Transformative Wave Technologies
Kent, Washington
www.transformativewave.com

WASHINGTON **GREEN 50**

technology/cleantech (small company)

Transformative Wave Technologies, Kent

TWT retrofits existing HVAC systems to increase their energy and cost efficiency.

catalysteec.com

transformative wave TECHNOLOGIES

manufacturers of the

CATALYST

Efficiency Enhancing Controller

Patent Pending

North America's Leading Energy Efficiency Solution for Constant Volume HVAC Systems

The CATALYST converts constant volume RTUs into highly efficient single-zone VAV with Demand Control Ventilation and Advanced Economizer Control

CATALYST

Efficiency Enhancing Controller

Patent Pending

- Proven track record of reducing overall energy use by 25%-40%
- Maintains comfort & assures indoor air quality
- Automatic air flow adjustments to protect equipment.
- Integrates with many existing Building Automation Systems
- Demand-Response Capability

The CATALYST is delivered as a complete retrofit “kit”

Pre-engineered, pre-programmed, and can be installed in only a few hours.
Produces a repeatable and scalable process with predictable results.

Energy Saving Strategies

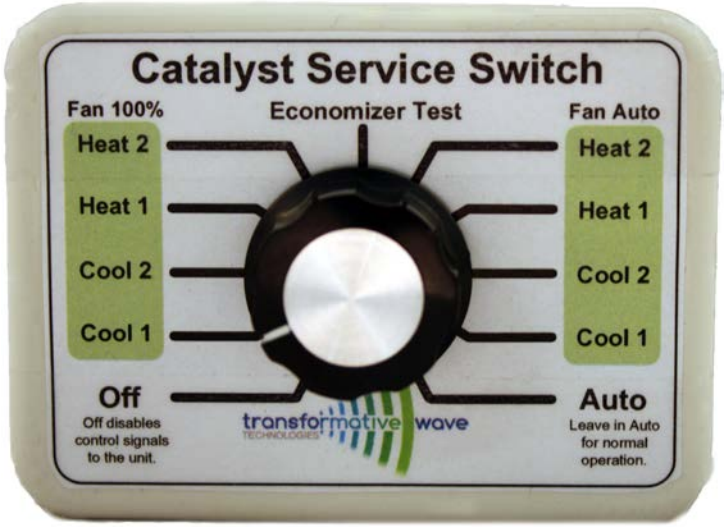
Integrated Economizer with Differential Changeover Control

Variable Speed Fan Control to Match the Needs of the Space Served

Elimination of Over-Ventilation via Demand Control Ventilation (DCV)

Remediation of Service and Operational Issues

CATALYST Service Switch



- A multi-position selectable switch for service personnel use. This will enable techs to operate the system in any mode of operation for maintenance purposes.
- The use of the service switch will suppress data collection by the eIQ Platform to avoid negative impact on fault detection and historic comparison functions.

Empowers contractors to easily perform preventative maintenance without undermining the CATALYST installation.

