



QUESTLINE

We Make Energy Engaging

Re•Thinking Energy Efficiency

In Healthcare Facilities

Questline Academy



Meet Your Panelists

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ENLIGHTEN



EDUCATE



ENGAGE

Contents

- Three Benefits Buckets
 - Utility savings
 - Non-utility cost savings
 - Non-financial benefits
- Common Hurdles
- Energy Efficiency Upgrades
- Healthcare Codes and Standards (NEW)
- Healthcare Initiatives

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Three Buckets

1. Utility cost savings

- Decreased utility bill
 - Equipment efficiency improvements
 - Savings from controls
- Challenges
 - Utility expenses as percent of operating expenses are low
 - Investment required to achieve savings is high



Three Buckets

2. Non-utility cost savings

- Higher employee productivity
- Fewer errors (adverse drug effects)
- Increased revenues
- Fewer on-the-job accidents
- Lower medical costs and fewer lost workdays



Three Buckets

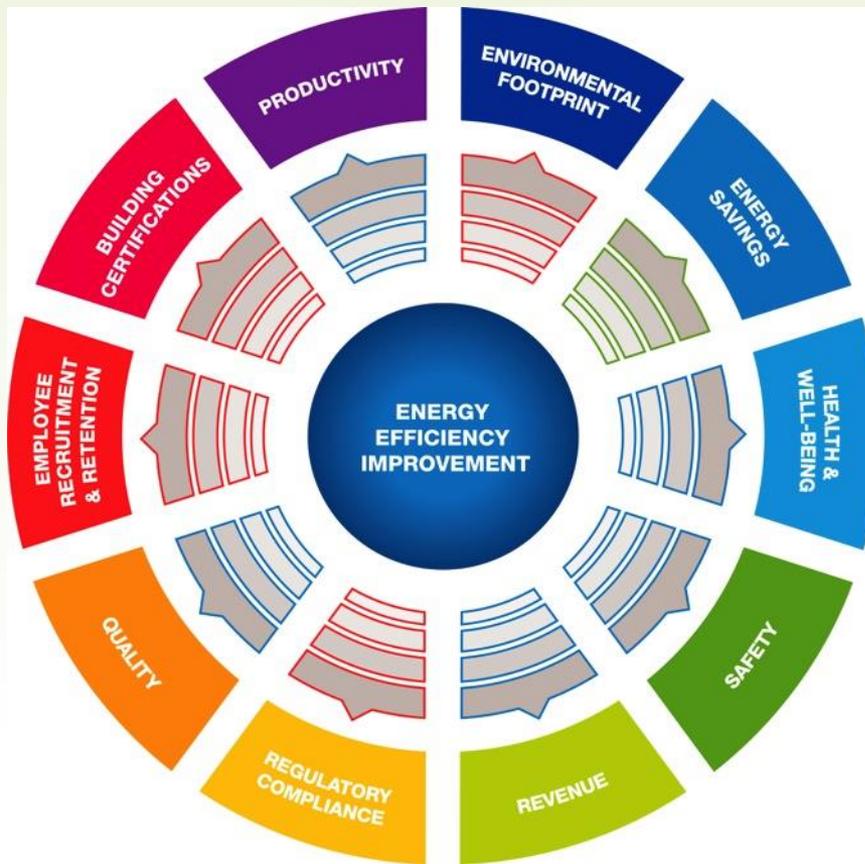
3. Non-financial benefits

- More comfortable employees
- Employee attraction and retention
- Regulatory compliance
- ENERGY STAR/LEED certification
- Faster patient healing



