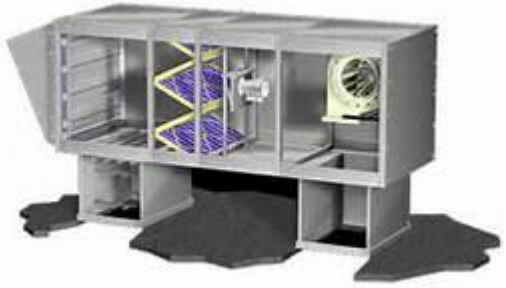
DCV, VFDs and Control Solutions for Packaged Roof Top Equipment

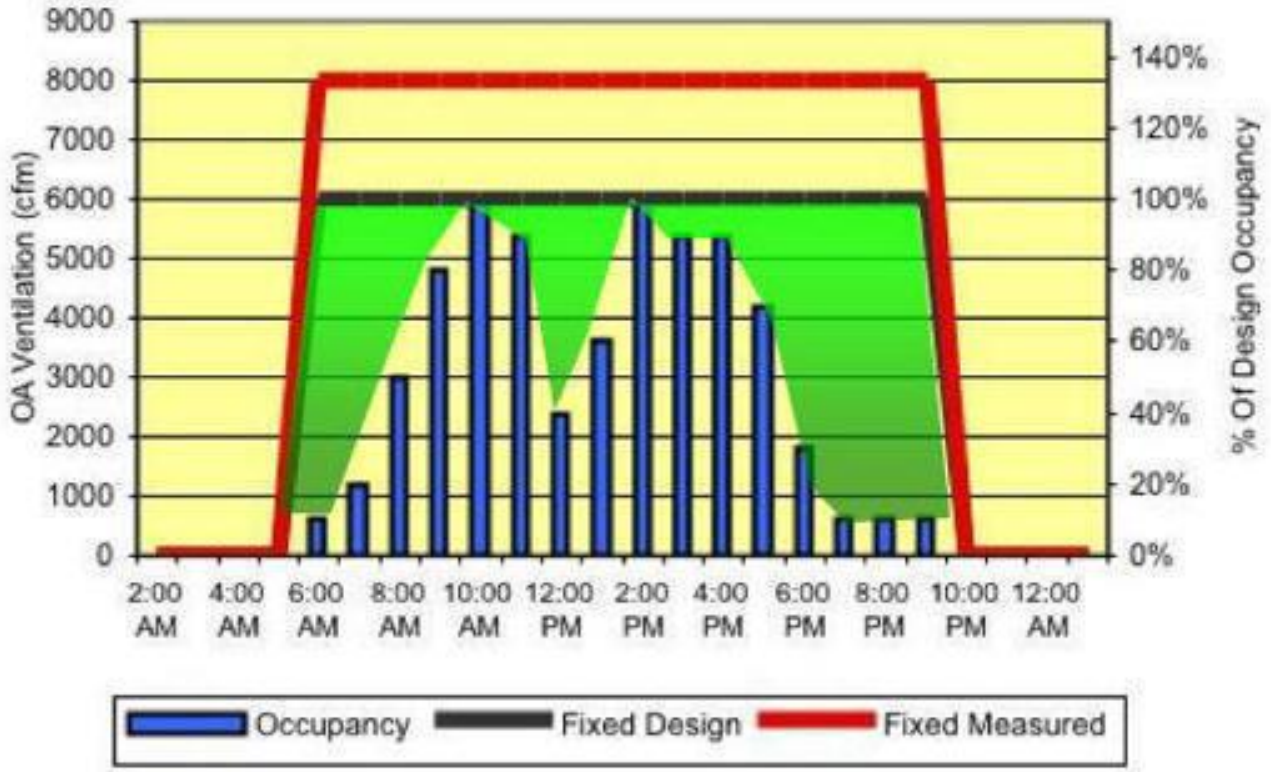
A Good, Better, Best discussion.
A bolt on multi component approach,
or a direct control purpose built advanced RTU optimization package?

