Retrofitting Legacy Pneumatic Controls

Overview

3/21/2023

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Customer Sites – Select List

Municipalities

- City of New York (20+ muni buildings)
- Tucson City Hall
- City of Winnipeg (6 buildings)
- New Hampshire State Legislative Office Building
- Park Ridge IL Library
- County of San Jose
- County of Sacramento

Universities

- Notre Dame (12+ buildings)
- CalPoly San Luis Obispo (5 buildings)
- Sacramento State (6 buildings)
- University of Toronto (Green Ribbon Award)
- Illinois State University
- UNC Charlotte and UNC Wilmington
- CUNY and SUNY

Schools

- 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 (6 sites)
- Advocate (Aurora)
- VA Medical Centers (12 sites)
- NY Health and Human Services (3 sites)
- Ascension
- Wyoming County Hospital
- LifePoint (14 sites spec'd for 2023)

Federal Sites – Select List

- Architect of the Capitol – Library of Congress, DC, 2022
- GSA Region 2 ESPC NYC, Weiss and Javits buildings 2017-2022
- GSA Region 7 ESPC, Gallup and Santa Fe, NM, 2021
- GSA Region 7 ESPC Ft. Worth TX, Lanham building, 2018
- GSA Region 7 Lubbock TX, 2019
- GSA Region 11, Ronald Reagan Center, Washington, DC, 2012
- VA Medical Centers (8 sites, 2010 to 2022)
- Social Security Administration, Crystal City, VA, 2009
- Architect of the Capitol – Ford Building, DC, 2010
- NASA Ames Research Center, CA, 2010
- NASA Johnson Space Center, Houston, TX, 2011
- US Coast Guard Station, Petaluma, CA, 2014
- US Department of Agriculture, Albany, CA, 2014

ESCOs

- ESG
- Ameresco
- Noresco
- Johnson Controls
- Siemens
- ConEd
- Trane
- AECOM
- Southland