Department of Energy

The CATALYST is the basis of the recently announced

ADVANCED RTU CAMPAIGN

ASHRAE

Better Buildings
U.S. DEPARTMENT OF ENERGY

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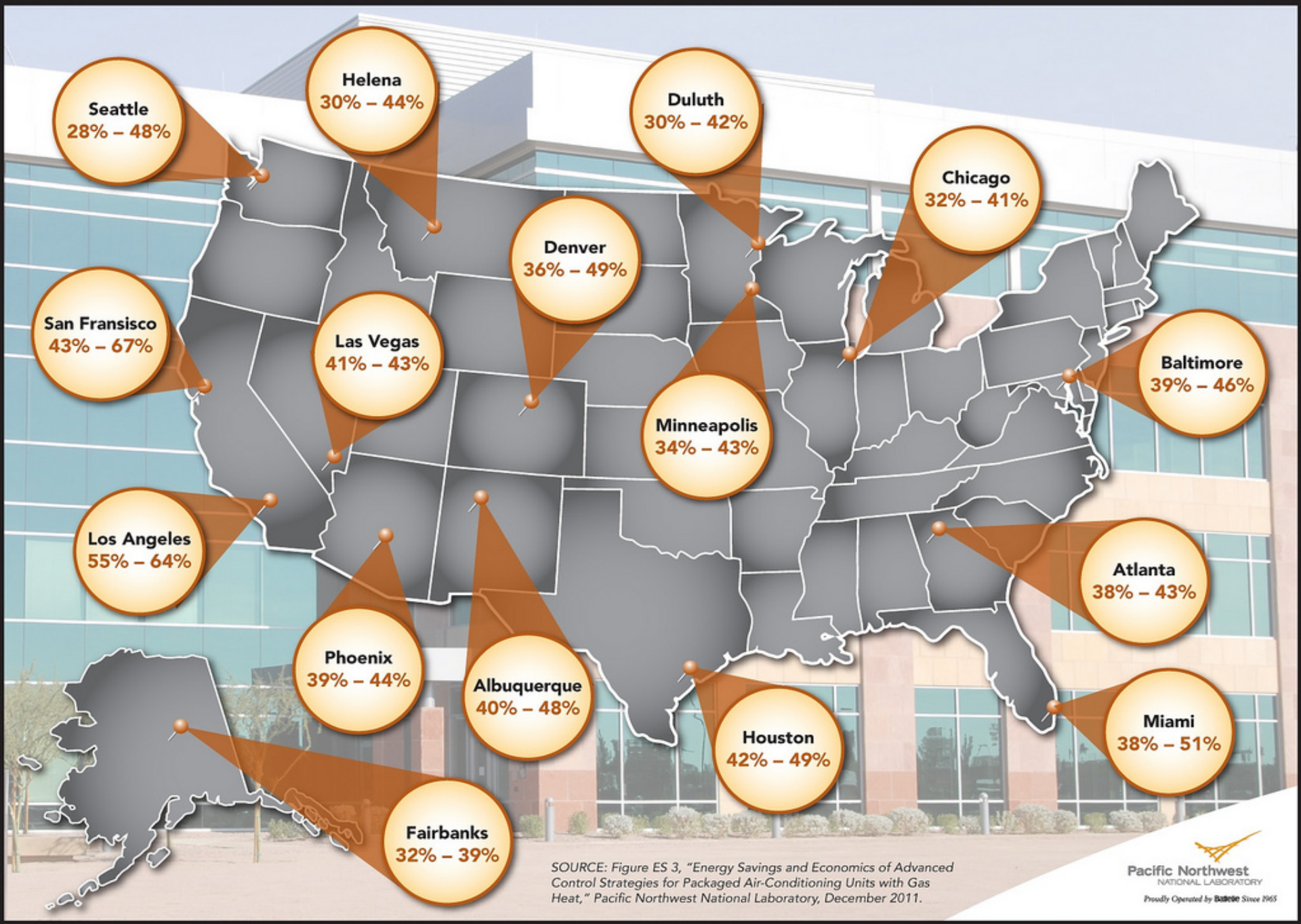
ESTIMATED COST SAVING RANGES FOR U.S. COMMERCIAL BUILDING HVACS WITH EFFICIENCY CONTROLS



SOURCE: Figure ES 3, "Energy Savings and Economics of Advanced Control Strategies for Packaged Air-Conditioning Units with Gas Heat," Pacific Northwest National Laboratory, December 2011.

Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

U.S. DEPARTMENT OF ENERGY

PNNL-XXXXX

Prepared for the U.S. Department of Energy
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Energy Savings and Economics of Advanced Rooftop Control Strategies: Field Results

