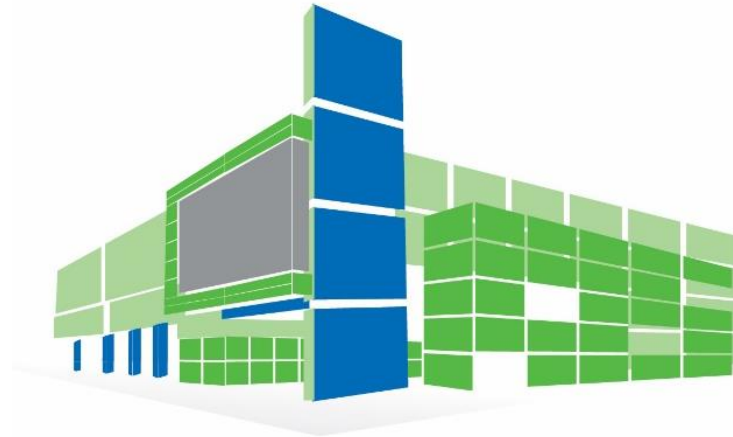

ARC - ADVANCED ROOFTOP CONTROLS

Overview, Install Training, and Lessons From the Field



PRESENTED BY:
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SVP, TECHNOLOGY
TRANSFORMATIVE WAVE

AGENDA

- Who is Transformative Wave
- What is an ARC / General Components
- Installing an ARC technology
- Lessons We've learned

WHO IS
TRANSFORMATIVE
WAVE

WHO IS TRANSFORMATIVE WAVE

- Established in 2010
- Born out of a 30+ year mechanical contractor
- Manufacture the CATALYST (ARC technology) and eIQ Platform (Monitoring/BMS Solution)
- Started working with the DOE to validate and expand the ARC market in 2009

- My background
 - Started in parts wholesale business
 - Joined Performance mechanical Group in 2008
 - Co-Inventor of CATALYST technology
 - Installed hundreds of units

GENERAL DISCLAIMER

- There are several ARC products on the market
 - The CATALYST is one solution for packaged rooftop efficiency
 - Kits Vs. Parts
 - Contractors can also make their own
- I'm only an expert in our product
 - I will do my best to provide general information
 - My answers and approach are guided by our product, it is not the only way to solve the problem, I'll be specific when I talk about how "we" do it.
 - Some of what I talk about in our sequence is covered by our patent
 - Some of what I talk about (motor replacements) is based on our experience
- Saving energy is important, but it's not the only thing.
 - Serviceability – How will it be serviced after the fact
 - Reliability of the technology – Does it have a proven track record
 - Protect the equipment



When you see this symbol it is TW specific Content.

WHAT IS AN ARC ANYWAY

WHAT IS AN ARC

ARC

Advanced Rooftop Controller

- Retrofit kit for existing packaged roof top units
- Brings modern energy savings technologies to older equipment.
- Extends equipment life and saves energy.

ADVANCED ROOFTOP CAMPAIGN

DOE sponsored educational site

- <http://advancedrtu.org>
- Great resource for customers, explains the benefits of ARC retrofits

WHY SO MUCH FOCUS

RTUs are everywhere, cover approx. 69% of the air conditioning in the US

Most units are performing well below current efficiency standards



ARCs AS PART OF THE ADVANCED RTU CAMPAIGN

The Advanced RTU Campaign is a national initiative that promotes high-efficiency RTU solutions to transform the commercial buildings market

THIS PROGRAM IS DESIGNED TO ENCOURAGE BUILDING OWNERS AND OPERATORS TO TAKE ADVANTAGE OF SAVINGS OPPORTUNITIES THAT ENABLE THE TRANSITION TO HIGH EFFICIENCY RTUs.

- ✓ High-Efficiency RTU Replacements and New Installations
- ✓ Advanced RTU Control Retrofits
- ✓ Automated FDD *new!*
- ✓ Quality Installation and Quality Maintenance



WHAT QUALIFIES AS AN ARC TECHNOLOGY

Only the best ARCs have all of the capabilities listed below



VARIABLE FREQUENCY DRIVE

Serves as the foundation, offering up to 60% or more of the savings



PREDICTIVE ECONOMIZATION

An advanced feature that begins economizing when it is most efficient



DEMAND CONTROL VENTILATION

Based on CO2 levels, it will automatically adjust to maintain proper indoor air quality



QUALITY INSTALLATION & MAINTENANCE

Properly installation and maintaining rooftop unit performance is the first key to making sure the energy savings last for entire life of the measure



ADVANCED ECONOMIZATION

Intelligently leverages outside air instead of return air when the conditions are right

