Wireless Pneumatic Thermostat Savings Estimates

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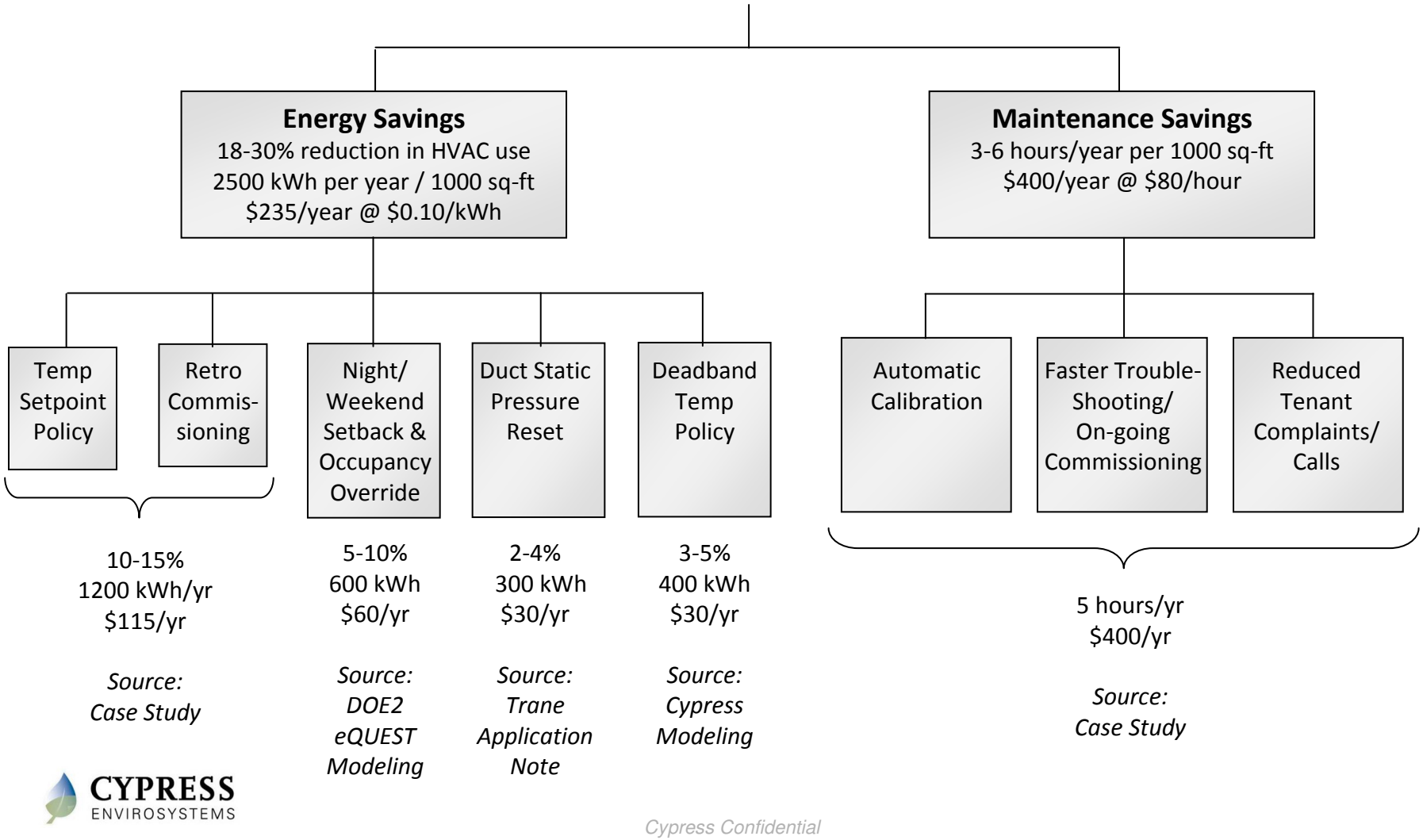
Wireless Pneumatic Thermostat Savings

Estimated Savings Potential

$635/year (per 1000 sq-ft)
Upfront Retrofit Cost: $600 (per 1000 sq-ft)
Payback Period: 11 months

Note: All calculations based on 300,000 sq-ft retrofit project, $0.10 per kWh electricity rate, and $80 per hour maintenance labor rate.



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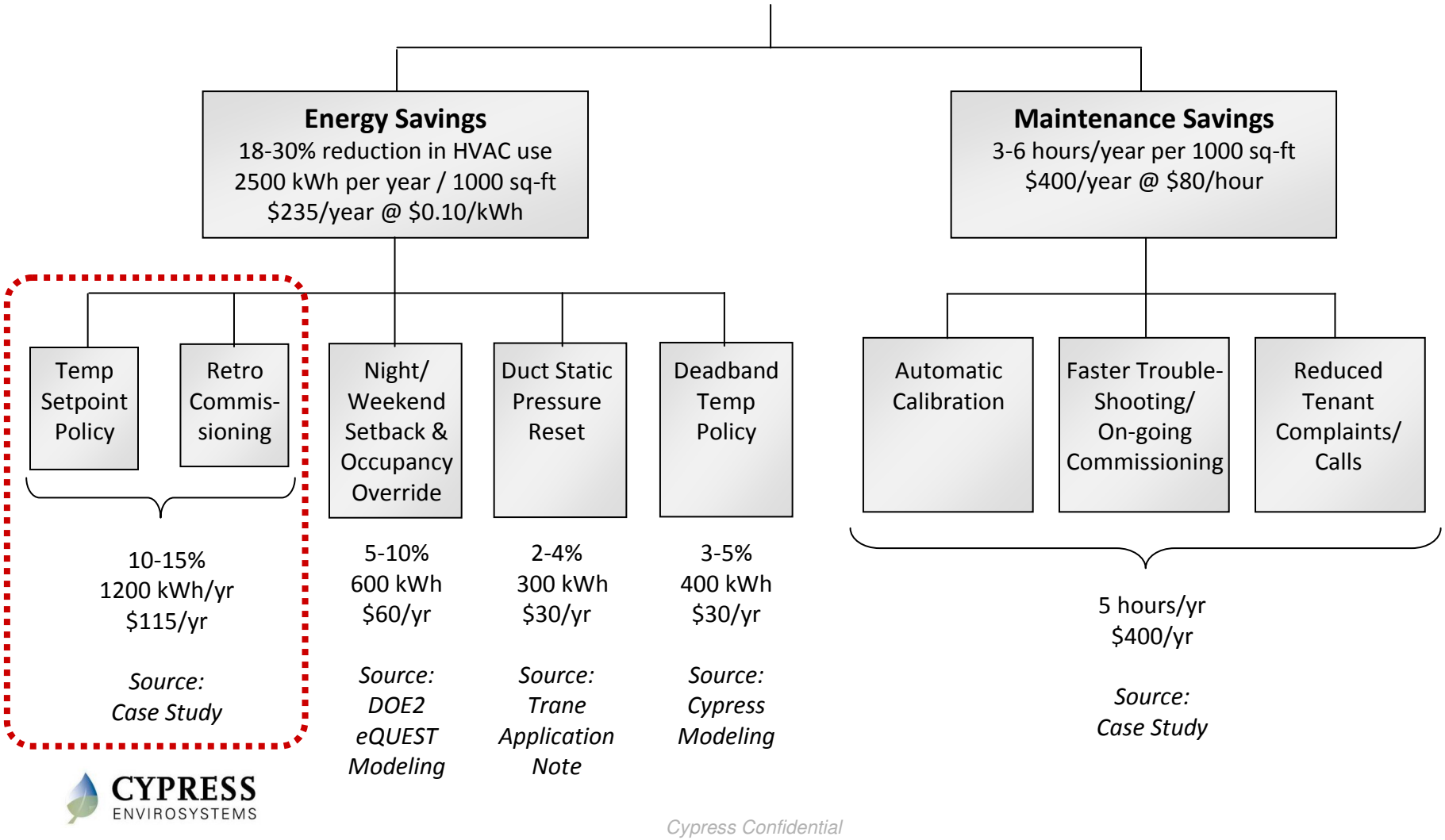

