

Emerging Technologies for the Commercial Sector

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E Source

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Today's Outline

Single-Zone RTU Retrofit Controllers
Evaporative Pre-Coolers for Rooftop Units
Cloud Thermostats
Dynamic Airzone Balancing
Latest and Greatest LED Products
Daylight-Redirecting Film
CO₂ Laundry Systems
Liquid Submerged Servers

Q&A



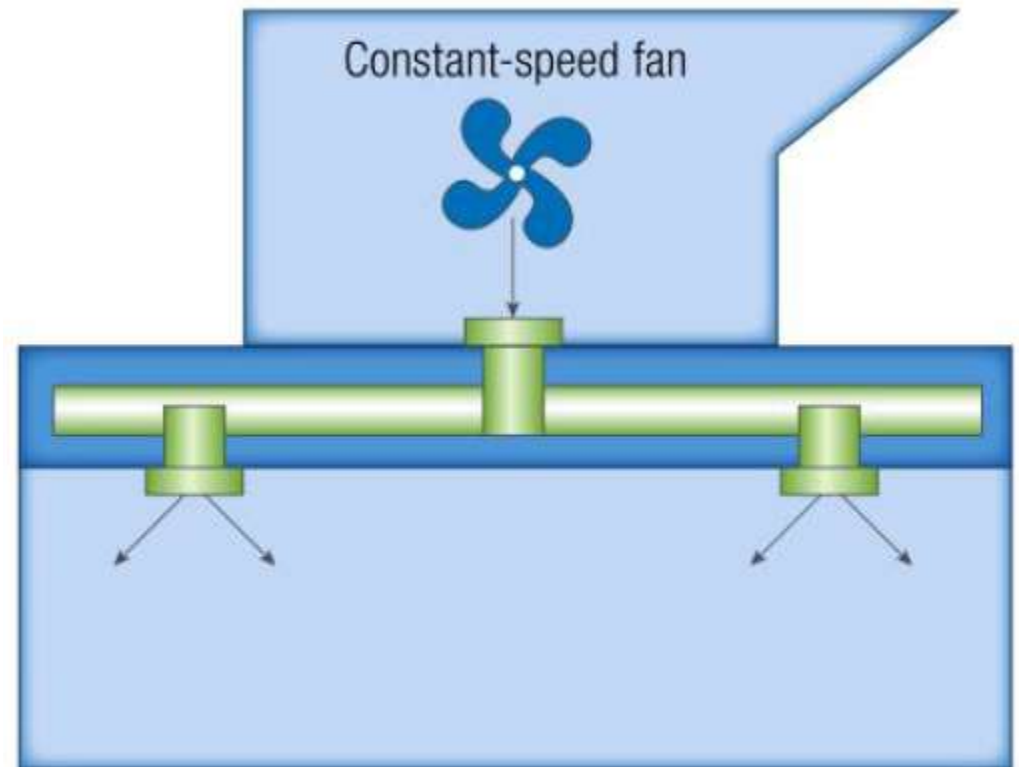
Single-Zone RTU Retrofit Controllers



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Single Zone RTUs Are UNINTELLIGENT Machines

- One zone
- Fixed fan speed
- Fan either on or off
- Ventilation kept at 100% when building is occupied



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RTU Variable-Frequency Drive Retrofit Devices

- Catalyst

[Transformative Wave Technologies](#)



Source: Transformative Wave Technologies

- Enerfit

[Enerfit LLC](#)



Source: Enerfit

- Digi-RTU Optimizer

[Bes-Tech](#) (DTL Controls)



Source: Bes-Tech



Different Strokes for Different Folks

Product	VFD evaporator fan	VFD compressor	VFD type	Damper for coil 2
Catalyst	✓		Indexed	
Enerfit	✓		Continuous	✓
Digi-RTU	✓	✓	Continuous	

Note: VFD = variable-frequency drive.

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Source: Wikimedia Commons



Source: Enerfit



All Provide Additional Features

- Demand-controlled ventilation
- Integrated economizer control
- Web control and monitoring
- Fault detection and diagnostics



Newest Results Continue to Be Positive: PNNL Study

- PNNL study published July 2013:
 - 66 Catalyst units
 - 8 different buildings (retail, shopping mall, office, food sales, healthcare)
 - 4 climate zones (warm coastal, mixed humid, mixed marine, cool moist)
- **Average savings of 57%!**
- Mostly due to fan energy savings when in ventilation-only mode
- Average simple payback of 3 years at \$0.10/kWh



Newest Results Continue to Be Positive: SDG&E Study

SDG&E study published November 2013:

- 2 different manufacturers (kept anonymous)
- 1 installation per manufacturer
- 1 building in San Diego, California

Device	Variable-speed evaporator fan	Variable-speed compressor	Demand-controlled ventilation (DCV)	Economizer controls	Fault detection & diagnostics (FDD)	Savings
Unit 1	✓	✓				27%
Unit 2	✓		✓	✓	Some	26%

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Newest Results Continue to Be Positive: NREL Study

NREL study published March 2014:

- 9 Catalyst units in large retail buildings
- 2 Catalyst units in small office buildings
- 3-6 months of demonstration
- Located in Hawaii
- 5-15% whole building energy savings