WHY CUSTOMERS ARE INTERESTED IN ARC SOLUTIONS

What goes into the customer decision process



CONTRACTORS

Bring value to existing client base

- Help your existing customers save energy

Separate yourself from the competition

- Efficiency opportunities are a great way to get on the roof when using maintenance alone doesn't work

More work for your team

- Installed by the same technicians you already have. Great filler work for down time



END CUSTOMERS

Energy Savings

- Lowers Operating Expenses

Improved comfort control

- By slowing down the speed of the fan, the air will spend more time on the coil creating a drier space
- Demand Control Ventilation will make sure the proper amount of outside air is provided

Improved Equipment Operation

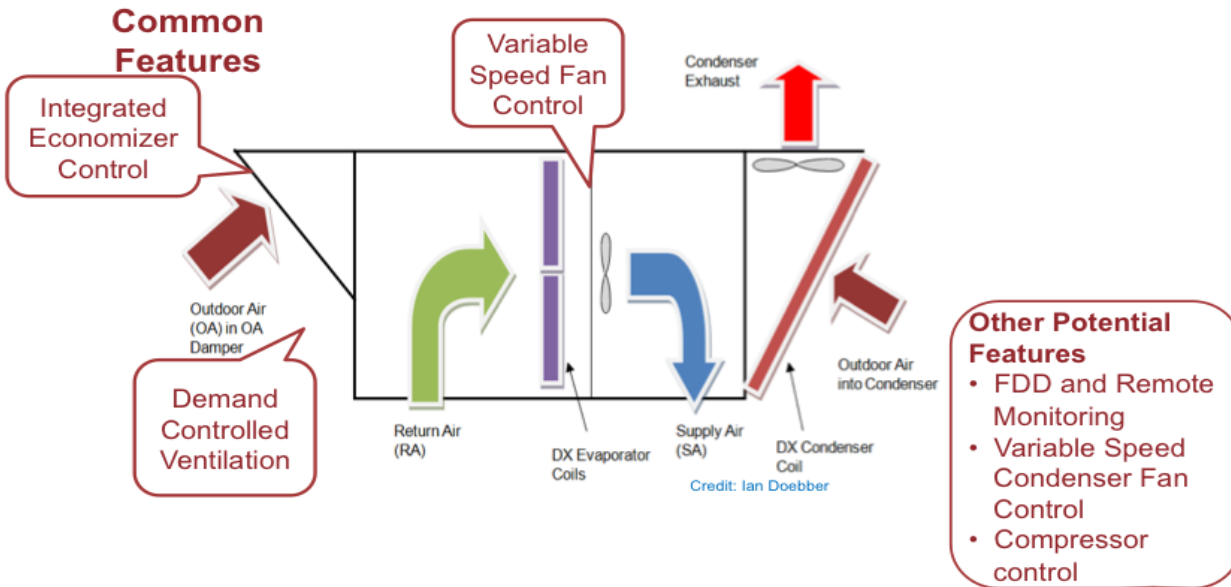
- Soft start, and better economizer control will reduce equipment runtime extending unit life