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Temp Setpoint Policy / Retrocommissioning Savings

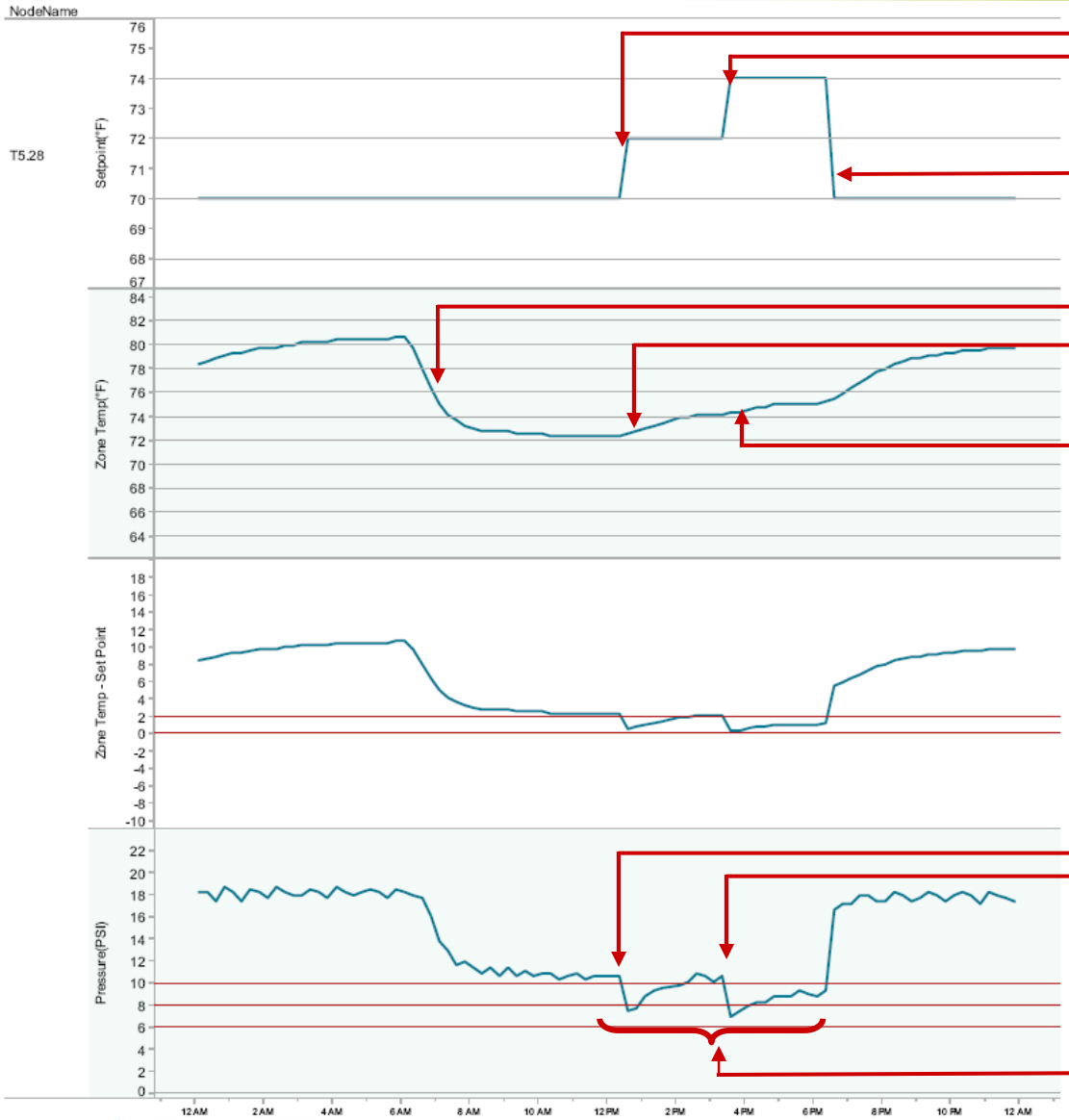
Enforcing Temperature Setpoint Policy

- Conventional Pneumatic Thermostats, do not have specific setpoint indicators, and are often manually set on full maximum or minimum by users. Lack of calibration adds to setpoint variance.
- Result: zones often over-cool or over-heat, and even fight among each other, wasting energy.
- WPT Solution: Enforce thermostat setpoint to a limited band e.g. 68-72 deg. Monitor constantly and set alarms if over/below limits.

Retrocommissioning

- Conventional Pneumatic Thermostats, do not provide any diagnostic data such as setpoints, zone temperature, or pneumatic pressure.
- Result: zones which are malfunctioning are not detected or corrected, wasting energy. E.g. dampers stuck open, lack of pneumatic air supply etc.
- WPT Solution: Monitoring data allows for discrepancies to be quickly identified, and typically low-cost or no-cost retrocommissioning steps to be taken to correct problems with zones.