Three Buckets

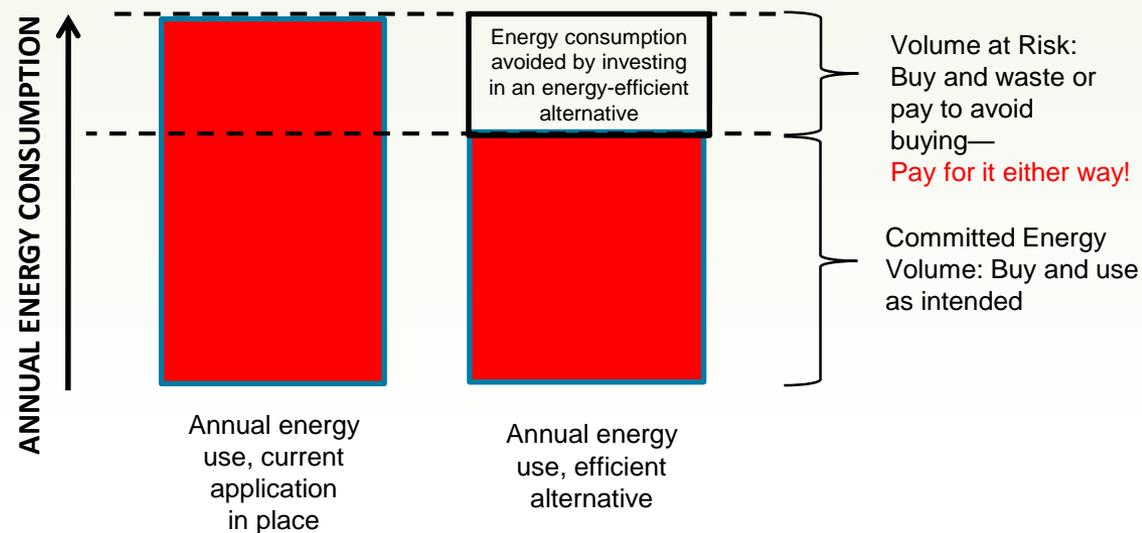
Energy Efficiency Benefits Wheel



-  Utility cost savings
-  Non-utility cost savings
-  Non-financial benefits

Common Hurdles

- We only fund projects with a two-year payback
 - A two-year payback is 50% ROI
 - Where else are you getting a two-year payback?
 - Prime rate is only 3.25%
- We have already plucked the low-hanging fruit
 - Do farmers only pluck low hanging fruit?
- We do not have the budget
 - You are paying for it, anyway →



Source: Christopher Russell, Energy PathFINDER

Poll Question

- What is the biggest roadblock for your healthcare customers to commit to energy efficiency projects?
 - a) Utility rebate process
 - b) Limited utility incentives
 - c) Capital budget
 - d) Lack of knowledge about lighting, HVAC, etc.
 - e) Do not know where to start
 - f) Other

Electric savings example

- A 500,000-square-foot hospital with 1,400 employees
 - An electric energy rate of \$0.10/kWh
- HVAC upgrade
 - 4.75 million kWh of energy consumed by cooling and ventilation
 - A chiller upgrade reduces that by 30% or 1.4 million kWh
 - \$140,000 annual savings
- Lighting upgrade
 - 3.65 million kWh of energy consumed by lighting
 - A lighting upgrade reduces that by 40% or 1.5 million kWh
 - \$150,000 per year savings



Non-Utility Cost Savings

- 500,000-square-foot hospital with 1,400 employees
- HVAC upgrade **productivity** benefit
 - Employee performance decreases on average, by 0.3% to 0.4% per each 1°F change in temperature (71°F)
 - \$150 to \$300 estimated savings per employee per year
 - Employee performance increases by approximately 0.8% per 10 cfm per person increase in ventilation rate
 - \$300 to \$700 estimated savings per employee per year



Non-Utility Cost Savings

- A 500,000-square-foot hospital with 1,400 employees
- HVAC upgrade benefits
 - Annual direct **medical cost** and lost workdays of building-related health conditions is \$2,750 per employee
 - Reducing health costs by one-third saves \$900 per employee
 - Energy efficient properties (LEED, green) have 10% less maintenance costs (~\$0.25/square feet)



Non-Utility Cost Savings

- A 500,000-square-foot hospital with 1,400 employees
 - Energy efficiency upgrades
 - Utility cost savings estimate of **\$290,000**



HVAC Savings Source	Unit Savings	Annual Savings
Employee productivity (+1%)	\$150/employee*	\$200,000
Employee health (-16%)	\$450/employee*	\$600,000
Building maintenance (-4%)	\$0.10/sqft	\$50,000
Non-utility cost savings estimate		\$850,000
* 50% of total HVAC effect (space cooling only)		



Non-Utility Cost Savings Office Space

- McGraw Hill 2014 study on impact of green buildings
 - Surveyed architects (456), contractors (183), owners (94) and medical practitioners (91)
 - 47% saw healthcare cost reductions (1% to 5%)
 - 56% reported reduced absenteeism
 - 21% reported increased productivity
 - 91% of owner human resources executives



Non-Utility Cost Savings Office Space

- CBRE green building tenant survey on productivity
 - Top factors that the 900 tenants saw impacting productivity
 1. Access to natural light
 2. Individual control over thermal comfort
 3. Places for social interaction
 - Willing to pay 2% more for building with first two attributes



Non-Utility Cost Savings Office Space

- 30,000-square-foot office building with 150 employees
 - \$5,000 per year HVAC savings
 - + \$6,600 per year lighting savings
 - \$11,600** total annual estimated savings



Retrofit Savings Source	Unit Savings	Annual Savings
Employee productivity (+1%)	\$300/employee	\$45,000
Employee health (-16%)	\$450/employee*	\$65,000
Building maintenance (-4%)	\$0.10/square foot	\$3,000
Non-utility cost savings estimate		\$113,000
* 50% of total HVAC effect (space cooling only)		



Non-Utility Cost Savings

Profit Perspective

- Average net profit margin of 3%
 - Profit from \$33 of revenue = \$1 of energy savings
- Achieving \$150,000 of energy savings

or

Generating \$5 million in new revenue

- An additional 1,500 patient days
 - At \$3,500 per in-patient day
- 300 new patients per year
 - At 5 days per in-patient stay
- Which is easier?



