Energy & Store Development Conference

E+SD 2015

Trends in High Performance Grocery Store Design

Presented by
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Tony Welter, PE, LEED AP

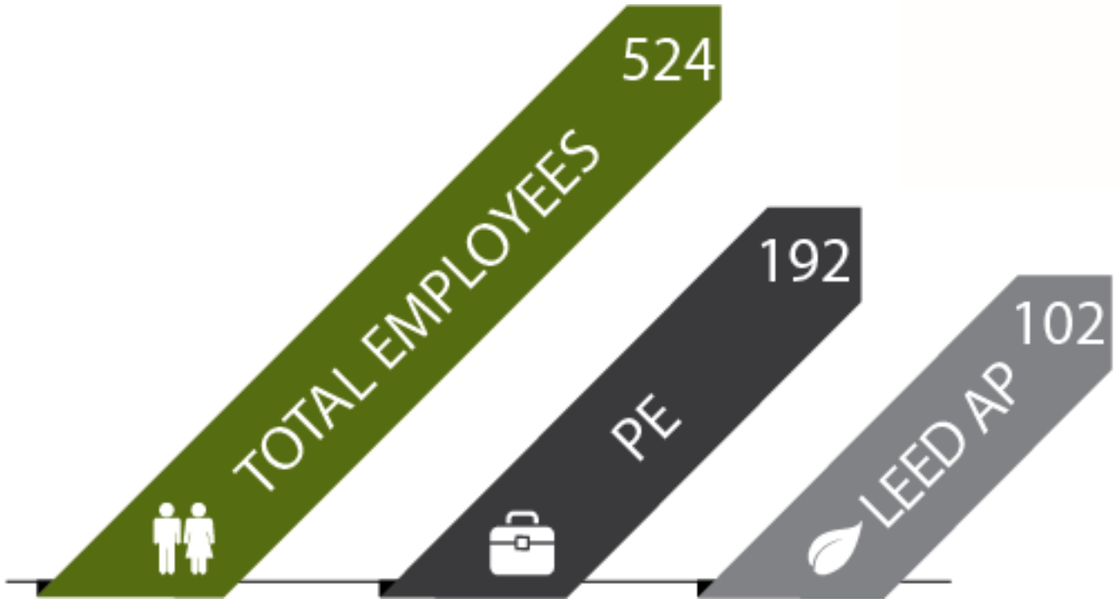
Vice President and Director of Refrigeration

The Boy, 4th Grader

King of Shenanigans

HENDERSON ENGINEERS INC

- LICENSED IN ALL 50 STATES
- 45-YEAR HISTORY OF GROCERY STORE DESIGN



- MULTIDISCIPLINARY NATIONAL MEP/F/R ENGINEERING FIRM
- WORK HARD. PLAY HARD. GIVE BACK.

AGENDA

- Title 24 Energy (Part 6) & *CALGreen* (Part 11) updates
- Trends
  - Refrigeration (energy, refrigerants)
  - Lighting (quality)
  - Water (reductions, reclaim)

Title 24 and CALGreen

- What is Title 24?
  - What sections have been updated that affect design?
    - Part 6 – Energy
    - Part 11 – CALGreen (Green Building Standards)
      - Effective July 1, 2014

Title 24 and CALGreen
What is the impact?

Mechanical highlights:

- **Section 110.2** - Updated minimum efficiency tables for mechanical equipment – EnergyPro model required (CALGreen)
- **Section 110.10** - Requirements for solar ready building
- **Section 120.1** - Requirements for ventilation
  - Additional outside air required
  - All systems shall include occupancy sensors

Title 24 and CALGreen
What is the impact?

Refrigeration highlights:

Section 120.6 - Condensers

- VFDs required
- 10°F TD for freezers, 15°F for coolers
- Minimum SCT 70°, reset by ambient
- Efficiency requirements for fan 65 Btuh/W (THR/Input Power)

- Liquid subcooling required for SST<-10°F, must be done by SST>18°F

Title 24 and CALGreen
What is the impact?

<u>Refrigeration highlights (cont.):</u>

Section 120.6 - Refrigerated display cases lighting requirements

- Automatic controls during non-business hours
- Motion sensor controls that **reduce** lighting power by at least **50%**

Title 24 and CALGreen
What is the impact?

<u>Refrigeration highlights (cont.):</u>

Section 120.6 - Refrigeration heat recovery

- Utilize minimum 25% for of THR for space heating on systems with THR>150 MBH
- Refrigerant in equipment and piping shall not increase more than 0.35 lbs/1,000 Btu/h

Title 24 and CALGreen
What is the impact?

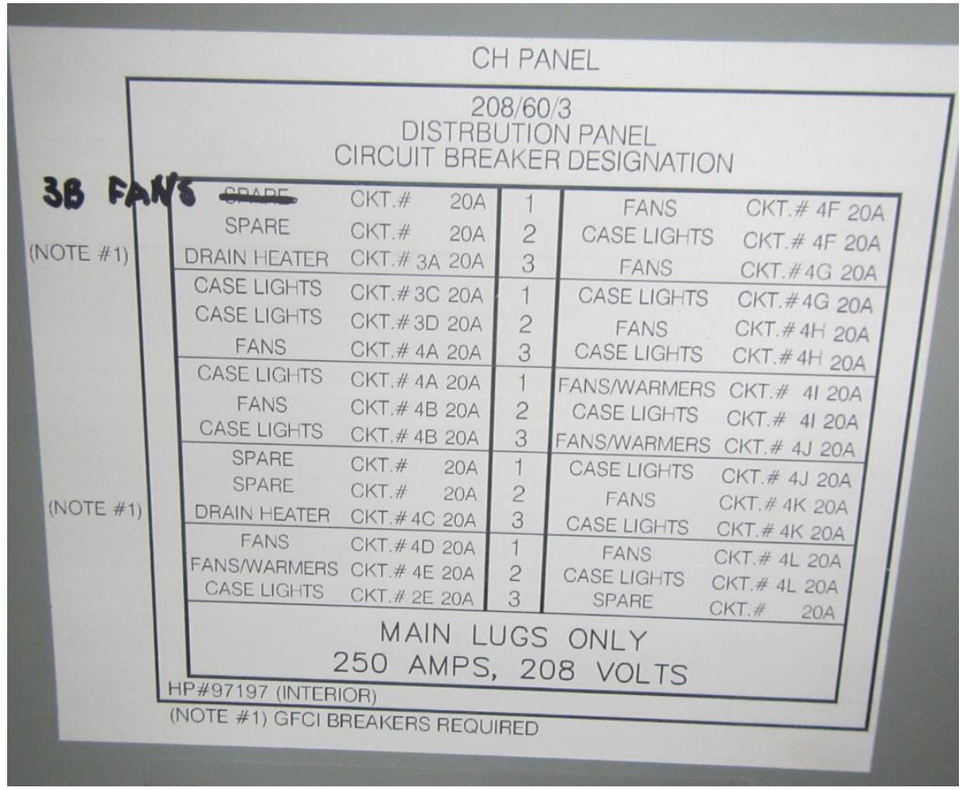
Electrical/Lighting highlights:

- **Section 130.1** - Requirements for indoor
  - Stepped/dimming
  - Partial on/off occupancy sensors
  - Demand responsive control
- **Section 130.2** - Requirements for outdoor
  - Nearly all outdoor lights shall be controlled
  - Added backlight/uplight/glare ratings for various luminaire types

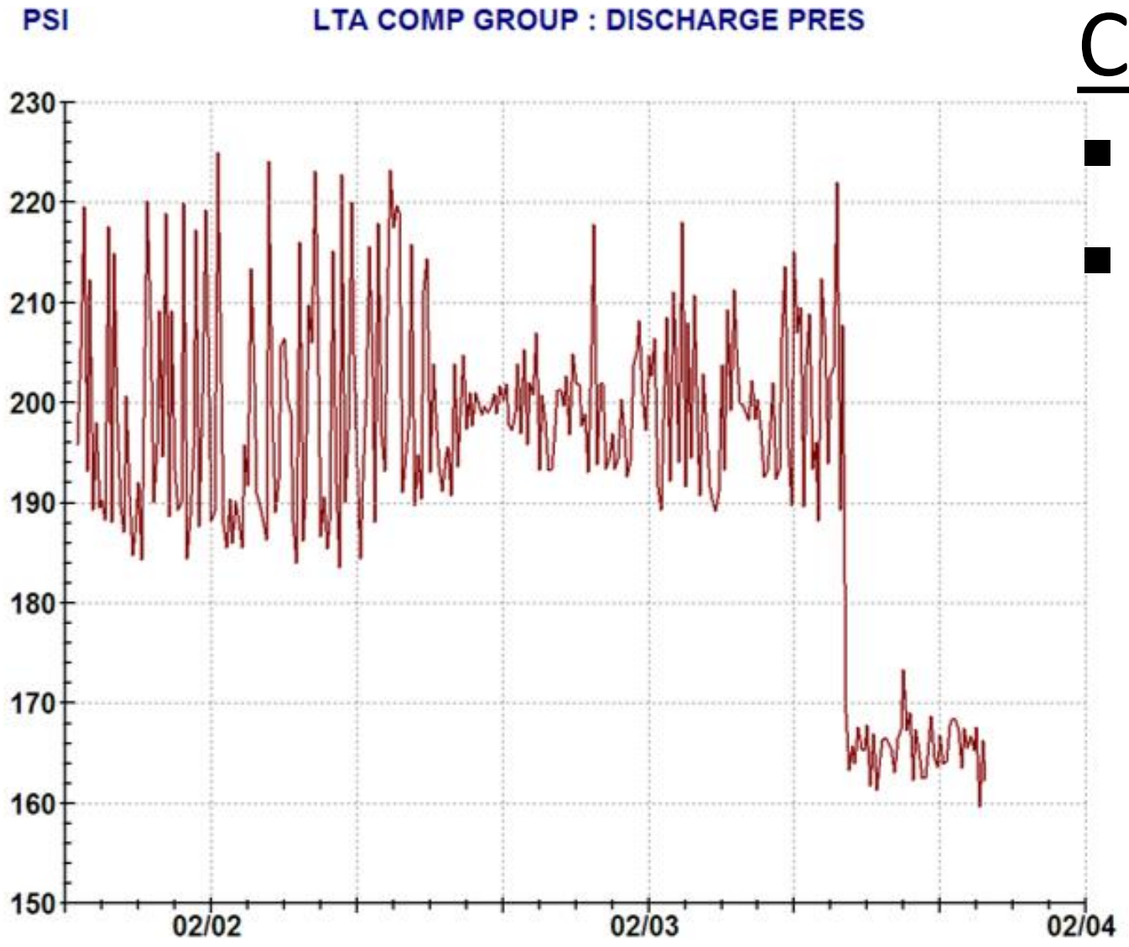
Title 24 and CALGreen
What is the impact?

Electrical/lighting highlights (cont.):

- **Section 130.5** – Mandatory electrical power distribution systems
  - Each electrical service shall have metering
  - Electrical service shall disaggregate loads for separate metering
  - Receptacle circuit in certain areas shall be tied with occupancy sensors