Zone Behavior – Proper Response (example)



SETPOINT TEMPERATURE
- 1st DR Event bumped up setpoint 2 deg
- 2nd DR Event bumped up additional 2 deg
- Completion of Event – back to normal

ZONE TEMPERATURE
- Morning A/C comes on
- Temp climbs after initial DR event
- Continues climbing after 2nd DR event

DELTA SETPOINT MINUS ZONE TEMP
- Should maintain to within 2 degrees of setpoint throughout

BRANCH PRESSURE
- Drops after first event called
- Drops after second event called
- Stays about neutral 8psi during entire DR period.

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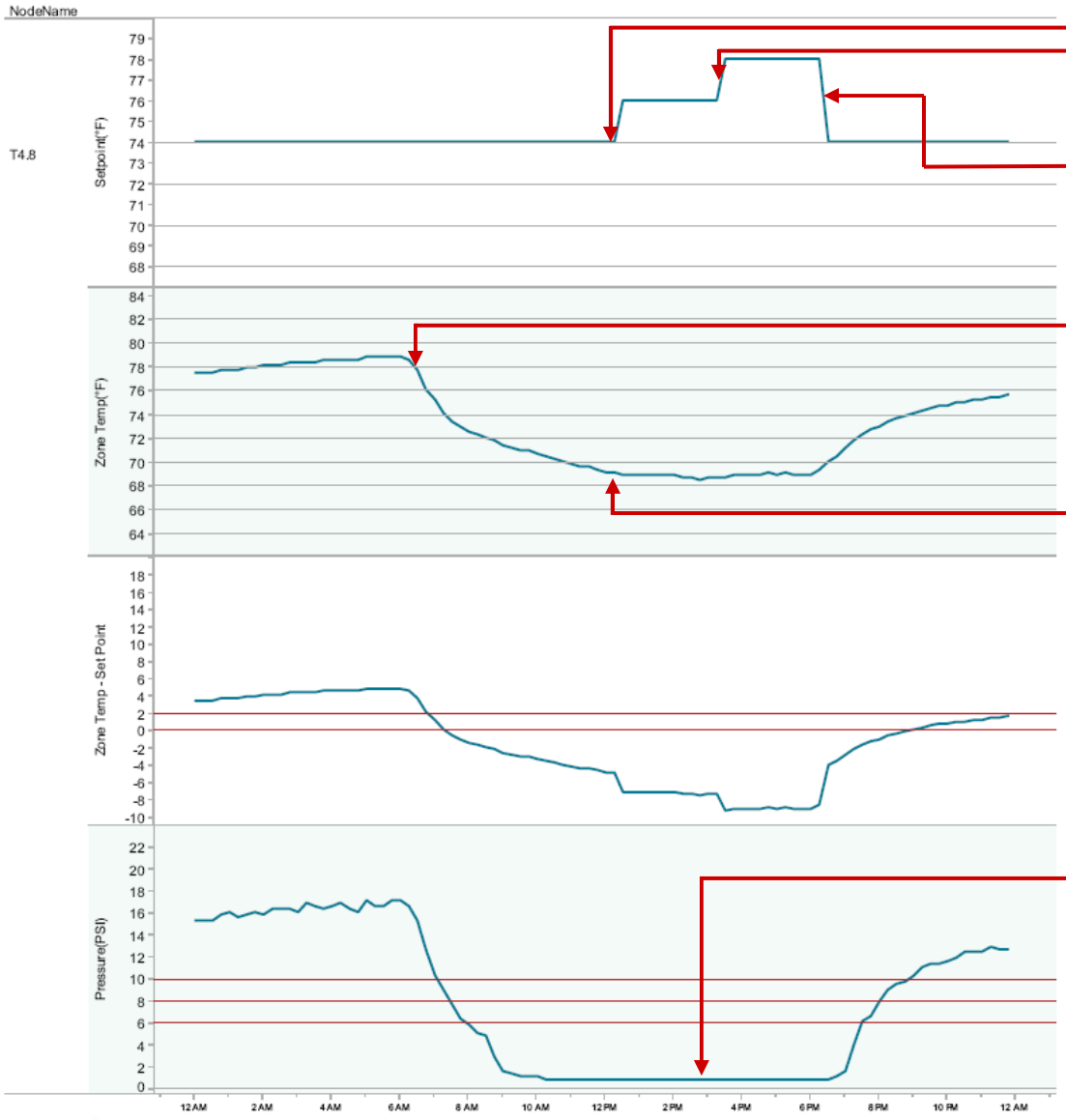
Zone Behavior – Too Much Cooling (example)



SETPOINT TEMPERATURE

- 1st DR Event bumped up setpoint 2 deg
- 2nd DR Event bumped up additional 2 deg
- Completion of Event – back to normal

ZONE TEMPERATURE

- Morning A/C comes on
- Temp keeps dropping, even below setpoint

DELTA SETPOINT MINUS ZONE TEMP

- Temperature way too cold, much below setpoint most of the day

BRANCH PRESSURE

- Thermostat is trying to compensate for over cooling all day long.

Causes/Remedy:
- Faulty Reset Velocity Controller
- VAV Box Fault
- Adjacent Zone Overcooling