U.S. DOE/GSA and NYC DCAS Independent Case Studies

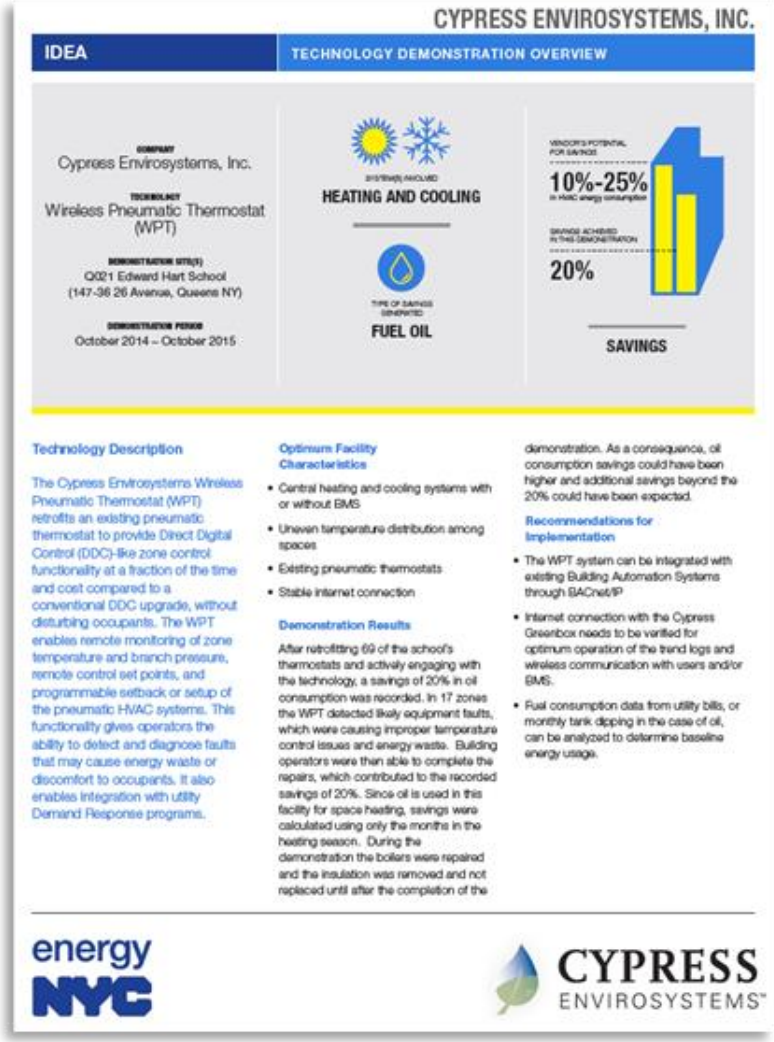
GSA

OAK RIDGE National Laboratory

U.S. DEPARTMENT OF ENERGY

"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



CYPRESS ENVIROSYSTEMS, INC.

IDEA | TECHNOLOGY DEMONSTRATION OVERVIEW

Cypress Envirosystems, Inc.

Wireless Pneumatic Thermostat (WPT)

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

October 2014 – October 2015

HEATING AND COOLING

FUEL OIL

10%-25%

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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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