Jim Stiber, Control Consultants Inc.

Control Consultants, Inc.

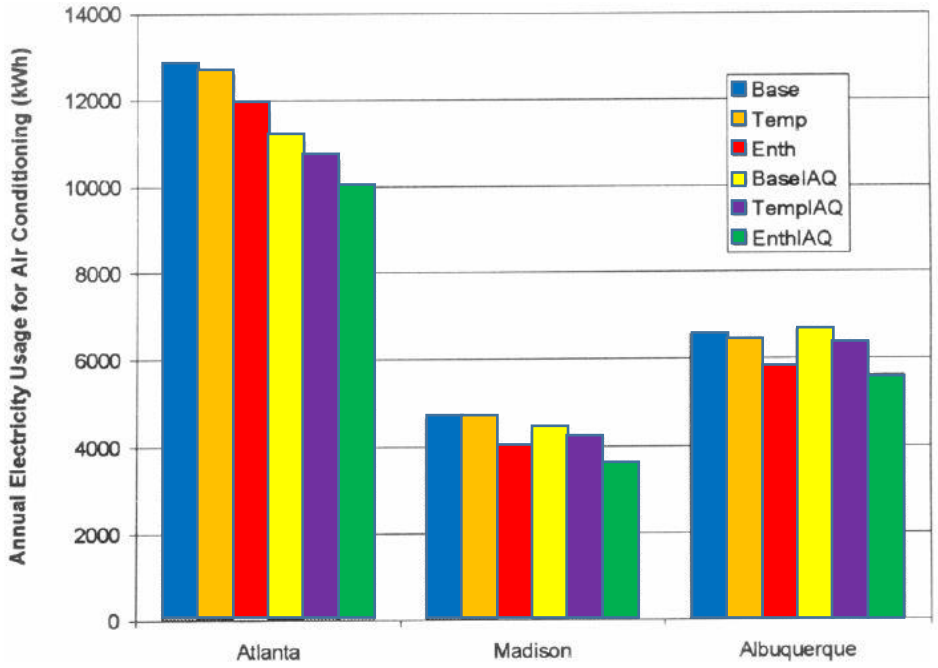


Demand Control Ventilation, why do it?



Fixed ventilation rates are based on maximum building occupant capacity and do not account for hourly building use and varying occupancy count.

What's the impact?



No Economizer
Dry Bulb Economizer
Enthalpy Economizer
No Economizer with DCV
Dry Bulb Economizer with DCV
Enthalpy Economizer with DCV

The sweet spot!

**The greatest savings,
in all cases, occurred for the combination of enthalpy economizer and demand-controlled ventilation. The maximum savings were about 23% for Atlanta and Madison and 14% for Albuquerque.**

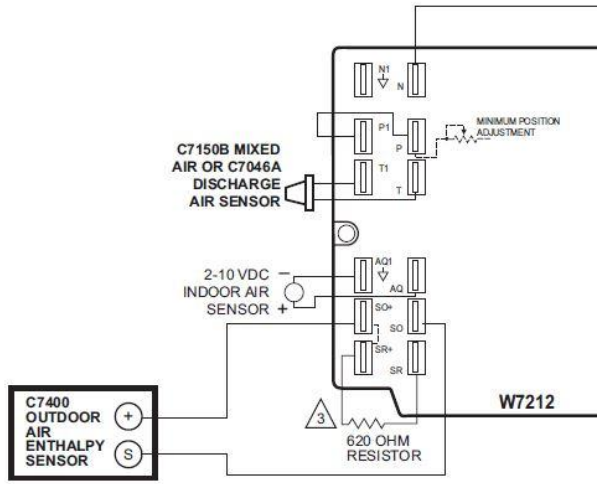
The savings potential associated with demand-controlled ventilation is much more significant for heating than for cooling.

The percent reductions in annual heating input energy were 27%, 38%, and 42% for Madison, Albuquerque, and Atlanta, respectively.