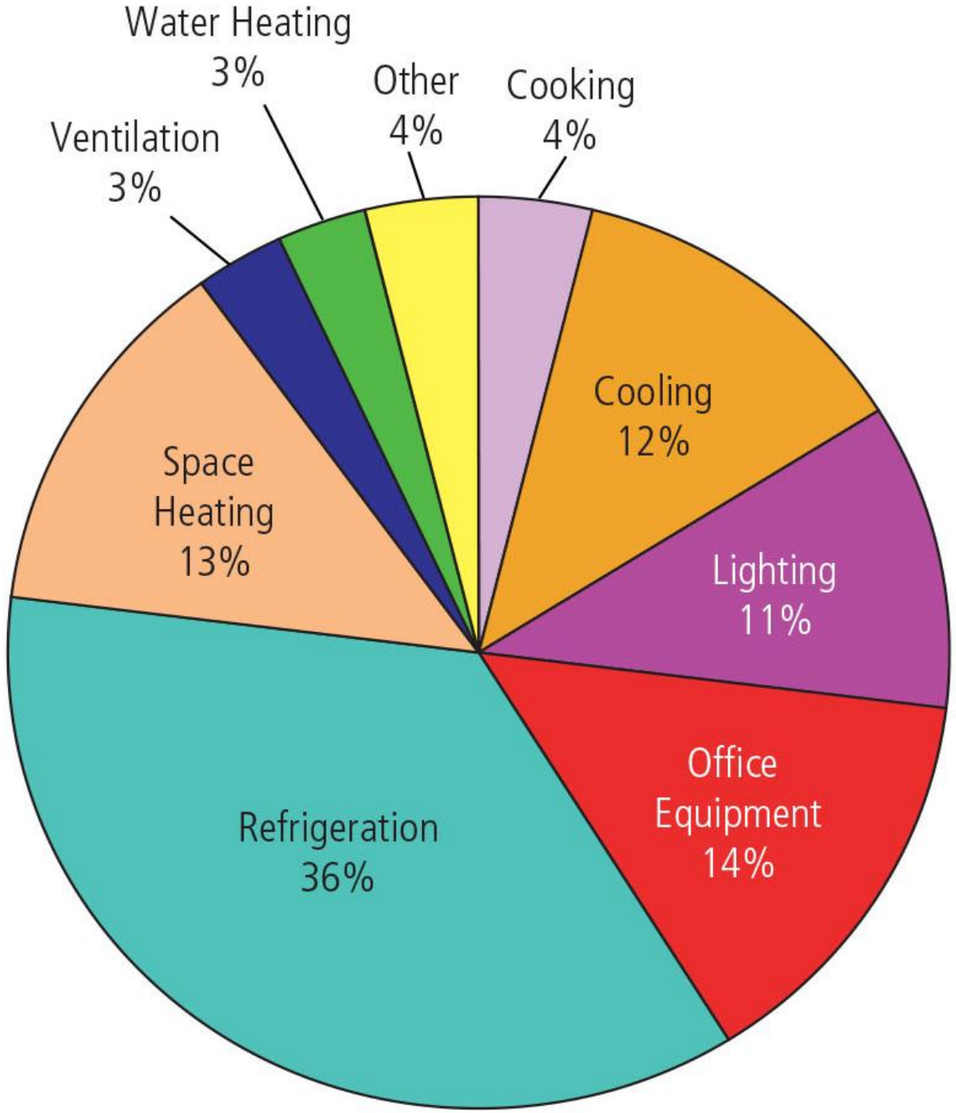
Title 24 and CALGreen
What is the impact?



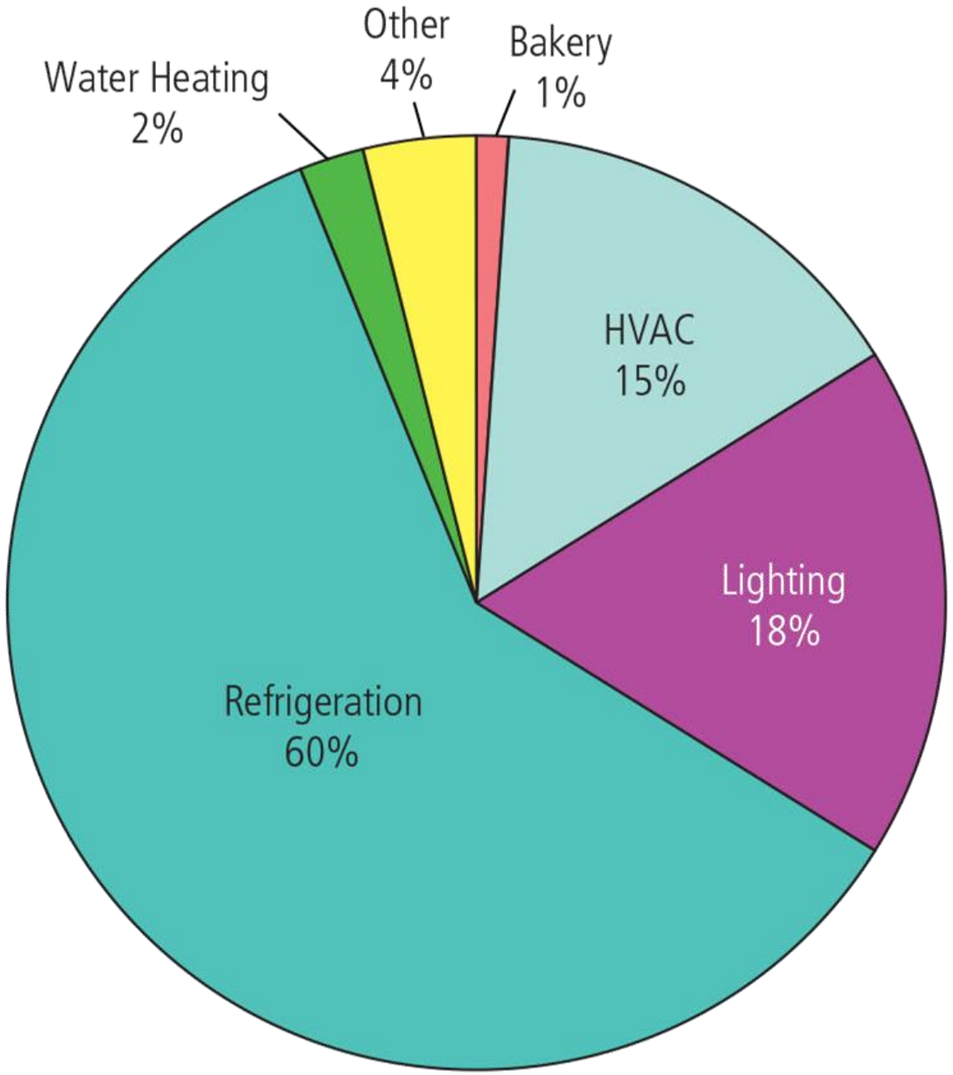
Commissioning Requirements:

- Must sample 100%
- Requirements change by size
  - < 10,000 SF = Design review only
  - < 50,000 SF = Design review + in-house commissioning
  - > 50,000 SF = Design review + 3rd party commissioning

All Energy



Electricity Only



Source: National Action Plan for Energy Efficiency (2008). Sector Collaborative on Energy Efficiency Accomplishments and Next Steps.
ICF International. <www.epa.gov/eeactionplan>