In Addition to Energy Efficiency
















Courtesy: Transformative Wave Technologies



Fault Detection and Diagnostics

Unit03

Health Status

Drive Communication	
Drive Fault	
Fan Run	
Fan Belt	
Heating Fail	
Cooling Fail	
Damper Fail	
Space Sensor	
Supply Sensor	
Return Sensor	
OSA Sensor	
CO2 Sensor	
Service Off	

Courtesy: Transformative Wave Technologies



Conclusion

- VFD Retrofit Devices Are Ready for Prime Time
 - Proven, significant savings
 - Units that modulate the compressor have not been shown to be any more effective than fan speed modulation



Evaporative Pre-Coolers for Rooftop Units



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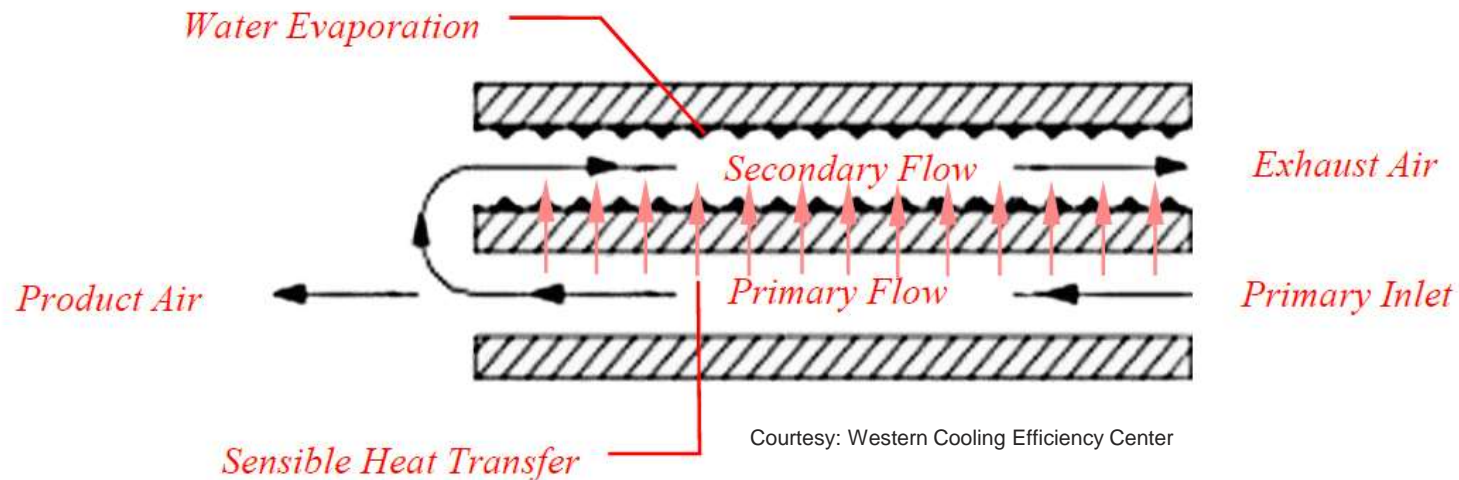
Coolerado M50 & Seeley Climate Wizard CWH 15: Big Energy Savings



Courtesy: Western Cooling Efficiency Center



Evaporative Cooling With No Added Moisture



Indirect evaporative cooling

- No moisture is added to the conditioned space
- Capable of cooling to a lower temperature than direct evaporative cooling
- Requires some additional fan energy compared to direct evaporative cooling



Coolerado VS Seeley Climate Wizard

Pacific Gas and Electric and Western Cooling Efficiency Center (WCEC) pilot field study

- Large retail store and grocery
- Bakersfield, California (California climate zone 13)
- Evaporative pre-coolers set up as DOAS units, but used existing ductwork
- Performance difference between the two units was too close to call