ARC COMPONENTS

UNDERSTANDING ARC TECHNOLOGY

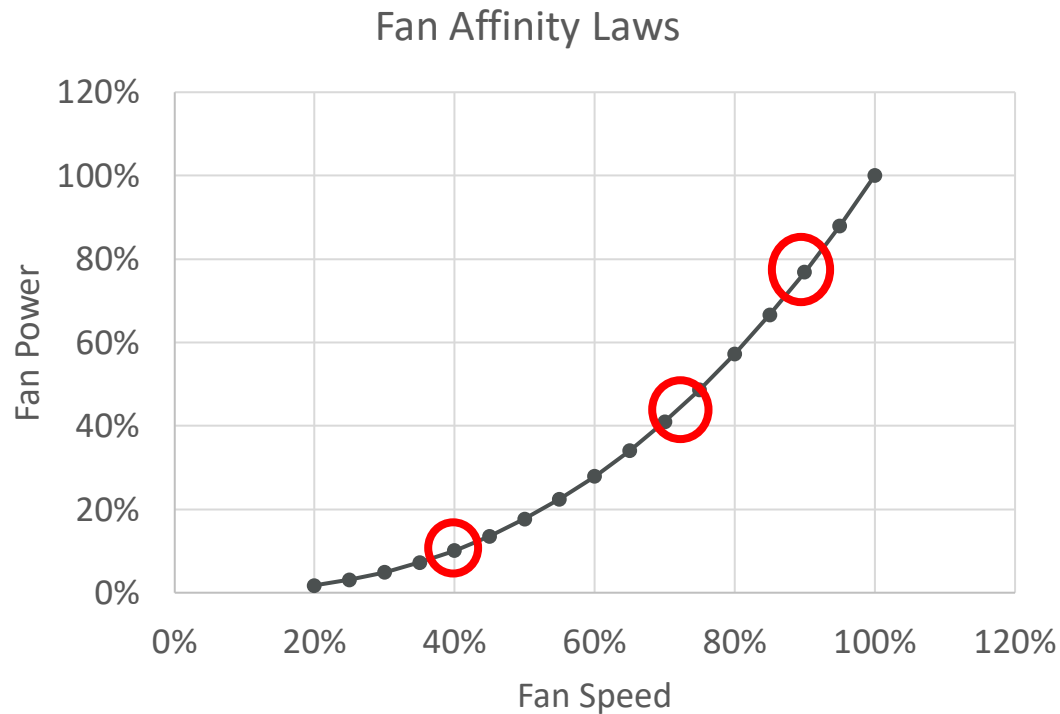
REDUCES OVERALL HVAC ENERGY USE 25%-50%

ARC technology transforms HVAC assets into smart machines delivering an intelligent solution for RTUs that give you greater control to extend the benefits of your current investments even further.



- ✓ **Variable Speed Drive:** The Variable Frequency Drive (VFD) provides savings through supply fan control.
- ✓ **Advanced Economizer Control:** Reduces the compressor runtime to improve efficiency and reduce wear and tear.
- ✓ **CO₂-Based Demand Control Ventilation:** Makes the most of the available outside air for cooling while ensuring proper ventilation.
- ✓ **It's more than a drive:** Providing a solution that provides equipment protection and serviceability.

FAN SAVING



- The most important savings factor.
 - In most markets about 2/3 of the energy savings
- Current code requires fans to run continuously during the occupied mode.
 - Not everybody plays by the rules watch for fans in “Auto”
- The Fan Affinity Laws are rules of physics that cover variable torque motor applications



The CATALYST uses 3 fan speeds 40%, 75%, and 90%

FAN SAVINGS

- 40% - Ventilation Mode - 90% Fan Reduction
 - Provides enough air across motor to keep it cool
 - Diminishing returns for going lower
- 75% - Stage One Speed – 50% Fan Reduction
 - Adequate air through diffusers to prevent cold air dumping
 - Adequate air across the coil and heat exchanged
- 90% - Two Stage Call – 27% Fan Reduction
 - Meets the manufacturers requirements for air to deliver rated unit capacity
 - Still provides a 27% consumption reduction
 - Translates into a 5% HVAC demand reduction

ECONOMIZER SAVINGS

- Economizers provide ventilation air to the space and use outside air for free cooling.
- Most economizers (70-80% NBI Institute, WHPA) have an issue.
 - Old controls don't work well
 - Disabled in the field
 - Failed Actuators
 - Improper settings
- Some issues will be addressed with new controls, some issues will need to be addressed by the customer
- There is a big opportunity for energy savings by improving economizer control
- The “change over” point is when the unit decides to switch to mechanical cooling

ECONOMIZER SAVINGS

Energy Savings is a function of where you are going from to where you are going to.

Outside Temperature

Less than 55 Deg
(A,B,C,D Setting)

Between 55 – 60

Between 60 and Return Temp

Greater than Return Temp
(~76°F)

Anytime you can leverage outside air when the compressor would have been running, you can generate savings.