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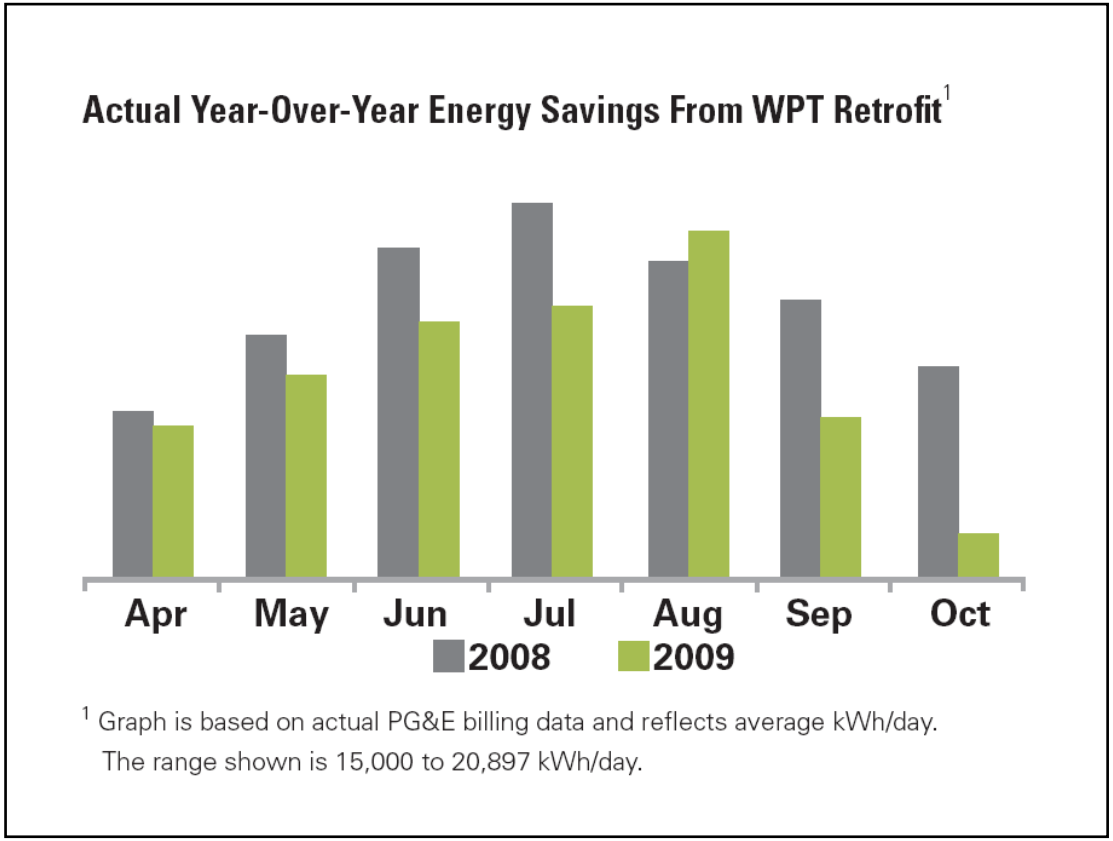
Actual Case Study Results: 15% Savings

- Santa Clara County Government Buildings – 300,000 sq-ft retrofit completed in March 2009.
- Actual Post-retrofit energy use compared with same period in prior year, adjusted for deg-days.
- Reduction in HVAC energy use of 15% due to temperature setpoint policy and retrocommissioning.



Full case study available at: http://www.cypressenvirosystems.com/files/pdf/CountyofSantaClara_EnergySavings_Final.pdf

Documented 15% Reduction on HVAC Energy Use vs. Prior Year Due to Retrocommissioning and Temperature Setpoint Policy Enforcement

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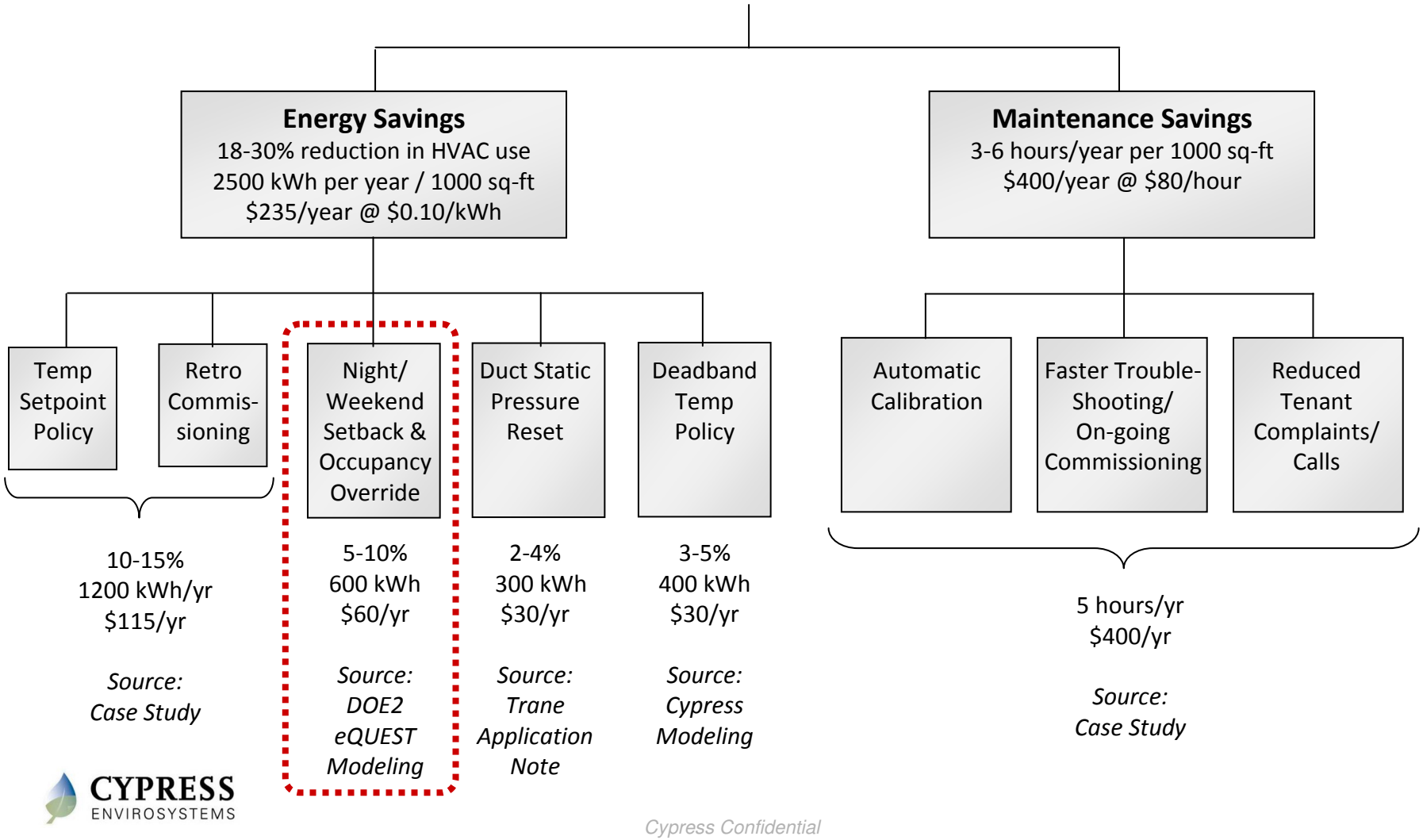

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Temp Setpoint Policy / Retrocommissioning Savings

Weekend/Night Setback

- Many buildings have mixed use occupants with different use schedules e.g. 24x7 data centers, vs. 9am-5pm offices, extended hours for lab or special projects work.
- Conventional Pneumatic Thermostats do not allow programmable zone controls.
- Result: Zones are cooled or heated even when they are not occupied, wasting energy.
- WPT Solution: Temperature Setbacks can be programmed for different zones to reduce unnecessary energy use.