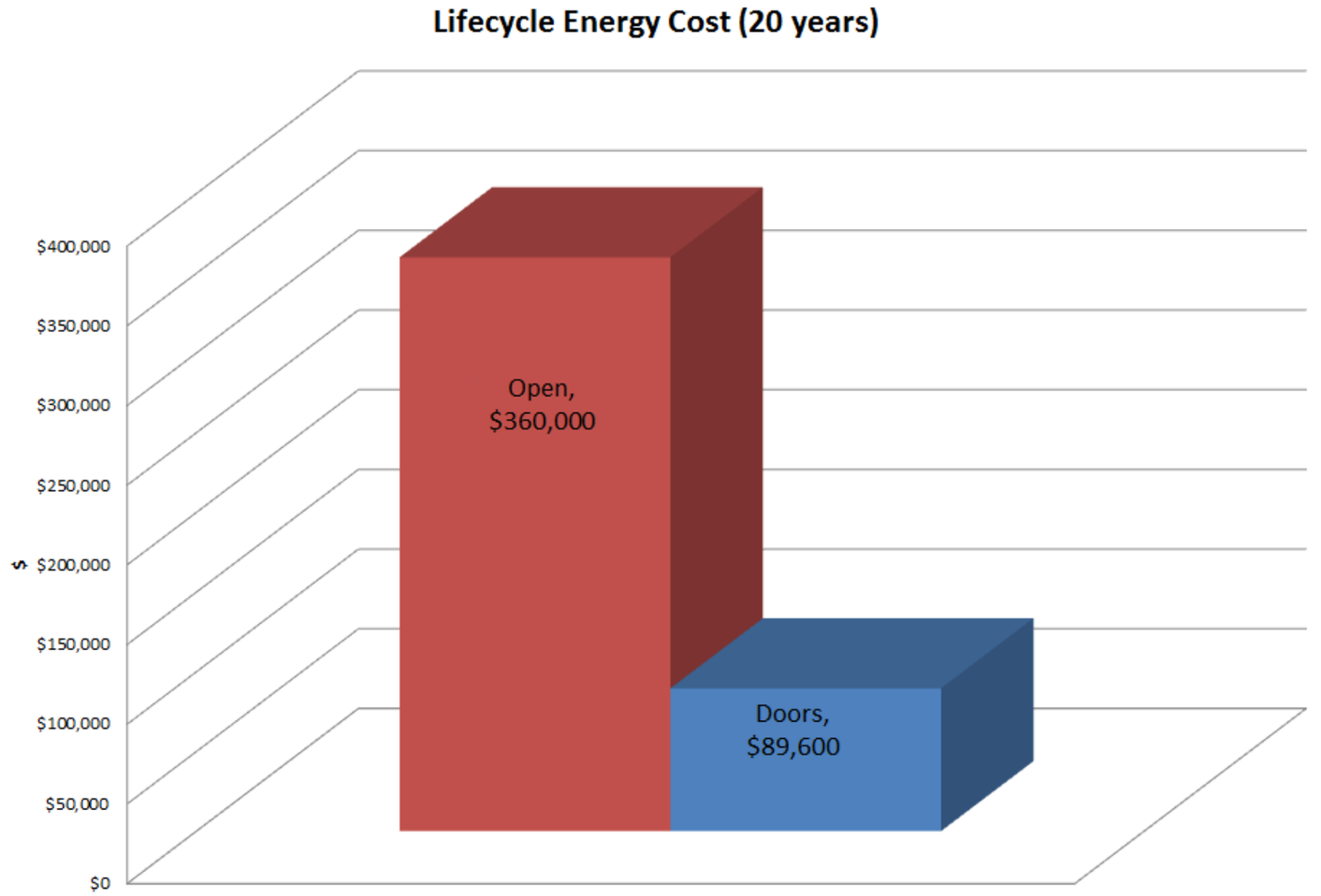
Trends in Refrigeration

ENERGY COST REDUCTION

How many residential refrigerators **without** doors are on the market?

Impact of Medium Temperature Doors

Adding doors **reduces** compressor horsepower by **83%** and energy usage by **75%!**



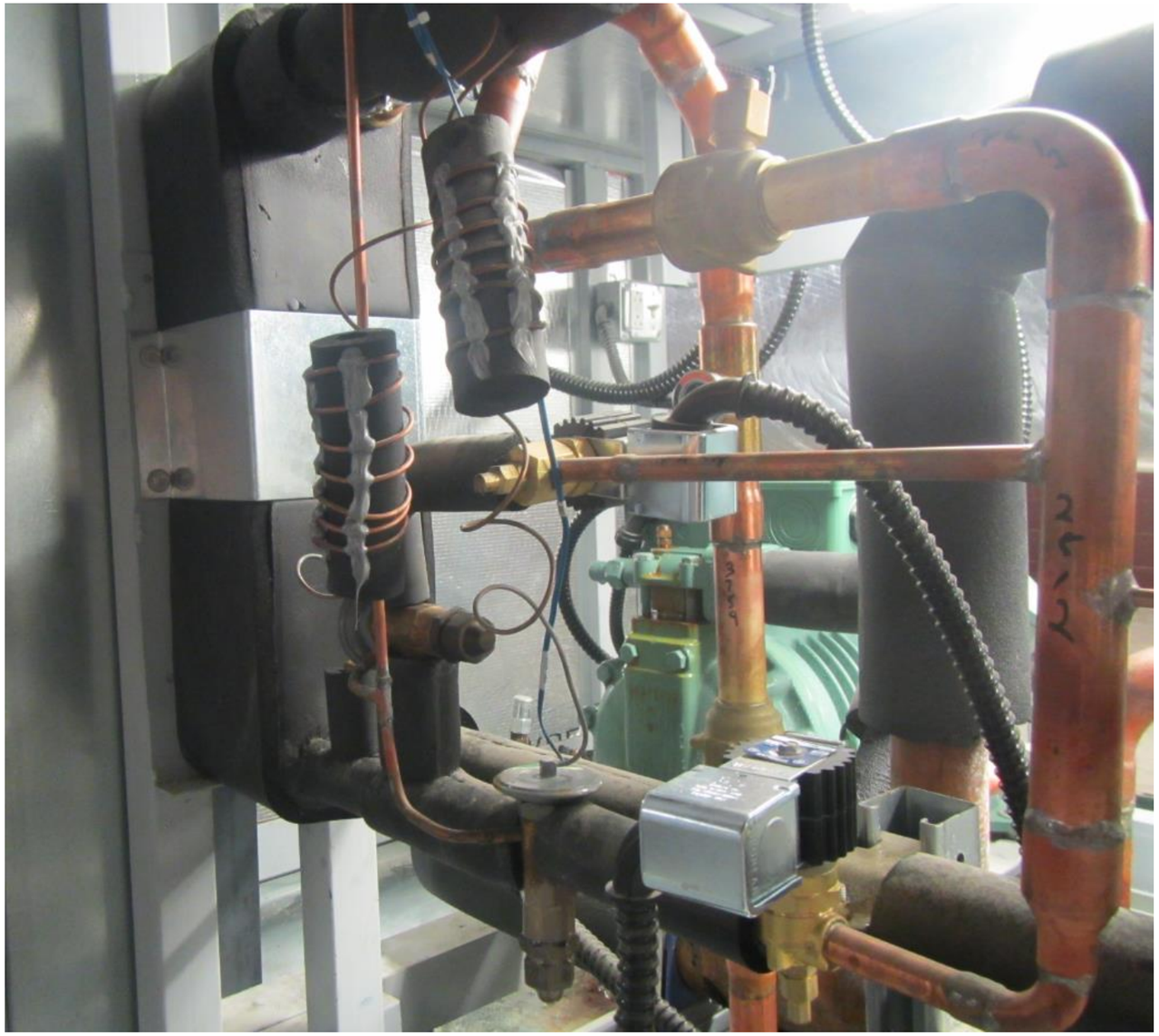
	Medium Temp (ft)	Load (MBH)	Suction Temp (°F)	Compressor (hp)	Energy (kwh)	Annual Energy Cost ($)*	Lifecycle Energy Cost (20 years)
Open	488	436	26	66	225000	$18,000	$360,000
Doors	488	118	32	11	56000	$4,480	$89,600
*Based on $.08/kwh							