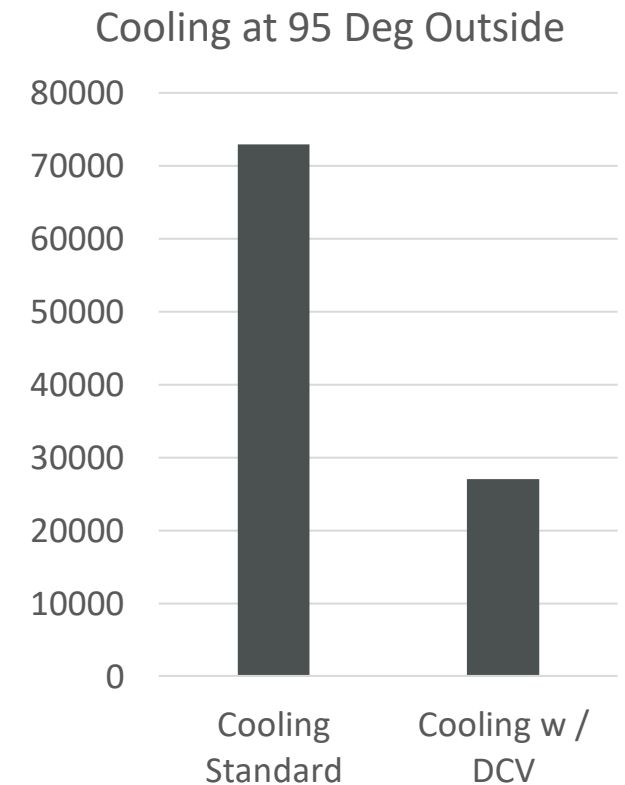
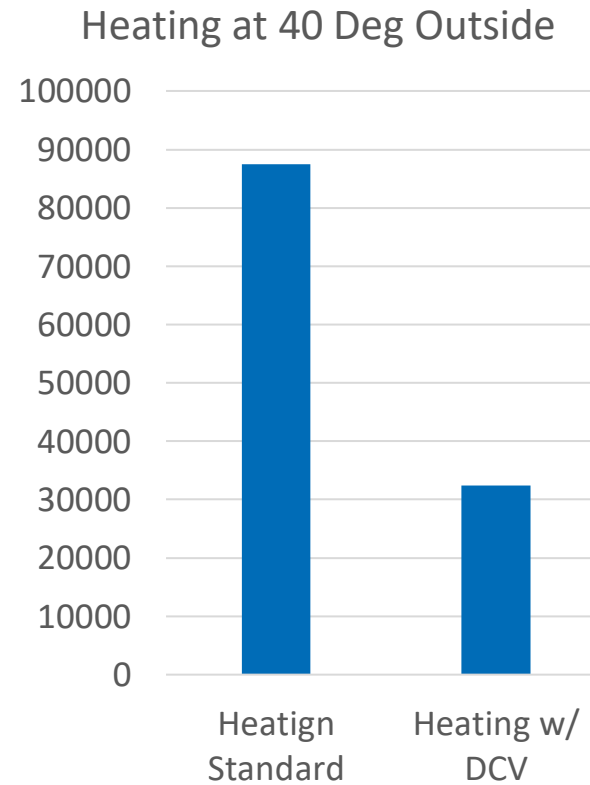
New units may have more advanced controls

DEMAND CONTROL VENTILATION

- Building codes require the ventilation rate to be based on the maximum number of people that can be in a space.
 - Usually, number of people per 1000 sqft
 - 15 CFM per person
 - Example - Retail building 15 people per 1000 Sq Ft, a 20 K retail facility would need to provide $(20 * 15 * 15)$ 4500 CFM of fresh air
- Demand Control Ventilation
 - ASHRAE 62.1 breaks ventilation in two parts
 - Occupants
 - Base the ventilation rate on the actual number of occupants in the space
 - Uses CO2 Sensor to measure occupants
 - Space Type
 - Minimum CFM based on space type
 - Office .06 CFM / Sq Ft, Retail .12 CFM Sq Ft.
 - Can't go to Zero
 - Don't have to go to full ventilation
 - **Current ASHRAE COVID guidance is no DCV, increase ventilation to remove contaminants**

DCV SAVINGS

- Energy Savings → What you're going from to what you're going to
 - Watch for closed outside air dampers
- DCV may not be appropriate for all building types
 - Office building sensor locations
 - Restaurant and Labs need special care



LIMIT AND SAFETIES – THINGS TO CONSIDER

- Never bypass manufacture safeties or limits
- Consider that air flow in a unit changes. Belt's wear, filters get plugged, and customers do wacky things. What you set on day one may not be the same as how a unit always operates.
- A VFD is a line voltage device and the smoke detectors are a low voltage device. Care needs to be taken to make sure the VFD shuts off (even when it's in manual) when the smoke detector trips.
- The outside air damper needs to be adjusted when the fan speed changes. It's important to maintain balance and proper ventilation flow.

TW Approach

- All limits and safeties stay in place
- The drive monitors the supply air temperature and will automatically ramp the fan if the temp gets to cold or to hot.
- There is a drive shut down circuit to make sure the drive will shutdown anytime the smoke detector trips
- The CATALYST will automatically adjust the damper based up on the fan speed.

BENEFITS OF A CONNECTED SYSTEM

- Remote access to your facilities – Easily connected to what’s going on.
- Display of diagnostic features – Some systems have remote testing features
- Building management controls – Setpoint and schedule control
- Improved Comfort – Temperature, Humidity, and Pressure Control
- Additional Energy Savings – Pre-Cooling, Unit Coordination, Demand Response
- Remote Changes – Adapt based on changing conditions





QUESTIONS & ANSWERS

We're happy to answer any questions at this time.

THANK YOU

The CATALYST is our passion, so we always welcome the opportunity to tell you more!

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