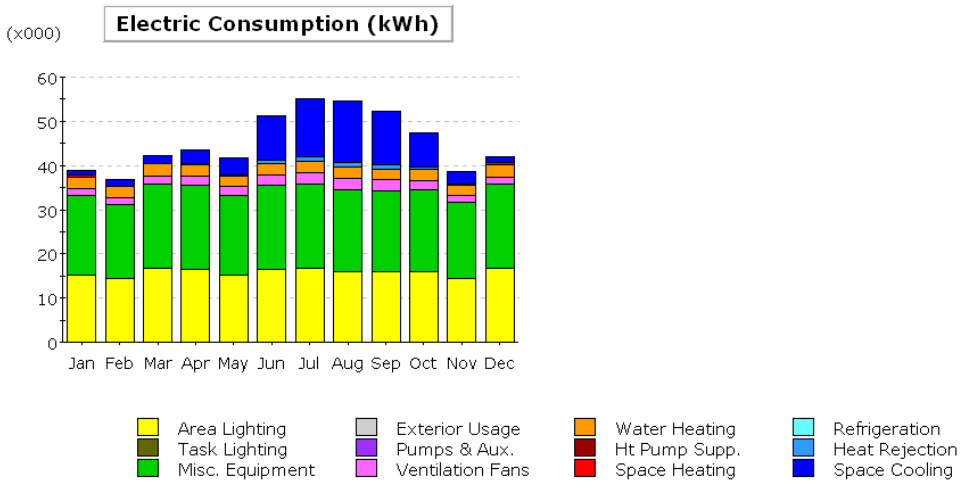
Occupancy Override

- Occupants may override programmed weekend or night setback if they are working late or on weekends.
- Front panel buttons on the WPT allow occupants to select override for temporary durations.
- Log of override zones are available to the building manager for optional billing allocation of costs.

Actual Case Study Results: 10% Savings

- Los Angeles Area Chamber of Commerce Building – 80,000 sq-ft retrofit completed in Sept 2009.
- Calculated energy savings for night/weekend setback using DOE2 eQUEST tool from US Dept. of Energy.
- Predicted reduction in HVAC energy use of 10%.

Project/Run: LA Chamber of Com - Baseline Design Run Date/Time: 05/13/09 @ 13:54



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.85	1.55	1.78	2.98	3.87	10.08	13.27	14.05	12.24	7.87	3.00	1.14	72.67
Heat Reject.	0.03	0.07	0.08	0.16	0.21	0.68	1.00	1.07	0.92	0.55	0.15	0.04	4.96
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.61	0.06	0.04	0.01	0.00	-	-	-	-	-	0.01	0.57	1.30
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	2.51	2.40	2.77	2.75	2.46	2.61	2.56	2.42	2.41	2.45	2.28	2.68	30.31
Vent. Fans	1.49	1.53	1.83	1.99	1.88	2.39	2.58	2.60	2.46	2.10	1.54	1.65	24.06
Pumps & Aux.	0.04	0.04	0.05	0.05	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.52
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	18.06	16.80	19.11	18.86	18.06	18.86	19.11	18.59	18.34	18.59	17.30	19.11	220.79
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	15.17	14.38	16.62	16.60	15.17	16.60	16.62	15.90	15.87	15.90	14.43	16.62	189.89
Total	38.76	36.83	42.28	43.40	41.71	51.28	55.18	54.68	52.29	47.50	38.74	41.85	544.49

Calculated 10% Reduction on HVAC Energy Using eQUEST Modeling Software from the US Department of Energy

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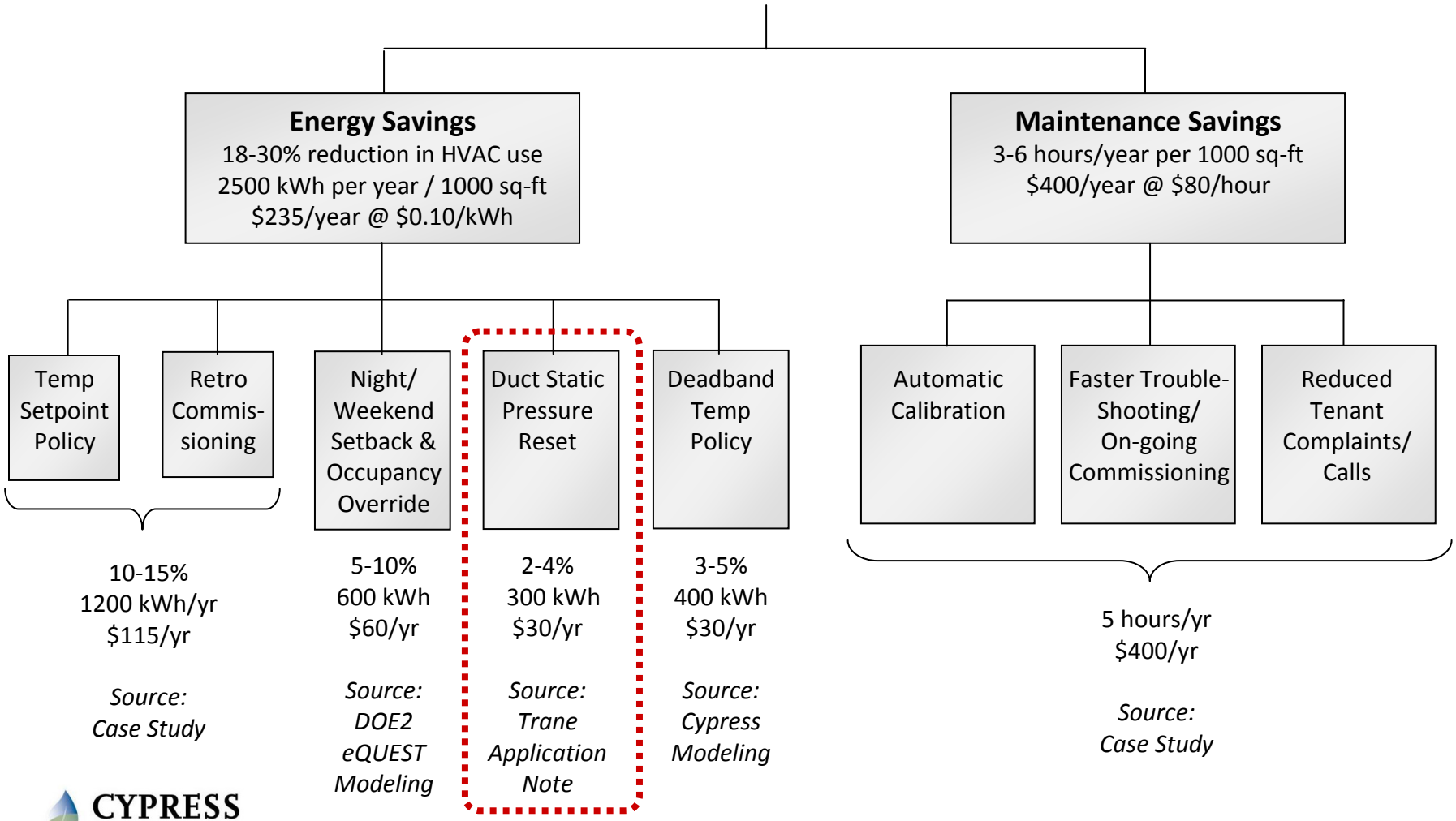

