

# **Eliminating Energy Waste in Commercial Facilities**

November 29, 2016

# Meet Your Panelist

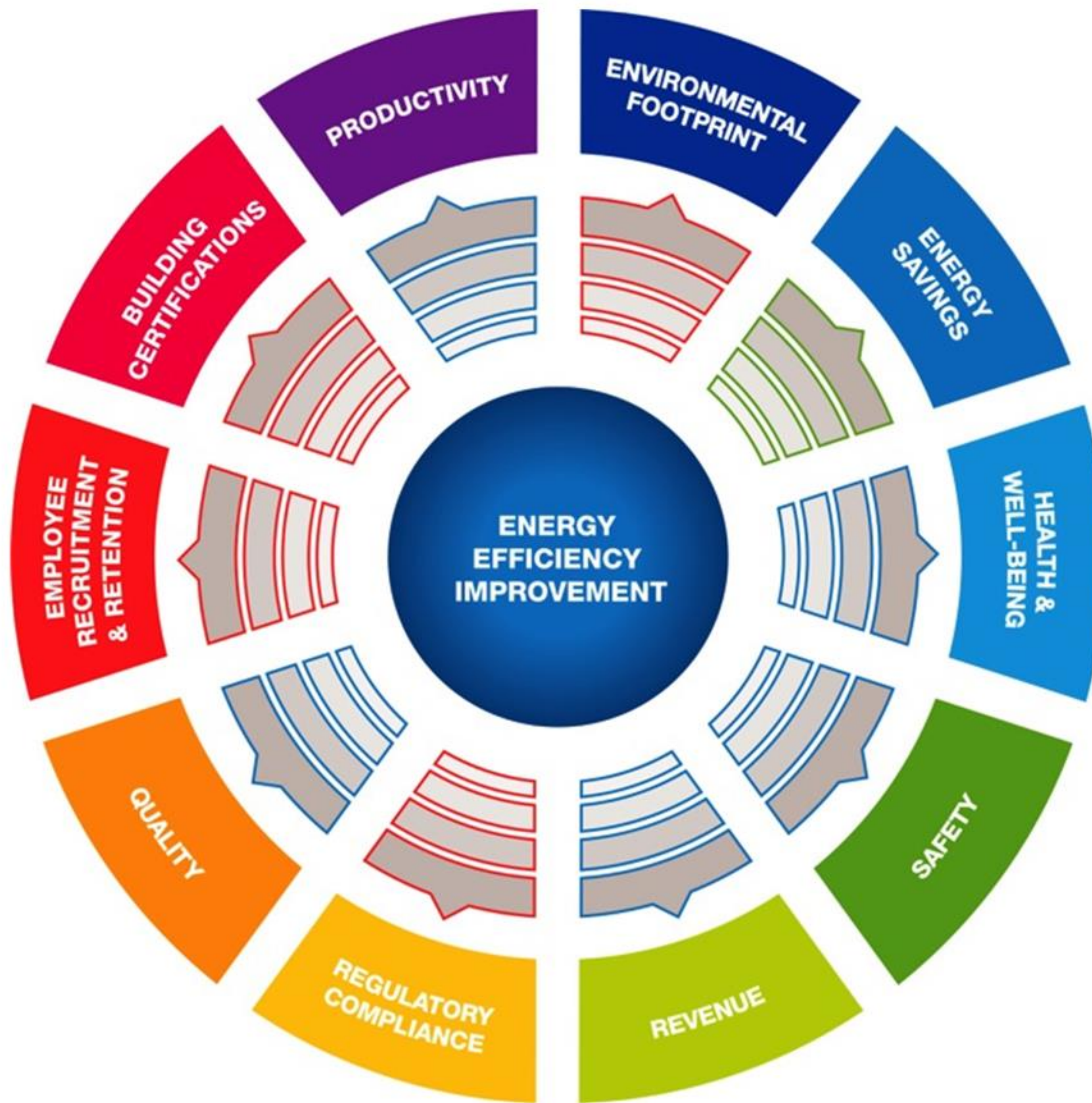
- Mike Carter








# Introduction

## Energy Efficiency Benefits Wheel



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



# Contents

- Basics
- Insulation
- HVAC
- Lighting
- Motors
- Restaurants
- Lodging
- Food Retailers



# Energy Efficiency Basics

## Power Versus Energy

- Kilowatt (kW) is a measure of **power**.
  - Peak power demand is usually measured as an average over a 15-minute period.
- Kilowatt-hour (kWh) is a measure of **energy/load** consumption.
- Energy cost = Power (kW) x Time (hrs) x Rate (\$/kWh)  
= kWh x \$/kWh
- A 113-Watt, four-lamp light fixture costs about \$66 annually when operating 16 hr/day.
  - Energy cost = (0.113 kW x 5,840 hr x \$0.10/kWh)  
= \$66



Source: stock.xchng



Source: Commonwealth of Kentucky



**PSEG**



# Energy Efficiency Basics

## Power Versus Energy

- Motor power (kW) = Horsepower (HP) x 0.746/efficiency
- A 10 HP motor = 10 HP x 0.746/0.90 = 8.3 kW
- A 10 HP motor operating 16 hr/day costs about \$4,850 annually

Energy cost = Power (kW) x Time (hrs) x Price (\$/kWh)

Energy cost = 8.3 kW x 5,840 hr x \$0.10/kWh  
= \$4,850

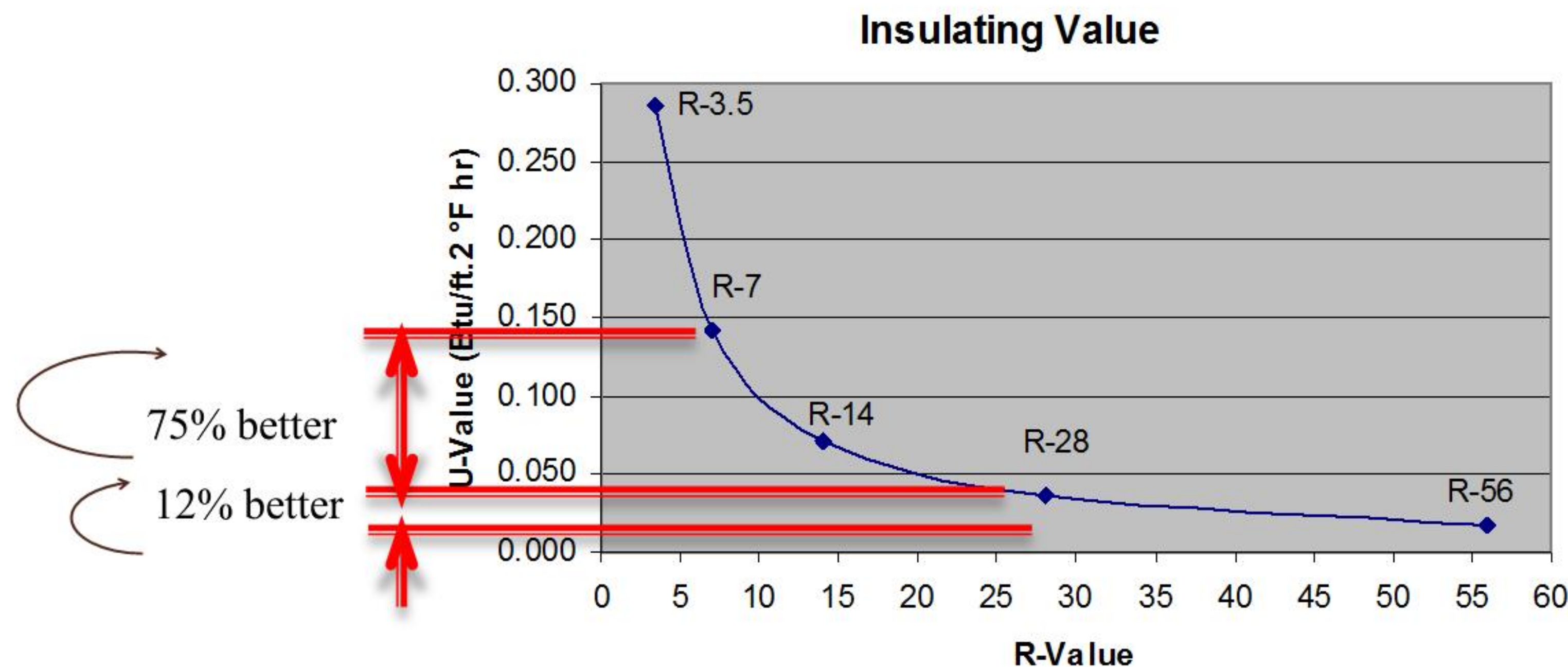
- Pay the price for improved energy efficiency!



# Insulation

## Insulation Diminishing Returns

- R-value is resistance to heat flow (additive)
  - $R-7 + R-21 = R-28$  (4 times R-7, and 75% better than R-7)
  - $R-7 + R-49 = R-56$  (only 12% better than R-28)
- U-value is conductance of heat; inverse of R-value

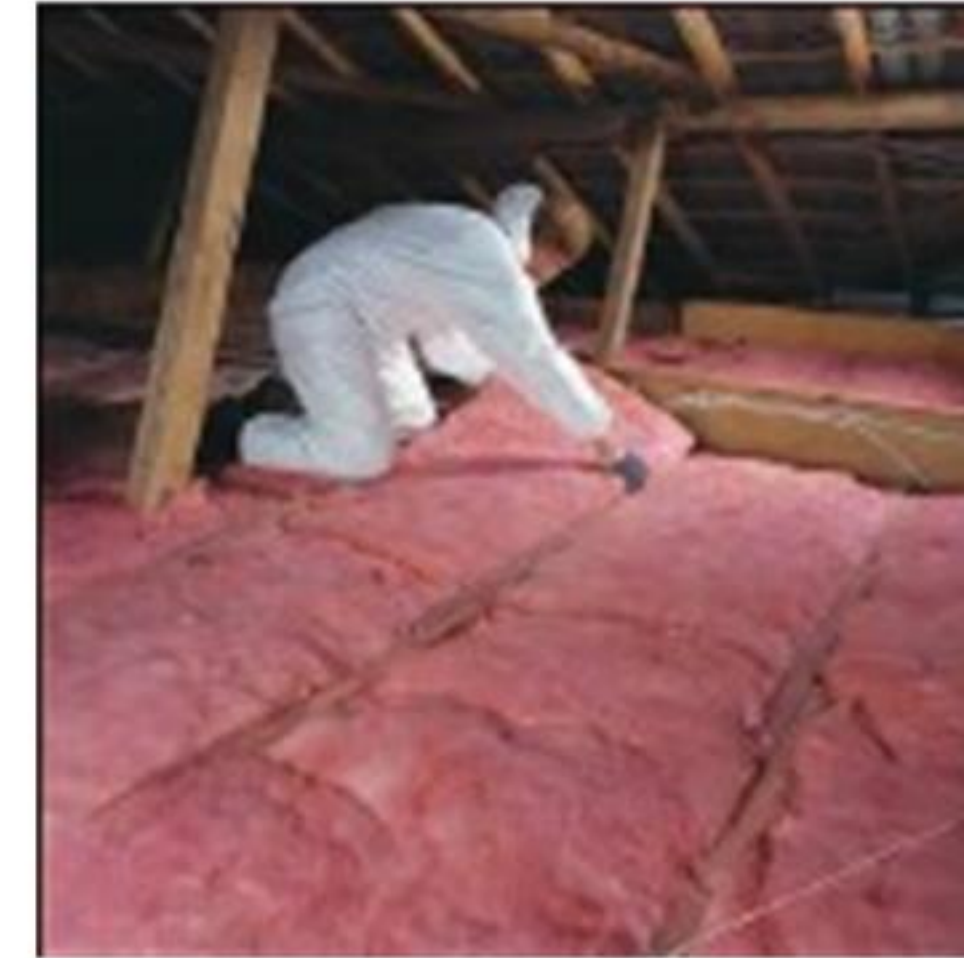




# Insulation

## Sources of Heat Loss

- 45% walls
- 35% roof
- 20% windows, doors, cracks



HDD Zone	Ceiling R-value
1 (0-500)	R-19
2 (501-3,000)	R-30
3 (3,001-5,000)	R-38
4 (5,0001-6,000)	R-38
5 (6,001-10,000)	R-49

Type	R-value per inch
Fiberglass	2.2-3.1
Vermiculite/perlite	2.4-2.8
Polystyrene	4.0-5.0
Polyurethane	6.0
Polyisocyanurate	6.0-7.1



# Insulation

## High-Performance Windows

- HVAC energy savings of 6% to 8% is typical; 10 year paybacks
- Solar Heat Gain Coefficient (SHGC) radiation;
  - 0 to 1; <0.55 is good
- U-Factor heat conductance
  - 0.2 to 1.2; <0.40 is good
  - Vinyl material and inert gas lowers U-Factor
  - Argon gas 35% lower than air; Vinyl 80% less than aluminum
- Window films
  - Tinted \$4 to \$6/ft<sup>2</sup>
  - Spectrally selective \$9 to \$12/ft<sup>2</sup> installed

Glazing	Coating	SHGC	U-Factor
Single	Clear Float	0.86	0.90
Double	Clear Float	0.76	0.49
Double	Bronze/Gray Tint	0.62	0.42
Double	Low Solar Gain, Low-E	0.39	0.35
Triple	Low Solar Gain, Low-E	0.33	0.25



# HVAC

## Temperature Setback/Set forward

- Save 3% per °F per 24 hours
- 72°F → 68°F ( $\Delta$  4°F) for 12 hours saves 6%