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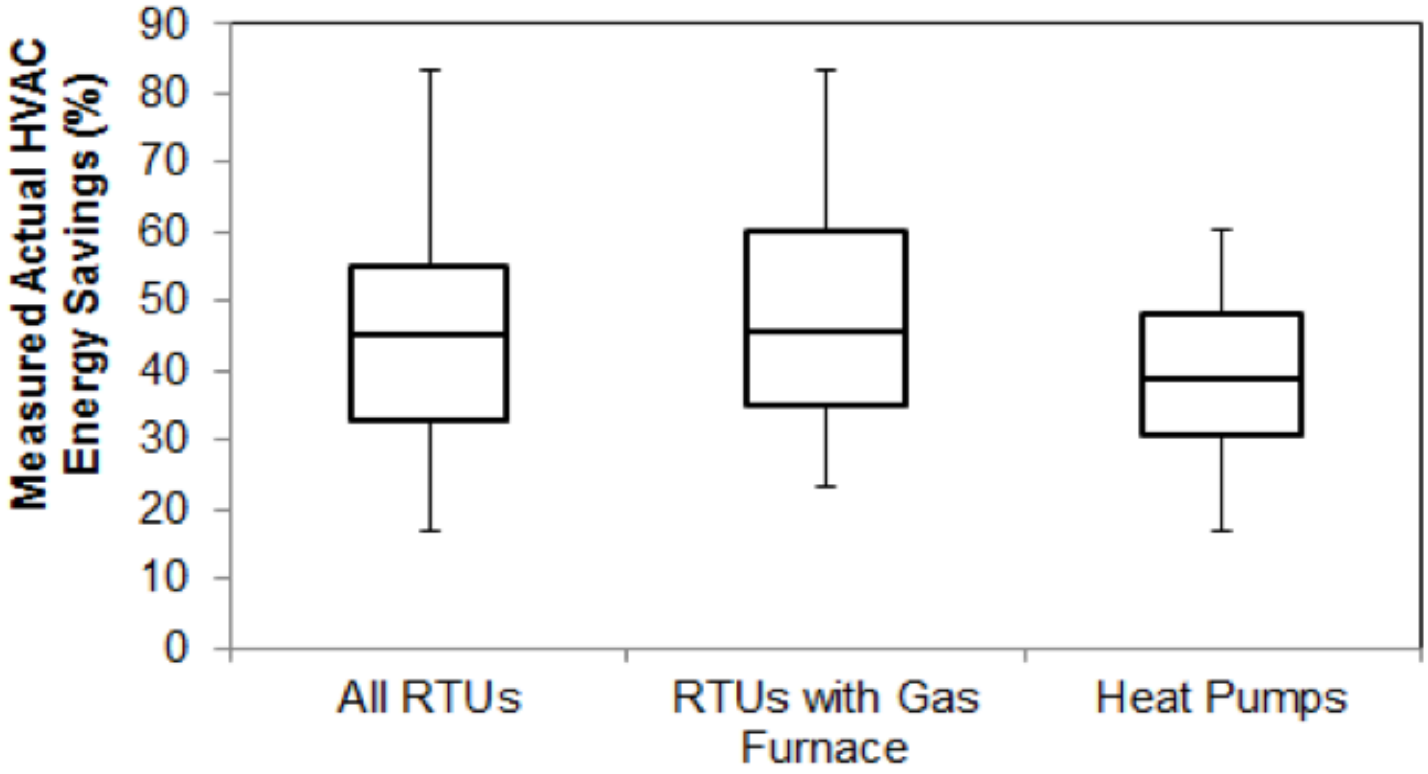
RTU Advanced Controls Electricity Savings from Field Measurements

- Preliminary electricity consumption from 51 RTUs were analyzed
  - 17 RTUs are heat pumps and the rest are air conditioners with gas furnaces



http://www1.eere.energy.gov/buildings/commercial/pdfs/commlbldgs16_brambley_040413.pdf