Non-Financial Benefits for Healthcare

- 500,000-square-foot hospital with 1,400 employees
 - Decreased carbon footprint
 - Saving of 3 million kWh annual equivalency
 - 1.6 metric tons of CO₂
 - Electricity production emits 1,180 lbs CO₂/MWh
 - Emissions from 0.5 cars
 - 380 gallons of gasoline per car x 17.7 lbs CO₂ per gallon
 - Carbon storage of 35 square feet of trees
 - 410,060 pounds of CO₂ sequestered per acre of trees



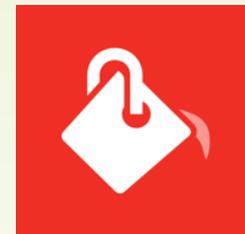
Non-Financial Benefits for Healthcare

- The Joint Commission for Accreditation for Healthcare Organizations (TJC)
 - Environment of Care EC.7.10.16 Ventilation Systems requirements
 1. Proper pressure relationships
 2. Air exchanges per hour
 3. Filtration efficiencies
 - An upgraded HVAC will make JCAHO compliance much easier
- 2014 Guidelines for Design and Construction of Hospitals and Outpatient Facilities
 - Medication safety zones and pharmacy areas must meet stringent high lighting level requirements



Non-Financial Benefits for Healthcare

- McGraw Hill 2014 study on impact of green buildings
 - 66% reported improved employee satisfaction
- Meet energy codes
- Qualify for ENERGY STAR or LEED certification
- Improved attraction and retention of employees



Poll Question

- Which of the following energy efficiency projects are of greatest interest to your healthcare customers?
 - a) HVAC
 - b) Lighting
 - c) Hot water
 - d) Motors
 - e) Building Automation Systems (BAS)
 - f) Other

Energy Efficiency Upgrades

- LED lighting
- Lighting controls
- Daylighting
- Chilled beam HVAC
- Variable refrigerant flow HVAC
- Desiccant energy recovery ventilation
- UV & plasma air cleaning



LED Lighting: Linear Fluorescent Replacement

Light Guide Products

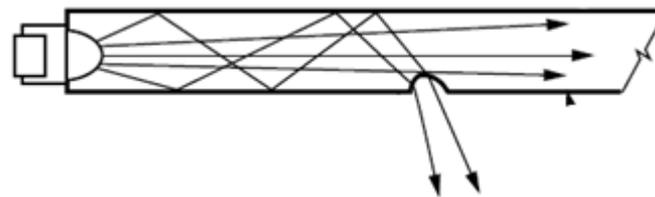
- GE Edge Lighting/Lumination
- Cree LN Series
- Cooper Lighting's Metalux Encounter
 - 8400 lumens @ 109 watts, 85 CRI



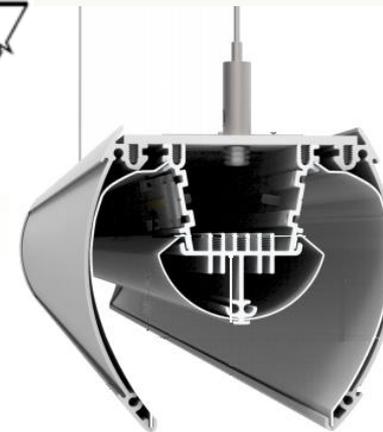
Source: Cooper Lighting



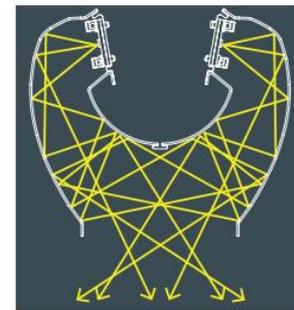
Source: Cree



Source: GE



Metalumen Manufacturing Inc.



LED Lighting: Recessed Downlights

- LED performance generally matches R-CFLs
 - 6-inch aperture
- Tunable individual addressable
- Small form factor MR16 LED



Source: Delray Lighting Kone 3



Source: Verbatim Americas



Source: Ketra S38 Tunable Lamp

LED Lighting: Parking Garages



Before (HPS)

Source: Progress Energy



After (LED)

Type	Watts	Lumens	LPW	CCT (K)	CRI
LED	86	6,765	79	6,000	75
HPS	120	11,400	95	2,042	21

