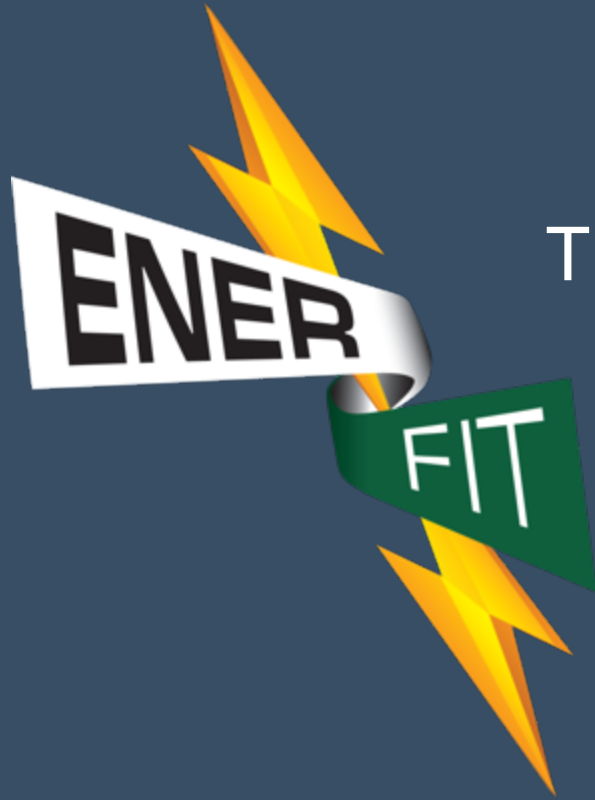


Department of Energy

The CATALYST is the basis for the inclusion of RTU retrofit in the recently announced
ADVANCED RTU CAMPAIGN





The Retrofit That Makes
Your HVAC Unit **Energy Fit**

Retrofit, Don't
Replace

®

Patented 2011

WHAT IS ENERFIT?

Enerfit is a patented retrofit system for single zone HVAC units.

Using a customized set of hardware, controls and logic, it dynamically scales the electrical and mechanical capacity of generally oversized HVAC units to yield massive energy savings and increase user comfort.

ENERFIT

what's in the box?

ENERFIT COMPONENTS

Enerfit Controller



VFD

(Variable Frequency Drive)



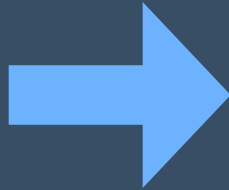
Enerfit Face Damper

(Used with face split DX Coils)



ENERFIT COMES IN 3 DIFFERENT VERSIONS:

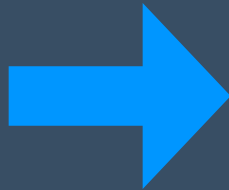
V
1



VERSION 1 (V1) operates in conjunction with your existing HVAC unit controls or thermostat.

It monitors heating and cooling calls from the unit controller or thermostat and integrates them into the Enerfit control logic.

V
2



VERSION 2 (V2) is a complete direct digital control system. It can operate as a standalone controller for your unit or as open-protocol BACnet HVAC unit controller.

Version 2 can operate in conjunction with the factory RTU controls or replace them entirely (V2 BACdrop).

V3



VERSION 3 (V3) works with chilled water systems and allows installers to use the same board, plugs and service tools that work with the DX rooftop & split systems.

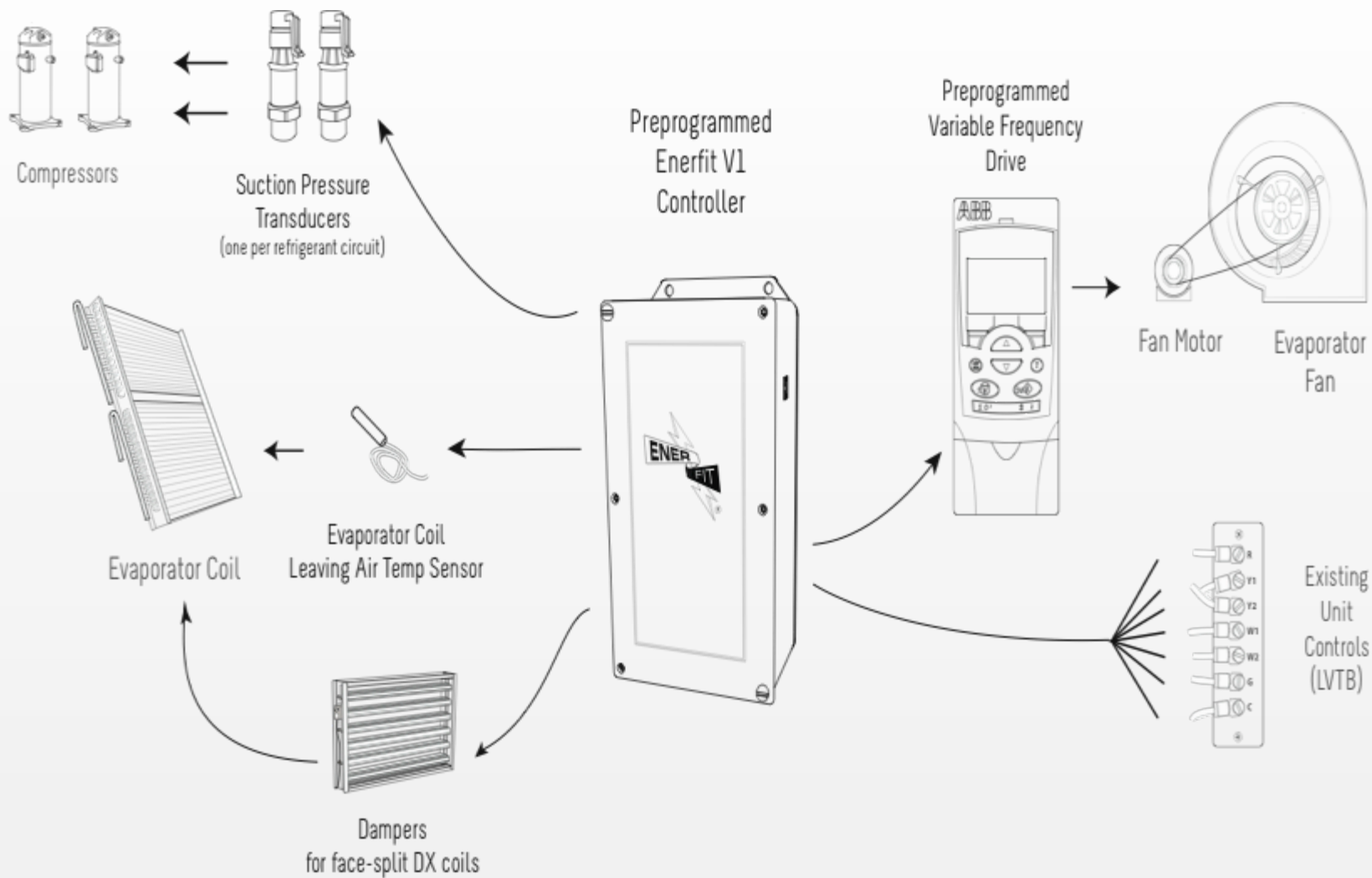
ENERFIT COMES IN 3 DIFFERENT VERSIONS:

ENERFIT VERSION 1 (V1)

Enerfit V1 works with your EXISTING control system.

The standard V1 Enerfit Retrofit Kit includes:

- The Enerfit Controller specifically pre-programmed for your unit.
- Variable Frequency Drive (VFD) specifically pre-programmed for your unit.
- All standard sensors plus custom options including DCV (Demand Control Ventilation)
- Custom evaporator coil face dampers where required.
- All cables come from the factory color-coded, labeled, and with pre-terminated plugs on the controller end (and terminated on the device end whenever possible).
- Pre-laminated custom wiring diagrams designed for quick and clear installation and troubleshooting.
- All controllers, onboard relays and cables are pre-tested at the Enerfit factory before shipping.
- Compatible with Enerfit EMT.



ENERFIT COMES IN 3 DIFFERENT VERSIONS:

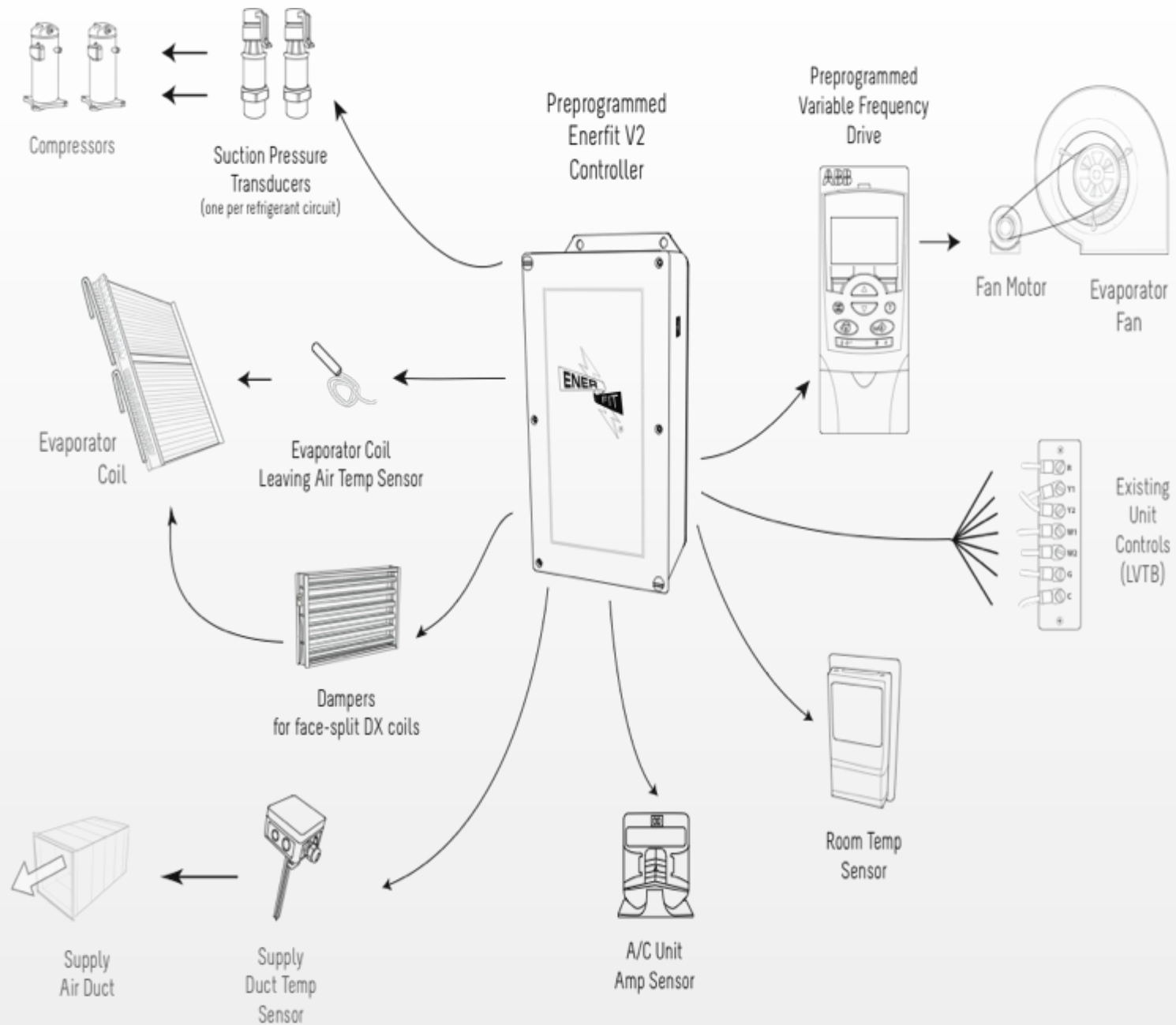
Enerfit V2 is a complete direct digital controller that can replace and unify obsolete, poorly working or disparate controls.