Source:
The Impact of Demand-Controlled and Economizer Ventilation Strategies on Energy Use in Buildings
Michael J. Brandemuehl, Ph.D., P.E. James E. Braun, Ph.D., P.E.
Member ASHRAE Member ASHRAE
Available for download at http://buildingcontrols.Honeywell.com

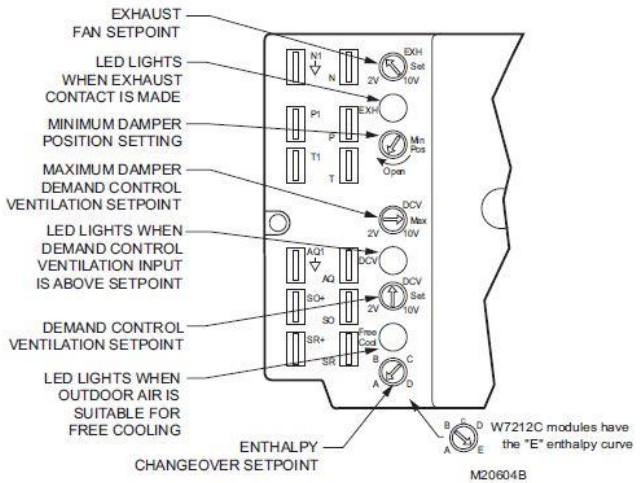
Adding simple DCV to RTU units











All modern RTU units made within the last 10 years should have a DCV input on the factory installed Economizer board making the addition of DCV a simple.

C02 sensor cost, reliability and accuracy has improved over the years making the addition of C02 sensor very economical!

Install a C02 sensor in the space or use a return air mounted sensor.

(Good) Typical hardware cost: $215 (New C02 sensor)

What if the Economizer is not working or the unit has no DCV terminals?











Several Economizer retrofit options and solutions are available from various manufacturers allowing the economizer portion of the RTU unit to be renewed and modernized!

Honeywell BELIMO SIEMENS

(Good +) Typical hardware cost: $525 (New C02 sensor + new Econ controls)

Kicking it up a notch!
Adding a VFD and DCV to Constant Volume RTU units



Why add a VFD?

Energy Savings

- Oversized Fans and Pumps
- Capacity usually exceeds demand
- Constant to Variable Flow

