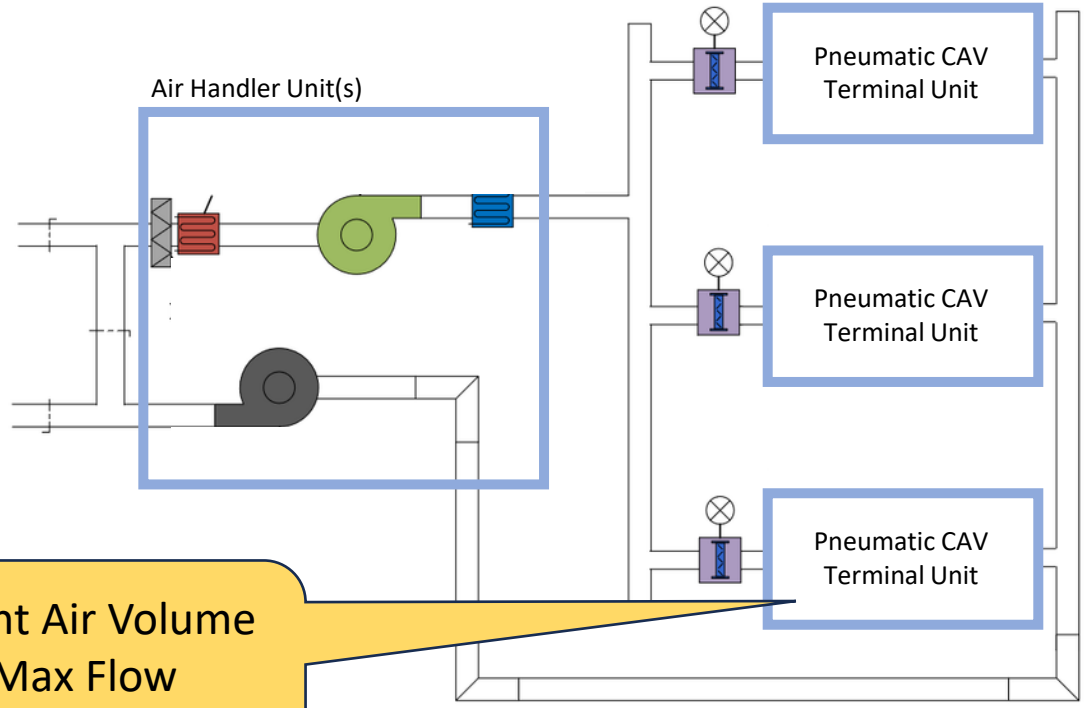
Multi-zone HVAC System - Before Upgrade

AHU's with VFD Fans

CAV Terminal Units with Hot Water Reheat

Pneumatic room thermostats



Constant Air Volume At Max Flow (worst case)

No visibility nor feedback from occupant zones

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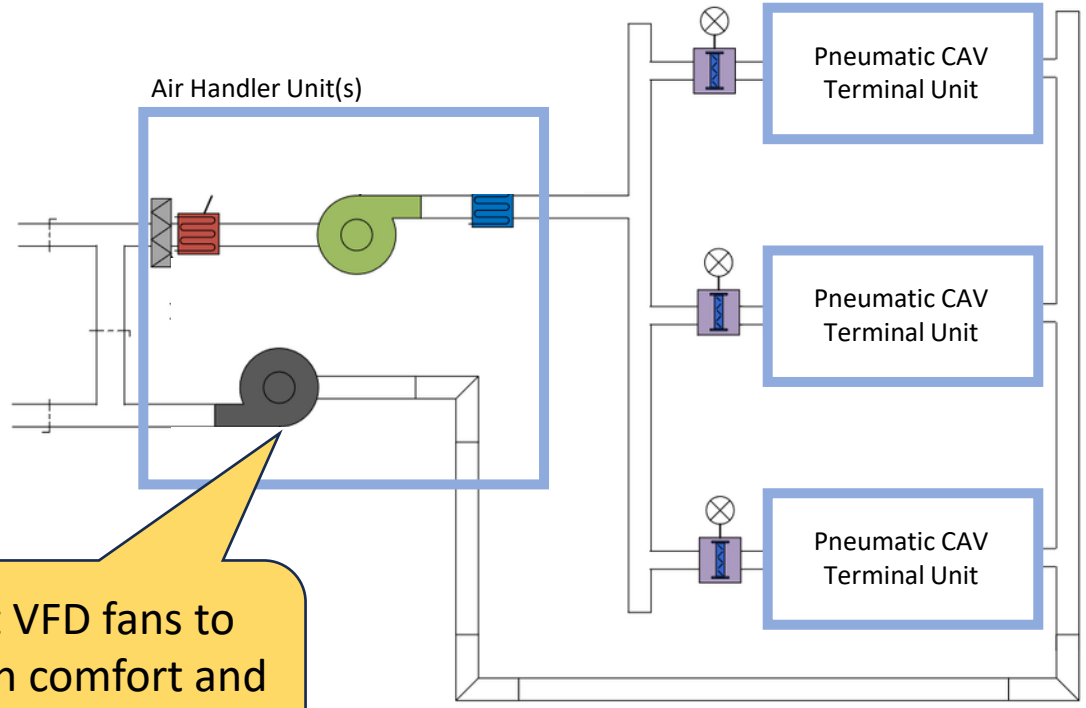
Multi-zone HVAC System - After Upgrade