While V2 can pay back aggressively through energy savings, the hardware required for a full control system replacement is already present. Upgrading it to replace your existing controller comes at a minimal cost, which is now paid back by the energy savings.

Also - because it is open-protocol BACnet, Enerfit can be integrated into any front-end controller with BACnet capabilities or [with a BACnet translator](#).

As such, it is a valuable upgrade for customers interested in operations management and monitoring tools like [SkySpark](#), [Tridium](#) or similar products that give facility managers a real-time dashboard of fault detection and energy consumption.

Units with formerly standalone controllers (or obsolete network controllers) can now feed real time data on dozens of points that can proactively detect faults and give service personnel advance warning of impending problems.

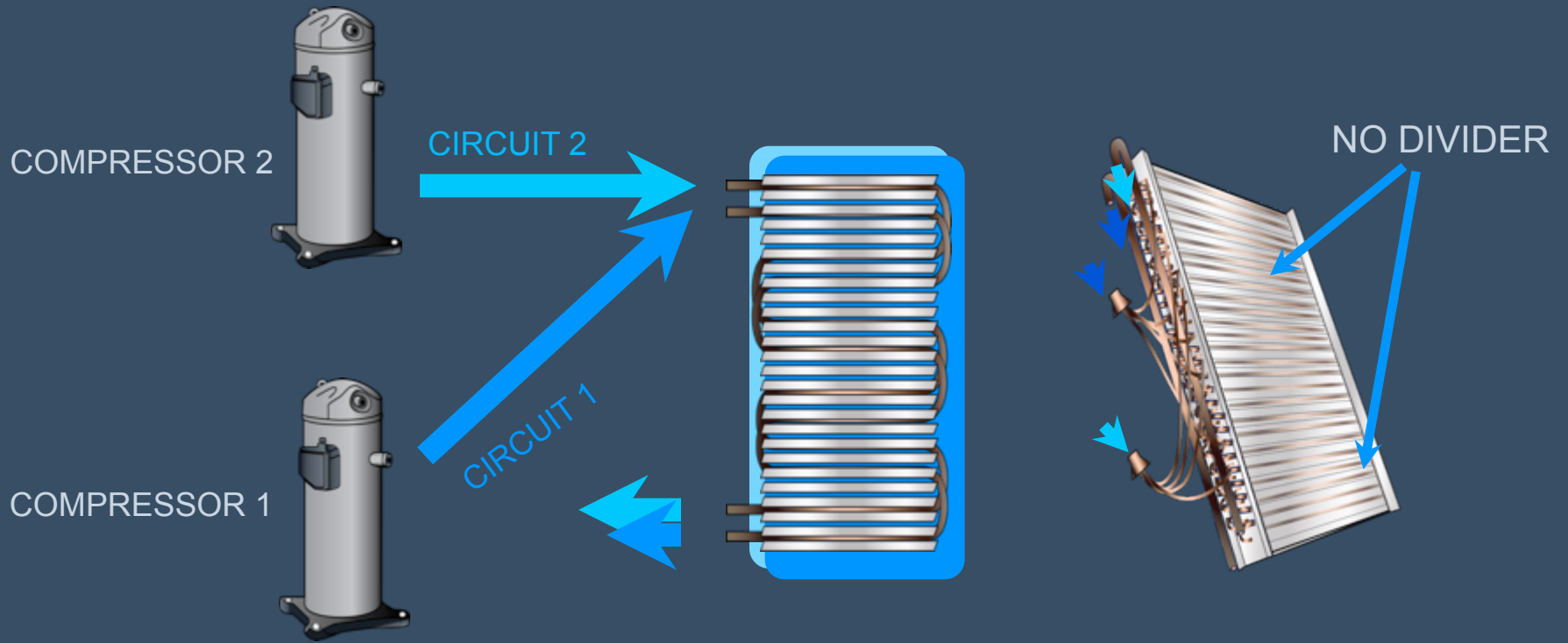


ENERFIT FACE DAMPER

Enerfit addresses the differences in the two primary evaporator coil circuiting schemes:

INTERLACED &
FACE-SPLIT

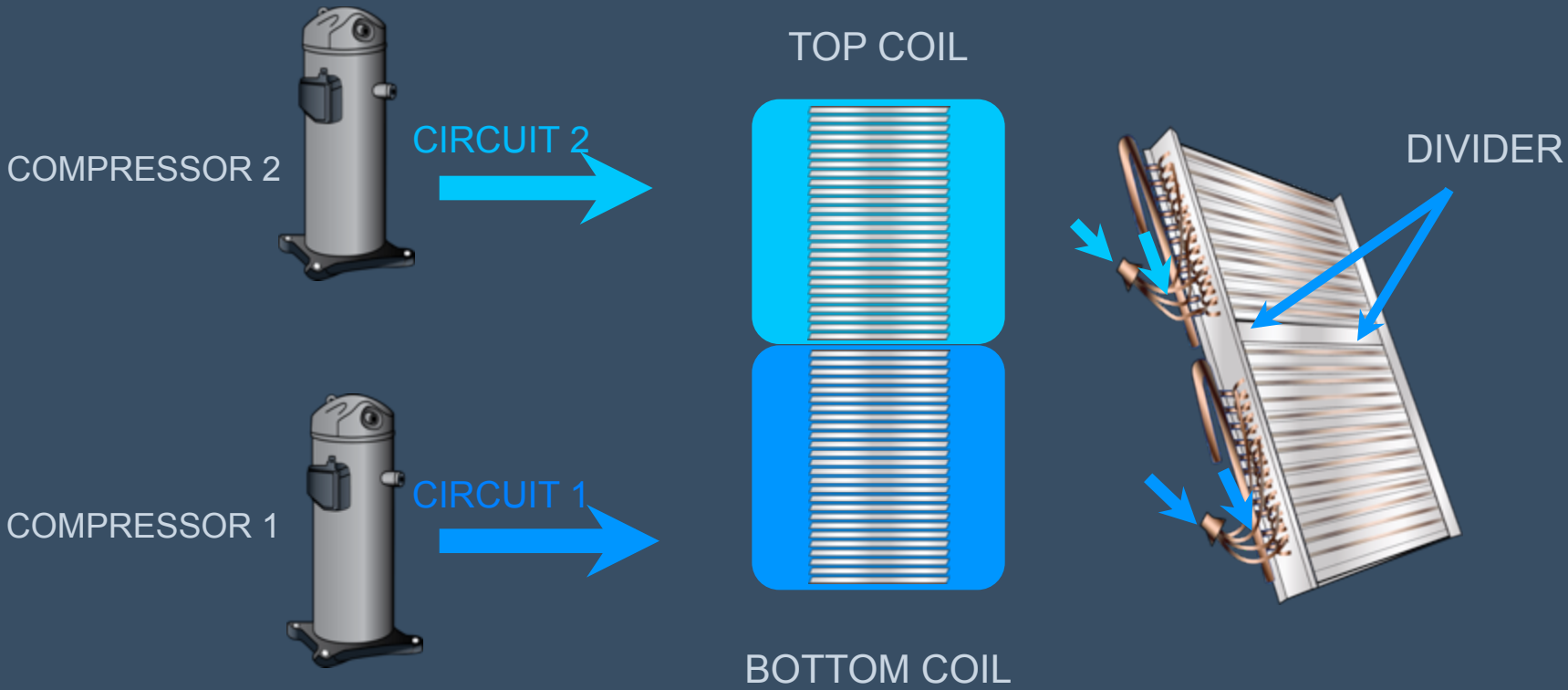
EVAPORATOR COILS: INTERLACED



FRONT/BACK VIEW

SIDE VIEW

EVAPORATOR COILS: FACE-SPLIT



FRONT/BACK VIEW

SIDE VIEW

ENERFIT: what does it do?

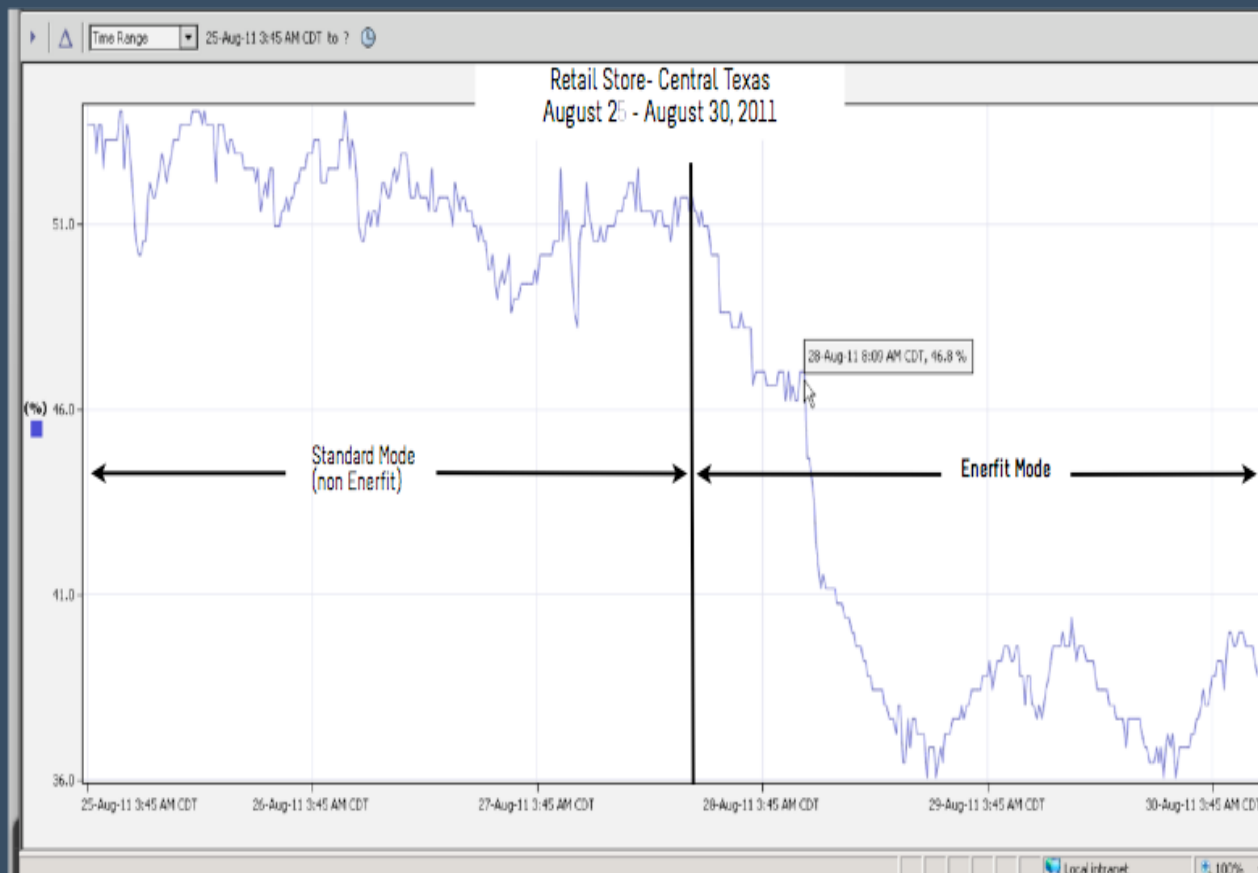
IMPROVES COMFORT



- Passive dehumidification
- Reduces drafts
- Reduces air noise
- Controls CO² levels

ENERFIT: what does it do?