Source: ENERGY STAR

## Obtain Proper Humidity Control

- In **Summer**, decrease relative humidity (RH) to feel cool
- Operation at 78°F / 40% RH provides the same level of occupant comfort as 74°F / 50% RH does
  - 74°F → 78°F set forward for 24 hours saves 10% to 12%
- In **Winter**, the opposite applies; raise RH to feel warm



# HVAC

## Economizers Bring in Cool Outside Air

- Now required by ASHRAE energy standards
- Typical two to five year payback for [economizers](#)
- Most appropriate for large systems (>10 tons)
- Not very effective in high humidity climates



## Heat Recovery Ventilators

- Can recover about 50% of heat in exhaust air
- A solution to ASHRAE 62 IAQ requirements

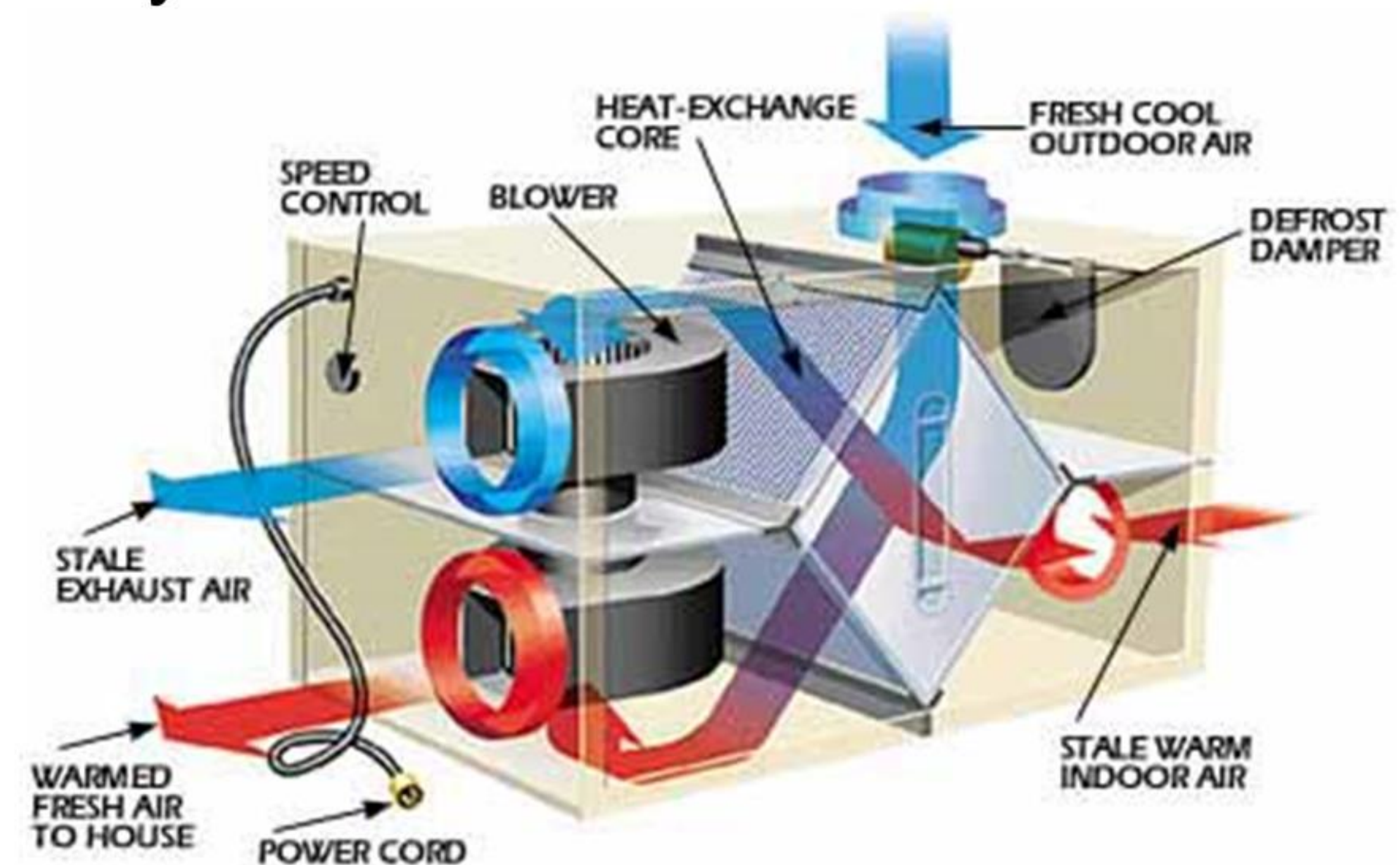


Photo source: George Retseck Illustrations



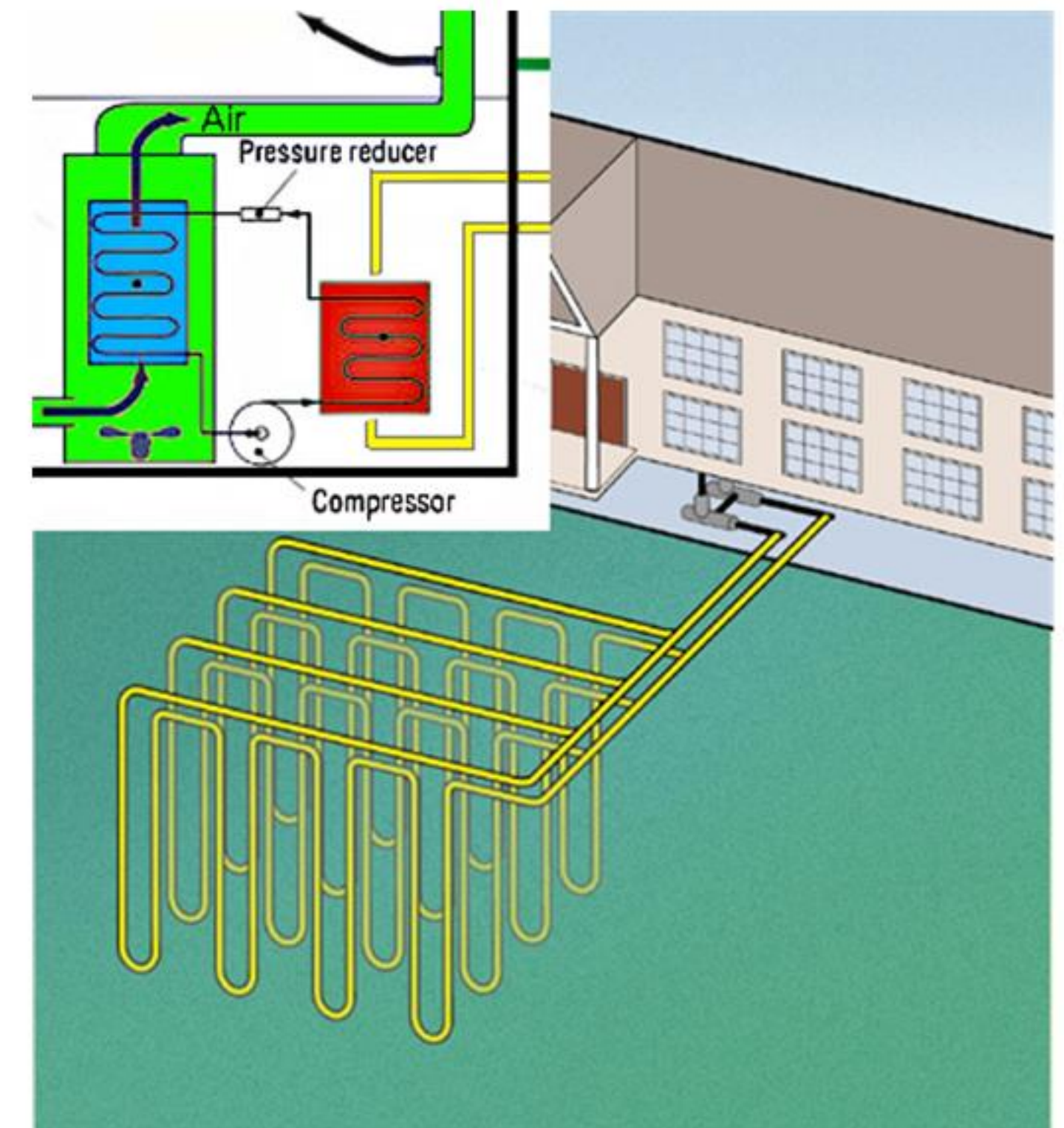
# HVAC

## Upgrade Older HVAC (10 to 15 years old)

- Chillers: 0.8 kW/ton → 0.5 kW/ton (37% less)
- Unitary rooftop: 1.5 kW/ton → 1.2 kW/ton (20% less)

## Geothermal or Water-Source Heat Pump

- Roughly 30% savings compared to AC/Boiler or AC/Furnace combo
- [Geothermal](#) requires a higher capital investment and may require lots of real estate
  - New construction accommodates verticals and pond loop



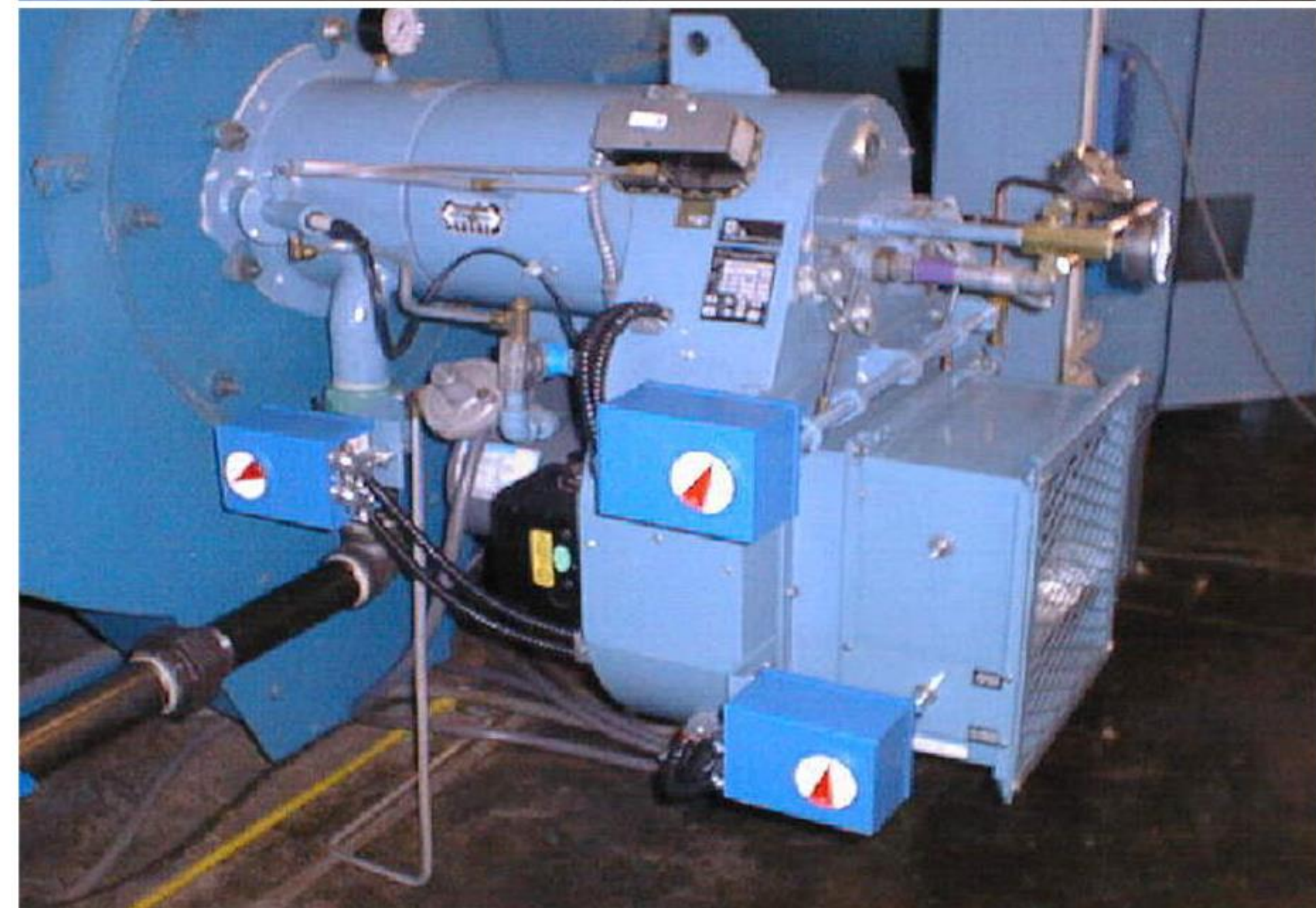
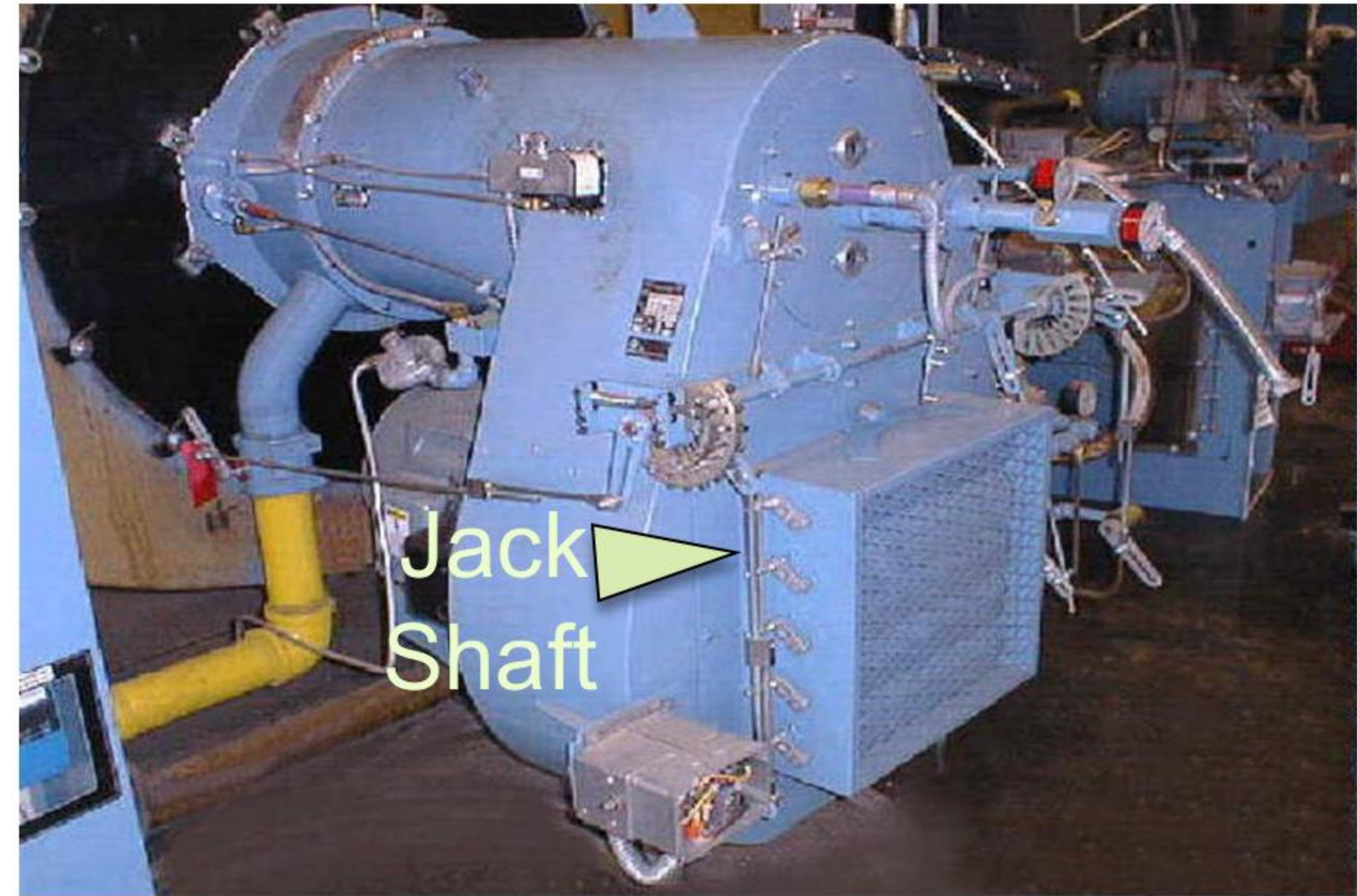
Source: Geothermal Heat Pump Consortium