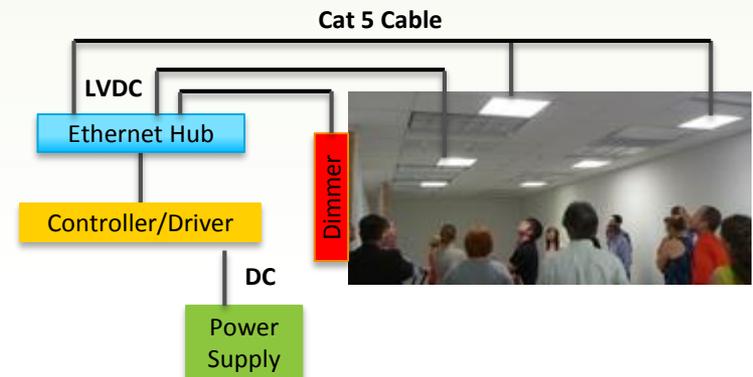
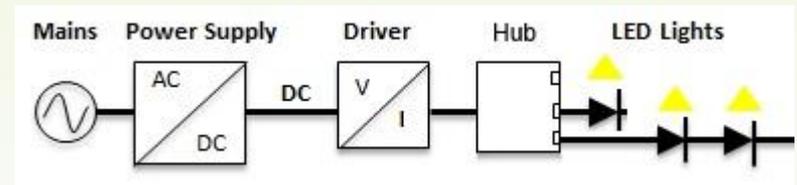


Source: Cree

Lighting Controls

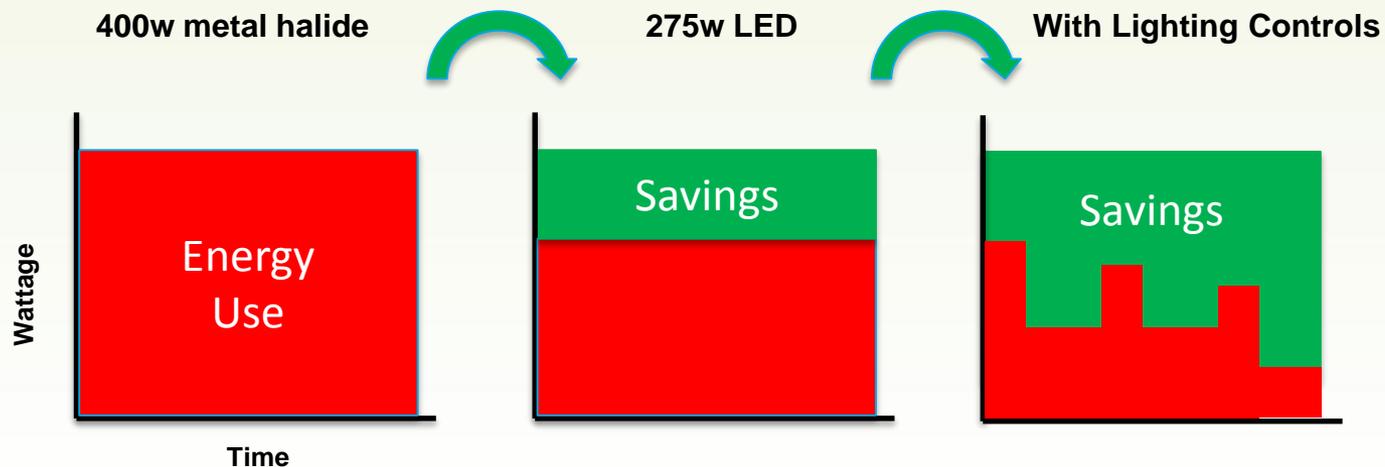
Power-over-Ethernet (PoE); Lighting-over-IP

- Few major suppliers
 - Philips
 - Eaton Cooper
 - Redwood Systems/CommScope (does not strictly follow PoE)
 - Innovative Lighting (Iowa)
 - nuLEDs (CA)
- 30 watts max per Cat 5 cable pair
 - Using additional pairs adds power capacity up to 60W
- Ports record power consumption
- IEEE 802.3at spec for PoE+
- Only one AC/DC converter needed to power many lamps



Energy-saving lighting controls

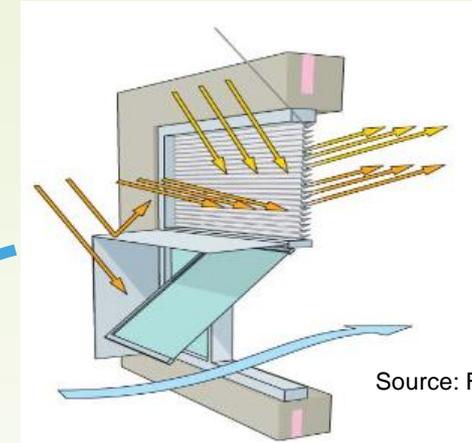
- Timers, photosensors, and motion sensors