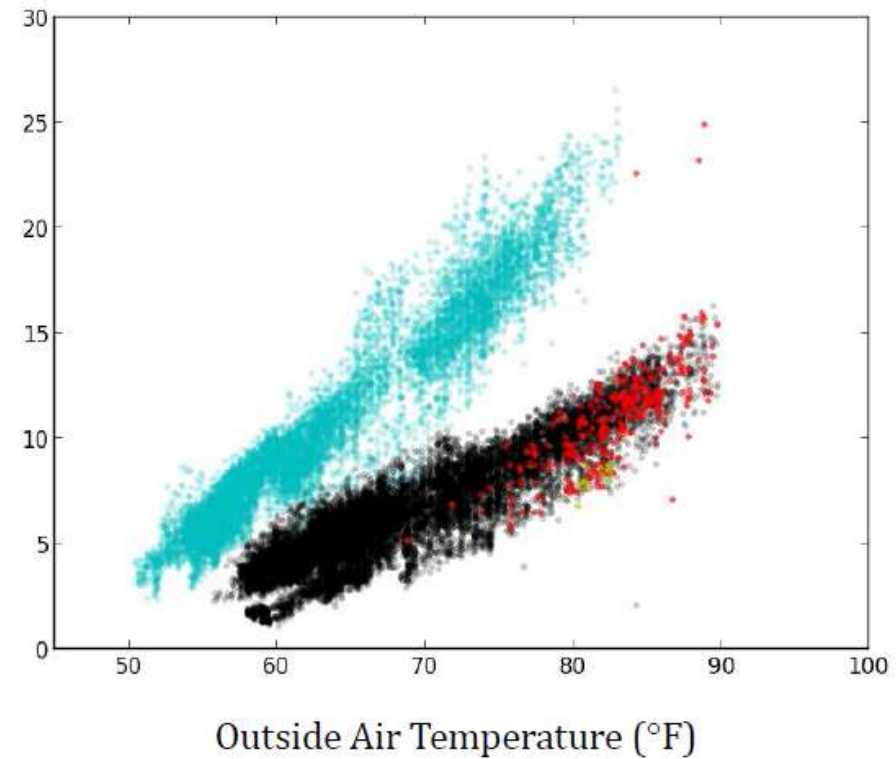
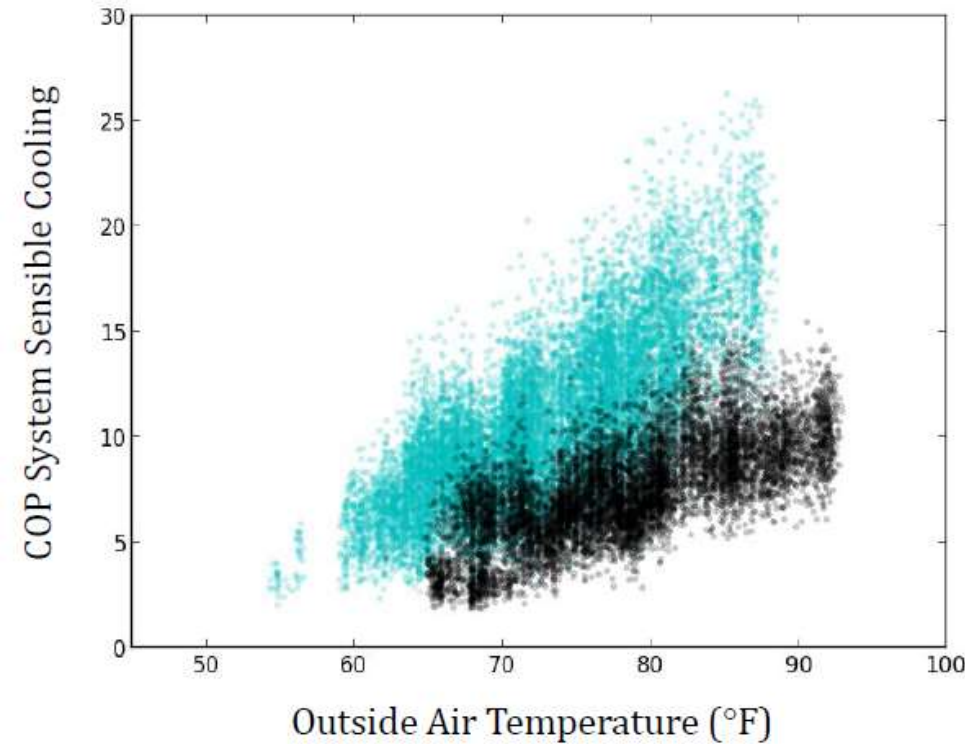
Courtesy: WCEC