# HVAC

## Direct Digital Control

- ▶ With jack shaft controls, air and gas are controlled together.
- ▶ Linkageless control reduces energy costs and helps protect the environment.



Source: Industrial Controls



# Lighting

## Light-Emitting Diodes (LEDs)

- 60 to 110 lumens per watt
- Driver replaces ballast
- Shock/vibration resistant
- No life impact from frequent switching
- Long life (years)
- Great in cold temperatures
- Daylight and occupancy



Source: Archipelago  
Lighting Candelabra



Source: Stack Lighting



Sengled Pulse Flex



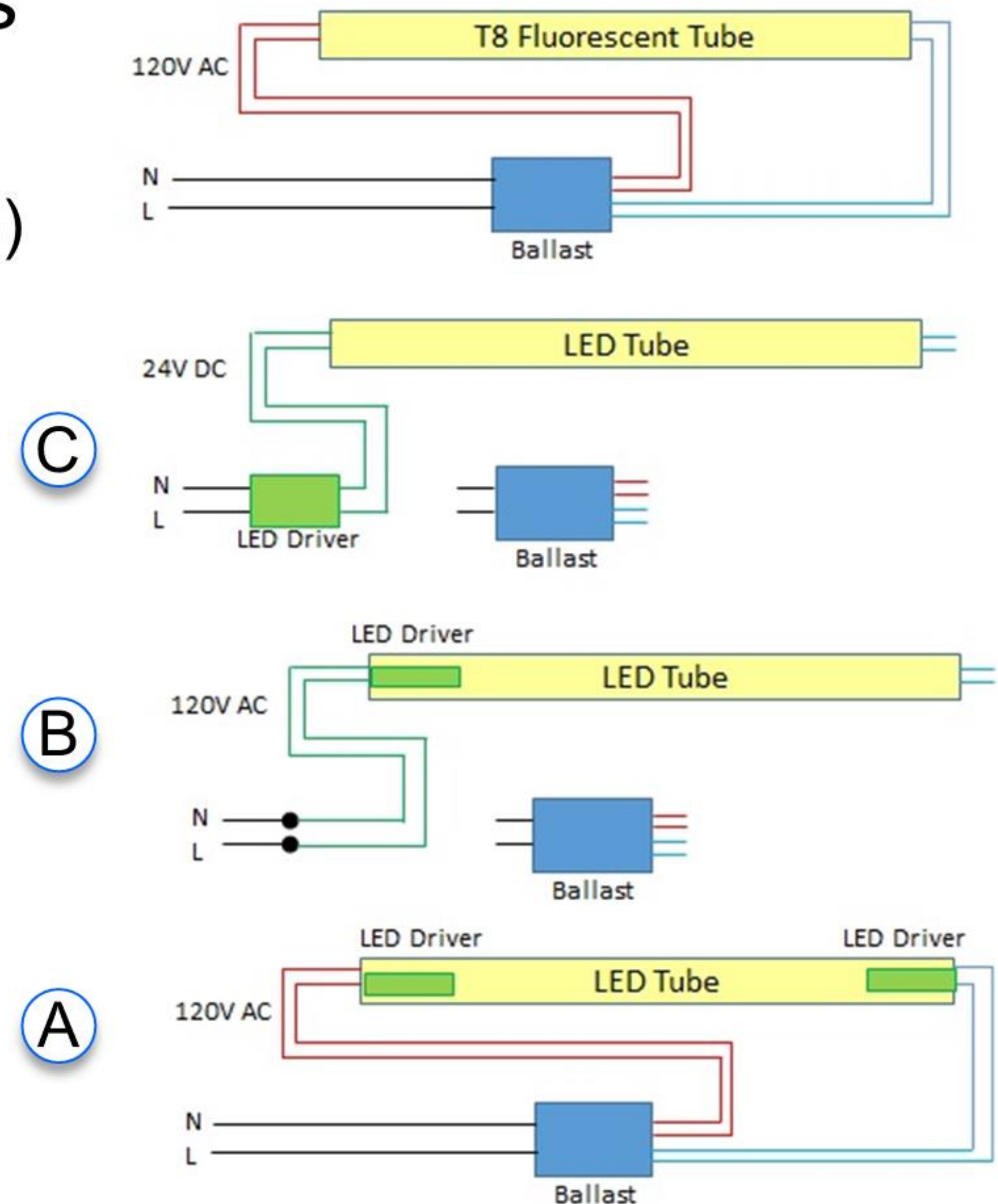
# Lighting

## Linear Fluorescent Replacement

- Drop-In retrofit Linear LED Tubes
  - DOE CALiPER test results
    - Better LED lumens/watt output (2016)
    - Narrow LED light distribution
    - Roughly \$10 to \$18 per LED lamp



Source: DOE





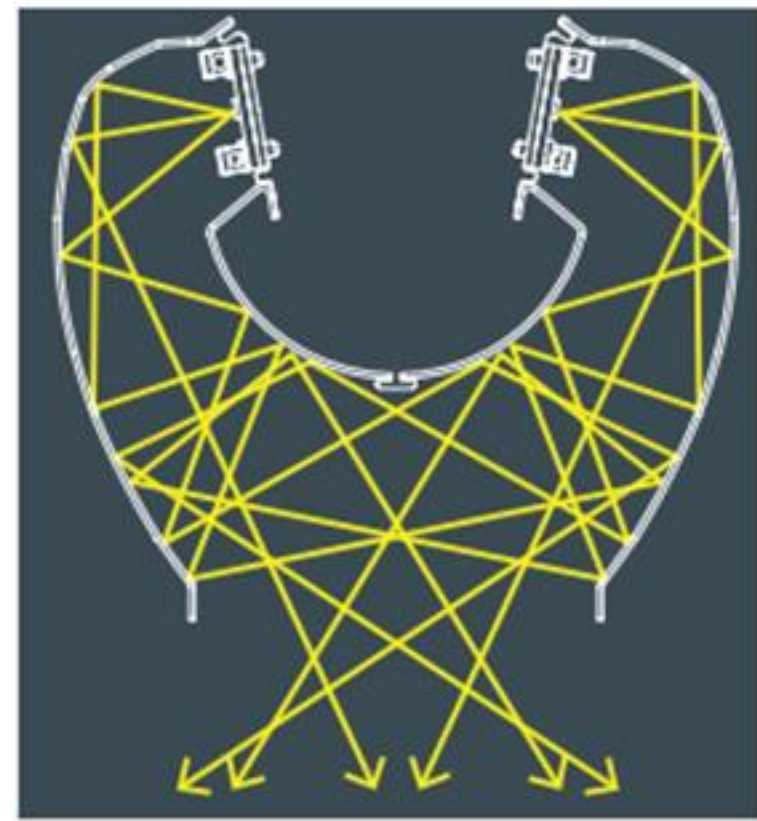
# Lighting

## Linear Fluorescent Replacement

- Purpose-Built Linear LED Troffers



Metalumen Manufacturing Inc.



Source: GE by Current



Source: Axis Lighting



# Poll Question

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What are the biggest barriers to your business investing in energy efficiency?

- a) Difficult to determine payback
- b) Do not know where to start
- c) Need more how-to information
- d) No time available
- e) Other



# Lighting

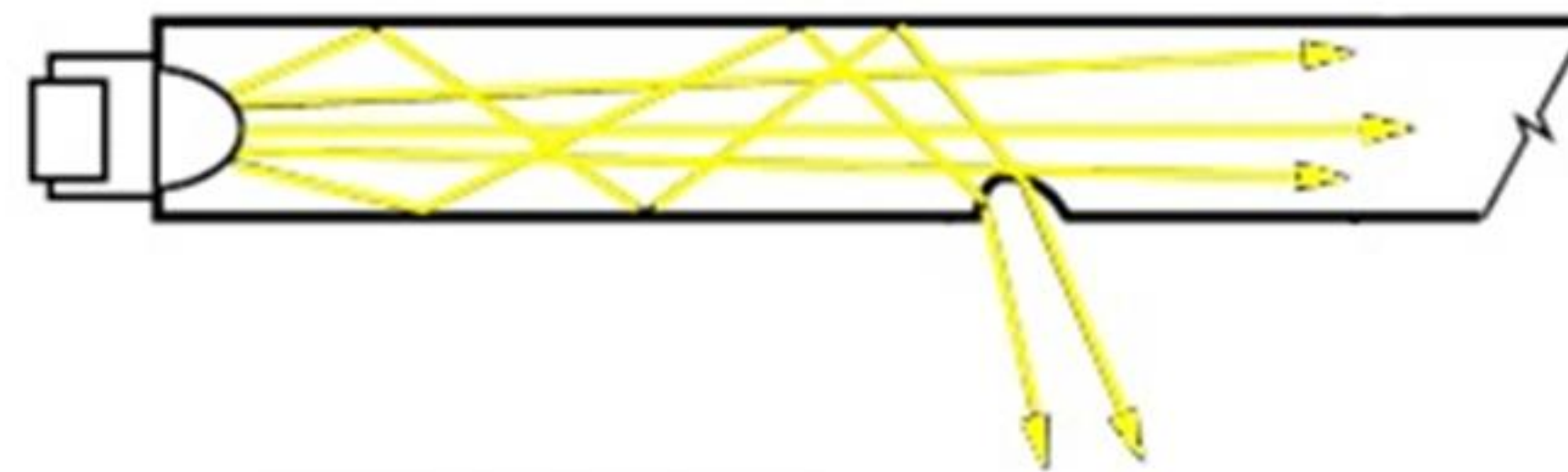
## Linear Fluorescent Replacement

- Light Guide Products
  - Cree LN Series
  - Philips CoreView
  - Cooper Lighting's Metalux Encounter
    - 8400 lumens @ 109 watts, 85 CRI