New construction implementation depends on store planning approval.

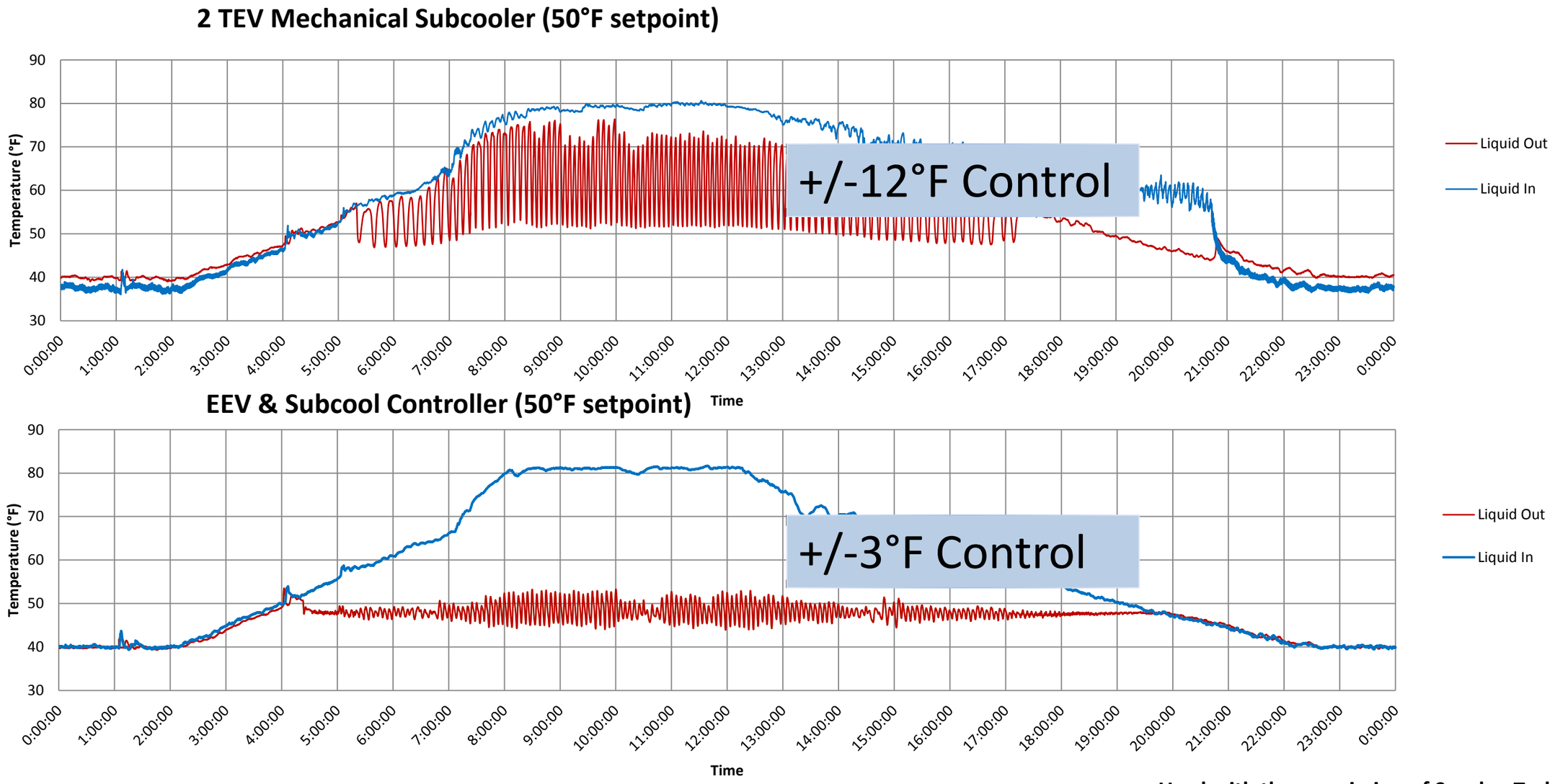
Retrofit

- New case or retrofit existing multi-deck?
- Retrofitting existing multi-deck considerations:
  - Control valve sizes
  - Riser and piping sizes
- Rack considerations