CASE STUDY: SPACE RELATIVE HUMIDITY



ENERFIT: what does it do?

REDUCES MAINTENANCE COSTS



- Reduces belt wear & tightening frequency
- Extends lubrication intervals
- Lowers filter change frequency

ENERFIT: what does it do?



EXTENDS UNIT LIFE

- Eliminates starting torque on fan and motor bearings
- Improves compressor motor cooling
- VFD adds safety protection for entire unit

ENERFIT

how do you service it?

Symbols: * Cooling On * Heating On * Fan On * Not Available

Item	Description	Units
1	FRI Fan Status	On / Off
2	SFR Supply Fan Amps	Amps
3	SPI SF VFD Speed Signal	Hz
4	CL1 Stage 1 Cooling	On / Off
5	CL2 Stage 2 Cooling	On / Off
6	CL3 Stage 3 Cooling	On / Off
7	HR1 Stage 1 Heat	On / Off
8	HR2 Stage 2 Heat	On / Off
9	ECN Economizer Enabled	On / Off
10	EF Exhaust Fan Status	On / Off
11	RT Room Temperature	°F
12	SPC Room Temp Setpoint	°F
13	LRC Cooling Coil Leaving Temp	°F
14	SPC A/C Unit Supply Air Temp	°F
15	SP1 Circ # 1 Suction Pressure	PSI
16	SP2 Circ # 2 Suction Pressure	PSI
17	SP3 Circ # 3 Suction Pressure	PSI
18	SP4 Circ # 4 Suction Pressure	PSI
19	DF1 Coil Face Damper 1 Feedback	% Open
20	DF2 Coil Face Damper 2 Feedback	% Open
21	DS1 Feedback Signal to Face Damper 1	% Open
22	DS2 Feedback Signal to Face Damper 2	% Open
23	DR1 Output to OA Damper	% Open
24	RLR Alarm Code	1-30

ENERFIT EMT (ENERFIT MONITORING TOOL)

Every job site comes standard with an EMT.

It was designed to be a quick and simple way to find out what's going on not only with Enerfit - but also the unit - in real time.

Connecting an EMT should be the first step to troubleshooting any Enerfit installation. It connects to the Enerfit controller and gives read-only access to over 20 different control points and alarm codes.



ENERFIT EMT

(ENERFIT MONITORING TOOL)

It connects to the Controller Enclosure and does not require the technician to unscrew the controller lid.



EXTERNAL
RJ45 JACK



Point Details
and Units are
printed on
back of EMT
lid flap for
easy
reference.

SUMMARY:

HOW DOES ENERFIT REDUCE OPERATING COSTS?



Improves
comfort



Reduces
maintenance
cost



Extends
the life of
your unit



Reduces
HVAC
operating
cost

SUMMARY:

HOW DOES ENERFIT REDUCE OPERATING COSTS?

EXAMPLE: TYPICAL 20 TON ROOFTOP UNIT

WITHOUT ENERFIT
(PER ANSI/AHRI STANDARDS)

10.7 EER

11.7 IEER

Room conditions = 75 ° F & 55% RH

WITH ENERFIT
(PER ANSI/AHRI STANDARDS)

10.7 EER

14.4 IEER

Room conditions = 75 ° F & 55% RH

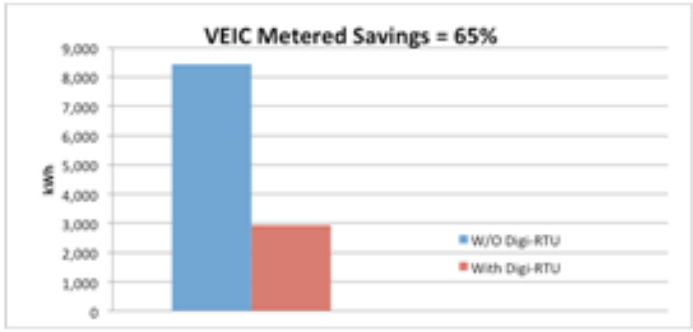
WITH ENERFIT
(ACTUAL OPERATION)

11.2 EER

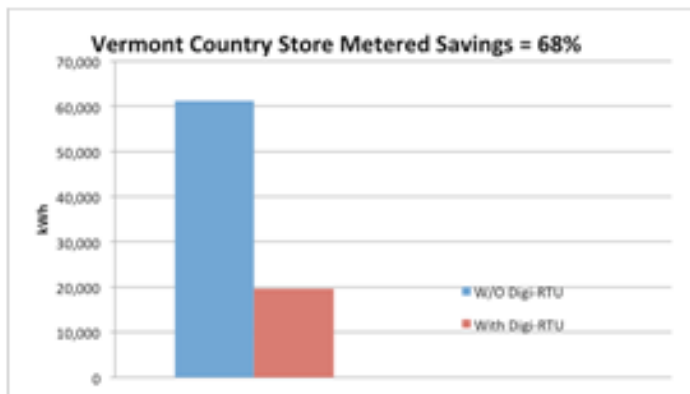
16.5 IEER

Room conditions = 75 ° F & 43% RH

Burlington Electric and Efficiency Vermont Find Digi-RTU™ Reduces Energy by an Average of 67%



Vermont Energy Investment Corporation, located in Burlington, Vermont reported metered and calculated electrical savings of 65% using the Digi-RTU developed by Bes-Tech. Vermont Country Store; located in North Clarendon, Vermont reported metered and calculated electrical savings of 68% using the Digi-RTU developed by Bes-Tech.



READ THE FULL RELEASE HERE

Click Here

The Digi-RTU by Bes-Tech is the most innovative product on the market. The benefits of using the Digi-RTU

REDUCE ENERGY CONSUMPTION AND DEMAND BY UP TO 65%

The Digi-RTU by Bes-Tech is the most innovative product on the market. The benefits of using the Digi-RTU

For Utility Companies:

- Lower peak system demand up to 65%
- Reduce kWh usage up to 65%
- Decrease carbon emissions

For Building Owners and Tenants:

- Reduce electricity consumption and costs
- Reduce compressor on/off cycling up to 75%, reduces maintenance cost
- Better maintains space humidity and temperature
- Reduces HVAC equipment noise in occupied space



Burlington Electric and Efficiency Vermont Find Digi-RTU™ Reduces Energy by an Average of 67%

Vermont Energy Investment Corporation, located in Burlington, Vermont reported metered and calculated electrical savings of 65% using the Digi-RTU developed by Bes-Tech. Vermont Country Store, located in North Clarendon, Vermont reported metered and calculated electrical savings of 68% using the Digi-RTU developed by Bes-Tech.

Ocala, FL (PRWEB) January 07, 2014 -- Bes-Tech, developer of the Digi-RTU, the most innovative and energy efficient aftermarket rooftop RTU AC unit control package on the market, announces electrical energy savings of 65% and 68% during an independent energy study by Efficiency Vermont, with additional funding support contributed by the Burlington Electric Department.

Burlington Electric partnered with a local contractor and Vermont Energy Investment Corporation, a tenant in a 51,000 square foot office building located in Burlington, Vermont. The study results reported metered and calculated electrical savings of 65%.

Efficiency Vermont partnered with a local contractor and Vermont Country Store, a 170,000 square foot retail distribution center located in North Clarendon, Vermont. The study results reported metered and calculated electrical savings of 68%.

For each building, one rooftop unit was metered for two weeks before the Digi-RTU was installed and metered for two weeks after the Digi-RTU was installed. Measurement and verification activities as well as analysis were managed by Efficiency Vermont.

The Digi-RTU, winner of the 2011 American Public Power Association's DEED Energy Innovator Award, is the most innovative and energy efficient rooftop RTU AC unit control package on the market. The Digi-RTU has a proven track record of reducing energy consumption and demand by up to 65% with a typical ROI of 1 to 3 years. The Digi-RTU is a simple plug-n-play solution for existing RTU which allows building owners to increase efficiency of older rooftop units without the expense of replacing them.

- Reduced electricity consumption up to 65%
- Reduced peak electricity demand up to 65%



Facility Information

Location:

Total RTU tonnage: tons

Annual HVAC Availability: hours per year

Weekly HVAC Availability*: hours per week

(Enter 168 unless HVAC system is completely shut off at night or on the weekends.)

Utility Information

Utility rate: per kWh

Escalation: (%)

Incentive Information

Peak Demand Savings Incentive: per kW

kWh Saving Incentive: per kWh

VSD Incentive: per HP

Equipment Information

RTU Size (tons)	Quantity	Supply Fan Operation	Voltage & Phase	Optimizer Size (tons)	Model
<input type="text" value="10"/>	<input type="text" value="1"/>	<input type="text" value="On"/>	<input type="text" value="208/3"/>	<input type="text" value="10"/>	<input type="text" value="RTU 3P 2000 208"/>
<input type="text"/>	<input type="text"/>	<input type="text" value="Auto"/>	<input type="text" value="208/1"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text" value="Auto"/>	<input type="text" value="208/1"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text" value="Auto"/>	<input type="text" value="208/1"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text" value="Auto"/>	<input type="text" value="208/1"/>	<input type="text"/>	<input type="text"/>



Results

Annual Estimated Electricity Savings

Consumption:	16,536 kWh
Demand:	4.60 kW
Utility Cost Reduction:	\$1,653.60 (\$165.4 / ton)
5-yr Return:	\$9,137.18
10-yr Return:	\$20,798.80

Incentive

kWh:	\$0.00
kW:	\$0.00
VSD:	-\$1000.00
Total:	\$1,000.00

Equipment Cost

Optimizer:	\$4,495.05
Installation (estimated):	\$800.00
Total:	\$5,295.05 (\$529.5 / ton)
Total (with incentive):	\$4,295.05 (\$429.5 / ton)

Project Simple Payback 2.6 years

Digi-RTU™

Pricing and Savings Estimator



4640 S 59th Street | Omaha, NE 68117
402.253.0143 | info@bes-tech.net | bes-tech.net

Facility Information

Location:	Phoenix, AZ
Floor area:	50,000 square foot
HVAC Operation Hours:	168 hours per week
Building occupancy Hours:	90 hours per week
Total RTU tonnage:	85 tons

Utility Information

Electricity rate:	\$0.0895 per kWh
Recommended electricity rate:	\$0.0895 per kWh
Gas rate:	\$0.7500 per therm
Recommended gas rate:	\$0.7500 per therm

*Enter your known gas rate

Incentive Information

Peak Demand Savings Incentive:	\$ 100.00 per kW
kWh Saving Incentive:	\$ - per kWh
VSD Incentive:	\$ - per HP