Way More Efficient than Vapor Compression

Climate Wizard CWH15

Coolerado M50



● IEC Part

● IEC Full

● IEC Full + DX1

● IEC Full + DX2

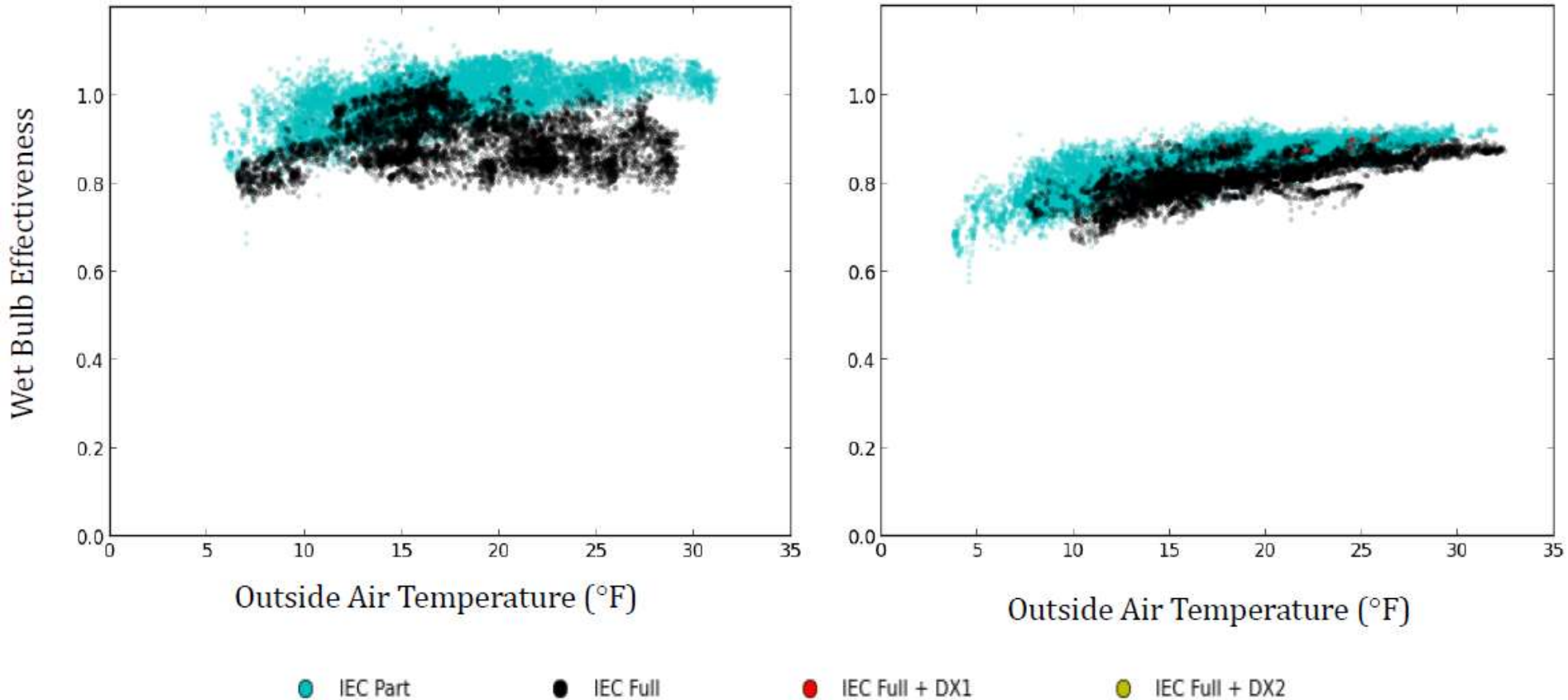
Courtesy: WCEC



Wet Bulb Effectiveness Will Likely Stay Consistent Across Different Climates

Climate Wizard CWH15

Coolerado M50



Courtesy: WCEC



Conclusion

- Works great in hot-dry climates
 - Especially for DOAS systems
 - Outstanding
 - Energy efficiency
 - Equipment performance
 - Improved reliability over previous models
 - Successfully reduced demand by more than 75 percent
- What we still need to learn
 - What's the climate range?
 - What are the economics?