Green House Gas Reduction

- 80% of commercial building CO_2 emission due to electricity consumption

Reduce Wear and Tear on the Motor

- Soft Start built in

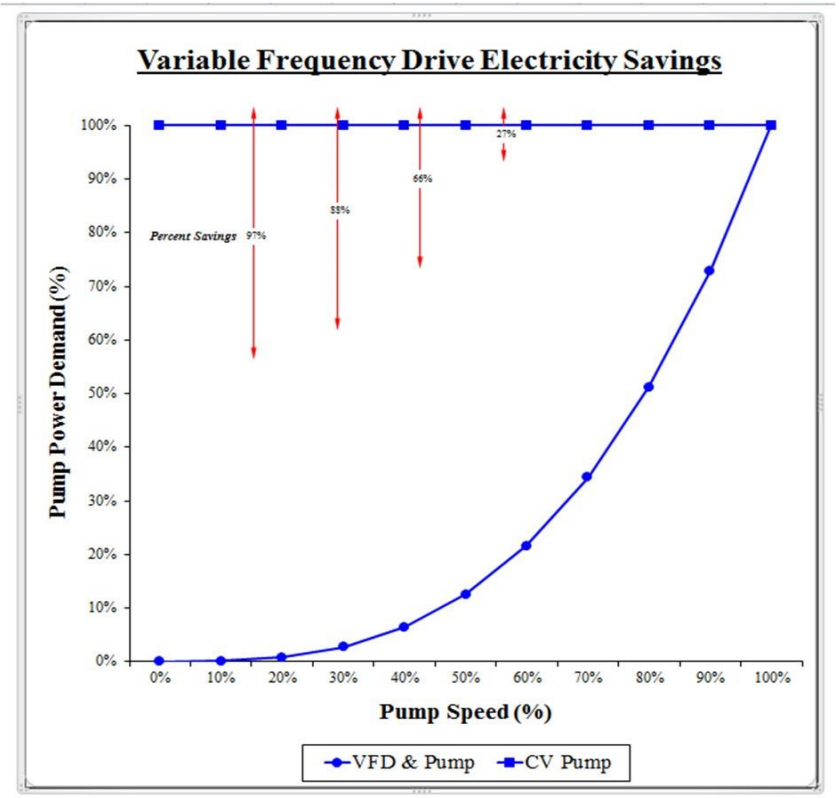
Improved Comfort

(Better) Typical hardware cost: $1100 (New C02 sensor + new Econ controls + 5HP VFD)

Saving energy and improving comfort with a VFD

WOW!

Percent Speed	Frequency (Hertz)	Percent Savings
100%	60	0%
90%	54	27%
80%	48	49%
70%	42	66%
60%	36	78%
50%	30	88%
40%	24	94%
30%	18	97%
20%	12	99%
10%	6	100%
0%	0	100%



Using simple relays the VFD can be controlled in a two or three speed manner for significant savings!

G
Y1
W1



Low
Med
High



Adding simple remote connectivity and control with Wifi Thermostats











Pros:

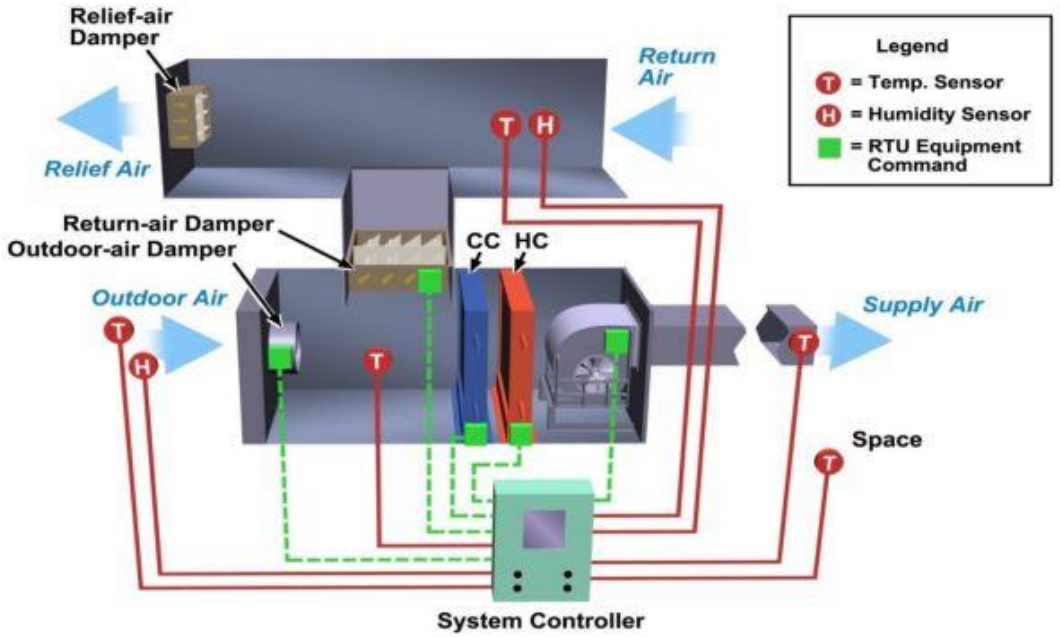
Easy to set up and install
Remote monitoring and control
Intelligent group scheduling
System alerts and alarms
Cloud based, nothing to maintain
Low cost
No wired communications bus needed

Cons:

Very basic control
No direct control of VFD
No direct control of Economizer
Historical data stored in the cloud and not on site
Additional non RTU building equipment cannot be added
Need to use customers Wifi network

(Best) Typical hardware cost: $1200 (New C02 sensor + new Econ controls + 5HP VFD + cloud based wifi t-stat)

Taking it to the next level!
Adding advanced remote connectivity and control with purpose built optimization solutions



Advanced RTU optimization packages have significant advantages over “bolt on, multi component” approaches. Direct coordinated control over the economizer, VFD speed and DX stages are key, as well as occupant set point limits, smart scheduling and outdoor temp based heating and cooling lockouts to name a few.