Our Solution: Wireless Pneumatic Thermostat

EXISTING LEGACY STAT

Minimal Disruption
10 Minute Upgrade

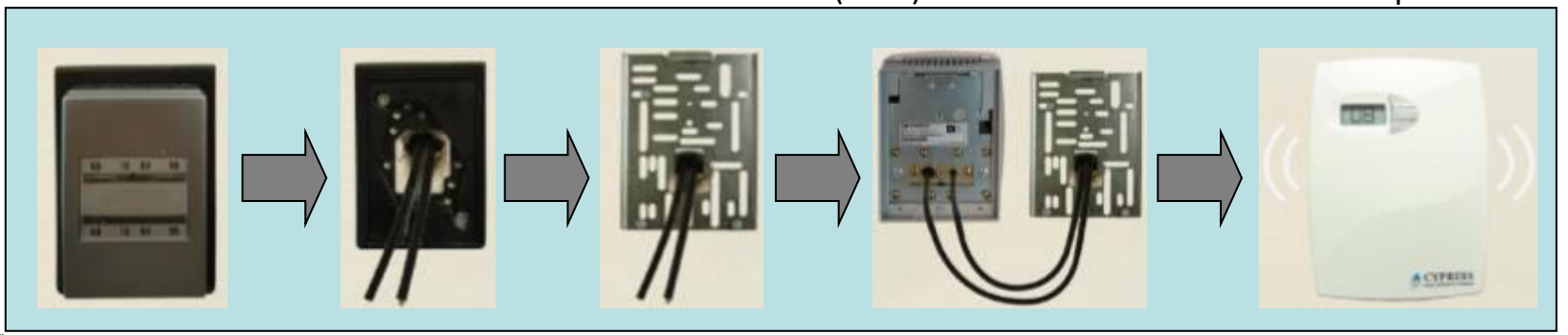
WIRELESS PNEUMATIC THERMOSTAT

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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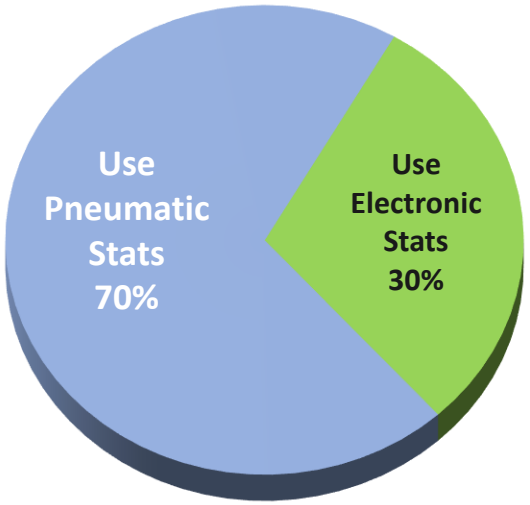
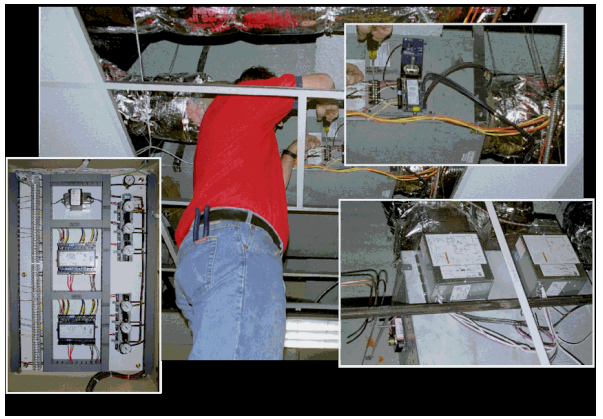
Most Non-Residential Buildings Still Employ Pneumatics

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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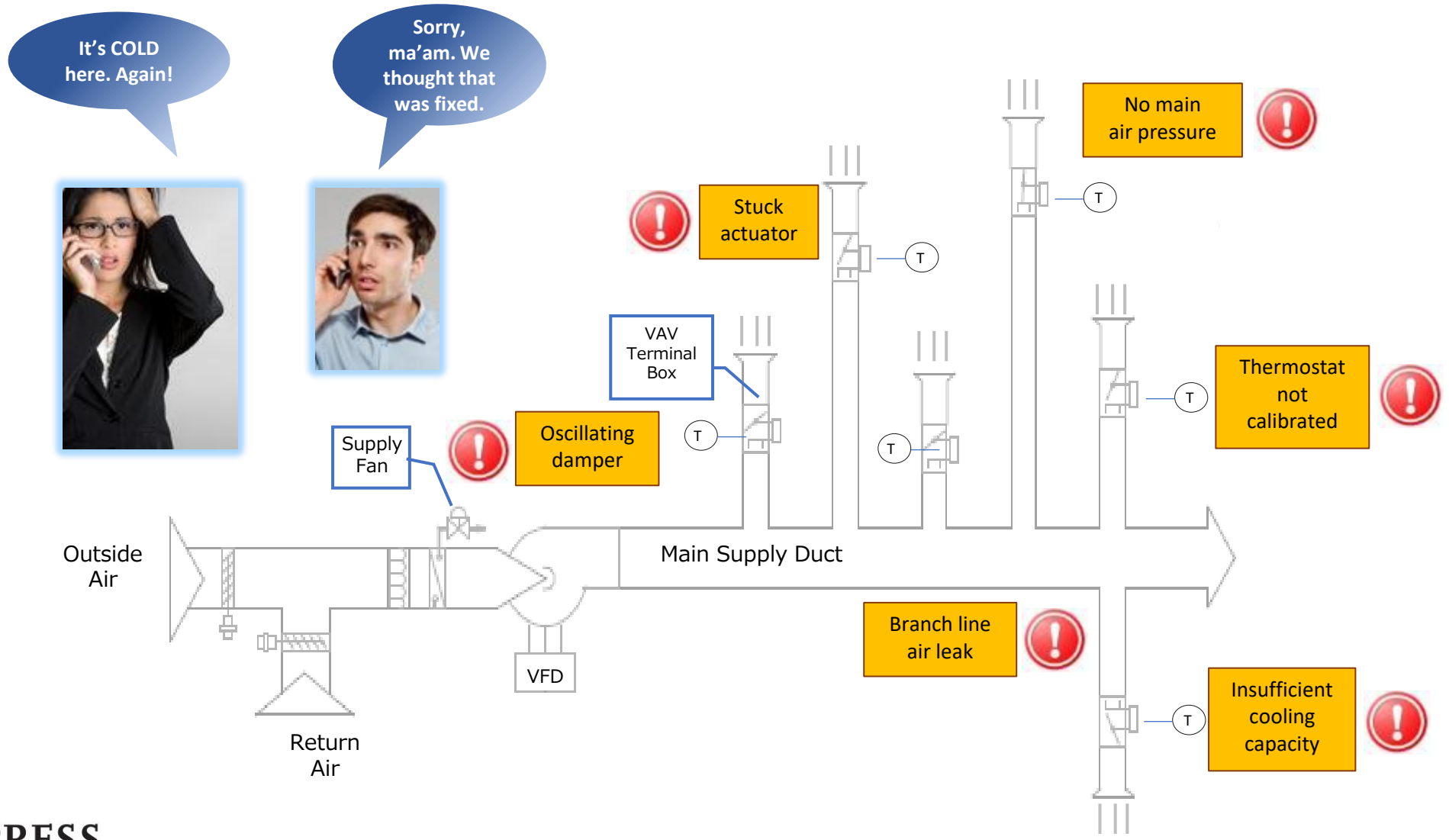
Pneumatic Shortcomings – No Visibility