Cloud Thermostats



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In Homes



Courtesy: Nest Labs



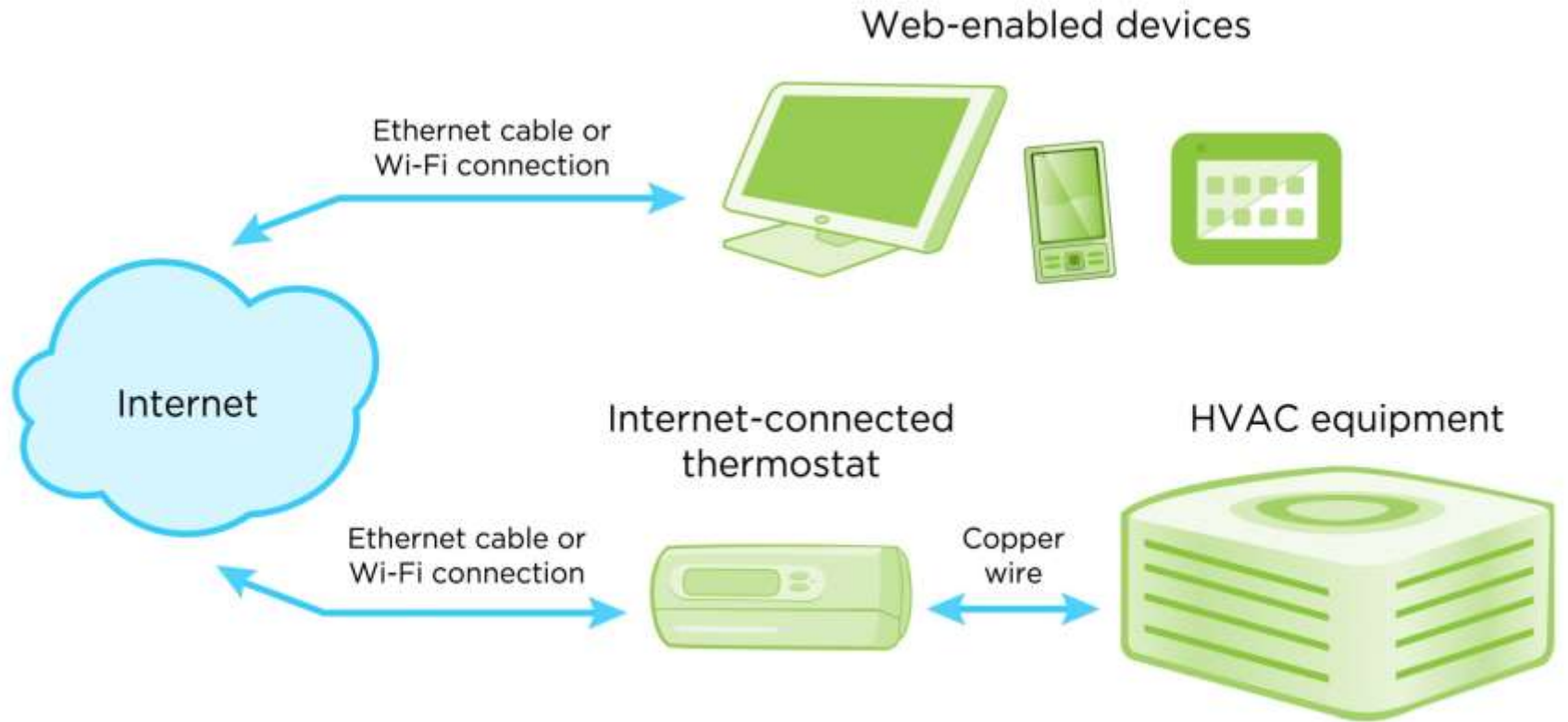
In Small to Midsize Buildings



© E Source



Here's How They Work



© E Source



Get a Lot for a Little

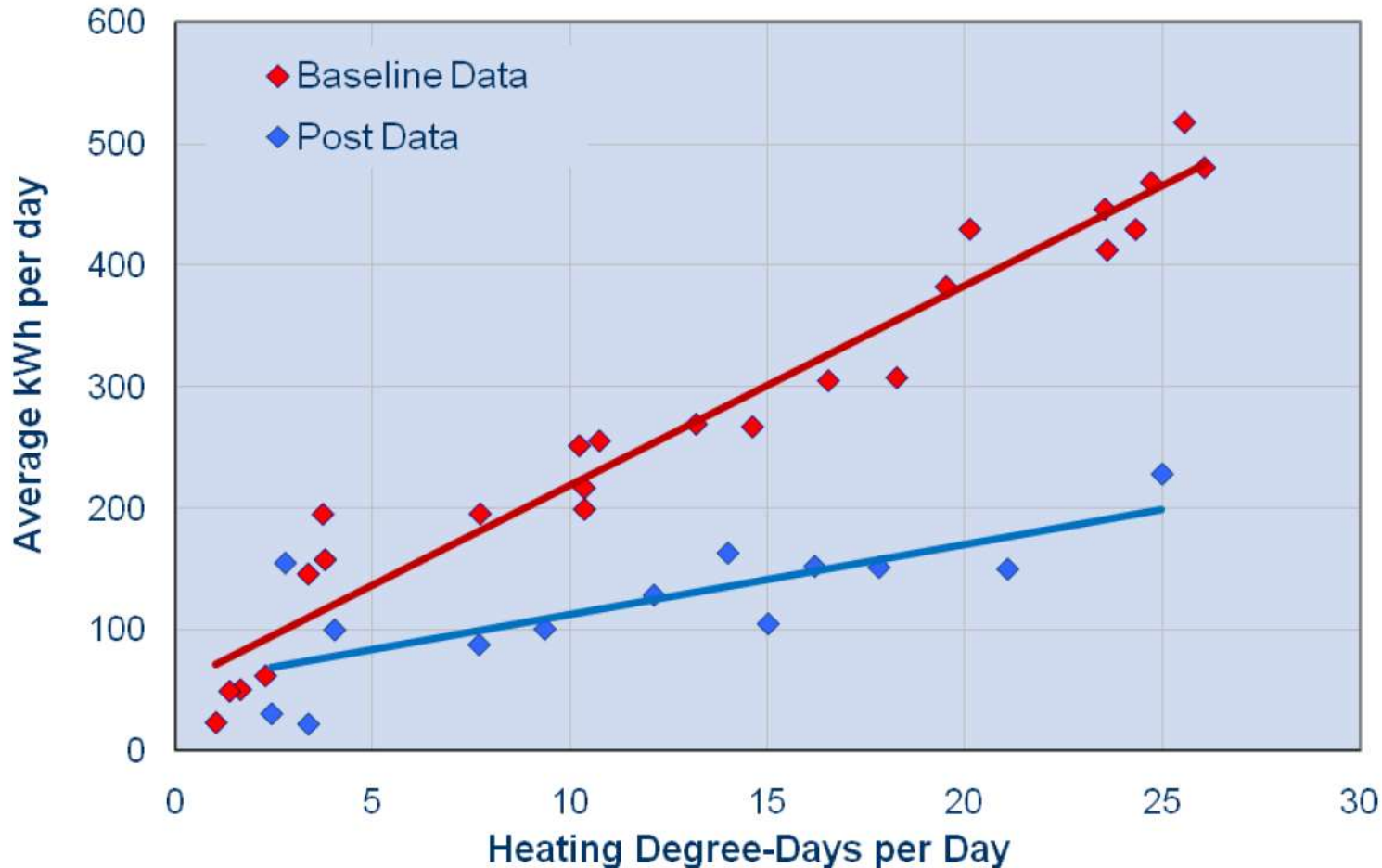
Item	Value
First costs	\$500 to \$1,000 per thermostat installed
Annual costs	\$36 to \$75 per thermostat
Energy savings	10% to 50% of overall energy costs
Other benefits	Reduced O&M costs

© E Source



Cloud Thermostats Go to School

Metered Electricity Use vs. Historical Heating Degree-Days



Source: Quantum Energy Services and Technologies



The Thermostats

- Proliphix
- Bay Controls
- Radio Thermostat
- Viconics



Courtesy: Proliphix



Thermostat Features

- Built-in web server
- Wired or wireless connectivity
- Multiple stages (3 heat, 2 cool)
- Password protected
- Automatic daylight savings time correction
- 366-day programming
- 5-year holiday scheduling
- Humidity and other additional sensing (3 sensor inputs)
- 2 auxiliary relays
- Intelligent recovery
- Built-in alarms



