



A study commissioned by the Department of Energy (DOE) through Pacific Northwest National Laboratory (PNNL) Validates Transformative Wave's CATALYST as a Retrofit Solution Providing on Average 57% HVAC Energy Savings On Existing Packaged Rooftop Units.

The CATALYST is more than a controller and more than a variable frequency drive (VFD). It is a complete HVAC energy efficiency upgrade that includes numerous components, adds 5-6 new sensors. When applied, it radically lowers the energy use and improves the overall performance of constant volume HVAC systems. The CATALYST assures proper ventilation, maximizes the use of outside air for free cooling beyond standard economizer logic, and reduces fan energy use by an average of 69%. Transformative Wave has a four year history of success in the field and a great deal of measurement and verification data to support the product's effectiveness.

CATALYST provides live interaction via the eIQ Energy Platform, a completely wireless solution that allows real-time monitoring and control over the web with energy savings and historic behavior reporting. Transformative Wave is doing some exciting things with embedded and server-based fault detection, diagnostic, and energy accountability features. The CATALYST can integrate with existing building management systems (BMS) or be applied as the BMS.

Transformative Wave and the CATALYST are a Tridium OEM and the eIQ Energy Platform is an open source automation solution. The technology combines several well-practiced efficiency measures with our proprietary Opti-Run fan control logic to create a highly intelligent system. This custom microprocessor-embedded program effectively manages the system's operation without compromising comfort or indoor air quality.

Transformative Wave has collaborated with the Department of Energy (DOE) through the Pacific Northwest National Laboratory (PNNL) for field trials of the CATALYST and shared operational data obtained via its eIQ Energy Platform. The purpose of the study was to evaluate the ability of the patented CATALYST to reduce commercial HVAC energy use as a retrofit upgrade to existing packaged rooftop units (RTUs). The study covered CATALYST upgrades on 66 RTUs across the nation in four climate zones and varying building types. The PNNL chose the CATALYST over other solutions based on the product's features and maturity.

Transformative Wave's CATALYST, a recent winner of the 2013 Defense Energy Technology Challenge, has been installed on hundreds of facilities for customers such as IKEA, Whole Foods, BJ's Wholesale Club, and more. The CATALYST averages a two-to-four year payback and when coupled with local utility rebates and incentives that payback period can be shortened.

To learn more about the CATALYST visit our website at <http://elliottlewis.com/catalyst-controller.html>



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CATALYST EFFICIENCY ENHANCING CONTROLLER



transformativewave
CATALYST

More than a VFD

CATALYST EFFICIENCY ENHANCING CONTROLLER



There are several things that are unique to the CATALYST compared with a typical Variable Frequency Drive (VFD) approach. These features, combined with the energy savings from the fan control, economizer logic, and Demand Controlled Ventilation (DCV), strengthen the product's position as a turnkey solution for any constant volume rooftop units (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, and demand response.
- Protects HVAC unit from low airflow 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 airflow. Filters get dirty and belts wear out. This reduces airflow from commissioned levels. Typical VFD cannot respond like the CATALYST and overcome airflow deficiencies that might impact performance.
- CATALYST logic overcomes the limitations of two-stage thermostatic control when three stages actually provide the maximum benefit.
- Most Controller-embedded fault detection routines cover critical aspects of the whole system performance. CATALYST Service Switch allows technicians to service and maintain the unit without the need to fully understand the CATALYST. 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. Also serves as a way to track whether performance maintenance is being performed.
- Innovative Control Sequences: Temperature-based demand control ventilation increases the savings over traditional demand control ventilation. Patented advanced economization techniques improve economizer benefit using a concept we developed called "Advance Cool" where the CATALYST proactively cools the space.
- Fan and damper control algorithms that evaluate 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 ranges. This maximizes the energy efficiency of

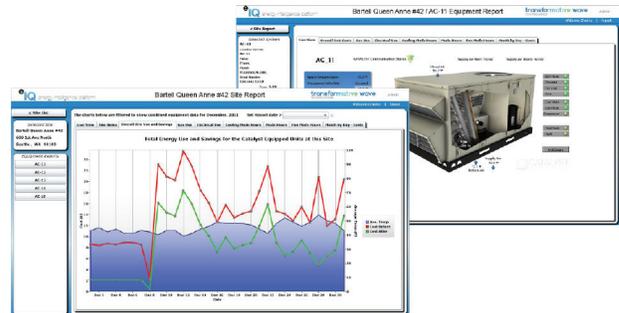
CATALYST controllers can be connected wirelessly via the **eIQ Platform**. The **eIQ Platform** provides an unprecedented level of monitoring, control, data collection and savings verification. The **eIQ Platform** adds remote access, fault detection, diagnostic capability, and a host of other features to the **CATALYST** installation. This communicating version will automatically notify operators of any equipment performance issues or compromised efficiency, allowing for the quick remedy of problems before occupant comfort suffers, and energy costs skyrocket. It also provides assurance that the anticipated savings are being achieved and sustained.

Features include:

Web-Based Access – The system can be accessed anytime, anywhere by an authorized user on any computer or wireless device. The **eIQ** can also be viewed on mobile and tablet devices.

Real-time Energy Consumption Monitoring – The **eIQ Platform** user interface displays the energy savings delivered by the **CATALYST**, shows historic performance data and system operational behavior.

Fault Detection and Diagnostics – Transformative Wave has developed several powerful diagnostic techniques to identify an array of conditions and service issues common to these HVAC systems. The **eIQ Platform** displays these faults in a simple icon indicating the health of the unit and allows for electronic messaging of alarms. This enables corrective action to be taken before occupant comfort starts to suffer or system efficiency degrades.



Building Management Controls – The **eIQ Platform** can be integrated with most Building Management Systems (BMS). However, the **eIQ Platform** is a full-featured Tridium building automation product and is commonly applied as the BMS to provide HVAC scheduling and space temperature control. It can also be expanded to control lighting or other automation needs.

Preventative Maintenance Cost Avoidance – The **eIQ Platform** provides considerable insight into aspects of HVAC system operation. It detects and communicates conditions such as fan belt slippage, filter performance, and other operational indicators. Preventative maintenance programs are often performed quarterly. The information provided by the **eIQ Platform** can allow operators to conduct maintenance on an as-needed basis, resulting in reduced overall maintenance costs.

When the **CATALYST** includes the **eIQ Platform**, the operational savings achieved during the initial installation can be maintained for the life of the equipment. This avoided electrical expense is sometimes as much as 10% of the annual utility cost.