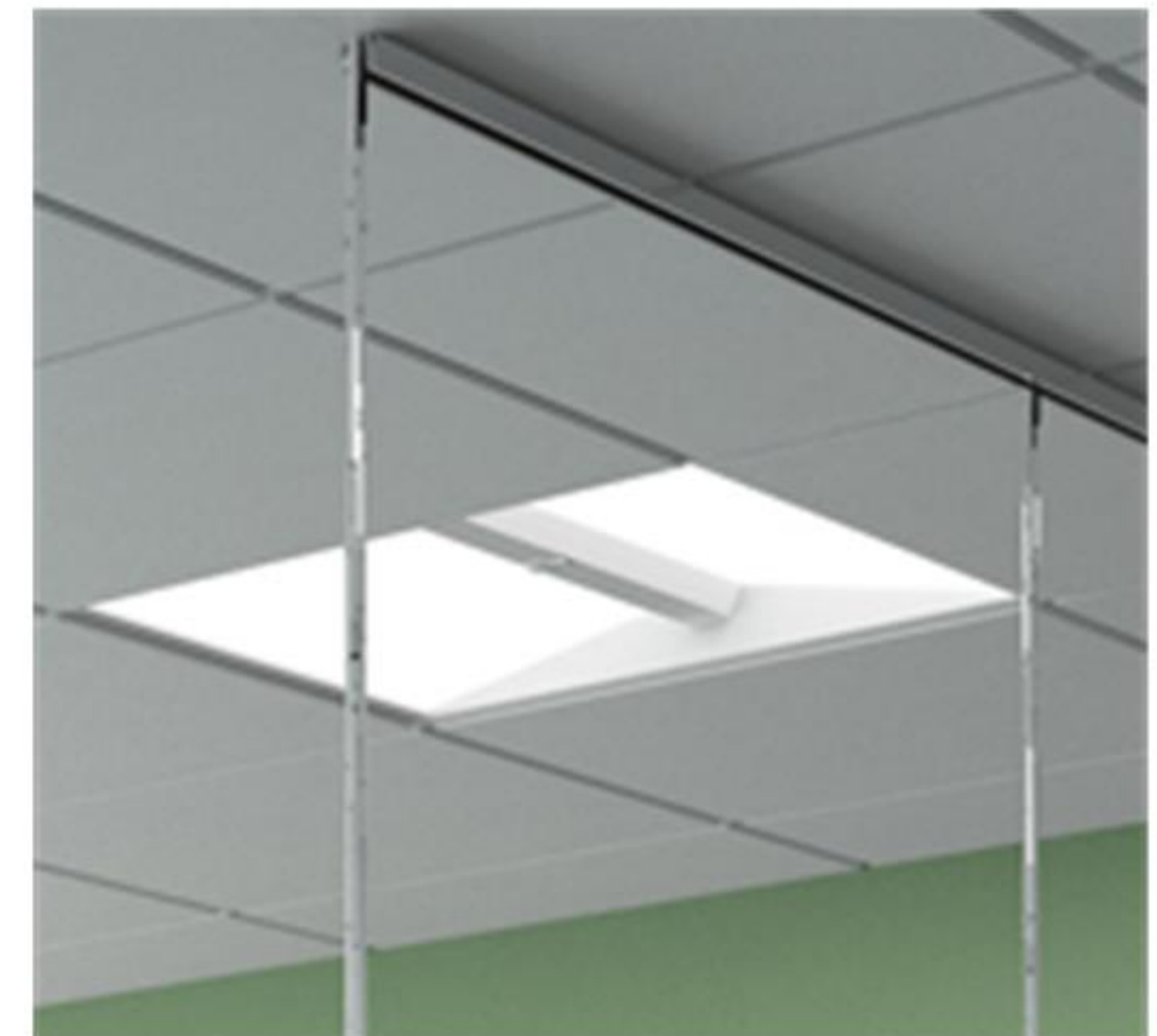


©2013 Cree, Inc.

Used with permission of Cree, Inc.



Source: LG  
Innotek



Source: Cooper  
Lighting



**PSEG**



# Lighting

## Linear Fluorescent Replacement

- Light Guide Products
  - GE Lumination™ LED Luminaires EL Series
  - Cooper Lighting SkyBar



Source: Cooper Lighting



Source: GE Lighting



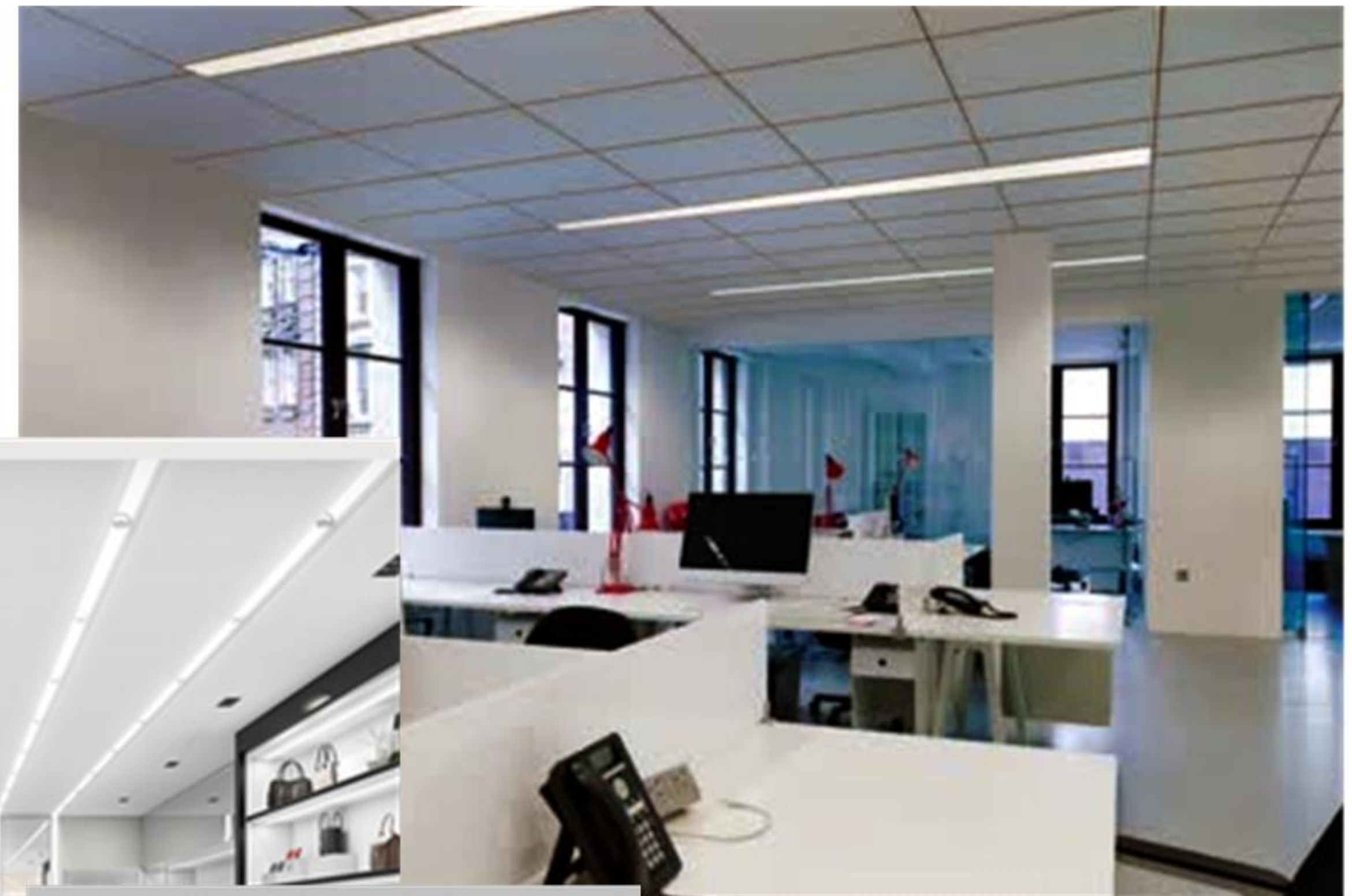
# Lighting

## Linear Fluorescent Replacement

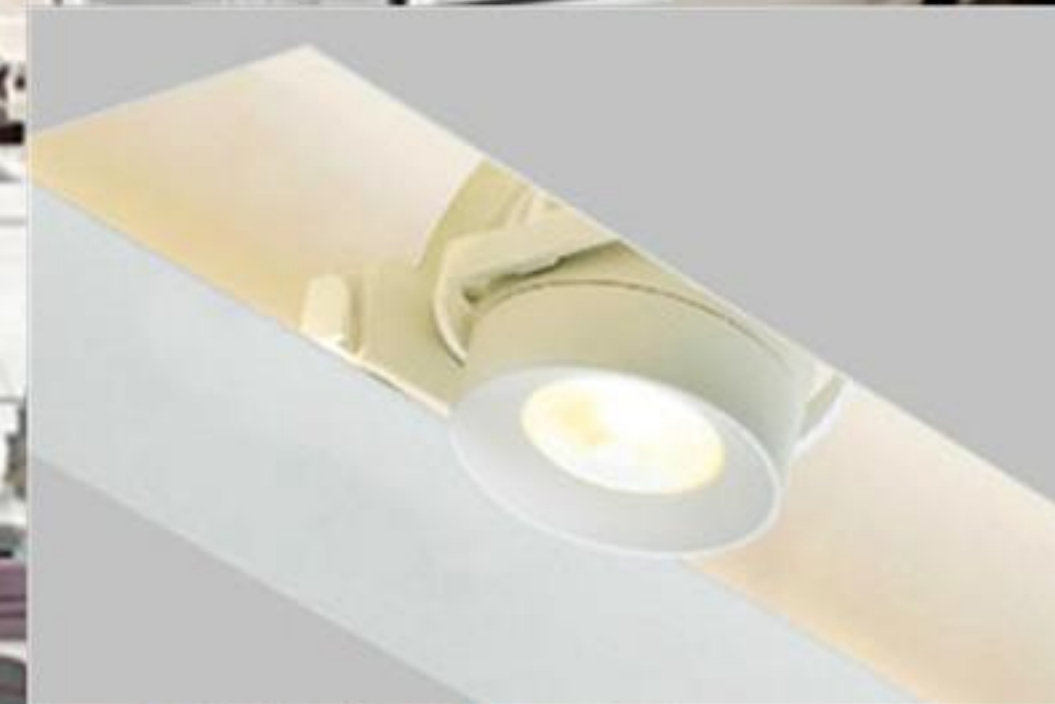
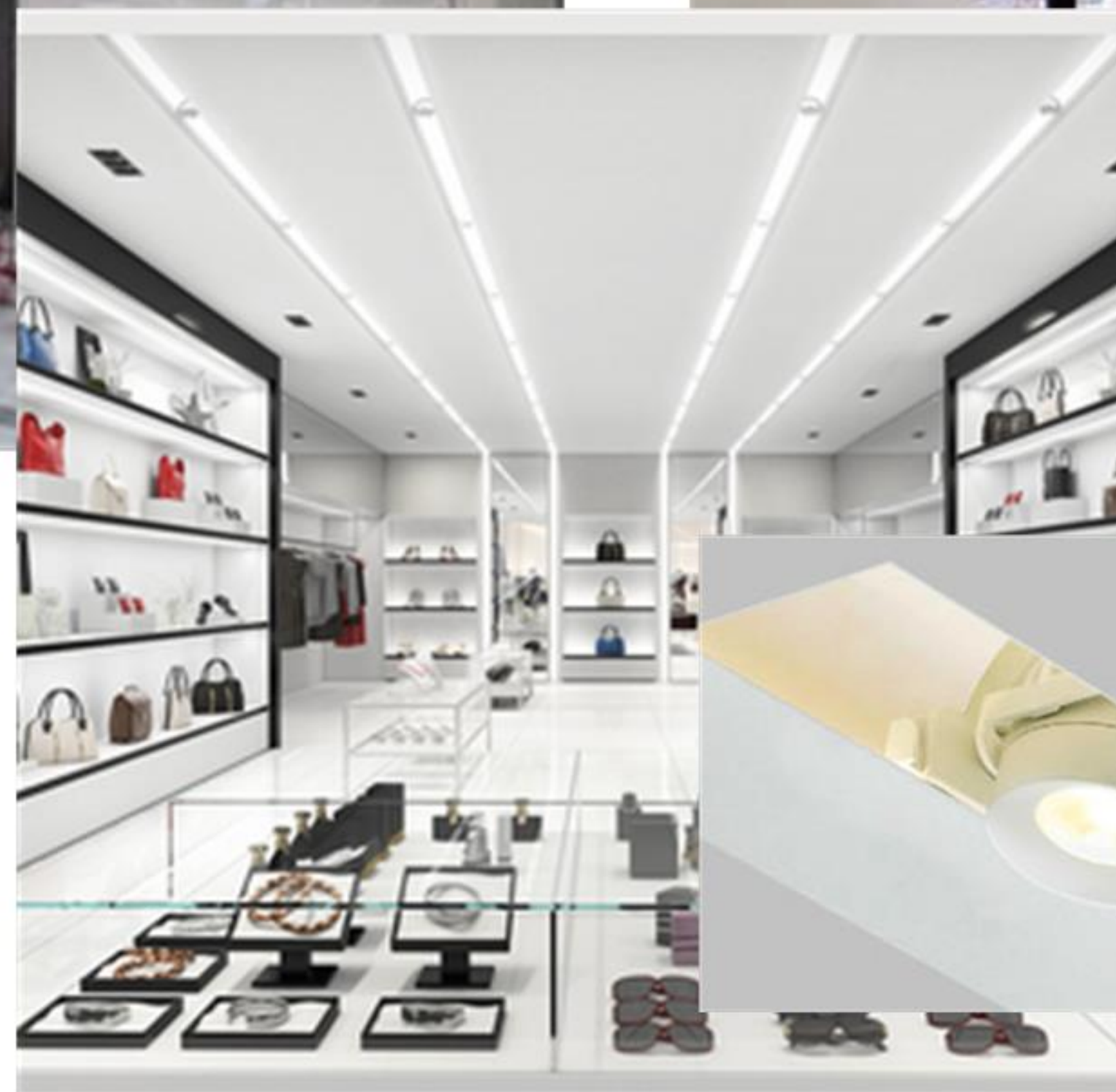
- Recessed or zero plenum lighting