Application Features

- Access from any web-connected browser, including smartphones and tablets
- Data storage
- Graphing
- Alerts
- Thermostat programming and scheduling
- Reporting
- Demand response



Conclusion

- Great features at a great price point
- Promising technology
- Savings have not been proven



Dynamic Airzone Balancing



E Source

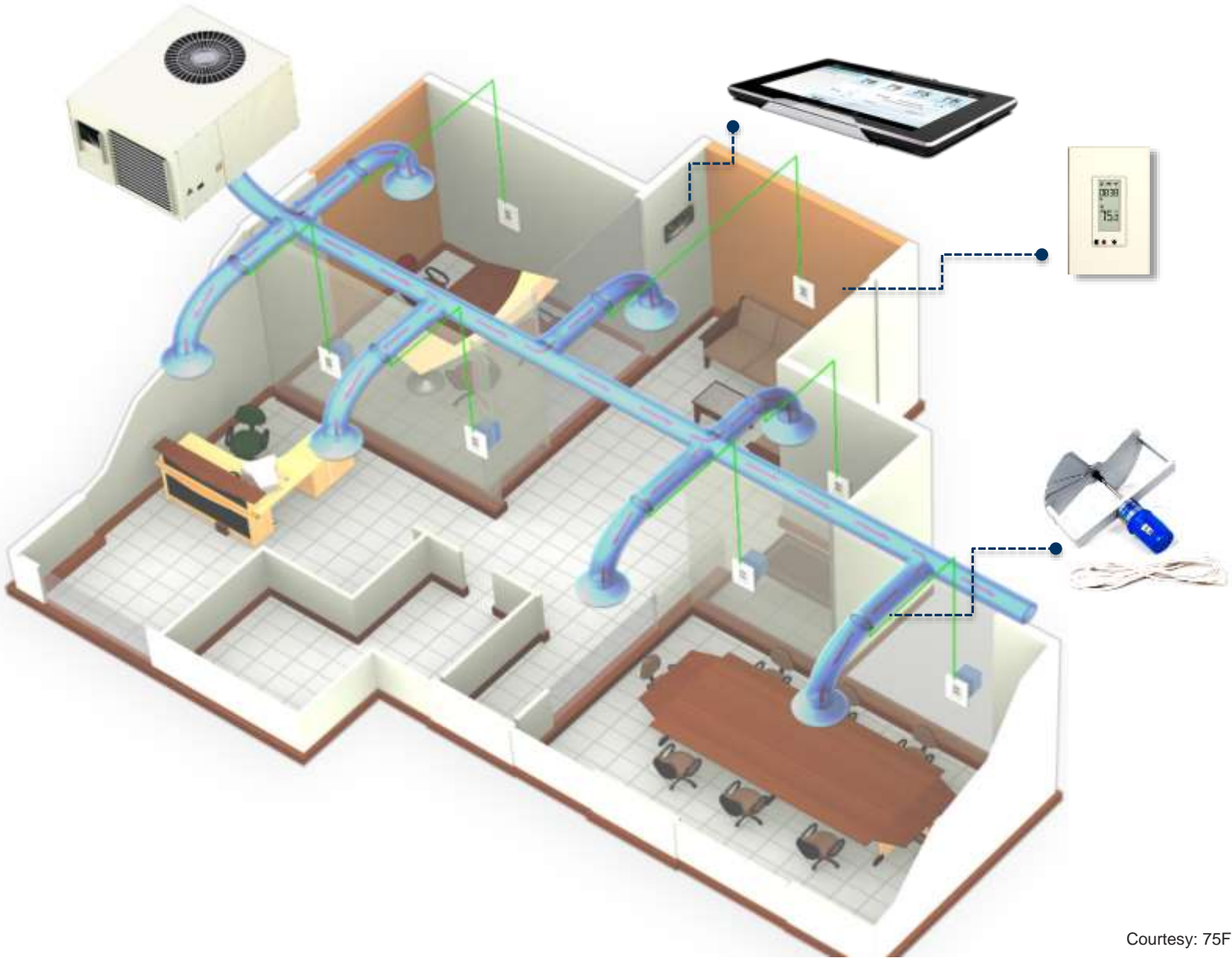
The Problem



Source: Cartoonaday.com



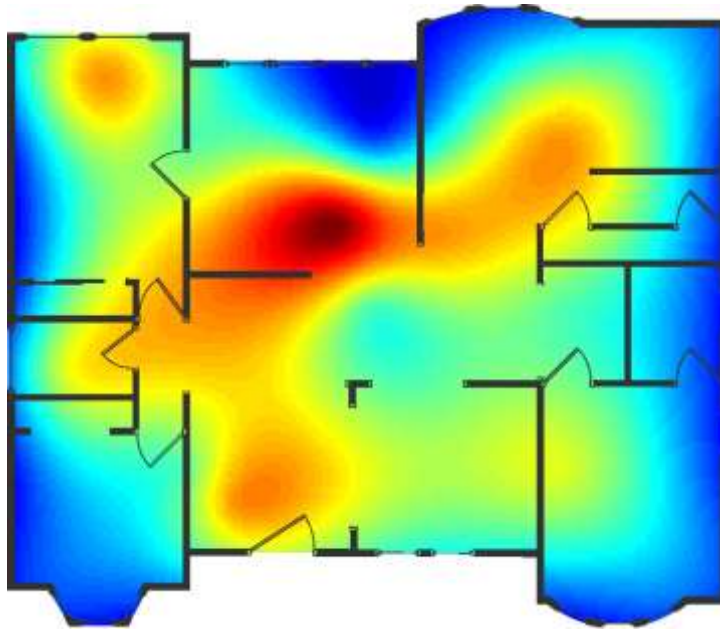
A New Solution



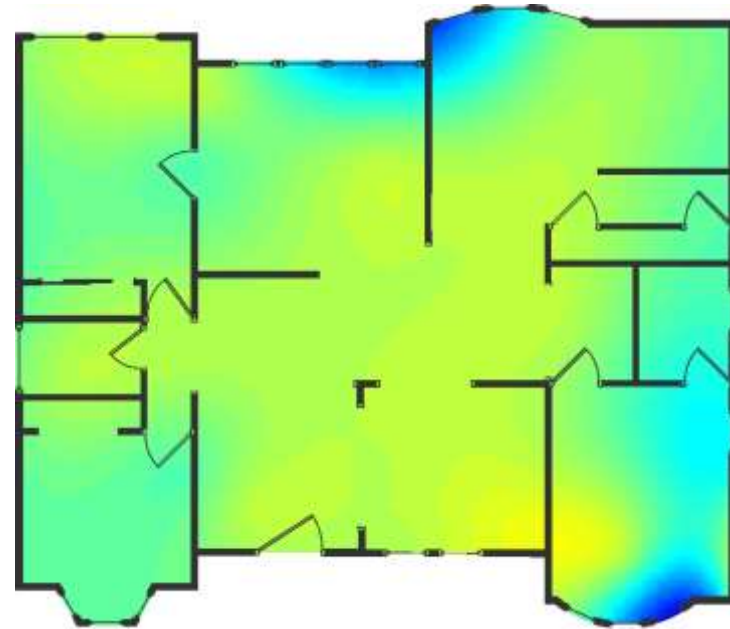
Courtesy: 75F



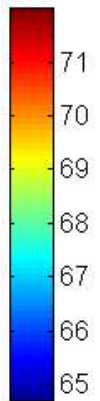
Getting in Balance



Before



After



Courtesy: 75F



Check Out Those Temperatures

mat.75fahrenheit.com/users/heatmap/2

Mb [edit profile](#) [logout](#)

75°F
THE NEW COOL

Heatmap

Status

Charts

Setup

Select CCU

W 62nd St

73.5 Foyer 1

71 Foyer 2

89.5 Greg 1

69 Greg 2

71 Kitchen

76 Open 5

89.5 Open 6

88 Open 7

88.5 Open 8

71.5 Conference 1

70 Open 1

89.5 Open 2

71.5 Conference 2

88.5 Open 4

70.5 Open 3

70.5 Copy Printer

72 Jack Office

69.5 Back Room

70.5 Maggie Room

71 Mike Office

70.5 Spare Office

Select the floor to view Heatmap

Main

Main

Play Heatmap movie