Lighting Controls

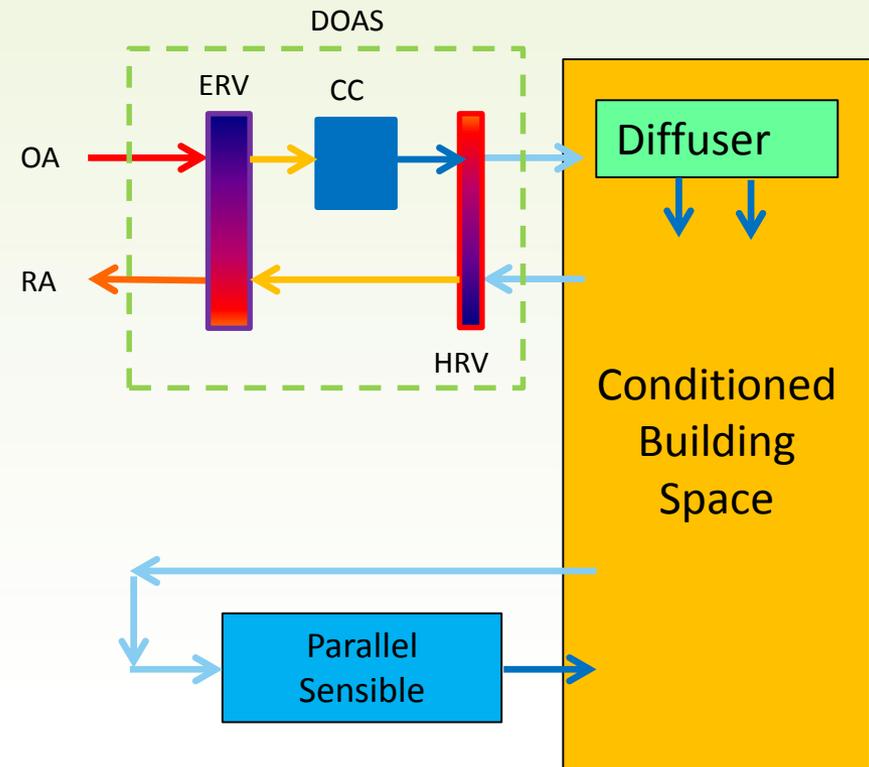
Daylighting

- Skylights/lightpipes, clerestory windows, and roof monitors
- Energy savings from \$0.25/ft² to \$0.50/ft², depending on the building type, location, office area plan, and local cost of energy
- Photo-sensor layout is important
- Daylight is BIG!
 - Foot-candles varies by 2X between summer and winter
 - Diffuse most of it (5% to 10% direct sunlight maximum)
 - About 3% to 4% of roof area is optimal for energy savings



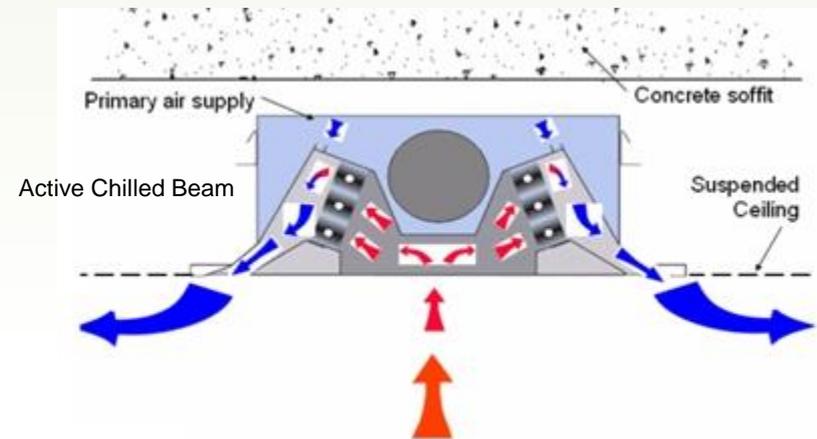
Dedicated outdoor air systems (DOAS)

- Use to decouple space sensible/latent loads
- Sensible only cooling
 - Radiant cooling panels
 - Fan coil units
 - Chilled beams
 - Unitary ACs
- Easier to defend compliance with ASHRAE Standard 62.1
- Typically 30% to 40% reduction in tonnage
- Up to 20% operating cost reduction at peak load



Chilled beam

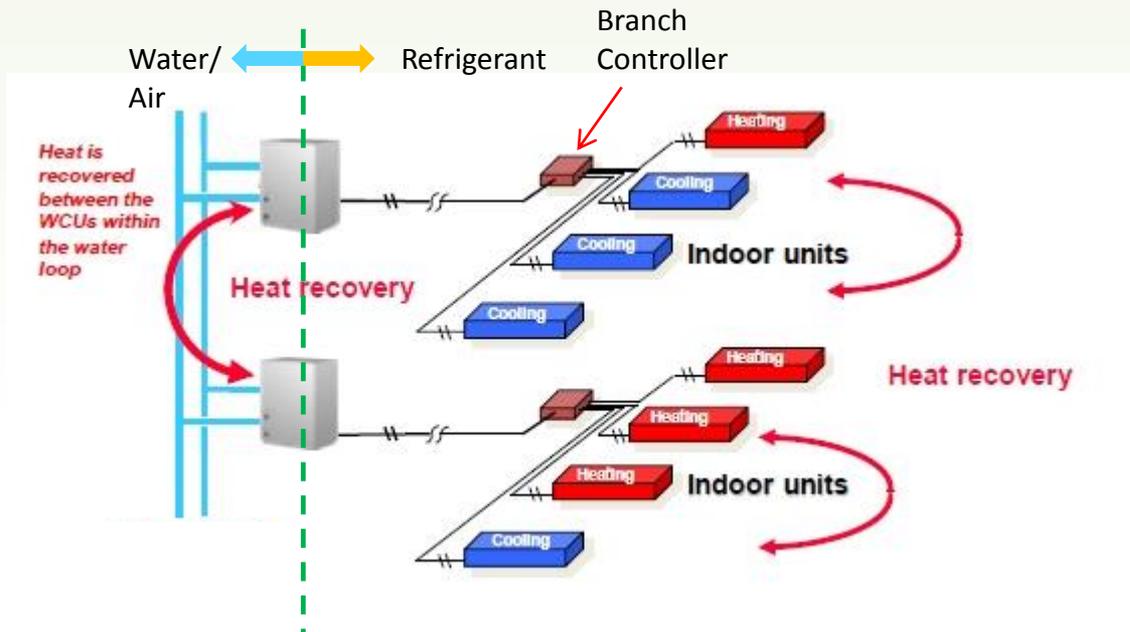
- Alternative to conventional variable air volume (VAV) system
- Separates ventilation and dehumidification
- A fan coil without a fan
 - Passive convective cooling
 - Warm air rises and is cooled by the chilled beam
 - Once the air is cooled, the air falls back to the floor, where the cycle starts over
 - Active chilled beam
 - Forced convection