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Pneumatic Shortcomings – Uses 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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Our Solution: Wireless Pneumatic Thermostat

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10 Minute Upgrade

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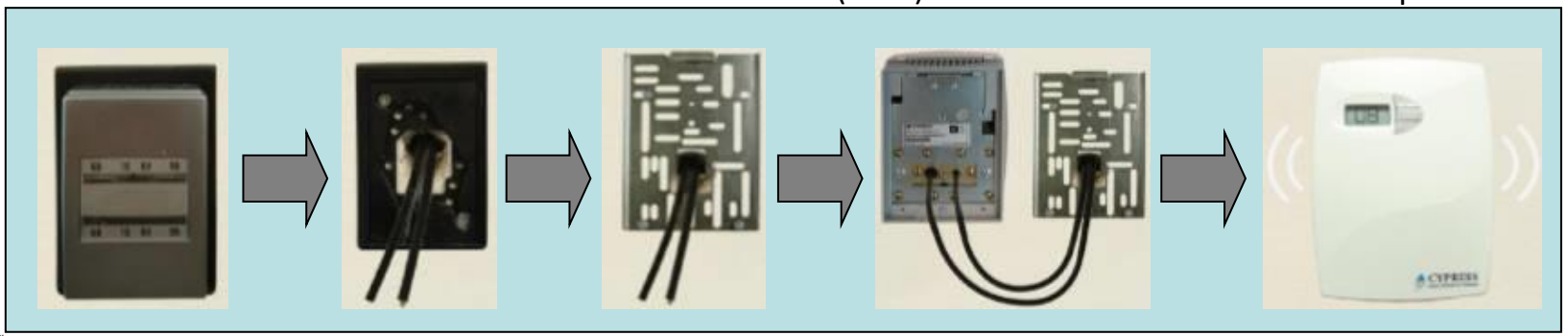