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Duct Static Pressure Reset Savings

- Adjusting Fan Airflow / Duct Static Pressures is a widely used energy savings application for DDC systems.
- When there is high heating or cooling load, fans are run on full to maximize temperature control. When there is minimal heating or cooling load, fans are run on minimum to satisfy indoor air quality requirements.
- Energy savings come from avoiding maximum fan airflow when not needed.
- Unlike DDC thermostats, conventional Pneumatic Thermostats do not provide sensor signals to indicate heating/cooling load. Result: Pneumatic control systems cannot take advantage of Duct Static Pressure Resets strategies to save energy.
- WPT Solution: The WPT provides a built-in branch pressure sensor, exposed as a BACnet property for each zone. This value directly indicates heating or cooling load, and enables existing Building Management Systems / Variable Speed Drive controls to implement Duct Static Pressure savings.
- Trane Corp. has performed analysis indicating 2-4% reduction in HVAC energy use for this application. http://www.trane.com/commercial/uploads/pdf/866/VentilationFanPressureOptimization.pdf

Trane Models for DDC Systems Show 2-4% Energy Savings from Duct Static Pressure Reset. WPT Achieves Same Application with Pneumatic System.

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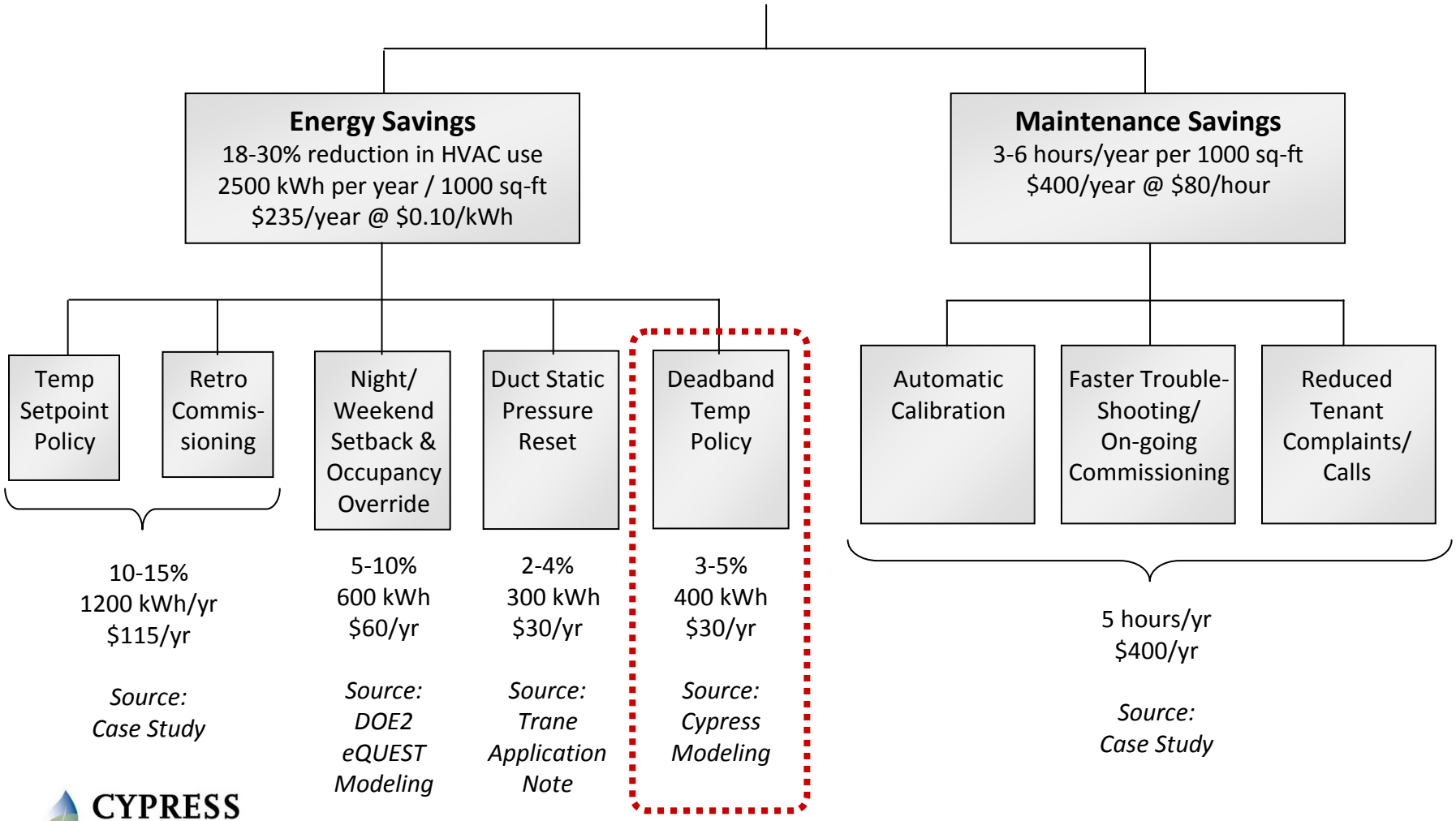

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Deadband Temperature Setpoint Policy

What is it?