Source: JLC TECH, T-BAR LED Smartlight™



XAL USA/Armstrong's Leno Zero Plenum



Tech Lighting's ELEMENT Merge



# Lighting

## LED Down Lights

- CALiPER tested 38 LED PAR38 and 9 LED PAR30 reflector lamp products
  - Much better than halogen bulbs
  - Best LED PAR38 are competitive with CMH
  - Can flicker when dimmed
- LED performance generally matches R-CFLs
  - 6" aperture



Source: Delray Lighting Kone 3



Source: Verbatim Americas



Source: Ketra S38 Tunable Lamp



# MR16 Reflector Lamp Replacement

## CALiPER Test Results

- ▶ 27 different 12V MR16 LED products tested in 2014
- ▶ LED Lighting Facts database at beginning of 2016
  - Some (20%) of 12V products have lumen output equal to 50 watt halogen lighting
    - Equivalency claims are suspect
    - CBCP is still poor



Source: Cree



Source: Verbatim Americas

Source: CALiPER Application Summary Report 22:  
LED MR16 Lamps (June 2014)



# Lighting

## LED High-Bay Lighting

- Lunera Lighting's drop-ins
  - No need to bypass HID ballast
    - Susan for metal halide
    - Lucy for high-pressure sodium
  - MultiWatt adjusts automatically
  - Up to 14,000 lumens output
- LSI Industries Augusta low bay
  - 5750 to 9860 lumens output at over 100 lpw
  - 70 to 80 CRI
  - Hard-wired LED tower



Source: Lunera Lighting



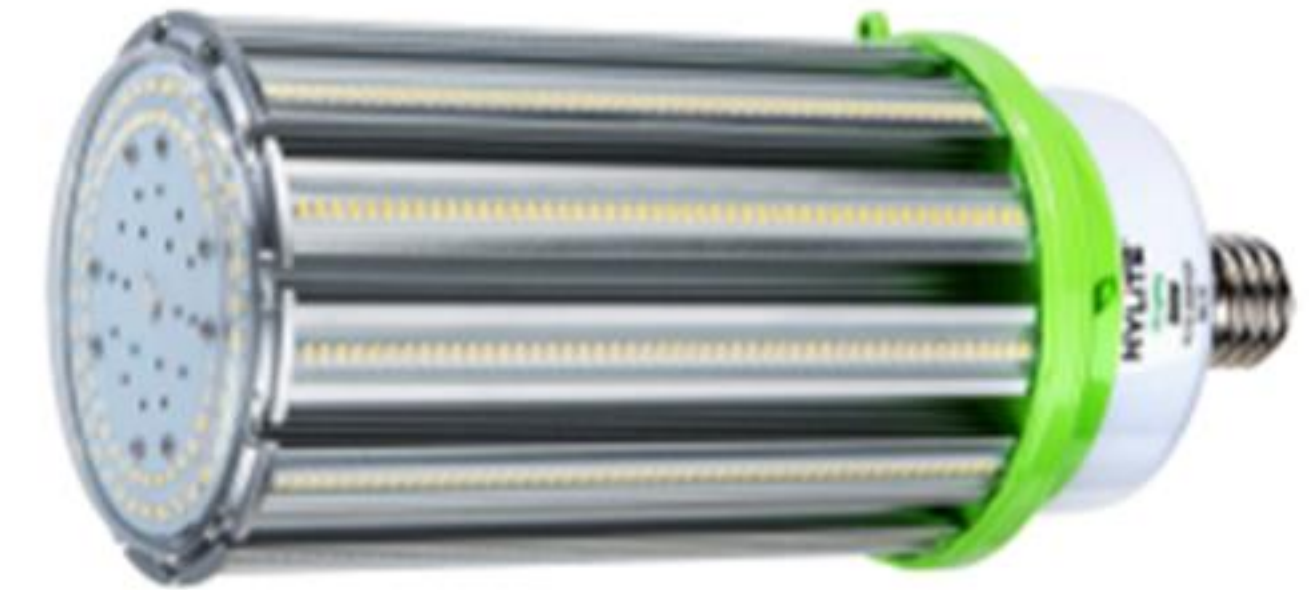
Source: LSI Industries



# Lighting

## LED High-Bay Lighting

- HyLite LED Omni-Cob
  - Ballast bypass
  - 28,000 lumens @200 watts (140 lpw)
- Dialight Vigilant®
  - 26,500 lumens @125 watts (125 lpw)
  - 10-year full warranty
- Acuity/Holophane Phuzion™ PHS
  - 24,000 lumens @230 watts (100 lpw)
  - 14% uplift
  - Patented borosilicate glass