Last update - from 6235 S. Oak Park Ave. Chicago 3 seconds ago

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Either Graphically

The screenshot displays a web browser window with the URL `mat.75fahrenheit.com/users/heatmap/2`. The page features a logo for '75 THE NEW COOL' and a user profile for 'Mb' with a 'logout' link. A sidebar on the left provides navigation for 'Heatmap', 'Status', 'Charts', and 'Setup', along with a 'Select CCU' section showing a map of the building location. The main area shows a heatmap of the 'Main' floor with rooms and their temperatures: Foyer 1 (72.5), Foyer 2 (71), Greg 1 (69.5), Greg 2 (69.5), Greg 3 (69), Kitchen (71), Open 5 (70), Open 6 (69.5), Open 7 (69), Open 8 (69.5), Conference 1 (71.5), Open 1 (70), Open 2 (69.5), Conference 2 (71.5), Open 3 (70.5), Copy Printer (70.5), Open 4 (69.5), Jack Office (72), Open 3 (70.5), Back Room (69.5), and Maggie Room (70.5). A modal window for 'Open 4' is open, showing 'Current Temp: 69.5', 'Desired Temp: 82', and 'Schedule: Zone'. A 'Last update' message indicates data from 6235 S. Oak Park Ave. Chicago was updated 3 seconds ago. The footer contains the copyright notice: '© Copyright 2014 75Fahrenheit. All rights reserved.'