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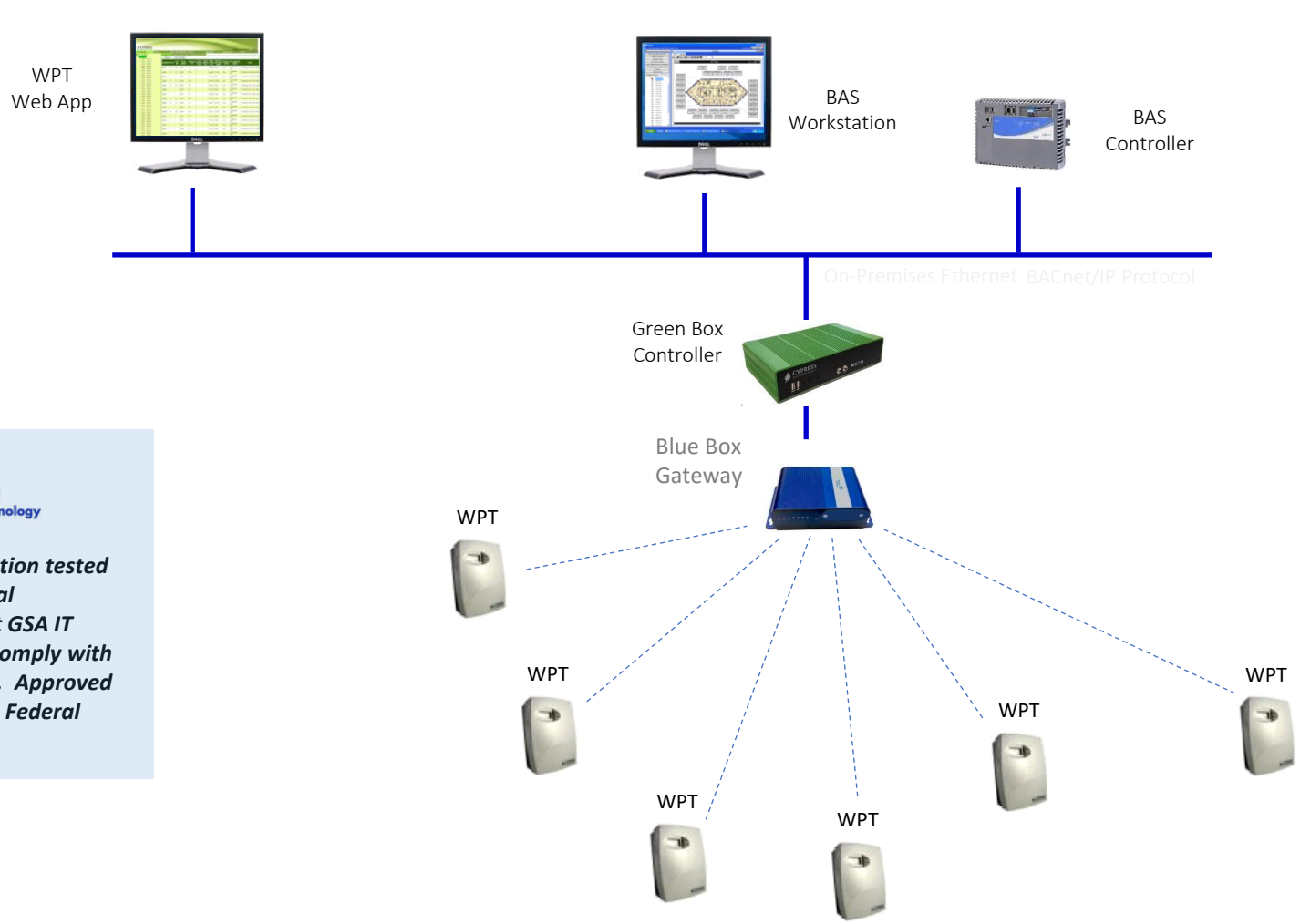
WPT System Components and Architecture