Images courtesy of Fläkt Woods

Variable refrigerant flow (VRF) heat recovery system

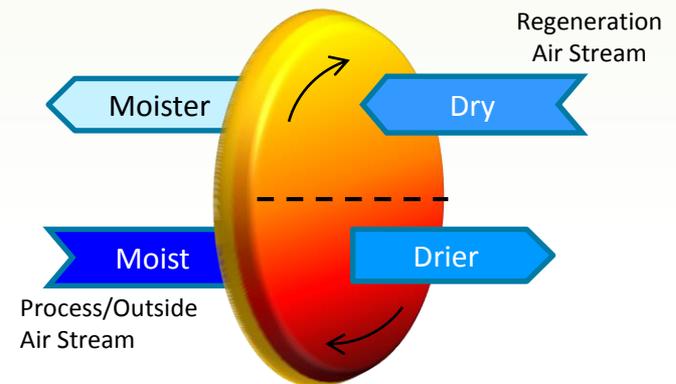
- VRF system moves refrigerant, not air
- 2-pipe or 3-pipe
- Minimum 5 tons capacity
- Can be easier to retrofit older hospitals



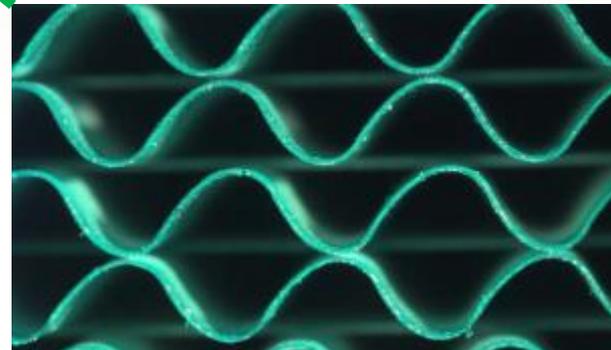
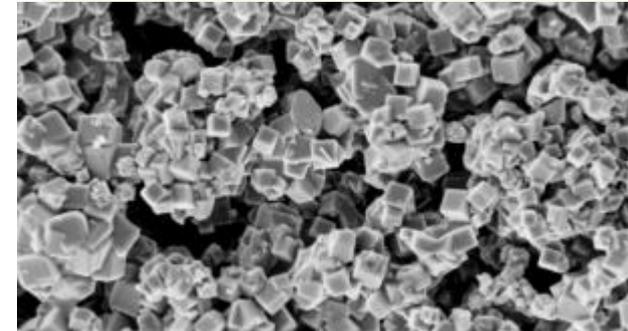
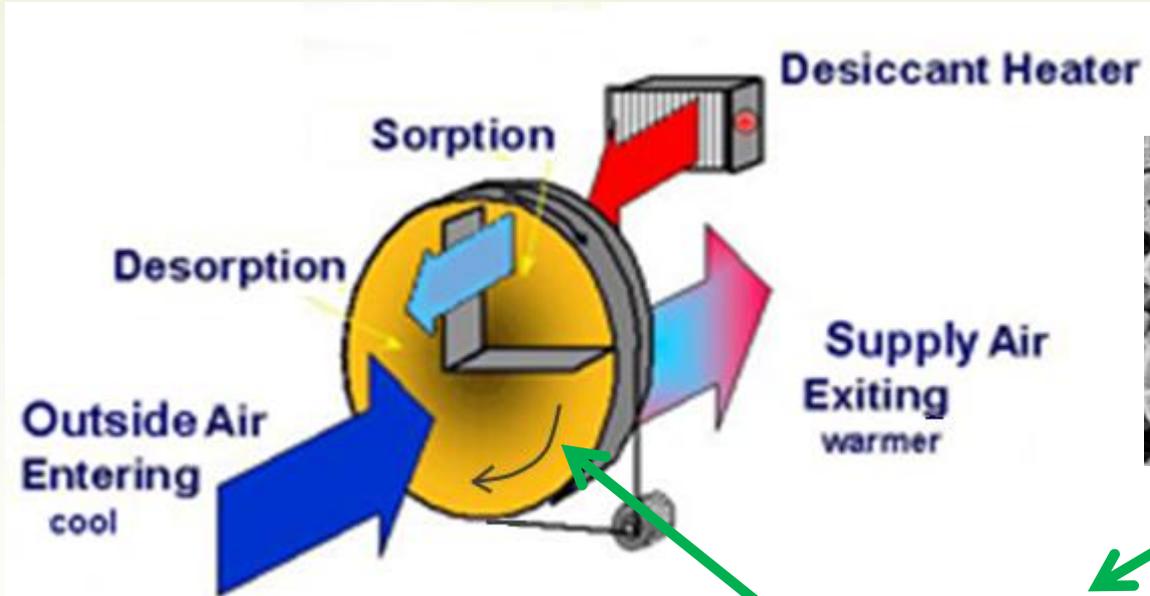
Source: Mitsubishi Electric