Annual Estimated Utility Savings

Electricity consumption	223,585 kWh
Demand	39.10 kW
Gas consumption	1,119 therm
Utility Cost Reduction	\$ 20,850 (\$ 245.3 / ton)
Carbon Reduction	154 ton

*Qualifies for EPACT Federal Tax Incentives

Equipment Information

RTU Size (tons)	Quantity	Heating Type	Supply Fan Operation	Voltage & Phase	Economizer	CO2 DCV Option	Communication Option	Digi-RTU Size (tons)	Digi-RTU Model
15	5	Gas	On	208/3	No	No	T-Stat	15	DRB-0-300-2-12
5	2	Gas	On	208/3	No	No	T-Stat	5	DRB-0-100-2-12
								0	
								0	
								0	
								0	
								0	
								0	
								0	
								0	

	Incentive
kWh	\$ -
kW	\$ 3,910
VSD	\$ -
Total	\$ 3,910

	Equipment Cost
Digi-RTU	\$ 34,665
Installation	\$ 2,100
Total	\$ 36,765 (\$ 433 / ton)
Total (with incentive)	\$ 32,855 (\$ 387 / ton)

Project Simple Payback 1.6 years

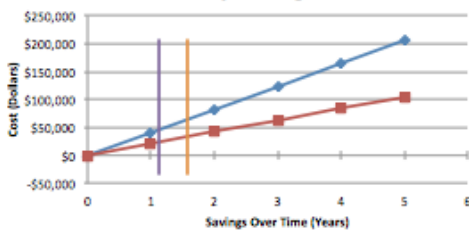
D.O.E EPACT Estimated Tax Incentive Value \$9,180 Adjusted ROI 1.1 years

Your Energy Savings With Digi-RTU Control Package

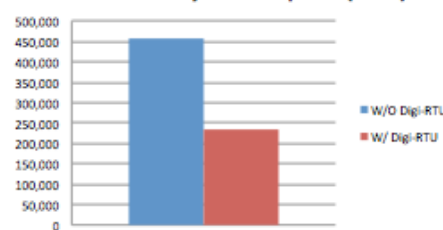
Customer Information:

Building Information:

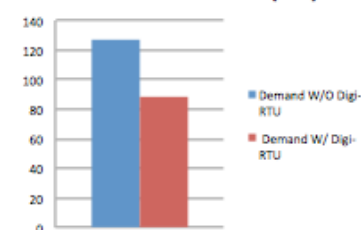
Operating Costs and ROI



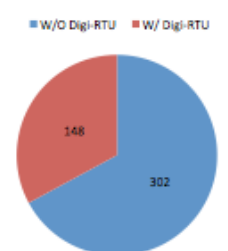
Annual Utility Consumption (kWh)



Demand Reduction (kW)



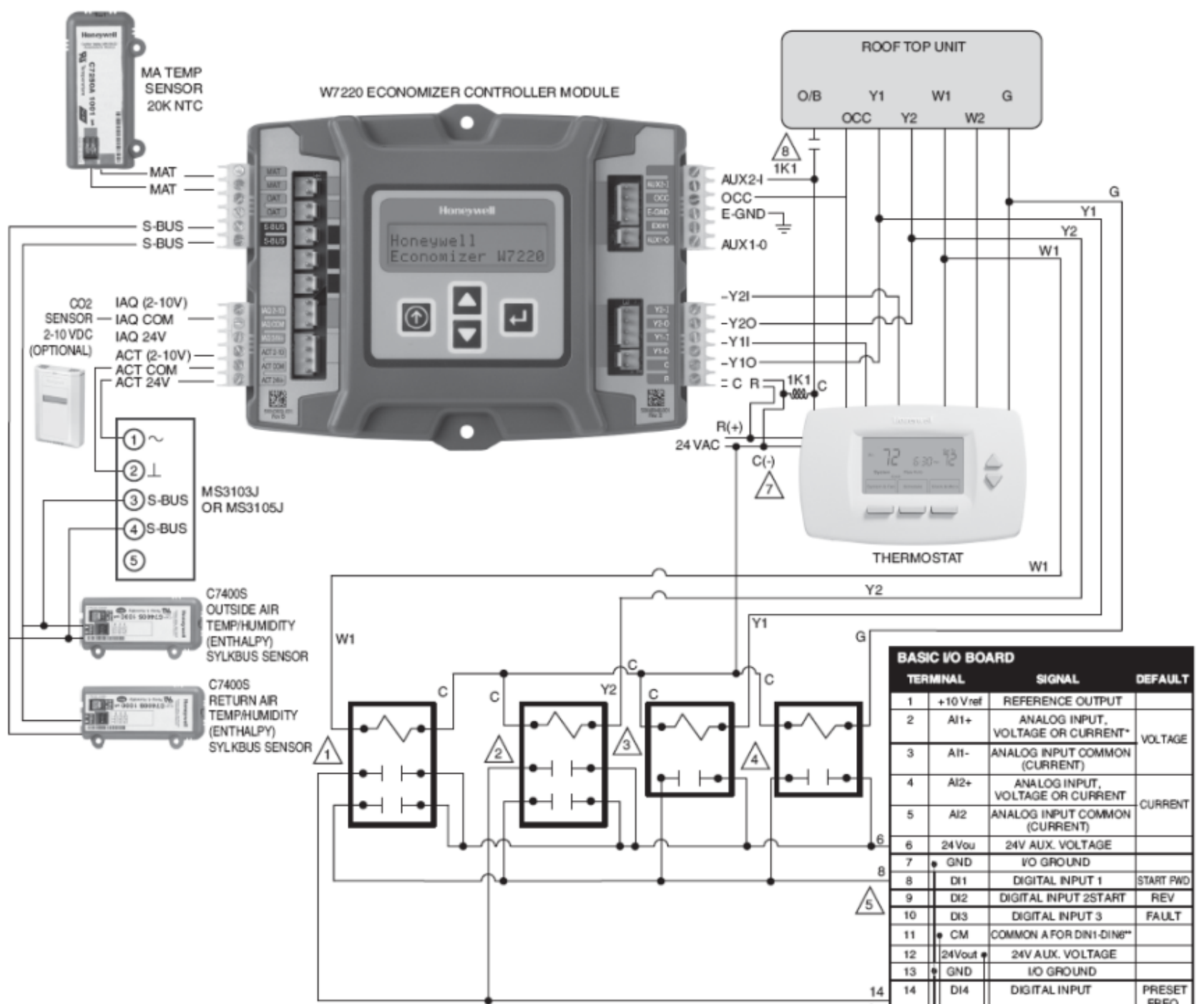
Carbon Emissions (Tons)



Off-the-Shelf, Non-DDC Solutions

- W7220A1000 – JADE economizer controller
- MS3105J3030 – economizer actuator, spring return, 44 lb-in torque (smaller 27 in-lb size available when needed)
- C7400S1000 – outside air temp & hum sensor
- C7400S1000 – return air temp & hum sensor
- C7250A1001 – mixed air temp sensor
- C7232A1016 – wall-mounted CO2 sensor w/o LCD
- TH8320R1003 – VisionPRO commercial programmable stat w/ economizer occupancy interlock
- THM6000R1002 - optional internet gateway for above stat
- HVFDSD3C0030G100 – 3hp, 480v, SmartVFD... sizes, voltage, model #, and costs will vary for each existing RTU, 3 to 10hp which should take care of 7.5 to 25 tons
- (4) DPDT relays