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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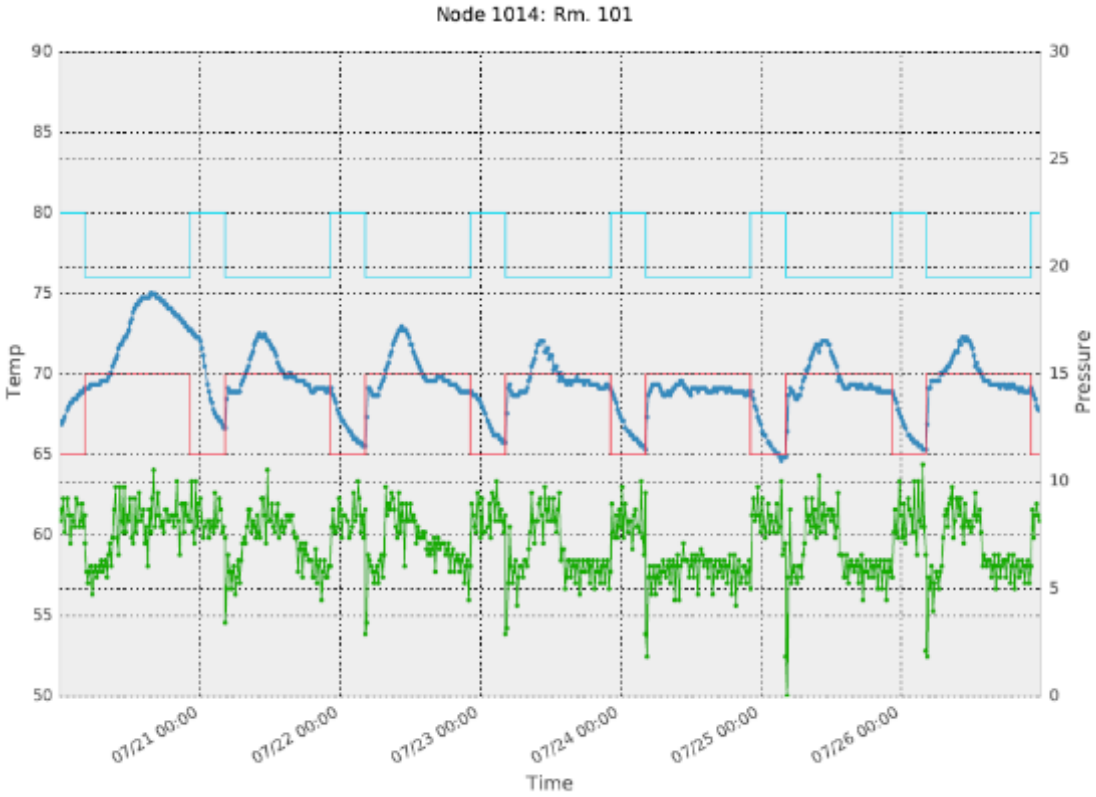
Improved Visibility