MANUAL VS. ELECTRIC VALVES



MECHANICAL SUBCOOLER VS. SUBCOOL CONTROLLER

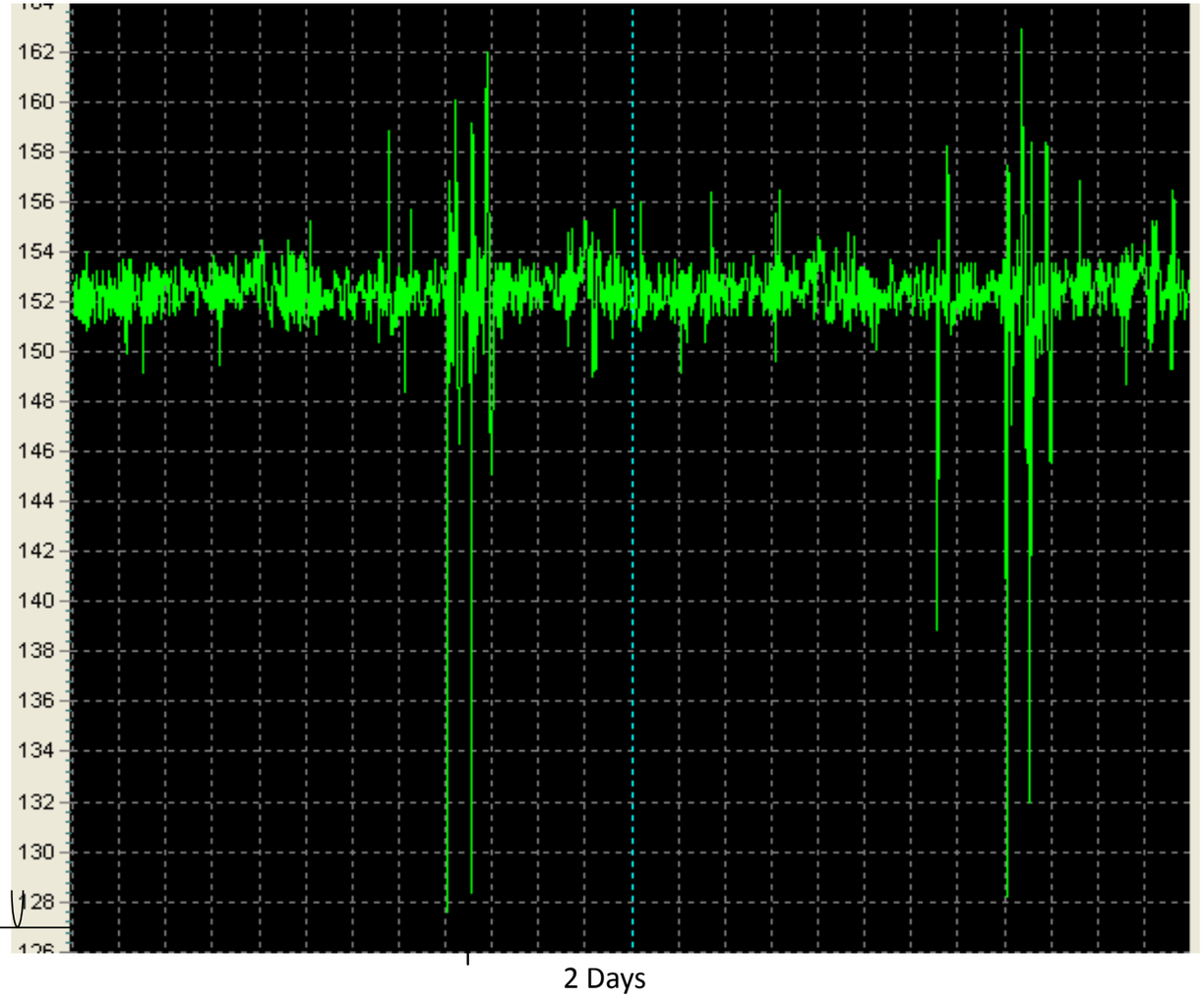


Used with the permission of Sporlan Technologies

CONDENSER OUTLET PRESSURE

Mechanical

Electronic



NATURAL REFRIGERANTS

REVISED:
July 20, 2015

www.epa.gov/ozone/snap

FACT SHEET

Final Rule - Protection of Stratospheric Ozone: Change of Listing Status for Certain Substitutes under the Significant New Alternatives Policy Program

EPA's Significant New Alternatives Policy Program

Final Rule

EPA's Final Rule

Phase-out Candidates*, Likely Alternatives* and Dates

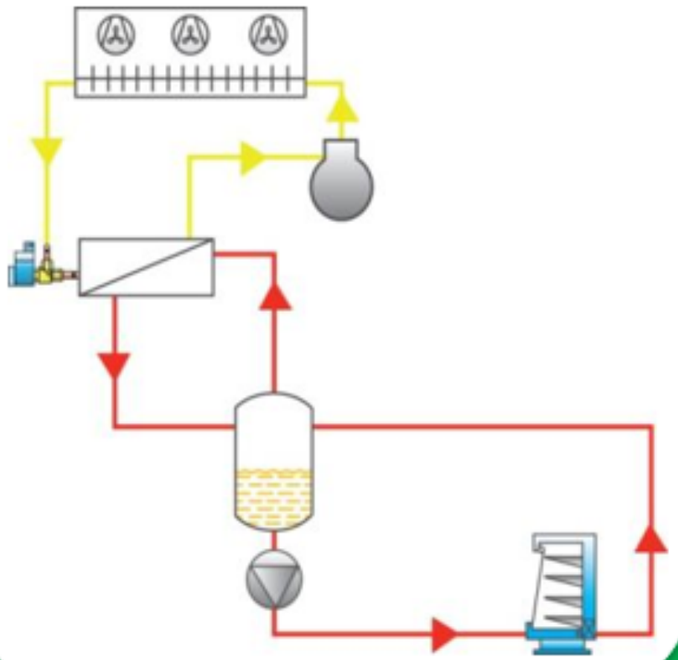
Phase-out Refrigerant	Super-market New	Super-market Retrofit	Remote Cond. Unit New	Remote Cond. Unit Retrofit	Stand-alone			
					MT <2,200 BTU/hr. and not contain flooded evap. New	MT ≥2,200 BTU/hr. with or without flooded evap. New	LT New	LT and MT Retrofit
R-404A/507A	Jan. 1, 2017	July 20, 2016	Jan. 1, 2018	July 20, 2016	Jan. 1, 2019	Jan. 1, 2020	Jan. 1, 2020	July 20, 2016
R-410A	OK	-	OK	-	Jan. 1, 2019	Jan. 1, 2020	Jan. 1, 2020	-
R-407A/C/F	OK	OK	OK	OK	Jan. 1, 2019	Jan. 1, 2020	Jan. 1, 2020	OK
HFC-134a	OK	OK	OK	OK	Jan. 1, 2019	Jan. 1, 2020	OK	OK
Likely Alternatives (Emerson Perspective)								
R-448A/449A	OK	OK	OK	OK	Neither SNAP-approved, nor banned	Neither SNAP-approved, nor banned	OK	OK for LT only
R-450A/513A	OK	OK	OK	OK	OK	OK	OK	OK
R-290	-	-	-	-	OK	OK	OK	-
R-744	OK	-	OK	-	OK	OK	OK	-
R-717	OK (in primary loop of secondary CO2 sys.)	-	OK (in primary loop of secondary CO2 sys.)	-	-	-	-	-