These packages are the “Mercedes Benz” of RTU control solutions and offer full “DDC like” capabilities.

In recent years advancements in controller hardware and technologies have converged bringing the cost of these solutions down to equal that of the “bolt on multi component” approach.

Is it worth it?

A multi-year research study was initiated to find solutions to improve packaged heating and cooling equipment operating efficiency in the field. Pacific Northwest National Laboratory (PNNL), with funding from the U.S. Department of Energy's (DOE's) Building Technologies Office (BTO) and Bonneville Power Administration (BPA) conducted this research, development and demonstration (RD&D) study.

A total of 66 RTUs on 8 different buildings were retrofitted with a commercially available advanced controller for improving RTU operational efficiency. This product can be regarded as a representative of comparable RTU retrofit controllers in the market. The findings from this work are not limited to that specific product, but apply to all products with advanced RTU control strategies such as fan speed control, DCV, and enhanced economizer control.

WOW!

The advanced controller reduced both actual consumption and normalized consumption by between 22% and 90%, with an average of 55% for all RTUs. The majority of RTUs had their electricity savings in the range between 40% and 90%.

Source: *Pacific Northwest National Laboratory, Advanced Rooftop Control (ARC) Retrofit: Field-Test Results (2012)*

Adding advanced remote connectivity and control with cloud based (wired) application specific direct control optimization solutions







Pros:

- Easy to set up
- Advanced remote monitoring and control
- Intelligent group scheduling
- System alerts and alarms
- Cloud based, nothing to maintain
- Sophisticated direct control of Econ and VFD
- Built in analytics

Cons:

- New communications bus wire required (T-stats in one location?)
- Higher skill set required for install
- Historical data stored in the cloud and not on site
- Additional non RTU building equipment cannot be added

(Best +) Typical hardware cost: $1250 (New C02 sensor + direct Econ control + direct control of new 5HP VFD + cloud based purpose built wired solutions)

Adding advanced remote connectivity and control with DDC based (wireless) optimization solutions



Pros:

- No new communications bus required
- Advanced remote monitoring and control
- Intelligent group scheduling
- System alerts and alarms
- Data stored on site locally
- Sophisticated direct control of Econ and VFD
- Built in analytics
- Does not use customers Wifi network
- Other non CV RTU equipment can be added
- Fully programmable

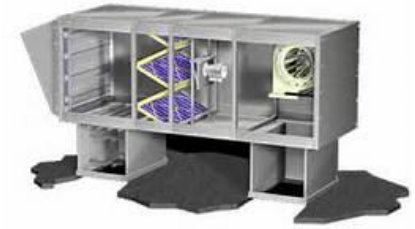
Cons:

- Higher level skill set required for install and set up

(Best ++) Typical hardware cost: $1270 (New C02 sensor + direct Econ control + direct control of new 5HP VFD + DDC based wireless purpose built applications)

Summary

- Increasing RTU efficiency can be approached in simple increments by adding bolt on individual components or by utilizing an all inclusive purpose built solution.
- Different skill levels are required for the different approaches.
- Hardware and labor costs can be very similar.
- Feature set and functionality are vastly different between the bolt on multi component approach and the direct control purpose built RTU optimization solutions.
- RTU units serve 60% of all commercial floor space in the US.





Regardless of which approach to increased RTU efficiency is used, the mission is a worthwhile endeavor that will improve occupant comfort and reduce each RTU units carbon footprint!

CCi Green Solutions

Control Consultants, Inc.

Thank You!