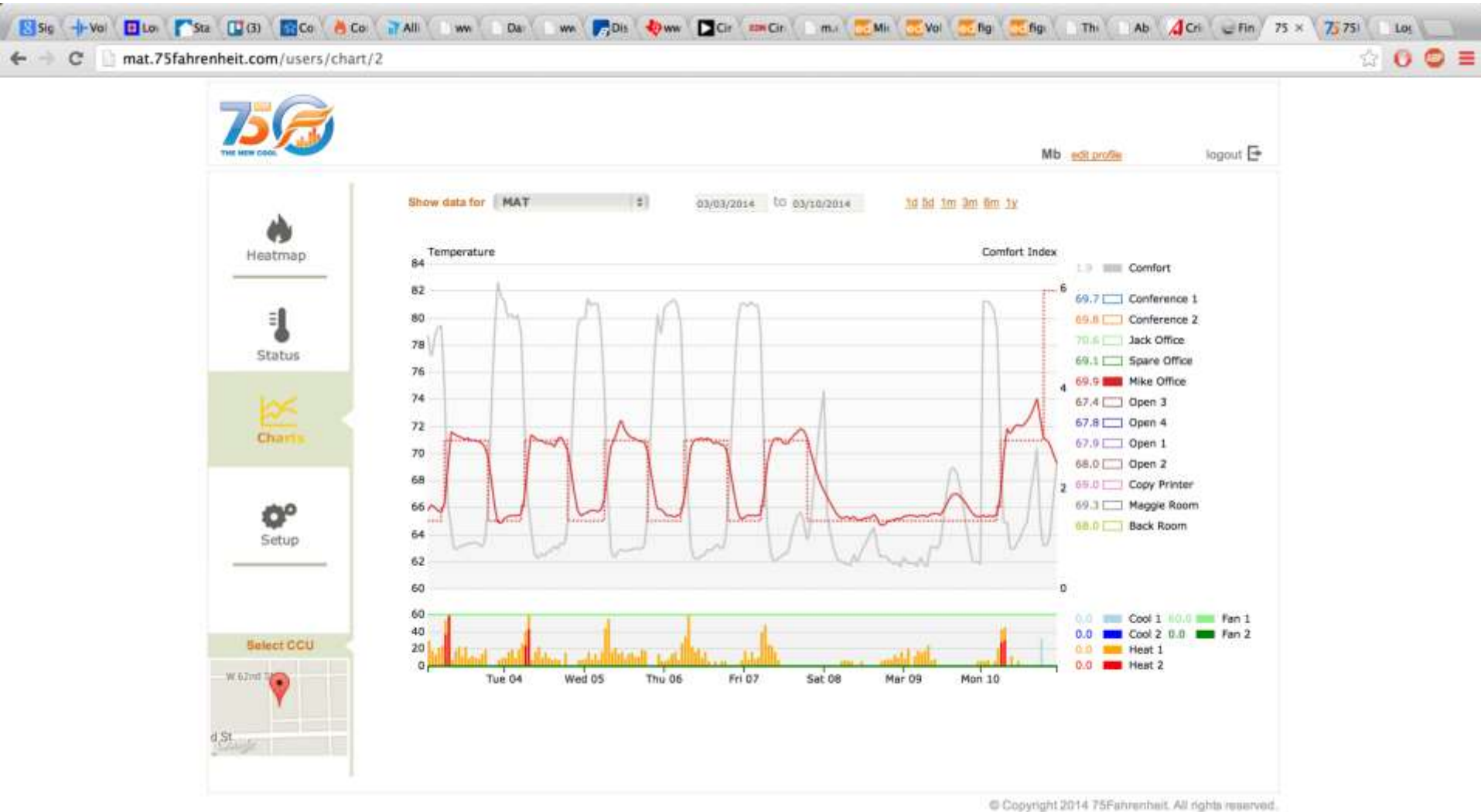
Or Tabularly

The screenshot shows a web browser window with the address bar displaying `mat.75fahrenheit.com/users/status/2`. The page features a logo for 'THE NEW COOL' and a user profile 'Mb edit profile' with a 'logout' link. A left sidebar contains navigation options: 'Heatmap', 'Status' (highlighted), 'Charts', and 'Setup'. Below the sidebar is a 'Select CCU' section with a map showing a location on 'W 62nd St'. The main content area displays a table with the following data:

Floor	Room	Temp	Desired Temp	Schedule	Occupancy
Main	Foyer 2	71	65	ZONE	Occupancy Disabled
Main	Greg 1	69.5	69	ZONE	Occupancy Disabled
Main	Greg 2	69.5	69	ZONE	Occupancy Disabled
Main	Greg 3	69	69	ZONE	Occupancy Disabled
Main	Kitchen	71	72	ZONE	Occupancy Disabled
Main	Open 5	70	72	ZONE	Occupancy Disabled
Main	Open 6	70	72	ZONE	Occupancy Disabled
Main	Open 7	69	71	ZONE	Occupancy Disabled
Main	Open 8	69.5	73	ZONE	Occupancy Disabled
Main	Foyer 1	73.5	65	ZONE	Occupancy Disabled
Main	Maggie Room	70.5	82	ZONE	Occupancy Disabled
Main	Back Room	69.5	82	ZONE	Occupancy Disabled
Main	Conference 2	71.5	82	ZONE	Occupancy Disabled
Main	Jack Office	72	82	ZONE	Occupancy Disabled
Main	Mike Office	71	82	ZONE	Occupancy Disabled
Main	Spare Office	70.5	82	ZONE	Occupancy Disabled
Main	Open 1	70	82	ZONE	Occupancy Disabled
Main	Open 2	69.5	82	ZONE	Occupancy Disabled
Main	Open 3	70.5	82	ZONE	Occupancy Disabled
Main	Open 4	69.5	82	ZONE	Occupancy Disabled



Even Graph History



Conclusion

- Great idea, but...
 - Energy savings undetermined
 - Young company
 - Reliability and quality control undetermined