About \$1,900 for a 10 ton RTU

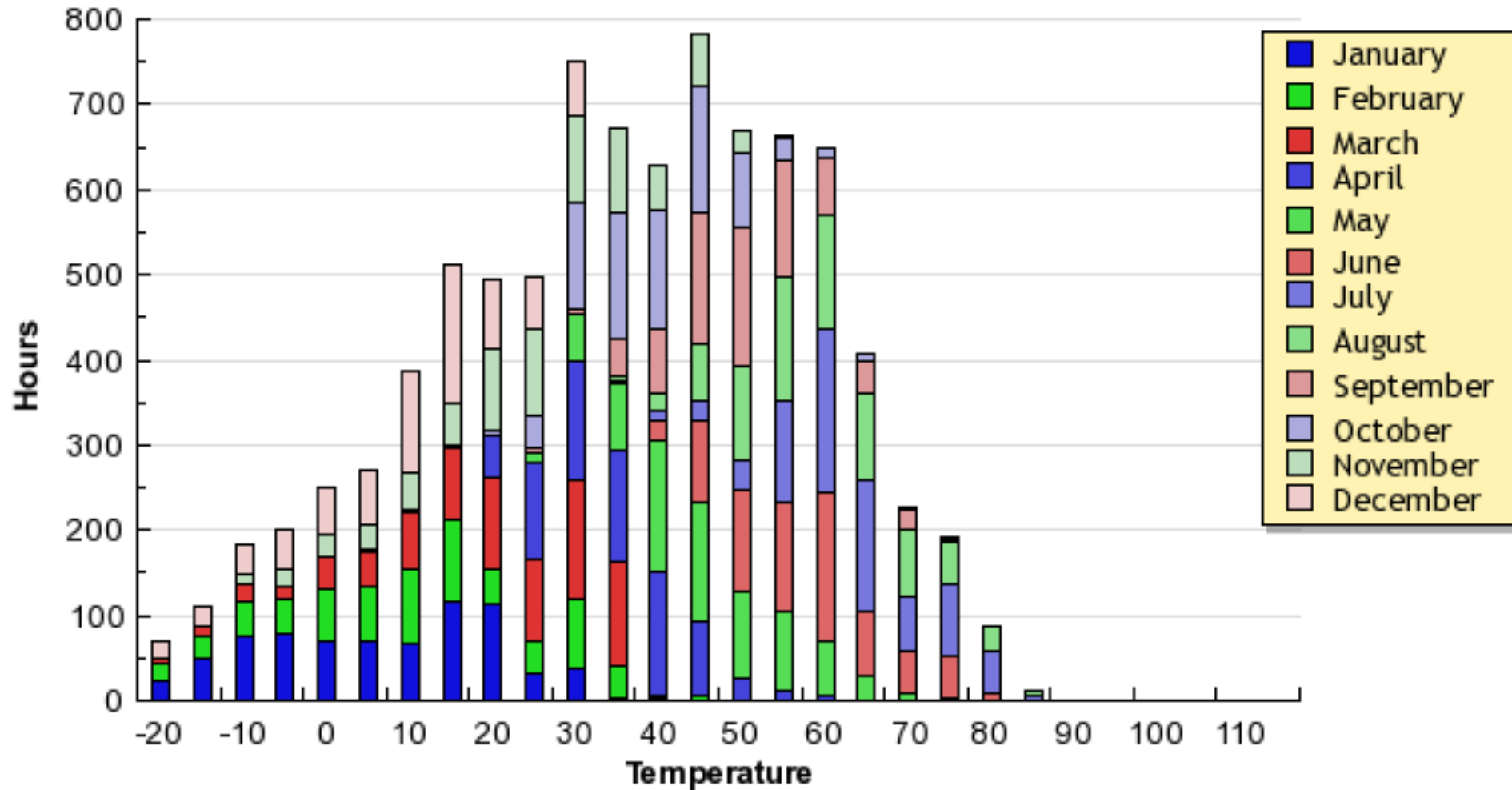


RELAY 1, DPDT RELAY. NO CONTACTS ENERGIZE DIGITAL INPUT 4 FOR HIGH SPEED FAN WITH W1 CALL

Compressor Capacity Control

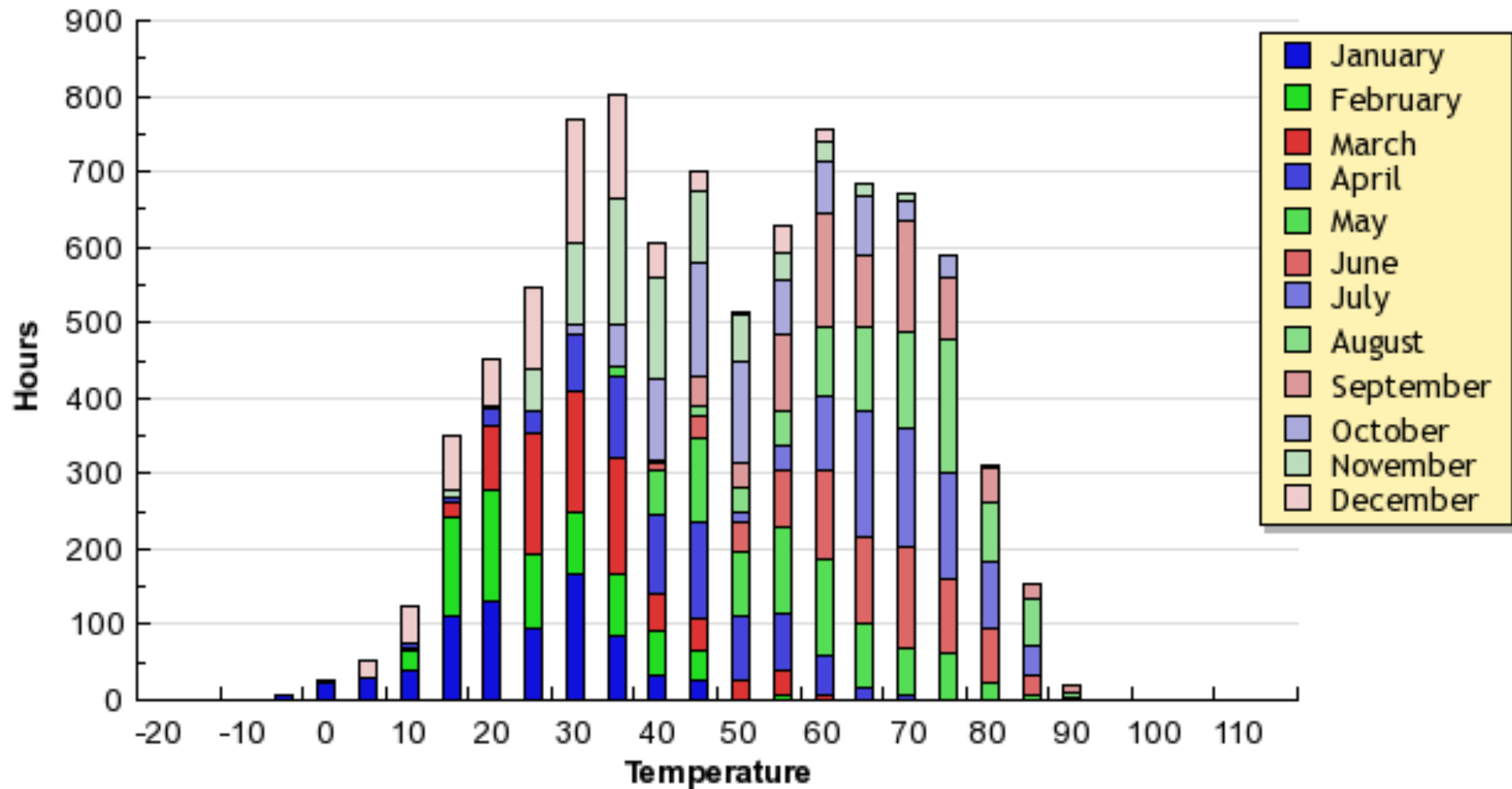
Full or Part Load?

Average Monthly Temperature for Duluth, MN



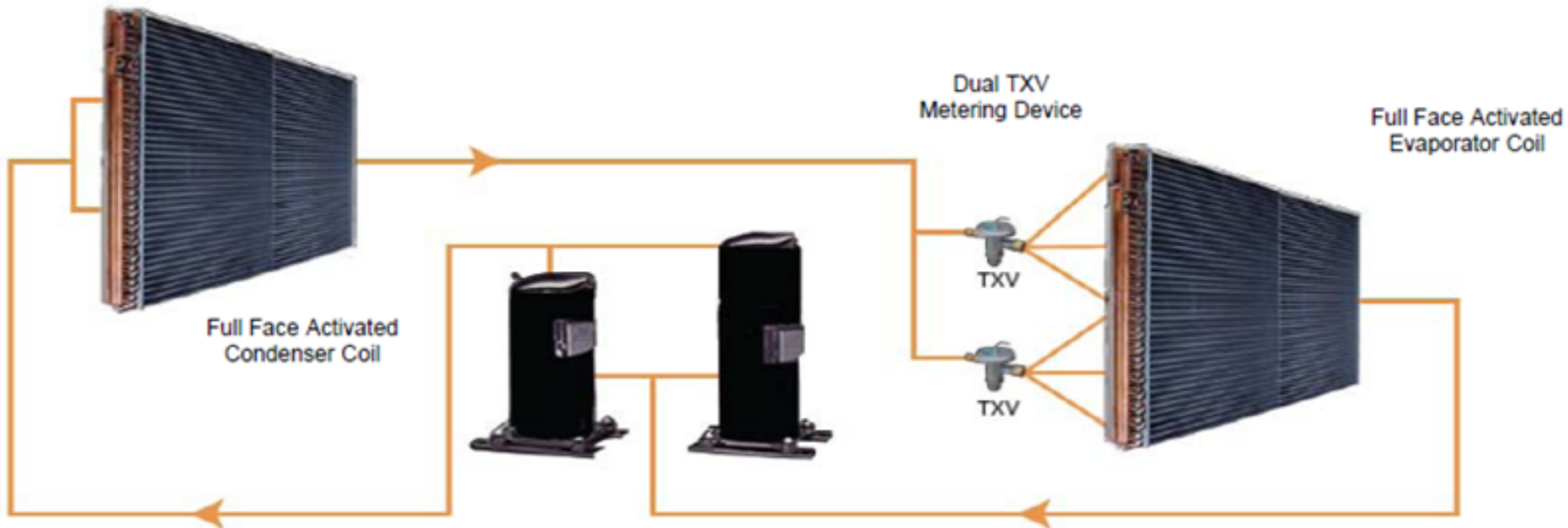
Full or Part Load?

Average Monthly Temperature for South Bend, IN



Capacity Control Options for DX RTUs

- On/Off – single fixed speed compressor
- Multiple, staged compressors
 - Saves energy
 - Improves humidity control
 - Cannot be retrofitted



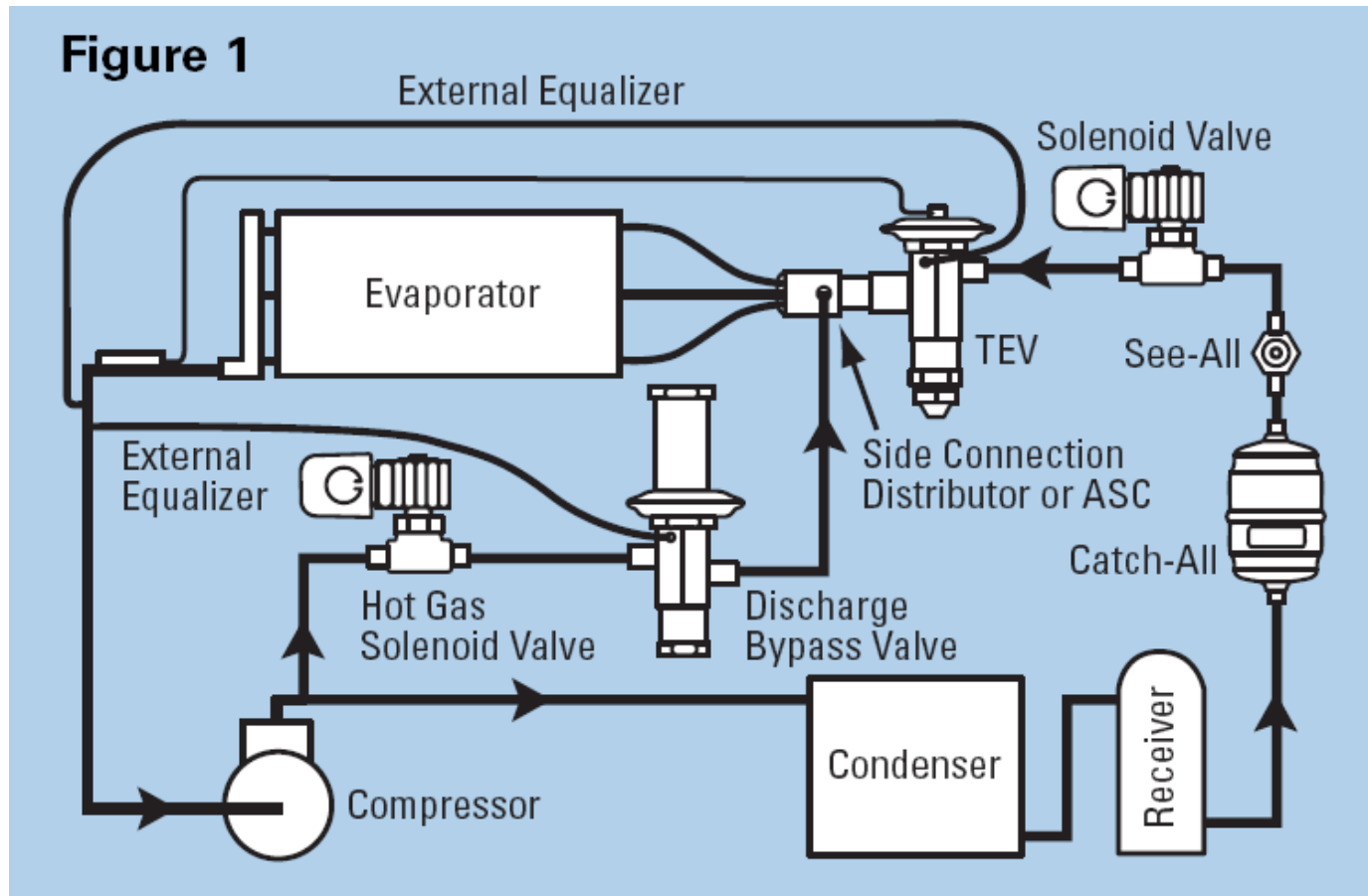
Unloaders

- Reciprocating compressors only
- Saves some energy
- Improves humidity control
- Can be easily retro-fitted
- Pressure unloaders vs. electric unloaders