- 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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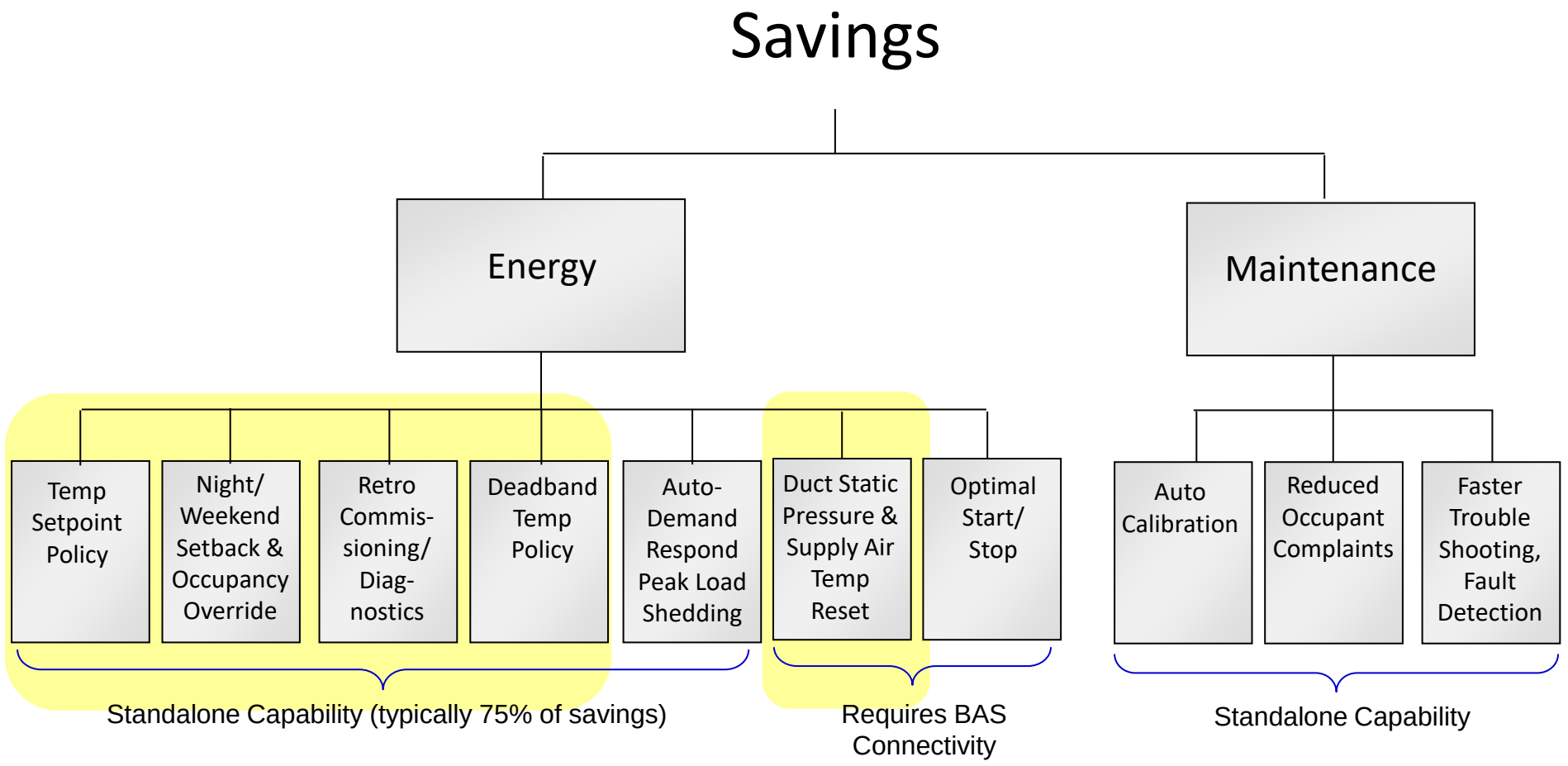
Enable Energy Savings Strategies



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 Gattuso, 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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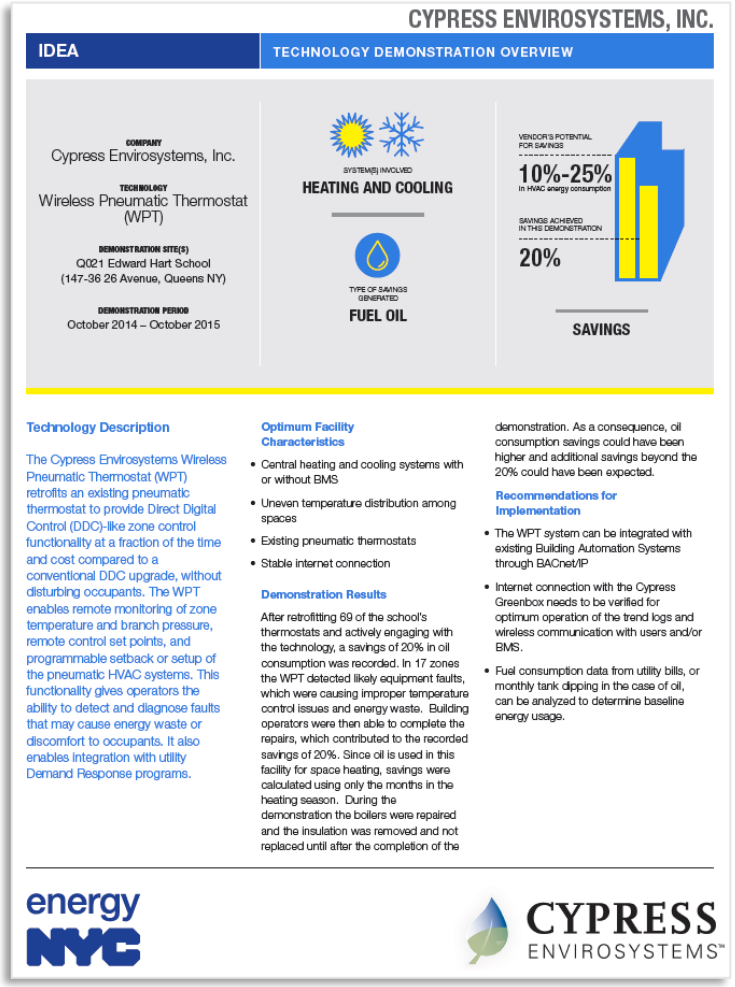
M&V Validated 20% Savings at NYC School