Source: HyLite LED Lighting



Source: Dialight

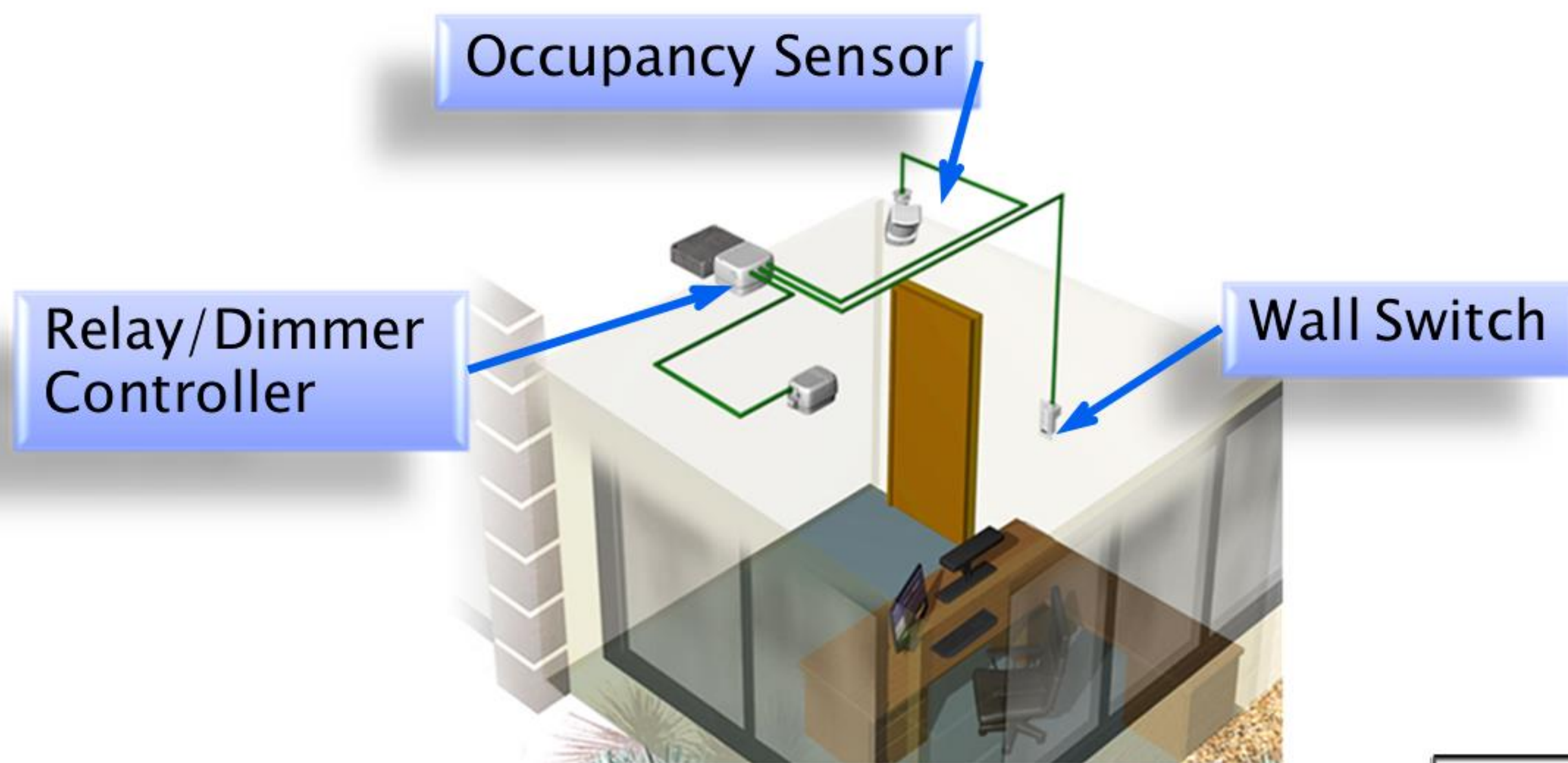


Source: Acuity

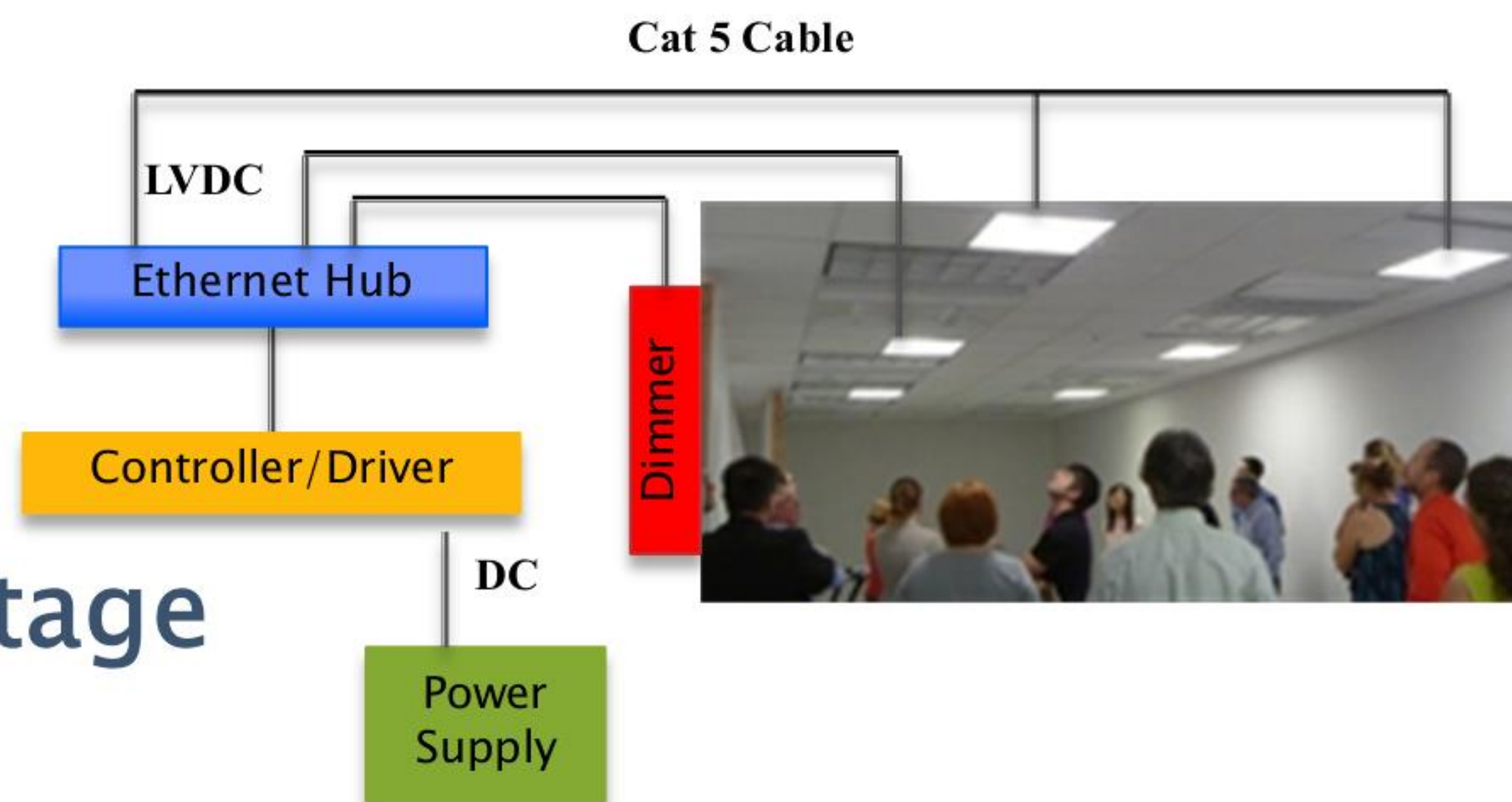


# Lighting Controls

## Room Level Integration



## Power-Over Ethernet



## Distributed Low Voltage Power (DLVP)



# Lighting Controls

## Typical Sequence of Lighting Controls

1. Advanced Time Scheduling



2. Occupancy



3. Task Tuning



4. Daylight Harvesting



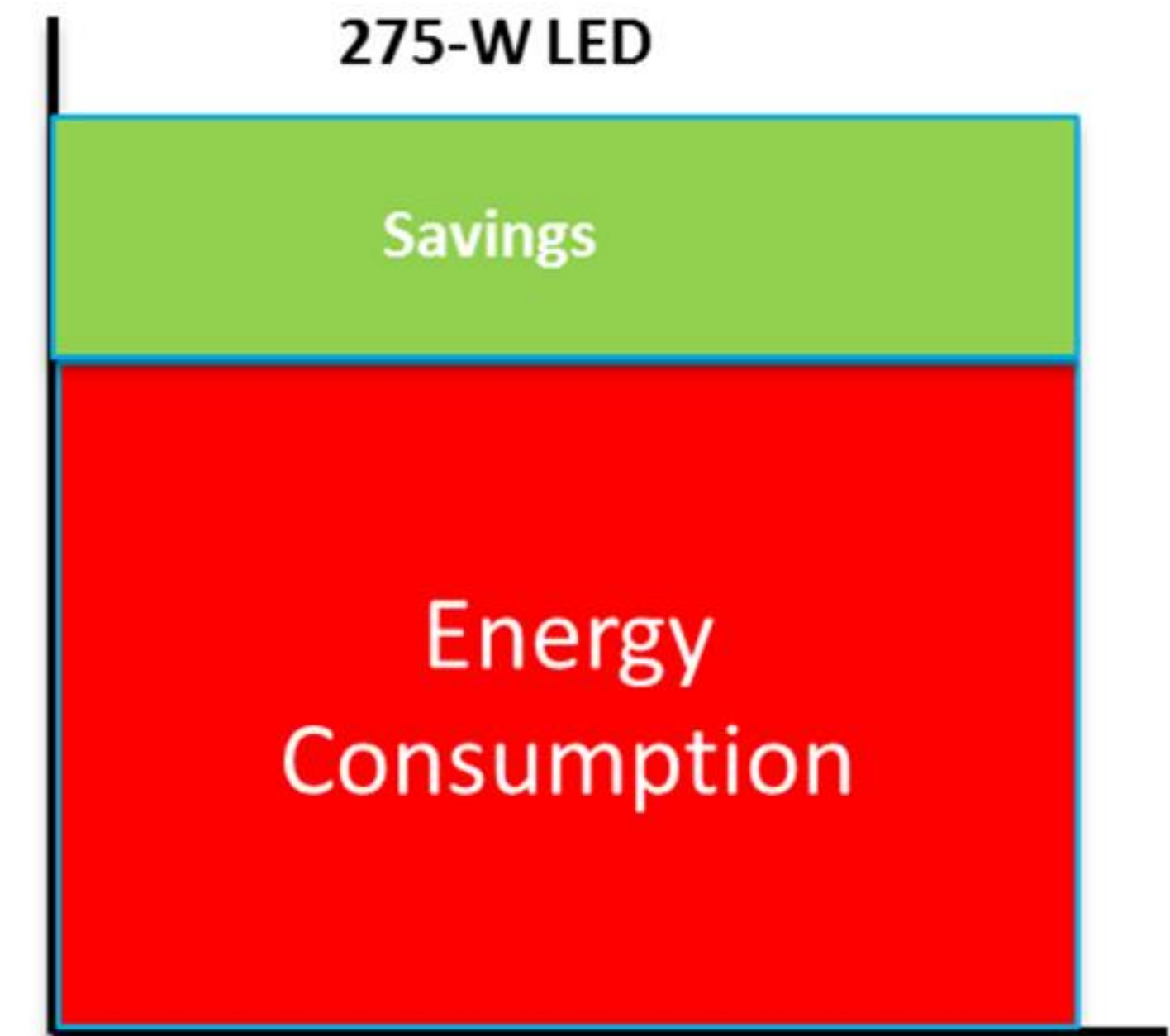
5. Personal Control



6. Demand Response



7. Receptacle Control





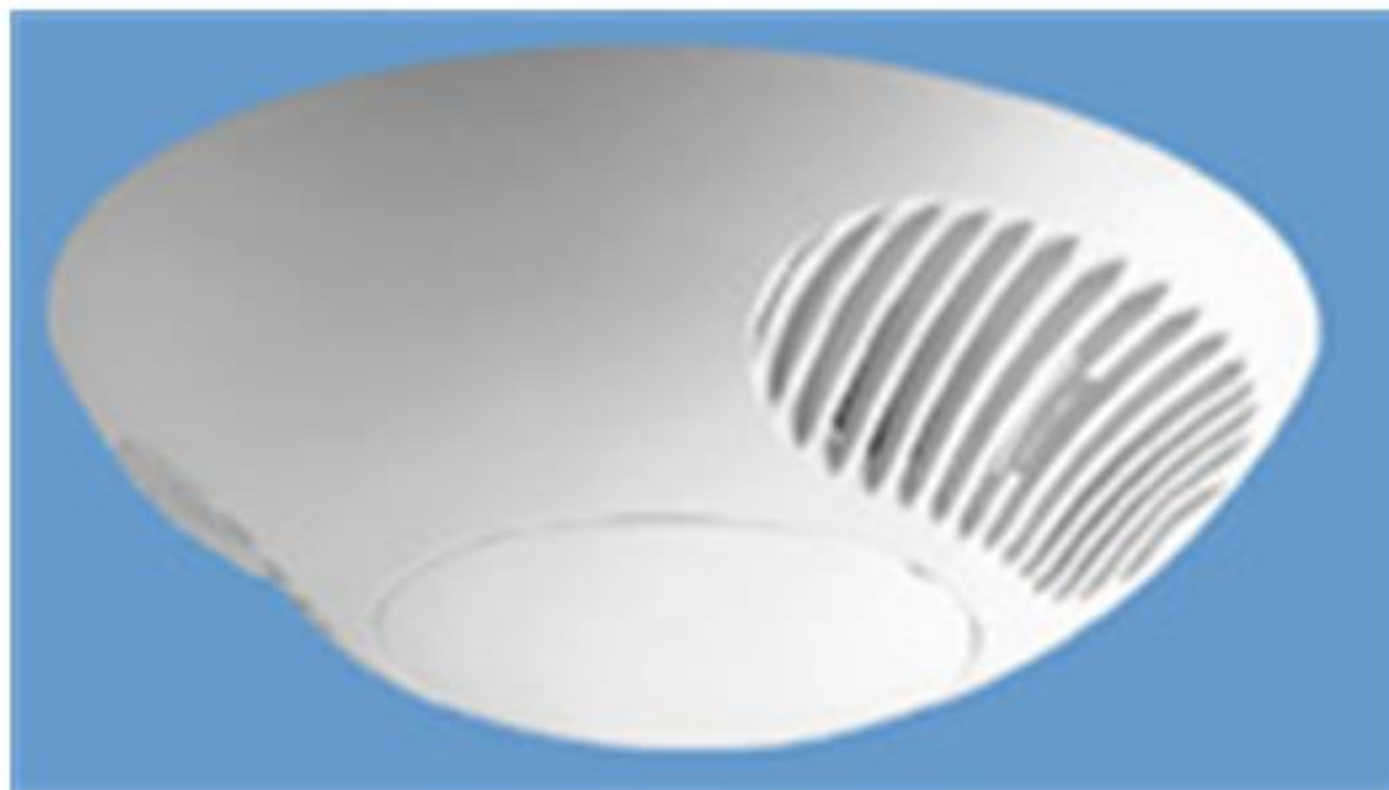
# Lighting Controls

## Daylighting

- Skylights/lightpipes, clerestory windows, roof monitors, light shelves
- Photosensor layout is important



Source: LightLouver LLC



## Occupancy & Vacancy Sensors

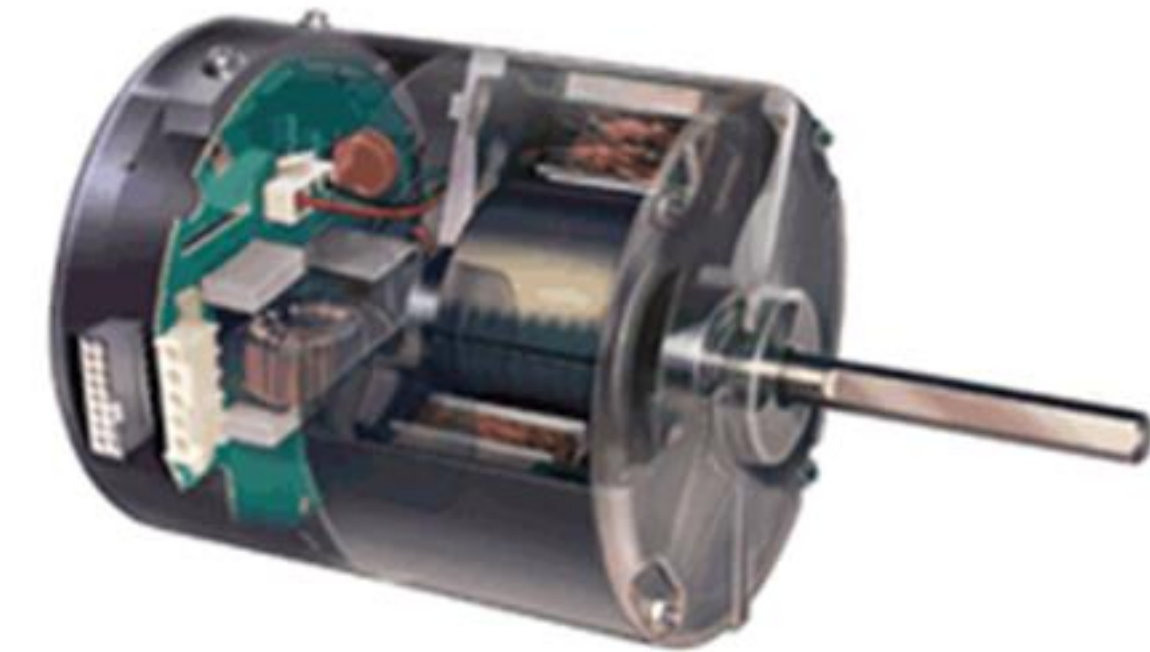
- Ultrasonic and/or infrared
- Can shorten life of fluorescents with instant start ballast
- \$30 to \$150 cost
- Two-year payback is normal



# Motors

## Electronically Commutated Motors (ECM)

- Brushless permanent magnet DC motors
- Uses from one third to one half of the electricity used by PSC AC induction motors
  - Helps offset a 40% cost premium.



## Variable Frequency Drives

- Three-phase AC induction motors
- Savings versus mechanical dampening
- At 50% speed, VFD saves:
  - 75-85% versus output dampening
  - 50% versus variable inlet vane speed control.

Speed	Power
100%	100%
90%	73%
80%	51%
70%	34%
60%	22%
50%	13%
40%	6%
30%	3%
20%	1%
10%	0.1%



# Restaurants

## Behavior

- Do not preheat cooking equipment until ready to use
- Turn cooking equipment down during slow periods
- Cold rinse and stack dishes until a full dishwasher load is ready

## Systems and Equipment

- Balance make-up air with vent hood exhaust air
  - Implement variable-speed exhaust fans
- Control humidity with desiccant system (10%)
  - 50% RH at 78°F = 70% RH at 74°F
- Vinyl strips on walk-in refrigerator doors
  - Overlapped by at least 50% can reduce cold air loss by up to 95%
  - Best if entrance/exit rate is less than five to six times per hour