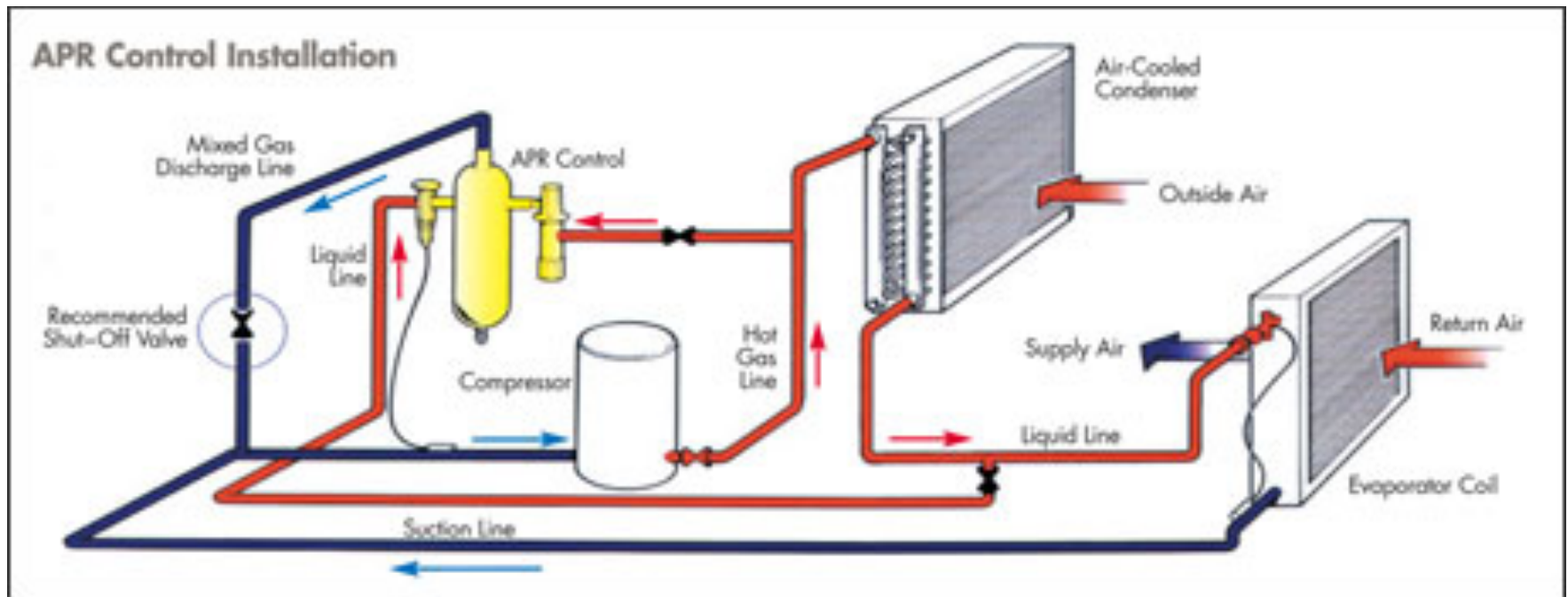
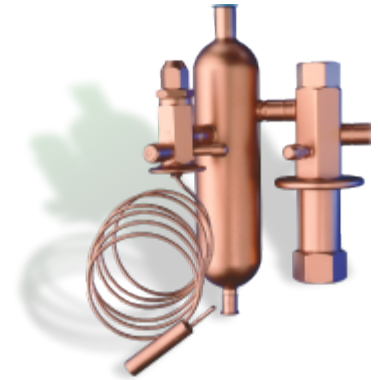
Hot Gas Bypass (HGB)

- Improves humidity control
- Can be retro-fitted



APR Control – Rawal Devices

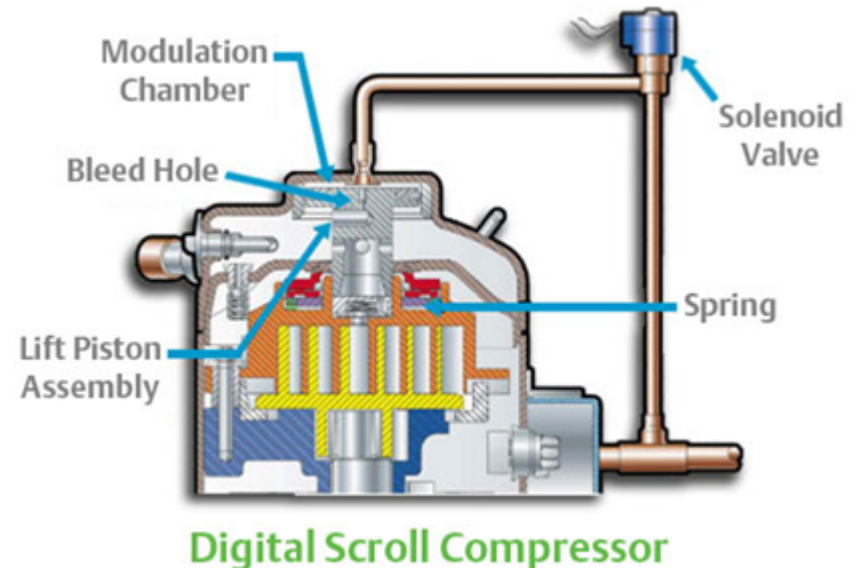
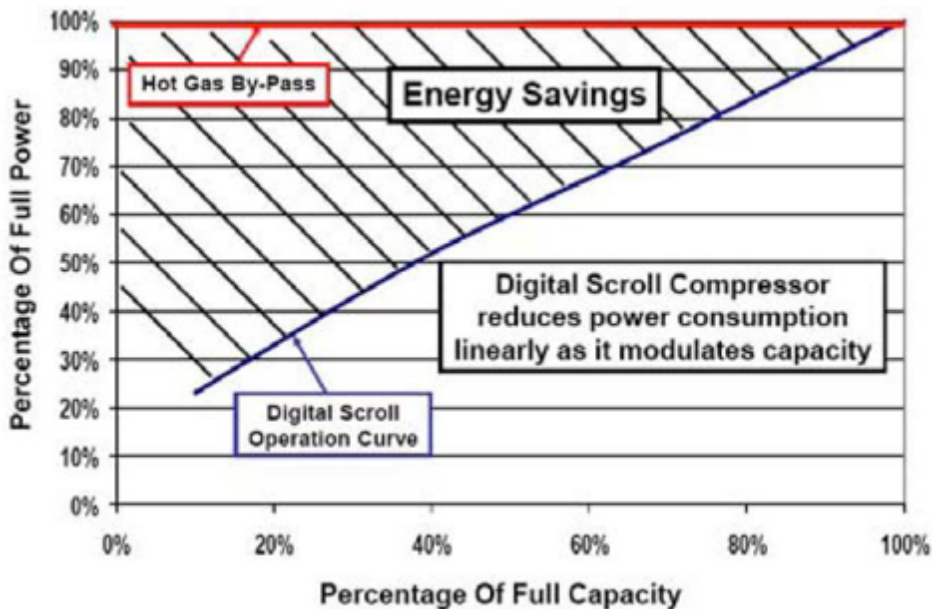
- Improves humidity control
- Can be retro-fitted
- Uses about 12% less energy than standard HGBP



Copeland Digital Scroll



- Modulates compressor capacity output from 10 to 100%
- Improves humidity control
- Can be retro-fitted, but not easily
- Uses about 30% less annual energy than standard HGBP



Variable Speed

- Scroll, rotary, screw, or centrifugal type compressors
- Modulates compressor capacity output from 20 to 100%
- Improves humidity control
- Can be retro-fitted, but not easily
- May use less energy than Digital Scroll



Final Thoughts & Additional Resources

Cumulative Savings...

Job Information

Job Title:

Job Type:

Notes:

Location Information

Region:

Location:

City:

Building Information

Building Type:

Unit Peak Clg Load: Tons

Energy Prices

Input Data:

Electric Price (Avg): \$/kWh

Gas Price (Avg): \$/MCF

Equipment Information

	Baseline	Proposed
Unit Description:	Unit 1	Unit 2
Equipment Type:	Cooling with Gas Heat	Cooling with Gas Heat
Model:	User-Defined	48LC
Size:		E012 (Medium Heat)
Refrigerant:	R-22	R-410a
Age (yrs):	15 Years	
Nominal Cooling Capacity:	10.0 Tons	10.0 Tons
AHRI Cooling Rating:	8.70 EER	13.00 EER
Capacity Control:	1-Stage	3-Stage
Heating Capacity:	184.0 MBH	184.0 MBH
AHRI Heating Rating:		
Heating Efficiency:	80 %	82 %
Indoor Fan Power:	User-Defined 3.70 BHP	Med. Static, 3Pr 3.70 BHP
Indoor Fan Control:	1-Speed	3-Speed
Economizer:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Energy Recovery:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
DCV (CO2) Control:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Purchase Cost (\$):	0	0
Installation Cost (\$):	0	0
Ann. Maint. + Repair (\$/yr):	0	0
Downtime Loss (\$/yr.):	0	

Cumulative Savings...

Job Title: Illinois Example

Job Type: Replacement

Notes:

Key Results

Energy Cost Savings over 5 years:	\$8,358
Maintenance, Repair, Downtime, Refrig. Savings over 5 years:	\$40
Total Savings over 5 years:	\$8,398
Annual Energy Cost Savings:	\$1,672 (62%)

Energy Cost Savings

Criteria	Unit 1 (\$)	Unit 2 (\$)	Energy Savings (\$)	Percent Savings (%)
Indoor Fan	\$1,376	\$568	\$809	59%
Cooling Electric	\$773	\$185	\$588	76%
Heating Electric	na	na	na	na
Heating Natural Gas	\$539	\$264	\$275	51%
Annual Energy Costs	\$2,688	\$1,017	\$1,672	62%

Cumulative Savings...

Job Information

Job Title:

Job Type:

Notes:

Location Information

Region:

Location:

City:

Building Information

Building Type:

Unit Peak Clg Load: Tons

Energy Prices

Input Data:

Electric Price (Avg): \$/kWh

Gas Price (Avg): \$/MCF

Equipment Information

	Baseline	Proposed
Unit Description:	<input type="text" value="Unit 1"/>	<input type="text" value="Unit 2"/>
Equipment Type:	<input type="text" value="Cooling with Gas Heat"/>	<input type="text" value="Cooling with Gas Heat"/>
Model:	<input type="text" value="User-Defined"/>	<input type="text" value="48LC"/>
Size:	<input type="text"/>	<input type="text" value="E012 (Medium Heat)"/>
Refrigerant:	<input type="text" value="R-22"/>	<input type="text" value="R-410a"/>
Age (yrs):	<input type="text" value="15"/> Years	<input type="text"/>
Nominal Cooling Capacity:	<input type="text" value="10.0"/> Tons	<input type="text" value="10.0"/> Tons
AHRI Cooling Rating:	<input type="text" value="8.70"/> <input type="text" value="EER"/>	<input type="text" value="13.00"/> <input type="text" value="EER"/>
Capacity Control:	<input type="text" value="1-Stage"/>	<input type="text" value="3-Stage"/>
Heating Capacity:	<input type="text" value="184.0"/> MBH	<input type="text" value="184.0"/> MBH
AHRI Heating Rating:	<input type="text"/>	<input type="text"/>
Heating Efficiency:	<input type="text" value="80"/> %	<input type="text" value="82"/> %
Indoor Fan Power:	<input type="text" value="User-Defined"/> <input type="text" value="3.70"/> BHP	<input type="text" value="Med. Static, 3Pt"/> <input type="text" value="3.70"/> BHP
Indoor Fan Control:	<input type="text" value="1-Speed"/>	<input type="text" value="3-Speed"/>
Economizer:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Energy Recovery:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
DCV (CO2) Control:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Purchase Cost (\$):	<input type="text" value="0"/>	<input type="text" value="0"/>
Installation Cost (\$):	<input type="text" value="0"/>	<input type="text" value="0"/>
Ann. Maint. + Repair (\$/yr):	<input type="text" value="0"/>	<input type="text" value="0"/>
Downtime Loss (\$/yr.)	<input type="text" value="0"/>	<input type="text"/>

Cumulative Savings...