Desiccant Wheels

- [Desiccant wheels](#) are most cost effective in climates with extreme winters or summers, and where fuel costs are high.
- In mild climates, the cost of the additional electricity consumed may exceed the energy savings from not having to condition the supply air.
 - A process air fan to pull air through the wheel and over the cooling coil.
 - A reactivation/desorption air fan
 - A fractional hp motor to rotate the wheel
 - 10-30 rotations per hour



Active desiccant wheels



Source: EERE

Air Filters

- Mechanical
- Electrostatic

Ultraviolet Germicidal Irradiation (UGI)

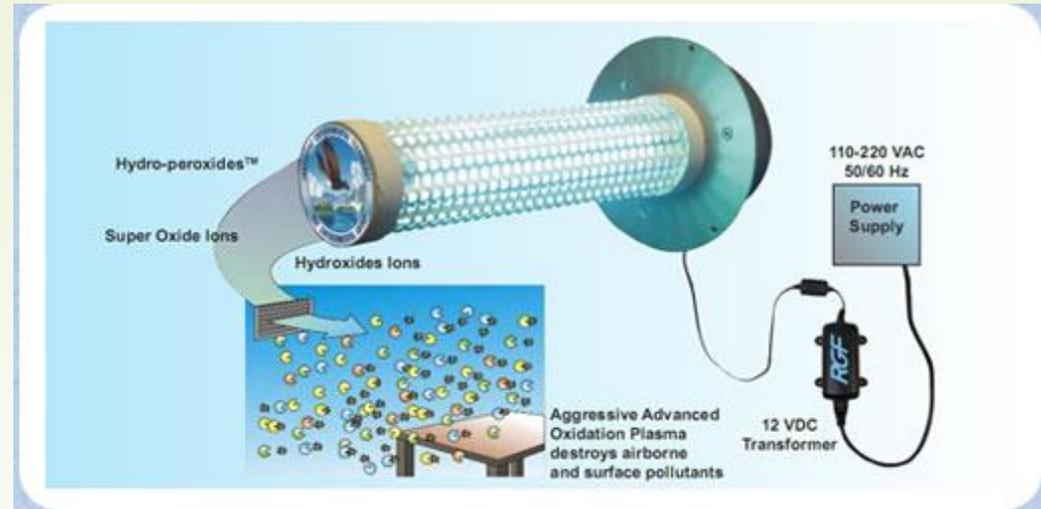
- Mobile units
 - Exposure times range from 9 to 20 minutes
- Passive, upper-room fixtures
- HVAC coil protection



Source: Whitenair Technocrats Pvt. Ltd

Cold Plasma Ionization

- Charged oxygen molecules
 - Particle reduction
 - Sterilization
 - Odors and VOCs



Source: RGF Environmental Group, Inc.

Technology	Working Mechanism	Particle Min. Size (Microns)	Relative Cost	Potential Hazard Level
Mechanical filters (<u>MERV</u> * 8)	Capture	3.0	Low	Low
Electrostatic filters	Capture	1.0	Medium	Low
Ultraviolet germicidal irradiation (<u>UVGI</u>)	Irradiate	<0.3	High	Medium
Ozone generators	Oxidize	<0.3	High	High
Ionization systems	Ionize	<0.3	High	Low

* Minimum efficiency reporting value (@75 percent efficiency)

Healthcare Codes and Standards

Facility Guidelines Institute (FGI) 2014 Guidelines for Design and Construction of Hospitals and Outpatient Facilities

- Implementation of medication safety zones
 - Lighting requirements: U.S. Pharmacopeia-National Formulary (USP-NF)
 - Task lighting required in areas where critical visual tasks are performed.
 - Illumination levels for computer order entry areas ≥ 75 footcandles (fc).
 - Prescription preparation, medication inspection and counseling areas should have illumination levels between 90 fc and 150 fc.
- Hot Water Use
 - For general hospital clinical use, 105°F to 120°F hot water required.
 - For warewashing, 180°F rinse water is required.
 - Unless a chemical rinse (not recommended) is provided
 - Water at 160°F shall be available (when needed) for laundry use.
- Food and nutrition areas service section rewritten
 - Occupancy sensors are required for all offices, restrooms and storage areas.
 - Including walk-in coolers and freezers
 - Natural daylight considered for food preparation and serving areas.