Source: OSHA

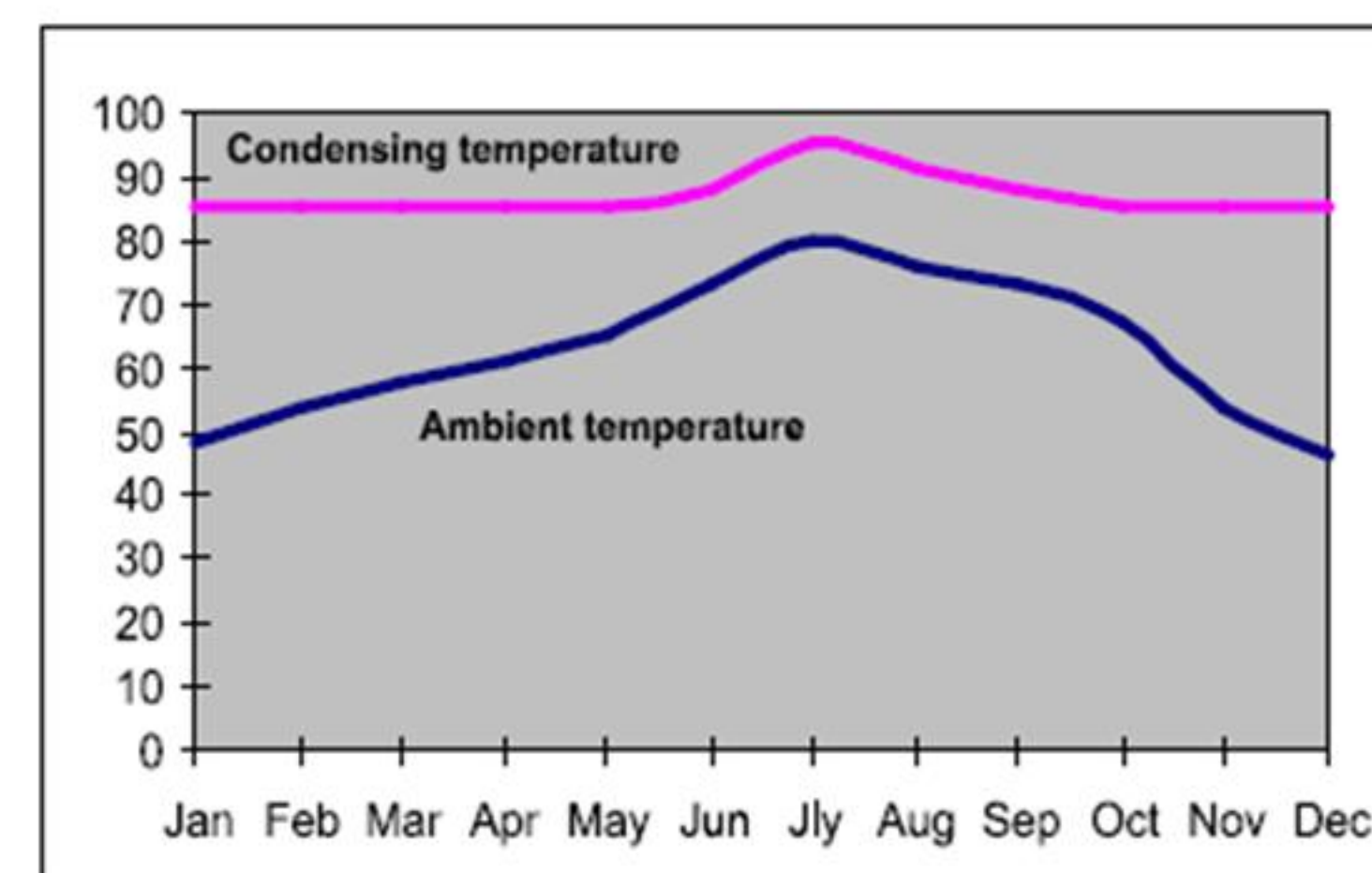


# Restaurants

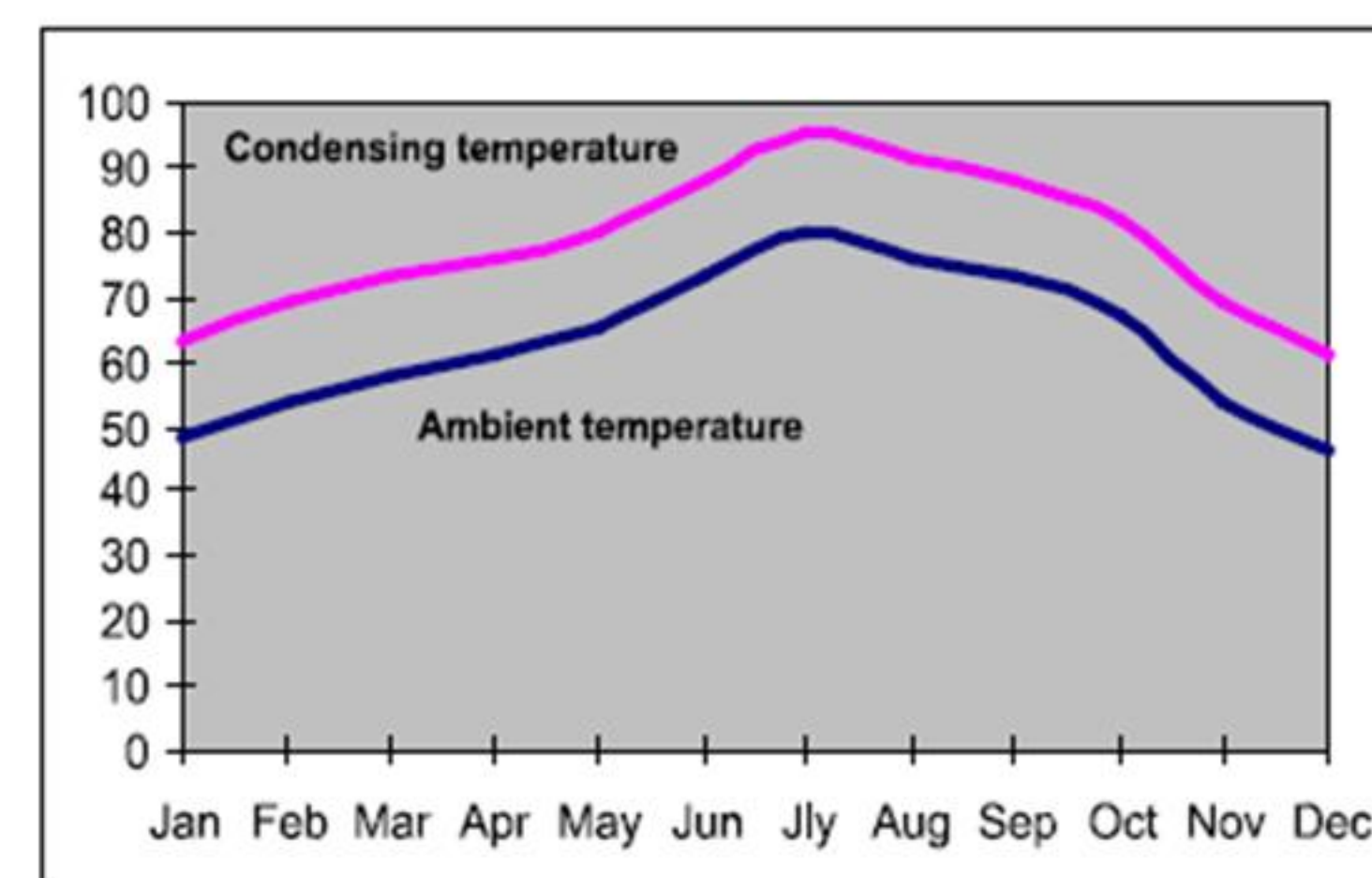
## Floating Head Pressure Controls

- Allow the compressor head pressure to vary with outdoor conditions (fall/winter)
  - Condensing temperature allowed to fall from 90°F to 95°F down to 70°F
- The compressor has to do less work at lower head pressures
  - Reduces refrigerator compression ratios
  - Improves system efficiency
  - Helps extend the life of the compressor
- Often a standard feature on new systems
  - Not usually used in conjunction with heat recovery
- Estimated 3% to 10% savings

## Fixed Head Pressure



## Floating Head Pressure



Source: David Wylie, P.E., ASW Engineering





# Restaurants

## ENERGY STAR Appliances

Equipment Type	Maximum Savings
Holding Cabinets	60%
Steam Cookers	50%
Refrigerators / Freezers	35%
Fryers	30%
Dishwashers	25%
Ovens	20%
Ice Machines	15%
Griddles	10%





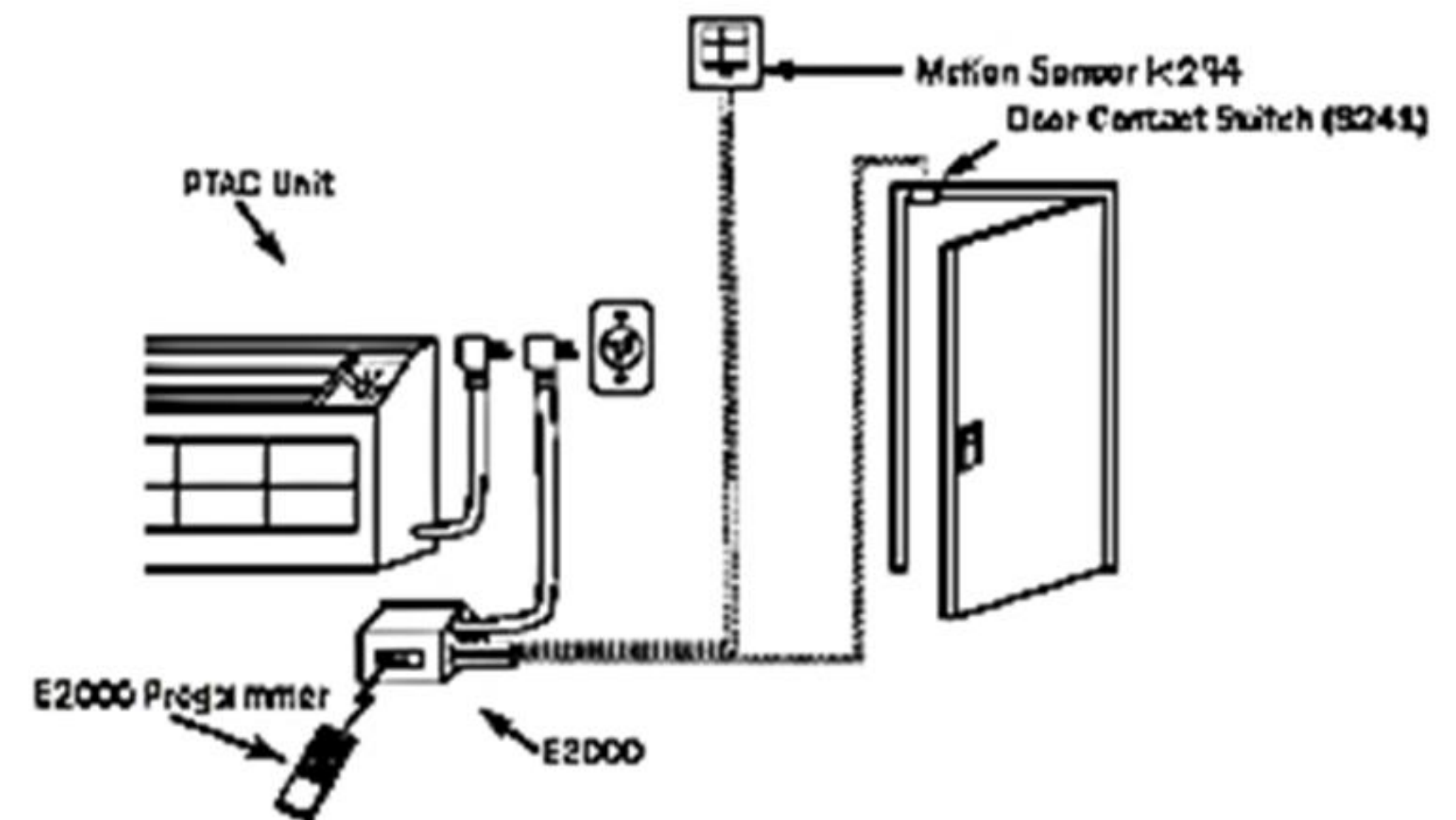
# Lodging Industry

## Hot Water Reduction

- Low flow showerheads (\$30 to \$60/yr)
- 120°F laundry temperature versus 140°F (20%)
- Pool and hot tub covers (50%)
- Solar hot water heaters (5% to 10% per °F pool water)

## Packaged Terminal Air Conditioner (PTAC) Controls

- Amana's DigiSmart
- ENERNET Corporation's T9000
- Verdant Environmental Technologies' eNviro iQ

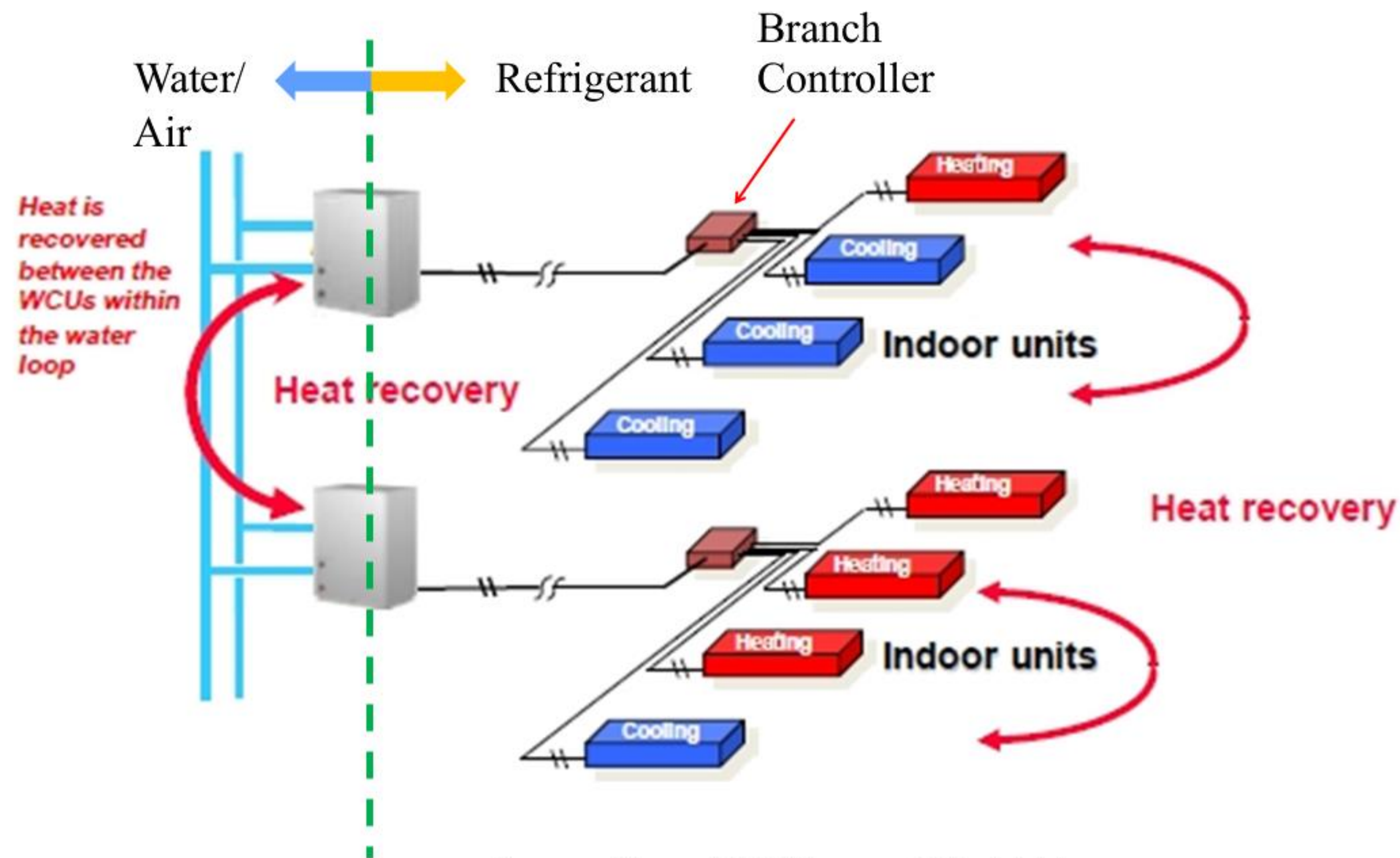




# Lodging Industry

## Variable Refrigerant Flow (VRF)

- Moves refrigerant, not air
- Heat recovery system
- 2-pipe or 3-pipe
- Minimum 6 tons capacity



Source: Dermot McMorrow, Mitsubishi



# Poll Question

I would like someone from PSEG to contact me about the Commercial Efficiency Program.