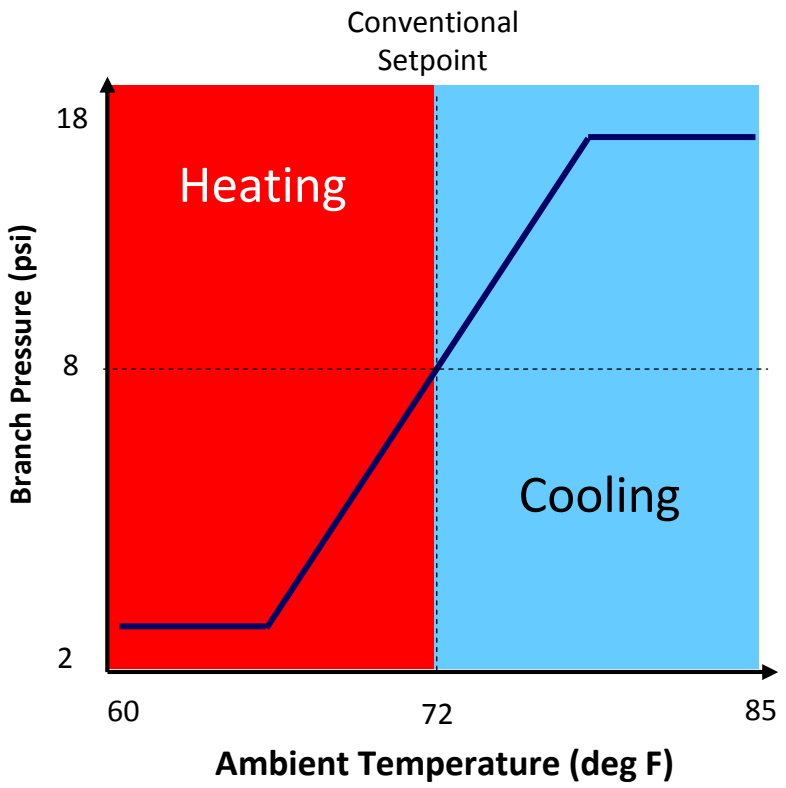
- When zone temperature is within certain limits e.g. between 68F and 78F, *ALL HEATING AND COOLING IS DISABLED* for that zone.
- When ambient temperature is outside these limits, heating and cooling is *ENABLED* to maintain basic comfort.

Why?

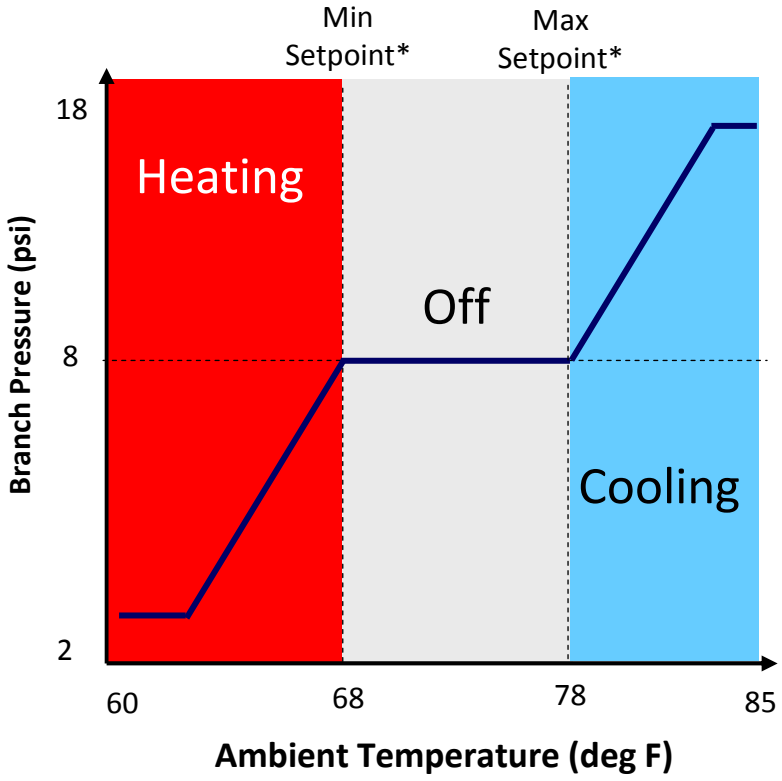
- Up to 60% energy savings potential, for occupants who can tolerate some range of temperature swing.
- Many universities and public institutions have mandated this type of temperature setpoint policy…the Deadband WPT enables and automatically enforces the policy.
- Benefits are INCREMENTAL to Night Setback, Occupancy Override, Demand Response and other energy management strategies available with the standard WPT (and also available on deadband WPT).

Comparison: Standard Pneumatic vs. Deadband Function

Standard Pneumatic Thermostat Behavior (Typical, Direct Acting)



Deadband Pneumatic Thermostat Behavior (Typical, Direct Acting)



*Minimum and Maximum Setpoints are selectable by user or building manager

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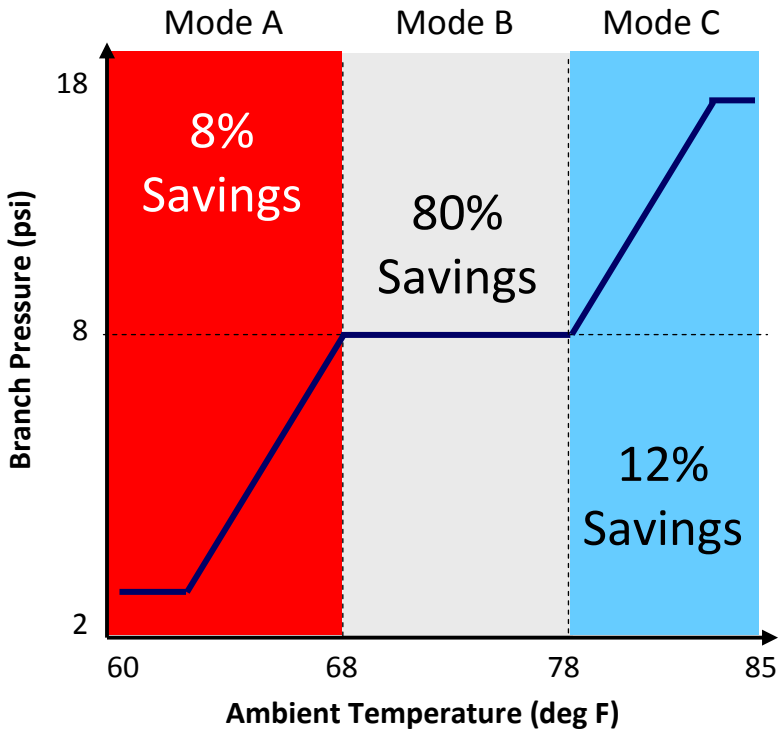
Energy Savings Enabled by Deadband

Significant Savings!