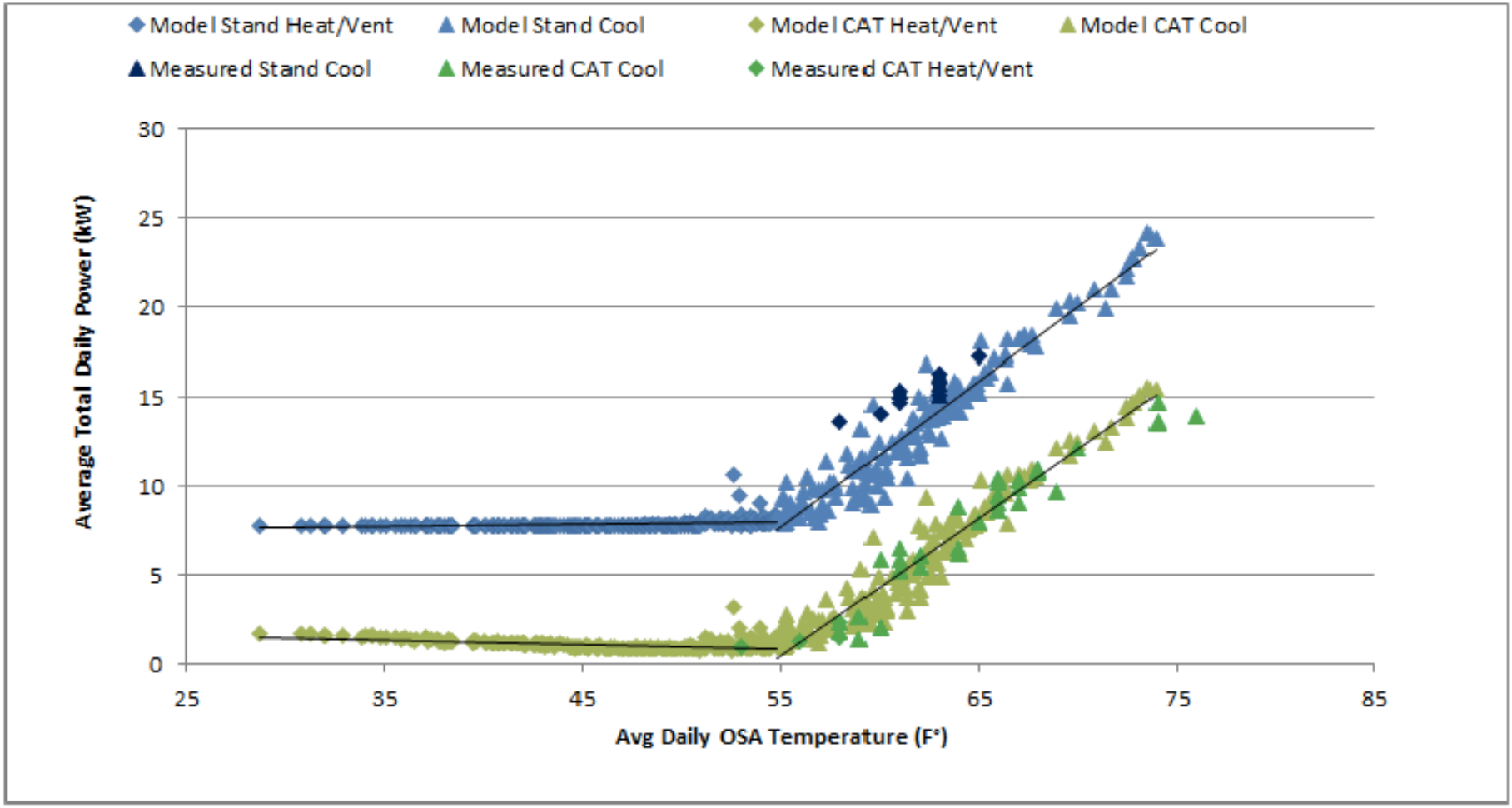


Fig 6. Average Daily Electric HVAC Usage by Average Daily Outside Air Temp.

Case Study

Install Date: March 2010

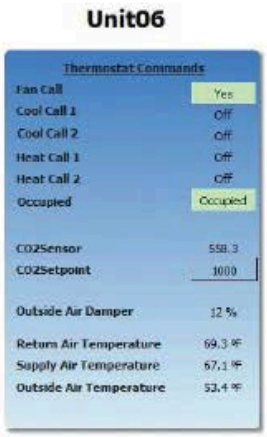
Location Type: Retail - Showroom

Project Details:

HVAC Equipment:	**(40) Gas/Electric units, Average Size 12.5 Tons**
Projected Savings:	**327,000 kWh/year**

Savings Summary

Projected Payback:	**1.8 Years**
ROI:	**56%**
HVAC Fan Energy:	**69% Savings in Fan Energy Usage**
Utility Bill Analysis:	**9% Reduction in Total Building Energy Use**