Job Information

Job Title: Madison Example

Job Type: Replacement

Notes:

Key Results

Energy Cost Savings over 5 years:	\$9,692
Maintenance, Repair, Downtime, Refrig. Savings over 5 years:	\$325
Total Savings over 5 years:	\$10,017
Annual Energy Cost Savings:	\$1,938 (61%)

Energy Cost Savings

Criteria	Unit 1 (\$)	Unit 2 (\$)	Energy Savings (\$)	Percent Savings (%)
Indoor Fan	\$1,663	\$719	\$944	57%
Cooling Electric	\$838	\$185	\$653	78%
Heating Electric	na	na	na	na
Heating Natural Gas	\$662	\$321	\$342	52%
Annual Energy Costs	\$3,163	\$1,224	\$1,938	61%

Cumulative Savings...

Job Information

Job Title:

Job Type:

Notes:

Location Information

Region:

Location:

City:

Building Information

Building Type:

Unit Peak Clg Load: Tons

Energy Prices

Input Data:

Electric Price (Avg): \$/kWh

Gas Price (Avg): \$/MCF

Equipment Information

	Baseline	Proposed
Unit Description:	Unit 1	Unit 2
Equipment Type:	Cooling with Gas Heat	Cooling with Gas Heat
Model:	User-Defined	48LC
Size:		E012 (Medium Heat)
Refrigerant:	R-22	R-410a
Age (yrs):	15 Years	
Nominal Cooling Capacity:	10.0 Tons	10.0 Tons
AHRI Cooling Rating:	8.70 EER	13.00 EER
Capacity Control:	1-Stage	3-Stage
Heating Capacity:	184.0 MBH	184.0 MBH
AHRI Heating Rating:		
Heating Efficiency:	80 %	82 %
Indoor Fan Power:	User-Defined 3.70 BHP	Med. Static, 3Pt 3.70 BHP
Indoor Fan Control:	1-Speed	3-Speed
Economizer:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Energy Recovery:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
DCV (CO2) Control:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Purchase Cost (\$):	0	0
Installation Cost (\$):	0	0
Ann. Maint. + Repair (\$/yr):	0	0
Downtime Loss (\$/yr.)	0	

Cumulative Savings...

Job Title: Eau Claire Example

Job Type: Replacement

Notes:

Key Results

Energy Cost Savings over 5 years:	\$9,632
Maintenance, Repair, Downtime, Refrig. Savings over 5 years:	\$325
Total Savings over 5 years:	\$9,957
Annual Energy Cost Savings:	\$1,926 (57%)

Energy Cost Savings

Criteria	Unit 1 (\$)	Unit 2 (\$)	Energy Savings (\$)	Percent Savings (%)
Indoor Fan	\$1,668	\$802	\$866	52%
Cooling Electric	\$791	\$176	\$615	78%
Heating Electric	na	na	na	na
Heating Natural Gas	\$917	\$471	\$445	49%
Annual Energy Costs	\$3,375	\$1,449	\$1,926	57%

Cumulative Savings...

Job Information

Job Title:

Job Type:

Notes:

Location Information

Region:

Location:

City:

Building Information

Building Type:

Unit Peak Clg Load: Tons

Energy Prices

Input Data:

Electric Price (Avg): \$/kWh

Gas Price (Avg): \$/MCF

Equipment Information

	Baseline	Proposed
Unit Description:	Unit 1	Unit 2
Equipment Type:	Cooling with Gas Heat	Cooling with Gas Heat
Model:	User-Defined	48LC
Size:		E012 (Medium Heat)
Refrigerant:	R-22	R-410a
Age (yrs):	15 Years	
Nominal Cooling Capacity:	10.0 Tons	10.0 Tons
AHRI Cooling Rating:	8.70 EER	13.00 EER
Capacity Control:	1-Stage	3-Stage
Heating Capacity:	184.0 MBH	184.0 MBH
AHRI Heating Rating:		
Heating Efficiency:	80 %	82 %
Indoor Fan Power:	User-Defined 3.70 BHP	Med. Static, 3Pt 3.70 BHP
Indoor Fan Control:	1-Speed	3-Speed
Economizer:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Energy Recovery:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
DCV (CO2) Control:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Purchase Cost (\$):	0	0
Installation Cost (\$):	0	0
Ann. Maint. + Repair (\$/yr):	0	0
Downtime Loss (\$/yr.):	0	

Cumulative Savings...

Job Title: Duluth Example

Job Type: Replacement

Notes:

Key Results

Energy Cost Savings over 5 years:	\$7,958
Maintenance, Repair, Downtime, Refrig. Savings over 5 years:	\$325
Total Savings over 5 years:	\$8,283
Annual Energy Cost Savings:	\$1,592 (55%)

Energy Cost Savings

Criteria	Unit 1 (\$)	Unit 2 (\$)	Energy Savings (\$)	Percent Savings (%)
Indoor Fan	\$1,384	\$682	\$701	51%
Cooling Electric	\$449	\$78	\$371	83%
Heating Electric	na	na	na	na
Heating Natural Gas	\$1,037	\$518	\$519	50%
Annual Energy Costs	\$2,870	\$1,278	\$1,592	55%

Cumulative Savings...

Job Information

Job Title:

Job Type:

Notes:

Location Information

Region:

Location:

City:

Building Information

Building Type:

Unit Peak Clg Load: Tons

Energy Prices

Input Data:

Electric Price (Avg): \$/kWh

Gas Price (Avg): \$/MCF

Equipment Information

	Baseline	Proposed
Unit Description:	Unit 1	Unit 2
Equipment Type:	Cooling with Gas Heat	Cooling with Gas Heat
Model:	User-Defined	48LC
Size:		E012 (Medium Heat)
Refrigerant:	R-22	R-410a
Age (yrs):	15 Years	
Nominal Cooling Capacity:	10.0 Tons	10.0 Tons
AHRI Cooling Rating:	8.70 EER	13.00 EER
Capacity Control:	1-Stage	3-Stage
Heating Capacity:	184.0 MBH	184.0 MBH
AHRI Heating Rating:		
Heating Efficiency:	80 %	82 %
Indoor Fan Power:	User-Defined 3.70 BHP	Med. Static, 3Pr 3.70 BHP
Indoor Fan Control:	1-Speed	3-Speed
Economizer:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Energy Recovery:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
DCV (CO2) Control:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Purchase Cost (\$):	0	0
Installation Cost (\$):	0	0
Ann. Maint. + Repair (\$/yr):	0	0
Downtime Loss (\$/yr.):	0	

Cumulative Savings...

Job Title: Indiana Example

Job Type: Replacement

Notes:

Key Results

Energy Cost Savings over 5 years:	\$8,394
Maintenance, Repair, Downtime, Refrig. Savings over 5 years:	\$40
Total Savings over 5 years:	\$8,434
Annual Energy Cost Savings:	\$1,679 (62%)

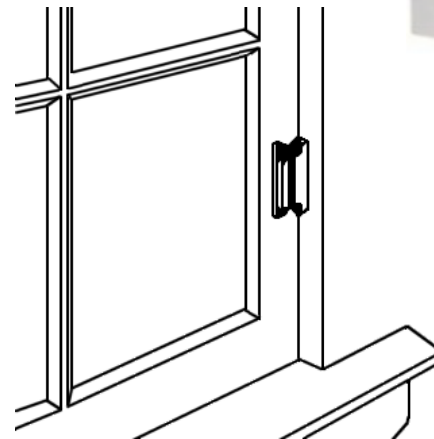
Energy Cost Savings

Criteria	Unit 1 (\$)	Unit 2 (\$)	Energy Savings (\$)	Percent Savings (%)
Indoor Fan	\$1,396	\$579	\$817	59%
Cooling Electric	\$782	\$184	\$598	77%
Heating Electric	na	na	na	na
Heating Natural Gas	\$520	\$257	\$264	51%
Annual Energy Costs	\$2,698	\$1,019	\$1,679	62%

Occupancy Sensors



- Motion & Thermal Detectors
 - Control lights
 - Relax HVAC setpoints
- Security system interlock
 - Swipe out of building with key fob and automatically turns off lights in your office and relaxes HVAC setpoints
- Light activated thermostats
 - Control HVAC when lights on
 - Payback less than 3 months
- Operable window and door interlock
 - Disables zone heat/cool/vent



Building Automation Systems

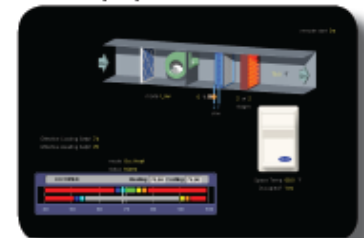
- Centralized controls
- Change scheduling for multiple HVAC units at same time
- Monitor “health” of equipment
- Internet accessible
- Alarming via text msg or email
- Collect/trend data
- Integrate to lighting control or security system



Floor Plan Views



Equipment Views



Historical Trending



“Right Sizing” Equipment

- On average building fan systems in the US are oversized by 60%*
- Most chillers are oversized by 50 to 200%**
- Spend < 1% of operation at full load
 - Don’t add “safety factors” when sizing or selecting
- Better dehumidification
 - Smaller equipment will dehum better allowing higher cooling setpoints
- Less temperature swings
 - Equipment runs even cycles instead of rapid on...off...on...
- Lower first cost
 - Smaller is better

Worker Productivity Costs MORE than Energy

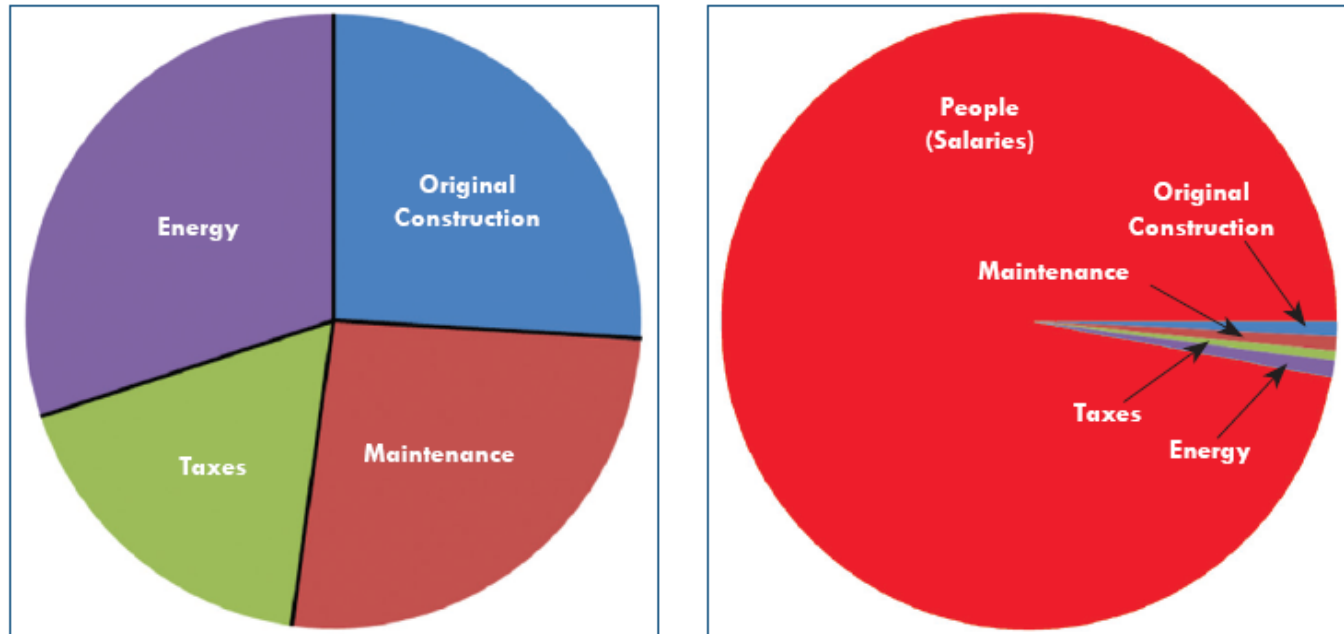


Figure 1: (left) Life-cycle building costs breakdown; (right) life-cycle building costs breakdown with people (salaries).