	% of time operating in:			Est. Energy Savings
	Mode A	Mode B	Mode C	
Location 1 (e.g. San Diego, CA)	20%	70%	10%	59%
Location 2 (e.g. Fargo, ND)	75%	20%	5%	23%
Location 3 (e.g. Miami, FL)	20%	50%	30%	45%

Deadband Savings By Mode vs. Standard Stat

- Mode A – Min Setpoint 4F below conventional Setpoint => 8% energy savings.*
- Mode B – Only ventilation fans running, no heat or cool => 80% energy savings.**
- Mode C – Max Setpoint 6F above conventional Setpoint => 12% energy savings.*

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* Every degree of setback equals 2% energy savings. Source: ACEEE.
** Ventilation uses about 20% of the energy in HVAC even when cooling or heating is not active.
Souce: US Energy Information Administration.

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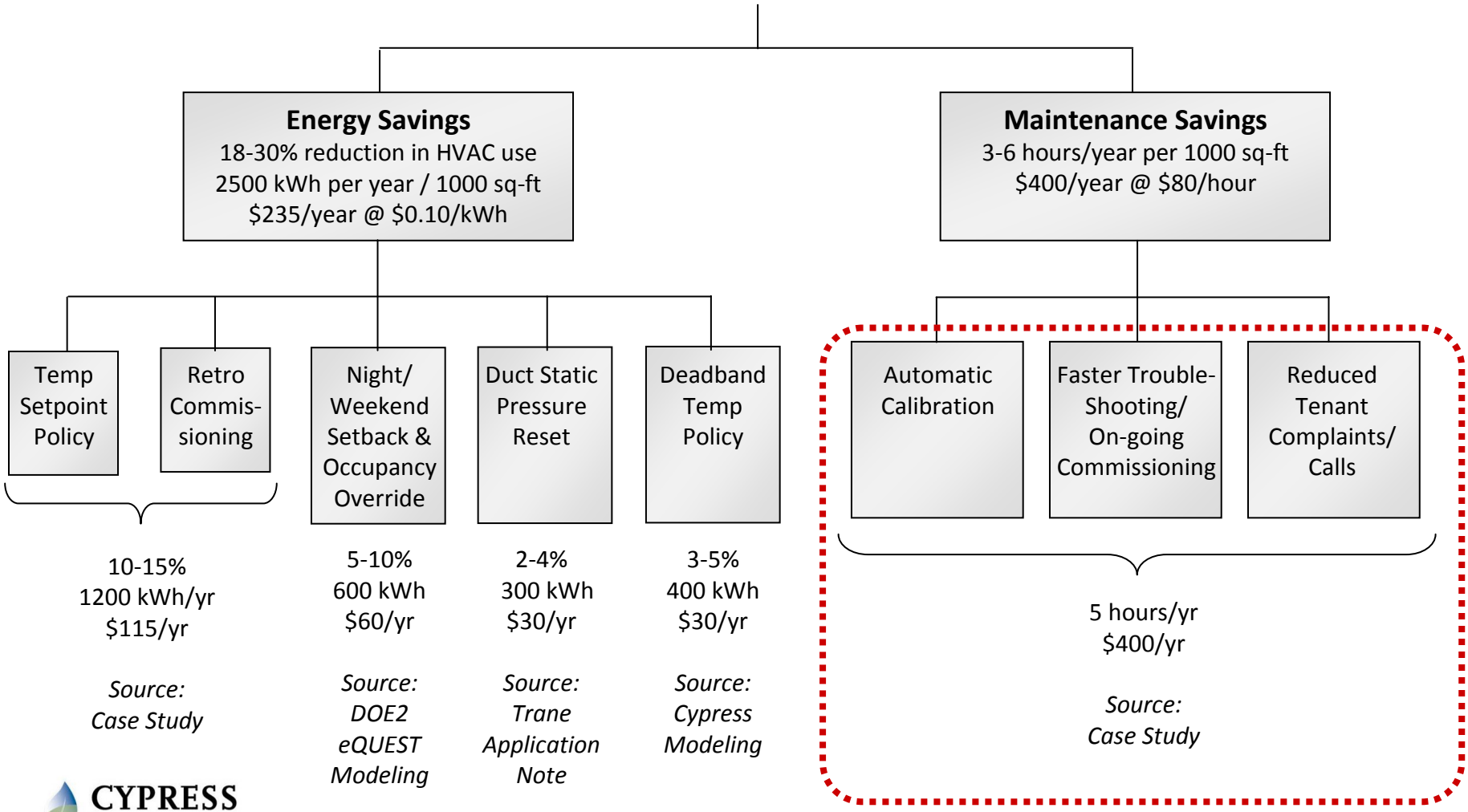

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Savings from Reduced Maintenance

- **Auto-Calibration:**
  WPT has built-in auto-calibration routines which save 15-30 minutes per zone for calibration.

- **Reduced Tenant Hot/Cold Calls:**
  WPT has built-in zone temperature sensing and alarming which proactively sends emails to operators in event of temperature excursion. Reduces unplanned emergency service calls.

- **Faster Troubleshooting/On-going Commissioning:**
  Pneumatic control systems lack sensor data which means that building managers are "blind". The WPT provides a built-in branch pressure, zone temperature, and setpoint temperature sensors. The system can alarm on high or low limits to send email alerts or BACnet alarms to operators before occupants complain. System can log and trend months of historical data which significantly reduces the effort troubleshooting. Service strategy converted from Scheduled Maintenance to Condition Based Maintenance, and enable Ongoing Commissioning.

- Actual Case Study Results, Santa Clara County Government– 300,000 sq-ft retrofit
  - Average pre-retrofit service charge of $25,000/month by external service supplier. Average post-retrofit charge of $10,000/month – 60% REDUCTION
  - Key learnings: Use monitoring data to predictively detect faults, dispatch service personnel only to zones with identified faults, and monitor to confirm fault is fixed post service call.

Full case study available at: http://www.cypressenvirosystems.com/files/pdf/CountyofSantaClara_EnergySavings_Final.pdf

60% Reduction in Maintenance Service Hours by Dispatching Service Work Only to Detected Problem Areas, and Faster Troubleshooting