Valencia Performance Summary

Mode	Standard		CATALYST		Savings		
	Total Energy	Avg Power	Total Energy	Avg Power	Total Energy	Avg Power	
	(kWh)	(kW)	(kWh)	(kW)	(kWh)	(kW)	
Fan	13,234	9.0	4,926	3.3	8,308	5.7	63%
Cooling	5,002	3.9	4,462	3.5	540	0.4	11%
Electric[2]	18,236	12.9	9,388	6.8	8,848	6.1	47%
	(Therms)	(BTU/h)	(Therms)	(BTU/h)	(Therms)	(BTU/h)	
Gas[2]	1,328	103,251	1,219	94,956	109	8,295	8%
	(MBTU)	(MBTU/h)	(MBTU)	(MBTU/h)	(MBTU)	(MBTU/h)	
Unit Total	195,006	147	153,907	118	41,099	29	20%

[1]Based on data collected by the eIQ Energy Intelligence Platform during Measurement & Verification (M&V) period from July 28th to December 15th including 5,854 hours of standard mode unit runtime and 5,927 hours of CATALYST mode unit runtime. Unit 05 excluded from sample

[2]Cooling & Heating values are for Full CATALYST Installations only (Unit #1 & Unit #3)

- CATALYST technology upgrades have provided an improved energy profile with 20% overall reduction in HVAC energy.
- Annual electrical HVAC savings are projected to exceed 77,000 kWh (48%)
- Analysis based on 4 units due to simultaneous cooling/heating calls from the CPC for Unit 05.
- The site will continue to be monitored for energy performance and fault conditions.

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Why stop at energy efficiency?

optimize

upgrade

perpetuate

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What can you do with:

a wireless rooftop network?

real-time connectivity?

40 points of RTU data?

one-minute interval histories?

Performance Monitoring

Visual Fault Reporting

Perpetual Trending

Fault Prioritization

Icon-based Status Indications

Demand Management

Unit sub-metering

Remote Troubleshooting

Outlier Identification

Predictive Maintenance

Life Cycle Extension

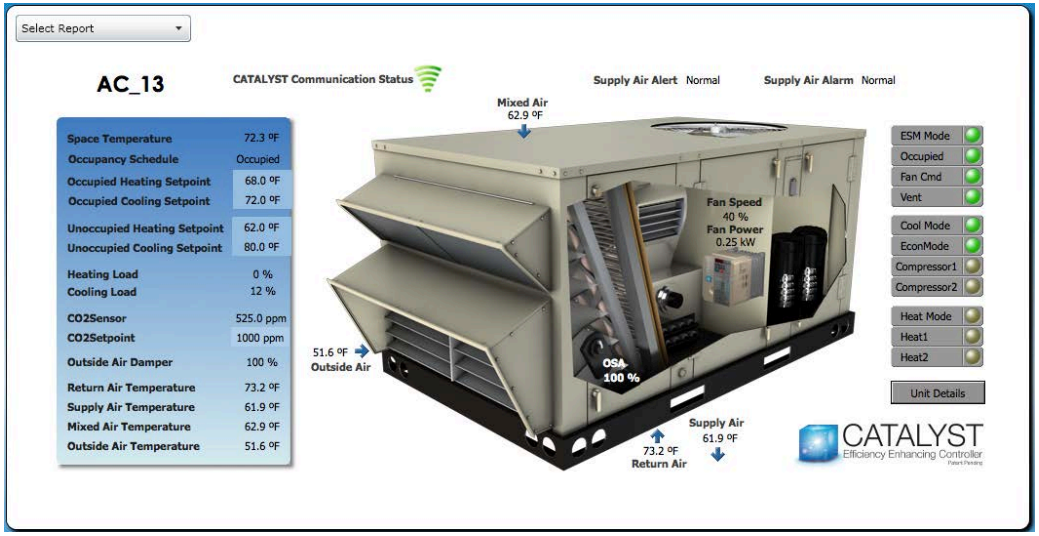
Advanced Fault Detection and Diagnostic Routines