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

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energy NYC

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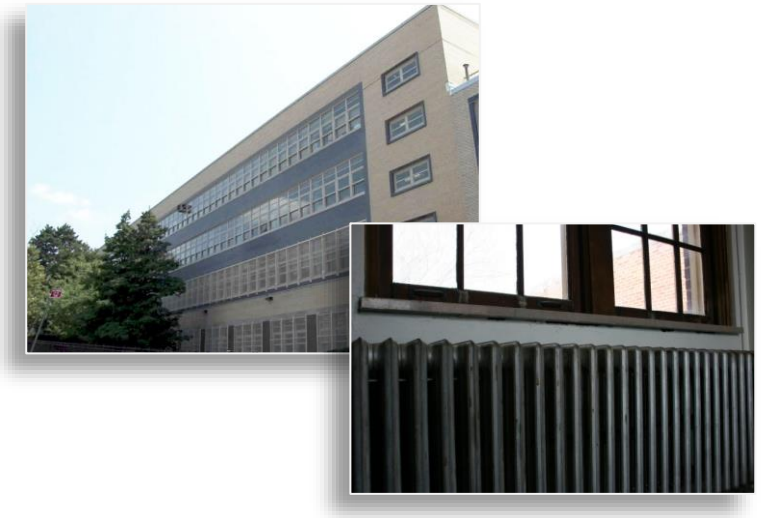
- Edward Hart Middle school Queens, NYC
- Uses Oil Fired Boilers, hot water radiators
- Fault detection, example:
  - Radiator hot water valve stuck open
  - Undetected probably many years
  - Occupants open window to compensate
  - Maintenance staff stretched thin, no data, not aware of situation



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Energy savings benefits - examples

- **Detect stuck hot water reheat valve**
  - NYC Schools: Faulty actuators stuck open, causing constant overheat and occupants to open windows. 10% savings after detection and replacement of actuator.

- **Detect damper oscillation**
  - Fortune 500 Telecom Company: Floorplan change caused damper and reheat oscillation – constantly cycled heating and cooling just to maintain average temperature. 15% savings after adjustment to pneumatic throttle range and actuator spring ranges.

- **Detect simultaneous heating/cooling at adjacent zones**
  - Class A multi-tenant hi-rise: one thermostat set at 85F next to another set at 65F. 10% savings after setpoints readjusted and limits imposed.

Benefits Summary

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

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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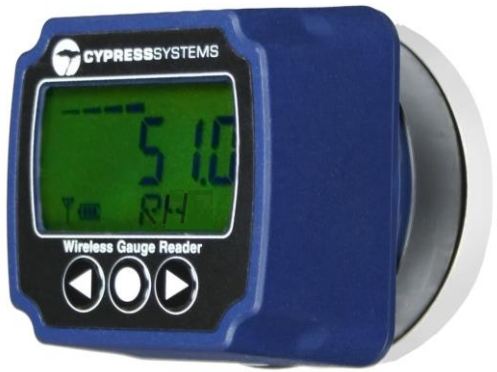
Wireless Gauge Reader

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