- a) Yes
- b) No

How valuable has this Webinar been to you?

- a) Not valuable at all.
- b) Slightly valuable.
- c) Moderately valuable.
- d) Very valuable.



# Food Retailers

## Condensation Sensor

- Run anti-sweat heaters only when they are needed (Door Miser)

## Case Doors/Covers

- Save up to 70% on refrigeration

## Case LED Lighting

- Decreases heat load
- Minimizes maintenance
- Works well with nighttime occupancy sensors



Source: Supermarket Energy Technologies



Source: RPI Lighting Research Center



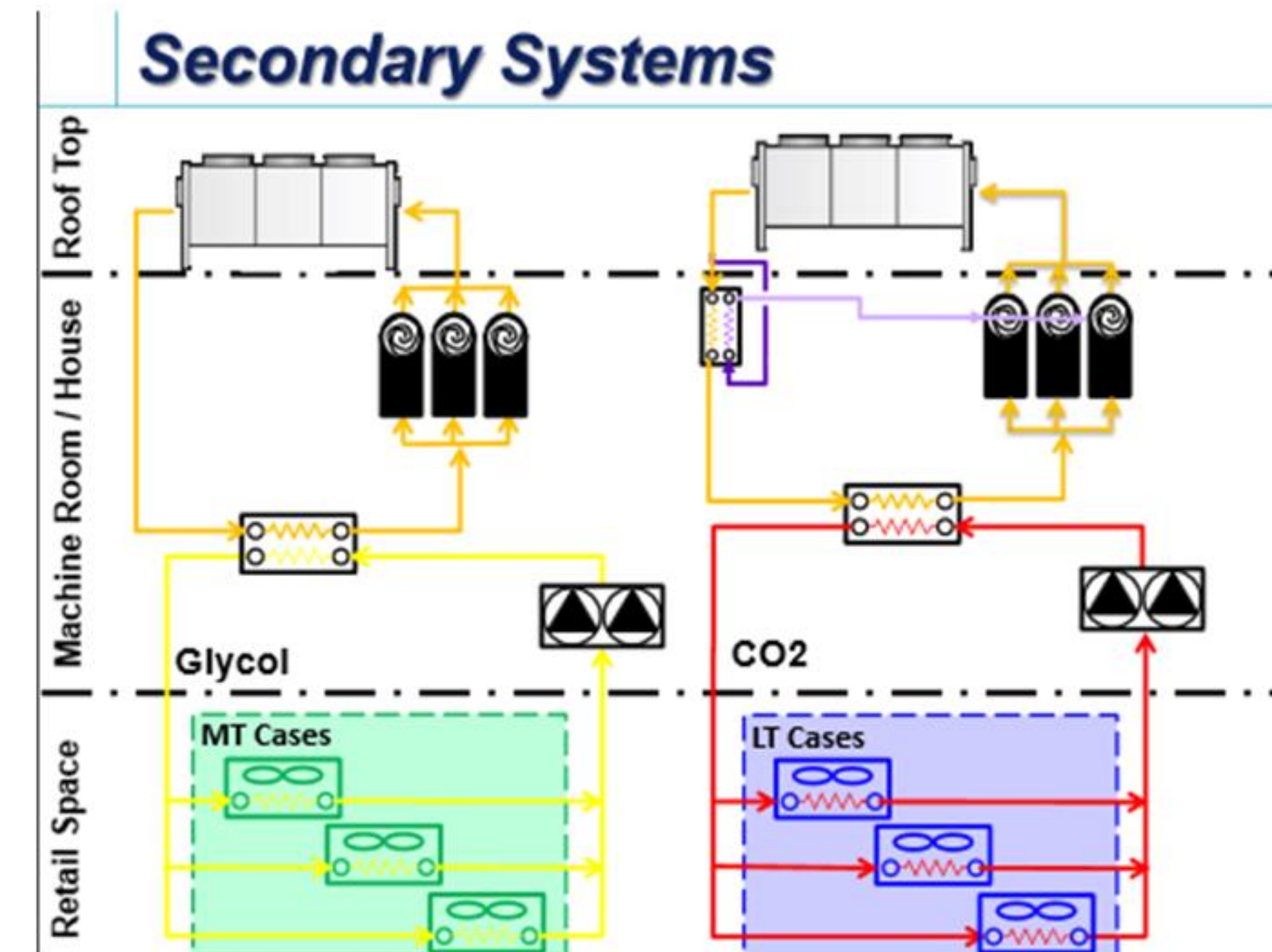
# Food Retailers

## Secondary Loop Refrigeration Systems

- Glycol or CO<sub>2</sub> used in secondary loop
- Minimizes HCFC refrigerant
  - 35% to 45% less refrigerant required

## Walk-in Refrigerator Maintenance

- Check and replace door gaskets
  - Keep clean and pliable
  - Replace every three years
  - Use infrared to check for air infiltration
- Adjust top and center door hinges (when applicable)
  - Lubricate hinges annually
- Clean evaporator and condenser coils
  - Keep air paths clear
  - Keep evaporator drain lines open
- Check refrigerant charge





# Questions

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# Helpful Resources

## Facility Assessment Wizard



### Facility Assessment Wizard

#### Where You Are:

- Select a Business Segment
- Climate Zone
- Energy Uses
- Questions
- Facility Details

Note: Depending on your selections, some steps will be inaccessible.

#### Questions About Your Facility

The questions below are designed to provide you with applicable recommendations for your facility. If you are unsure of an answer, select the question to be provided with recommendations in that area.

##### Cooling

- Is the maintenance of the facilities cooling equipment informal and infrequent?
- Is your cooling equipment more than 10 years old?
- Should the design aspects of the cooling system be re-evaluated and updated (variable speed drives, sizing to accommodate building and equipment changes, economizers, etc)?
- Is there a concerted effort to reduce peak demand?

##### Lighting

- Has it been at least ten years since your facility was upgraded to higher efficiency lights and lighting systems?
- Are there some areas (facility, parking lot, etc.) where the lighting design could better fit the application?
- Are lights consistently left "on" in unoccupied spaces?

##### Distributed & Onsite Generation

- Do you have a need for backup or emergency power capability?
- Are you using capacitor banks for power factor correction?

##### Energy Management

- Do you need help in justifying an Energy Management Systems (EMS)?
- Do you need to increase the frequency or thoroughness of your EMS maintenance program?

##### Power Quality

- Are you experiencing symptoms of harmonics (high current in neutral conductor, nuisance trips of circuit breakers, etc.)?
- Are you experiencing equipment overheating or damage that may arise from power surges or spikes?

Back Next

The screenshot shows the PSEG EnergyLink website interface. At the top, the PSEG logo and 'EnergyLink' branding are visible. Below the navigation bar, there is a section titled 'Tools You Can Use' containing several tool icons: Commercial Energy Benchmarks, Industrial Energy Benchmarks, Commercial Energy Efficiency, Industrial Energy Efficiency, Energy POSTERS, Facility Assessment Wizard (circled in red), Carbon Footprint CALCULATOR, Fuel Cost Calculator, En-er-gy Glos-sa-ry, LIGHTING Calculator, and Motor Calculator. A red arrow originates from the 'Facility Assessment Wizard' icon and points towards the right-hand page.



# Helpful Resources

## Energy Efficiency Recommendations



**Energy Function**

Process Heating

Select End Use Function

HVAC

Process Heating

Process Cooling/Refrigeration

Motors/Machine Drive

Lighting

Boilers

Office / Warehouse

Compressors / Generators

**Industrial/Manufacturing Business Segments**

Fabricated Metal Products

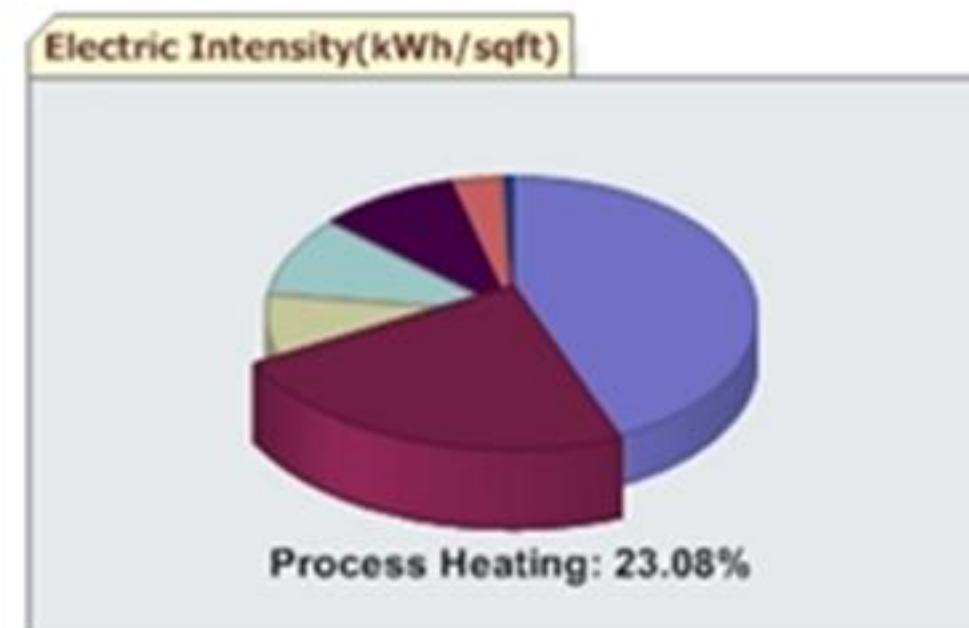
Go

[Not a Manufacturer? View our Commercial Efficiency Recommendations](#)

Recommendations related to Fabricated Metal Products intended to help you lower your Process Heating efficiency:

### Heat Generation

- Consider equipment capability to idle at low heat or to shut down for periods of time when the product flow will be stopped.
- Annual inspection and cleaning of a boiler by a qualified technician is essential. [more on this topic](#)



**Business Segment**

Restaurants

Select a Segment

Colleges & Universities

Data Centers

Dry Cleaning/Laundry

Grocery/Convenience Stores

Hospitals

Large Office Buildings

Large Retail

Lodging

Multi-Family Apartments

Other Healthcare

Public Assembly

Refrigerated Warehouses

Restaurants

Schools

Small Office Buildings

Small Retail

Warehouses

**Energy Use**

Cooking

**Climate Zone** [Map](#)

Zone 2

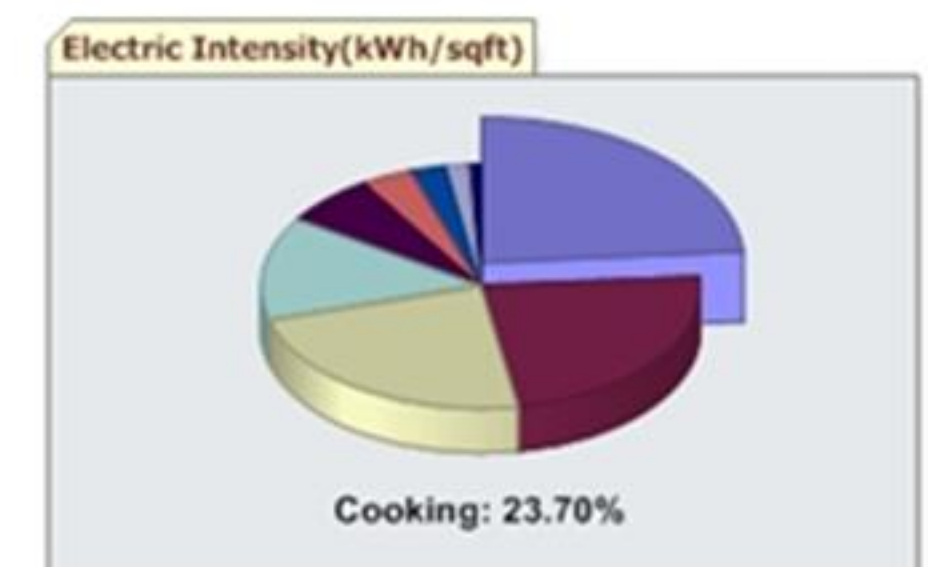
Go

[Are you a Manufacturer? View our Industrial Efficiency Recommendations](#)

Recommendations related to Cooking intended to help you lower your energy costs and

Recommendations related to the major business of Star appliances and review electric and gas steam fryers, hot food holding refrigerators.

- Integrate controls that turn down the heat input with sensors that determine when food is not present. A large percentage of food equipment continues to run (idle) at high heat input rates even when food is not present.





# Helpful Resources

- Air-Conditioning, Heating, and Refrigeration Institute (AHRI)
  - <http://www.ahrinet.org/>
- DOE Commercial Lighting Solutions Tool
  - <https://www.lightingsolutions.energy.gov>
- Food service technology center
  - <http://www.fishnick.com/>
- Improving Compressed Air System Performance sourcebook
  - <http://www.compressedairchallenge.org>



# Helpful Resources

## Energy Auditing Software

- EnerSys Analytics - [Energy Profile Tool](#)
- InterEnergy Software - [Building Energy Analyzer Pro](#)
- DOE [Industrial Facilities Scorecard](#)
- DOE Integrated Tool Suite/[Plant Energy Profiler](#)
- ENERGY STAR - [Portfolio Manager](#)



# Questions?

## Contact Information:

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  - 1-855-249-7734
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  - <http://www.njcleanenergy.com/>
  - <http://members.questline.com/Default.aspx?accountID=197>