Portfolio Energy & Performance Management

HVAC Asset Management Tools

energy intelligence platform

Powered by Niagara AX FRAMEWORK®



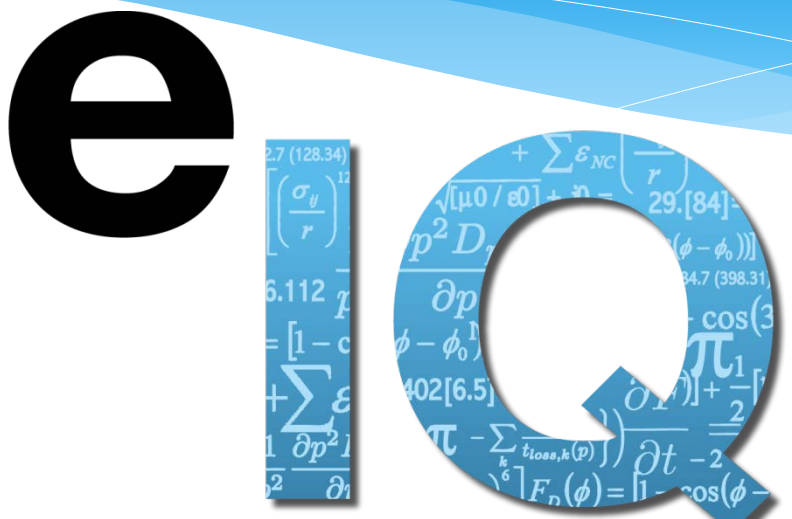
Demand Response Strategies

Cycle Control Units are turned off at specific intervals during the demand period. Works with a lot units

Dynamic Control – A demand level is established for the building, and the available energy is passed to the units with greatest demand

Set points are adjusted during the demand period

Pre Cooling the electrical loads are shifted to off peak times



LIVE DEMONSTRATION

Transformative Wave Technologies
www.transformativewave.com

energy intelligence platform

Benefit Summary

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- Customization, integration, and creative application opportunities.
- Optimize control of HVAC assets for proper space humidity, temperature, and IAQ.
- Non-proprietary, open architecture, open source license, vendor independence, broad support in the marketplace
- Energy savings potential that creates and ROI-basis to the BMS investment
- Positive life cycle impact from maintenance and fault detection features
- Reduces critical system downtime
- Maximizes productivity
- Predictive maintenance
- Lowers total cost of ownership
- Reduced wear & tear
- Extended life of the asset
- Increase in available capital
- Escalation tables, alarms, alerts, emails.
- Historic data and comparative tools
- Enterprise portal
- Portfolio approach with rollup of data to management levels, regions, etc.
- Completely wireless rooftop solution with ability to hardwire

The CATALYST Technology: More than a VFD

There are several things that are unique to the CATALYST compared with a typical VFD approach. These features, combined with the energy savings from the fan control, economizer logic, and DCV, strengthen the product's position as a turnkey solution for any constant volume RTU.

- The CATALYST, with the drive, economizer, and sensor information provides deep integration into the RTU and acts as the gateway for data collection, Fault Detection, & Diagnostics.
- Comes as a "Retrofit Kit" that increases ease of installation, provides predictable results, and reduces labor cost. No parts mounted throughout the unit. (probably cuts the install time in half compared to trying to do it as parts and pieces)
- Protects unit from low air flow conditions that might cause evaporator to ice or high temp limits to be exceeded. Onboard logic increases speed of the fan in response to indications of low air flow. (Over 70 percent of the units we have installed have needed to rely on this feature at some point. Filters get dirty and belts wear out. This reduces air flow from commissioned levels. Typical VFD cannot discern this and respond.
- Controller-embedded fault detection routines covers critical aspects of system performance.
- CATALYST service switch allows technicians to service and maintain the unit without the need to fully understand the CATALYST. Serves as a way to track whether PM is being performed. This helps prevent technicians from jumpering, overriding, or dismantling the product. Without this, there is a high likelihood that in the course of normal maintenance and service, uniformed technicians will not bother understanding how the units is being controlled and will undermine the investment.
- Innovative Control Sequences: Temperature-based demand control ventilation increases the savings over traditional DCV
- Improved economizer cooling using a concept we developed for BMS applications called "Advance Cool"
- Fan & Damper control scheme that evaluates the benefit of outside air versus the fan savings. This logic dials in an optimum balance between the fan energy and the cooling benefit from outside air in certain temperature bins.
- CATALYST logic overcomes the limitations of two-stage thermostatic control when 3 stages actually provides the maximum benefit. Most BMS and Tstat applications do not address this. (Economizer, Comp #1, Comp #2)