AHU's with VFD Fans

CAV Terminal Units with Hot Water Reheat

Pneumatic room thermostats



Adjust VFD fans to maintain comfort and code

Feedback from Zones Temperature, Comfort

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Challenges and Opportunity

Challenge:

- Pneumatic thermostats – no communications for room temp, setpoint, nor heating valve position
- Cannot optimize CFM nor SAT w/control strategies
- CFM sized per worst case heating/cooling scenarios with outside air. Minimum ASHRAE and FGI Guidelines are much less usually 25-30% of maximum heating and cooling
- But for most of the year, high CFM is unnecessary and wastes energy:
    - Must cool to supply air reset temp
    - Consume fan energy
    - Must reheat to room setpoint

Opportunity:

- Upgrade existing pneumatic thermostats to Wireless Pneumatic Thermostats (WPT)
- Feedback to BAS via BACnet: Room Temperature, Branch Pressure (heat/cool demand), and Setpoint Temperature
- Enable BAS to modulate CFM airflow using fan VFD's
- Save Energy:
    - Reduce Chiller Load
    - Reduce Fan Energy Consumption
    - Reduce Hot Water Reheat load on Boiler

Implementation of Non-Invasive WPT Upgrade

WPT Retrofit

- Replace 156 pneumatic stats
- Non-invasive installation
  - 10-15 minutes per room
  - No above ceiling work
  - 5 days to complete
  - virtually no patient/operational disruption
- Seamless integration with existing Johnson Controls Metasys BAS
- Average installed cost of $1,100 per stat (room)

vs.

Conventional DDC Retrofit

- Costly and Disruptive
  - 4-6 hours per room
  - Above ceiling work
  - IRCA may be required
  - Months to complete
  - Relocation of staff/patients
- Average installed cost of $3,600 per stat (room)

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Resulting Energy Savings - P Building (128 Rooms)

CFM Airflow Control Sequence:

- Reduce airflow when max cooling/heating not needed
- Maintain FGI minimum four air exchanges/hour
- Average 200 CFM reduction per room

Equipment	Savings per room per year		
Fan & Cooling	Elec.	2,530 kWh	$202
Reheat	Gas	17.00 MMBTU	$87
Total			**$289**

Number of Rooms	128
Total Annual Savings for Building P	$36,992

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Project Payback Period: 2.9 yr with Utility Rebates

Project Cost and Payback (P Building)

Est. cost per installed thermostat	$1,100
Number of thermostats	128
Utility Rebate (for Electricity)	$32,385
TOTAL COST WITH REBATE	$108,415

Energy Savings (Gas and Electric)	$36,990
Payback Period without Rebate	3.8 Yrs
Payback Period with Rebate	2.9 Yrs

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WPT Retrofit: 1/3 Cost of DDC, 3x Faster Payback

Comparison WPT vs. Conventional DDC Retrofit per Room

Est. cost per installed thermostat	$1,100	$3,200
Number of thermostats	128	128
TOTAL COST WITHOUT REBATE	$140,800	$409,600

Energy Savings (Gas and Electric)	$36,990	$36,990
Payback Period without Rebate	3.8 Yrs	11.1 Yrs

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When to Consider WPT vs. DDC

WPT approach particularly effective for:

- Avoiding operational disruption, occupant relocation
- i.e. Patient Floors, Office Suites
- Infection Control Risk Assessment areas

WPT has most attractive payback for:

- Rooms and spaces with low/med airflow

Conventional DDC effective for:

- Areas with higher airflows
- i.e. Operating Rooms, Cath Lab, Waiting Areas, Labs, Lobbies
- Upfront cost is higher for DDC, but high airflow locations can save more energy to help shorten payback period

LifePoint Health - WPT Installations

• Sovah Danville Regional Medical Center, Danville VA	80 WPT's – Completed
• Lake Cumberland Regional Medical Center, Somerset KY	90 WPT's - Completed
• Clinch Valley Medical Center, Richlands VA	83 WPT's - In Progress
• Southern Tennessee Winchester, Winchester, TN	40 WPT's – In Progress
• Starr Athens Regional Medical Center, Athens, TN	60 WPT's – In Progress
• Sumner Regional Medical Center, Gallatin, TN	50 WPT's – In Progress
• Additional Locations Planned	Later 2025 and 2026

Summary

- Pneumatically controlled buildings use more energy, require more maintenance, and provide lower tenant comfort
- Upgrading to conventional Direct Digital Controls (DDC) can be extremely costly and disruptive to tenants
- The Wireless Pneumatic Thermostat (WPT) provides a non-invasive upgrade solution which cost 70% less than conventional DDC
- Payback periods are typically three years or less – utility rebates may deliver even shorter payback periods
- The Wireless Pneumatic Thermostat is proven technology which is tested and recommended by the US Dept of Energy and receives rebates from numerous utilities nationwide.

Additional Non-Invasive Retrofit Solutions

Wireless Steam Trap Monitor

Leaking Traps Waste Energy

Typical Steam Trap

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WIRELESS STEAM TRAP MONITOR

- Necessary part of the steam distribution system, usually hundreds of units per site
- 15-20% average failure rate; leaks steam
- Failed traps lose $5,000 per year (1/8” orifice)
- Manual inspection typically done annually – labor intensive, do not catch problems in timely manner
- Solution: Wireless steam trap monitor detects faults and alarms on error, avoiding expensive leak loss
- Non-invasive installation: no breaking seals, wireless, integrates with BMS
- Battery life of 3+ years at typical sample rates
- IP65/NEMA 4 rated for outdoor use
- One year payback on investment

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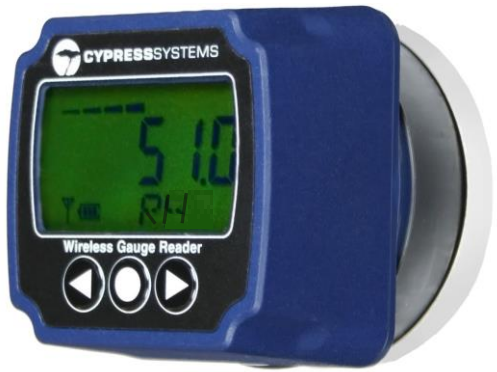
Wireless Gauge Reader

Compatible with most dial gauges, hour meters, panel meters:

- “Electronic Eyeball” reads gauges and transmits readings wirelessly
- Non-invasive, clamp-on to existing gauges in minutes
- No downtime, no leak check, no wiring, no drawings
- Battery life of 3+ years at 15 minute sample rate
- IP56/NEMA 4 rated for outdoor use
- Various size and types of mounting adapters to fit most existing gauges
- Reads dial gauges, hour meters, LED/LCD displays

Wireless Humidity and Temperature Monitor



- -20 ºC to +70 ºC (-4 ºF to 158 ºF) Temperature Range
- 0 – 100% Relative Humidity Range
- Magnetic Mounting for steel walls or columns
- Adhesive Mounting for other surfaces
- Battery life of 3+ years at 15 minute sample rate
- IP56/NEMA 4 rated for outdoor use

Wireless Transducer Reader

- Enables wireless remote monitoring of virtually any analog transducer or instrument with the following outputs: 4-20mA, 0-5V, or 0-10V, RS-232, RS-485, thermocouple, thermistor
- Compatible with most existing flow meters, current meters, particle counters, thermocouples, weigh scales, etc.
- Battery life of 3+ years at 15 minute sample rate
- Optional enclosures for NEMA 6, IP 67 protection
- Enables data logging to enable trend analysis, notification, or statistical process control