Healthcare Codes and Standards

2013 ASHRAE 170, Standard for Ventilation of Health Care Facilities

- Ducted exhaust systems in lieu of return air systems
 - Introduced displacement ventilation (DV)
 - Only for single-bed patient rooms.
 - Special requirements for locating DV supply diffusers and exhaust grilles.
- Addressed Energy Recovery Ventilators (ERV)
 - Shall not be used at all for airborne infectious isolation (All) room exhaust systems.
- Reduced total air changes per hour (ACH) in patient rooms
 - Only when the space is unoccupied, provided that
 - The required pressure relationship to adjoining spaces is maintained
 - The minimum number of air changes required is re-established anytime the space becomes occupied.
- Lowered relative humidity limits for short-stay rooms
 - Design lower limit RH of 20 percent allowed.
 - Reduces energy use
 - Reduces potential condensation problems

Healthier Hospitals Initiative (HHI)

- Engage leadership on environmental health and sustainability
- Serve healthier foods and beverages
- Reduce energy use
 - Track energy use and greenhouse gas emissions through ENERGY STAR's Portfolio Manager
 - Reduce energy use by 3 to 10 percent
 - Leaner energy participants include Advocate, Bon Securs, Inova, Kaiser, Partners, Tenet and Catholic Health Initiatives.
- Reduce waste and increase recycling
- Use safer chemicals
- Purchase environmentally preferable products

ENERGY STAR Portfolio Manager

- Track your hospital's performance over time
- Make comparisons between similar hospitals

DOE's [Advanced Energy Retrofit Guide for Healthcare Facilities](#)

- Plan, Execute, Follow Up
- Existing Building Commissioning
- Building Retrofits
 - 4.1 Whole-Building Approach
 - 4.2 Staged Approach
 - 4.3 Leveraging Opportunities for Higher Savings
 - 4.4 Retrofit Energy Efficiency Measure Summary Table
 - 4.5 Recommended Retrofit Packages
- Measurement and Verification
- Continuous Improvement through operations and maintenance

American Society for Healthcare Engineering (ASHE) **Energy to Care**

- Five year campaign launched in 2014
- American Hospital Association's sustainability roadmap
- Benchmarking tools (ASHE)
- Energy to Care dashboard (Lucid's BuildingOS)
- Participate in regional challenges

Poll Questions

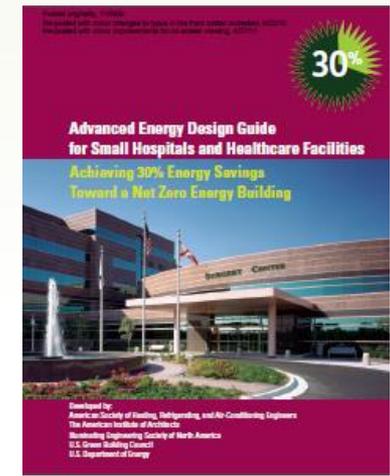
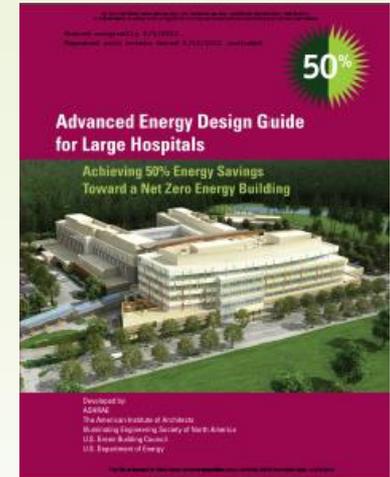
- How valuable has this Webinar been to you?
 - a) Not valuable at all
 - b) Slightly valuable
 - c) Moderately valuable
 - d) Very valuable
 - e) Extremely valuable

ASHRAE Advanced Energy Design Guide

... for Large Hospitals

... for Small Hospitals and Healthcare Facilities

- 50% less energy than conventional facilities
 - ASHRAE Standard 90.1-2004 Energy Standard for Buildings
- Recommended energy efficiency measures
 - Enhanced building opaque envelope insulation, window glazing, and overhangs
 - Reduced lighting power density and installation of occupancy sensors
 - Daylighting in patient rooms, meeting rooms, lounges, waiting rooms, and lobbies
 - Interior lighting power density reductions
 - Plug load reductions and improved controls
 - Minimize HVAC reheat





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Thank You!

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