Table 2-1: Breakdown of Typical Small Office Building Annual Expenditures (from Cler et al.)

Expenditure	Annual Cost, \$/ft ²
Office-Workers' Salaries	130
Gross Office Rent	21
Total Energy Use	1.81
Electricity Use	1.53
Repair and Maintenance	1.37
Space Cooling and Air Handling Electricity	0.61 ^a
Space Cooling and Air Handling Maintenance	0.82
Total Building Operations and Management Salaries	0.58

Pie charts: ASHRAE Journal
July 2013

Table: U.S. Department of
Energy July 2002

Supporting Documents Available

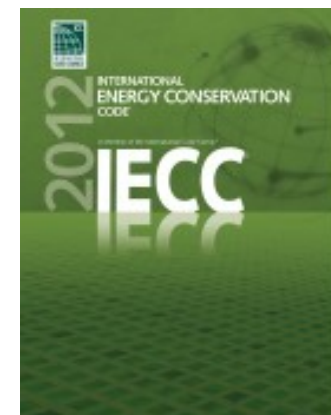
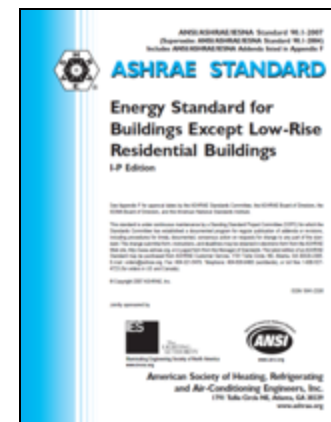
- Advanced Rooftop Control (ARC) Retrofit: Field-Test Results
 - Pacific Northwest National Labs (July 2013)
- Single-Zone VAV Performance Evaluation
 - Quest Energy Group (Feb. 2010)
- Energy Savings and Economics for Advanced Control Strategies for Packaged AC Units with Gas Heat
 - Pacific Northwest National Labs (Dec. 2011)
- Staged Air Volume System – 2-Speed Fan Control Strategy for Packaged RTUs
 - Carrier Corp. (March 2012)

Supporting Documents Available

- Identifying Energy Savings Potential on Rooftop Commercial Units
 - Ecotope, Inc. & Eugene Water & Electric Board
- How People Actually Use Thermostats
 - Lawrence Berkley National Labs (2010)
- Unique Approach to Part Load Operation and Energy Savings for Unitary Applications
 - Carrier Corp. (May 2010)
- Understanding Single Zone VAV Systems
 - Trane (April 2013)
- Review of Commercial RTU Field Studies in the Pacific NW and CA
 - New Buildings Institute (Oct. 2004)

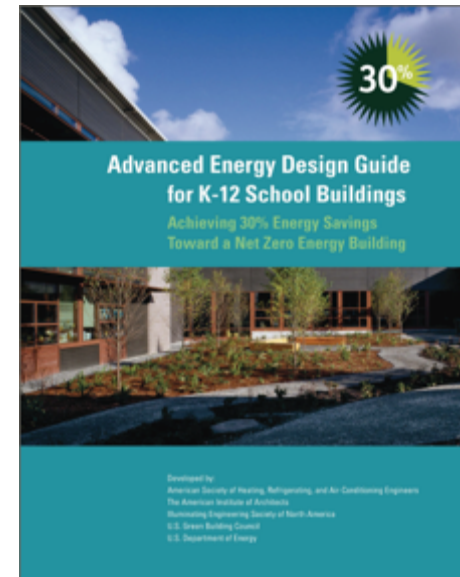
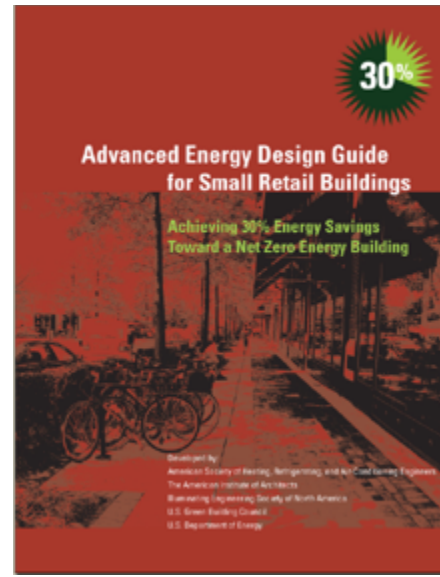
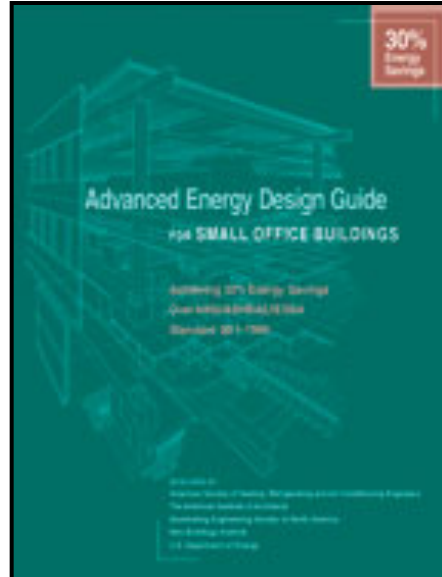
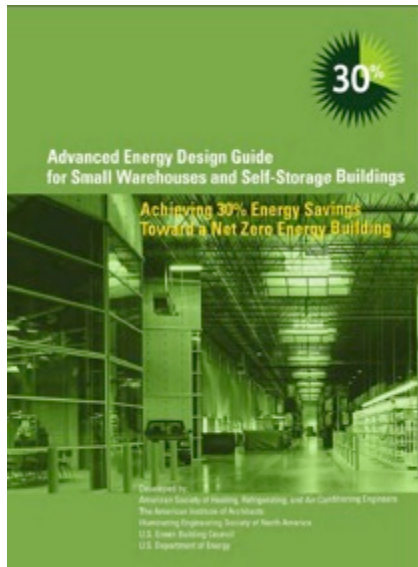
Resources

- ASHRAE 90.1
 - Updated every 3 years
 - Specifies minimum energy performance for new buildings
 - www.ashrae.org
- International Energy Conservation Code (IEEC)
 - www.iccsafe.org
- Advanced RTU Campaign
 - New effort to promote RTU efficiency
 - Tools, calculators, webinars, etc.
 - www.advancedrtu.org



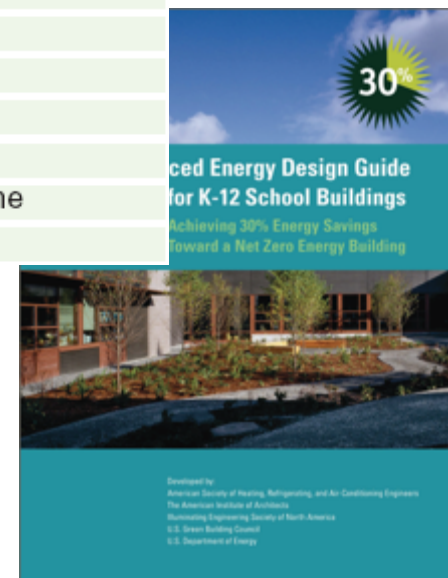
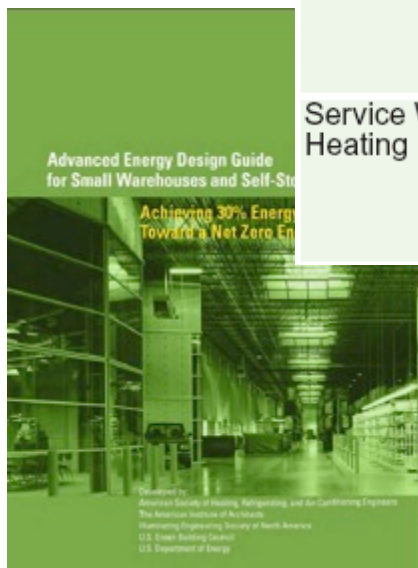
Resources

- ASHRAE Advanced Energy Design Guides
 - Prescriptive approach by climate zone
 - 30% Guides
 - Save 30% more energy than ASHRAE 90.1-1999
 - 6 versions published: Office, Retail, School, Warehouse, Hotel, Healthcare
 - 50% Guides
 - Save 50% more energy than ASHRAE 90.1-2004
 - 4 versions published: Office, Retail, School, Hospital
 - Free download at www.ashrae.org/aedg



Resources

HVAC	Air conditioner (0-65 KBtuh)	13.0 SEER
	Air conditioner (>65-135 KBtuh)	11.0 EER/11.4 IPLV
	Air conditioner (>135-240 KBtuh)	10.8 EER/11.2 IPLV
	Air conditioner (>240 KBtuh)	10.0 EER/10.4 IPLV
	Gas furnace (0-225 KBtuh - SP)	80% AFUE or E_t
	Gas furnace (0-225 KBtuh - Split)	90% AFUE or E_t
	Gas furnace (>225 KBtuh)	80% E_c
	Heat pump (0-65 KBtuh)	13.0 SEER/7.7 HSPF
	Heat pump (>65-135 KBtuh)	10.6 EER/11.0 IPLV/3.2 COP
	Heat pump (>135 KBtuh)	10.1 EER/11.0 IPLV/3.1 COP
Economizer	Air conditioners & heat pumps - SP	Cooling capacity > 54 KBtuh
Ventilation	Outdoor air damper	Motorized control
	Demand control	CO ₂ sensors
Ducts	Friction rate	0.08 in. w.c./100 feet
	Sealing	Seal class B
	Location	Interior only
	Insulation level	R-6
Service Water Heating	Gas storage	90% E_t
	Gas instantaneous	0.81 EF or 81% E_t
	Electric storage 12 kW	EF > 0.99 – 0.0012xVolume
	Pipe insulation ($d < 1\frac{1}{2}$ in./ $d \geq 1\frac{1}{2}$ in.)	1 in./ 1½ in.





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Special Thanks to those who allowed me to use their slides or graphics today...



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