** Abbreviated; see EPA final rule for complete listing.*

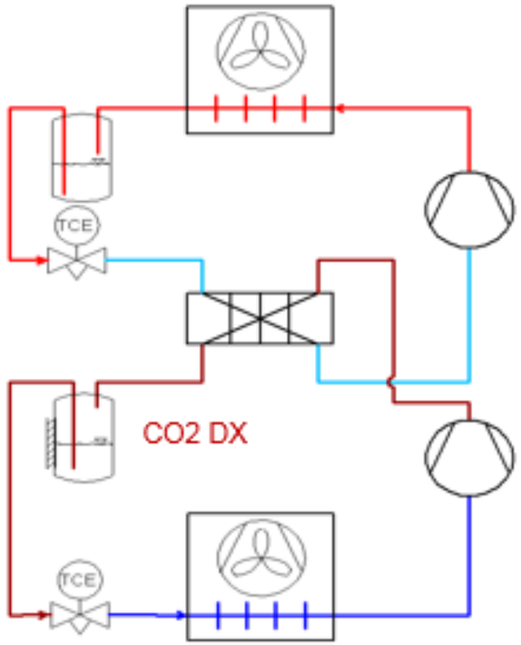
E360

NATURAL REFRIGERANTS – OPTIONS

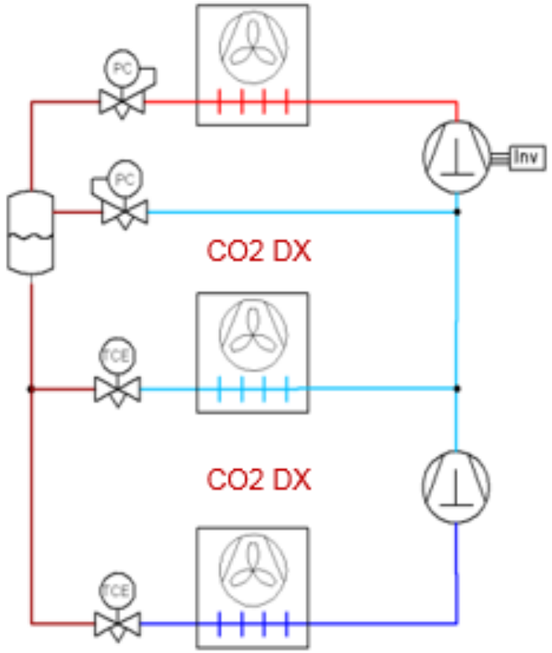
SECONDARY



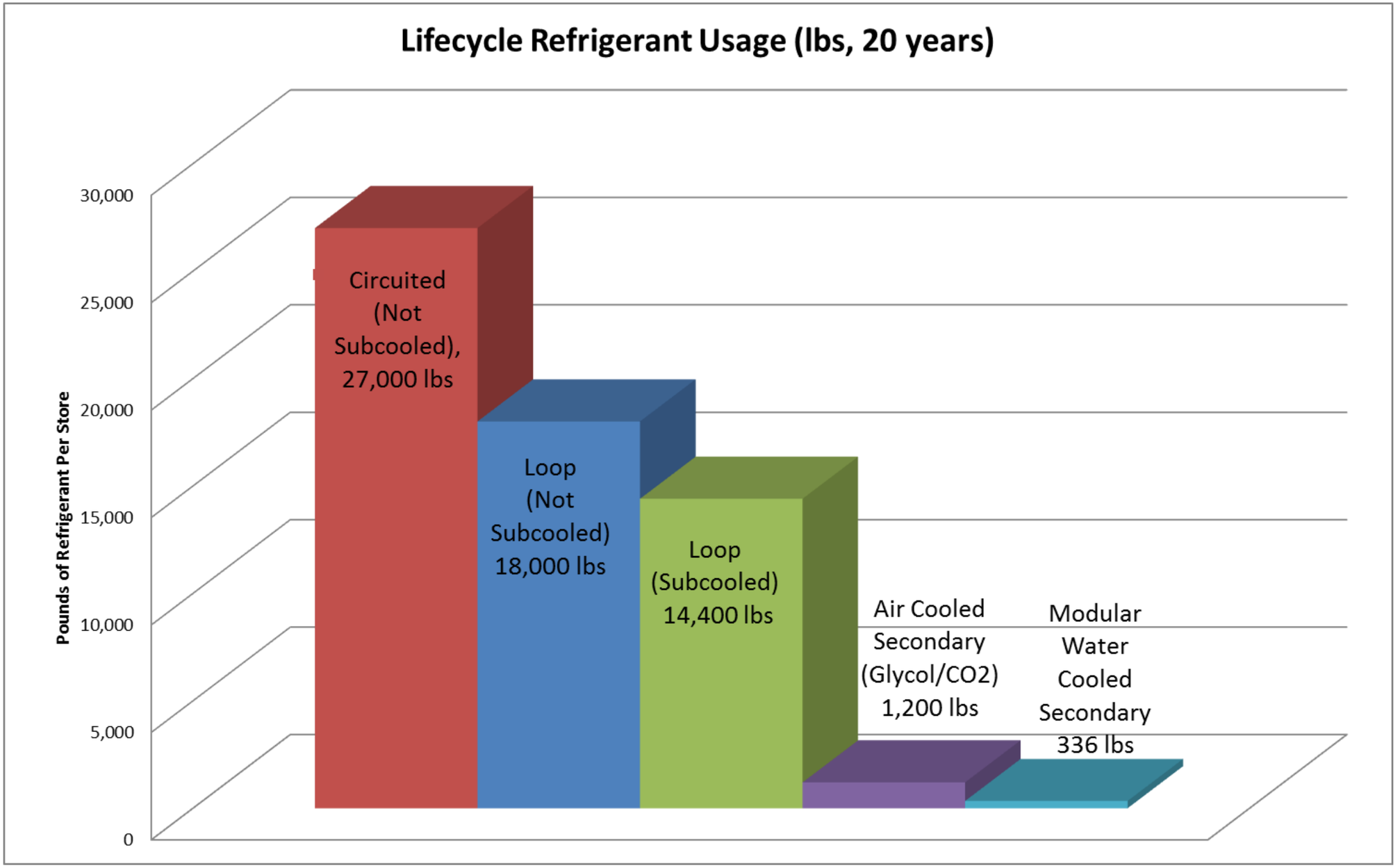
CASCADE



TRANSCRITICAL BOOSTER



WHY SECONDARY?



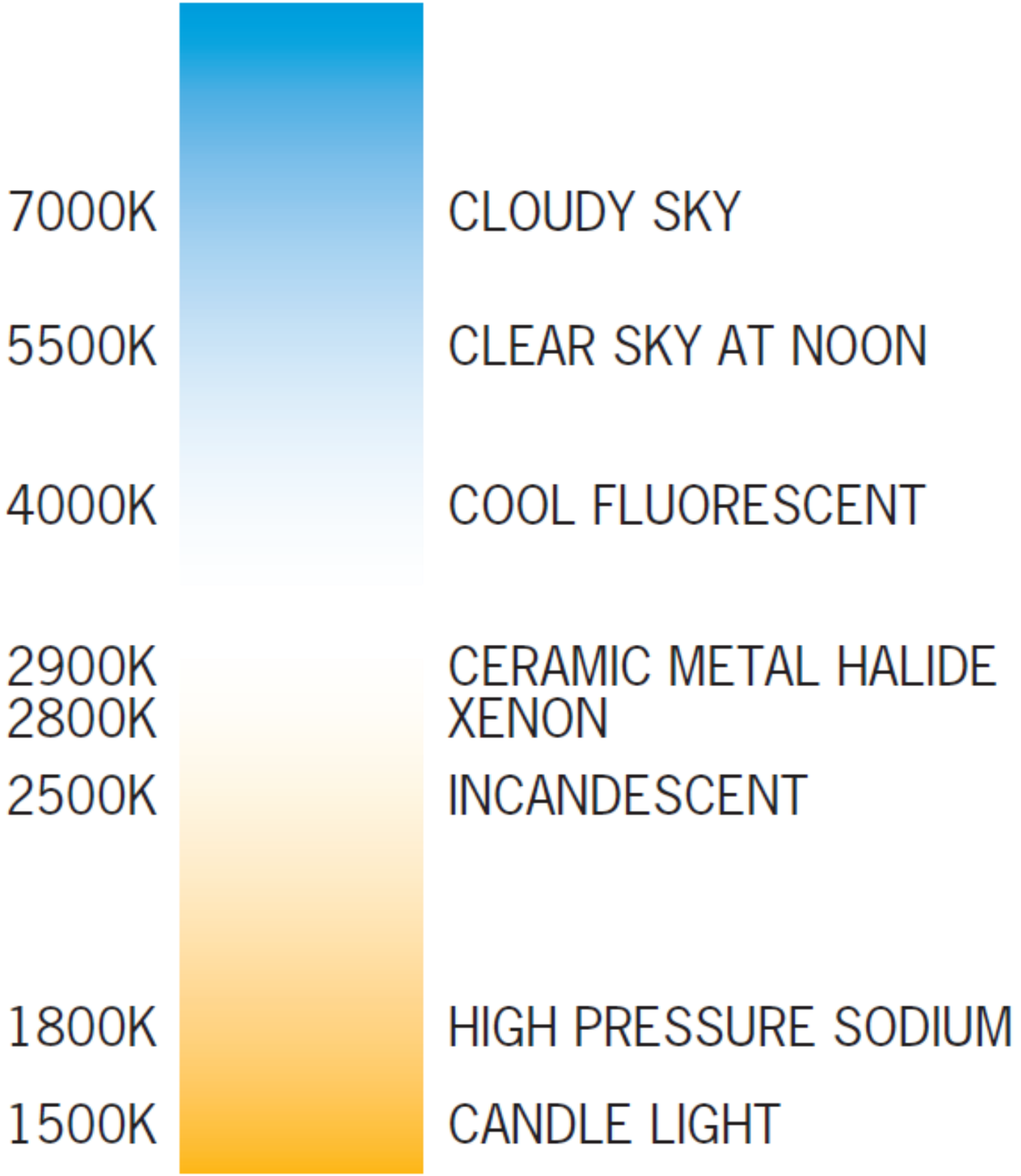
CHILLERS FOR MEDIUM TEMPERATURE GLYCOL

- Packaged equipment with lower first cost
- Piping could be installed by mechanical contractor
- Controls integration presents challenges

Trends in Lighting

Sales $\propto$ Customer Perception

COLOR TEMPERATURES IN KELVIN SCALE



CRI 96

CRI 65

Best Practices: Produce

- Use 2700K-3000K lamps with reflectors to accent reds, oranges, and yellows
- Use LEDs to eliminate emission of UV/IR and lengthen maintenance cycles
- Limit overhead ambient lighting
- Light surrounding walls to make the space feel open

Best Practices: Floral

- Use high contrast ratios of at least 5:1
- Use LEDs to limit infrared
- Limit overhead ambient lighting
- Use daylighting wherever possible

Best Practices: Meats

- Use high CRI pf 80-95
- Use a color temperature of 2700 K
- Use LEDs for in-cooler

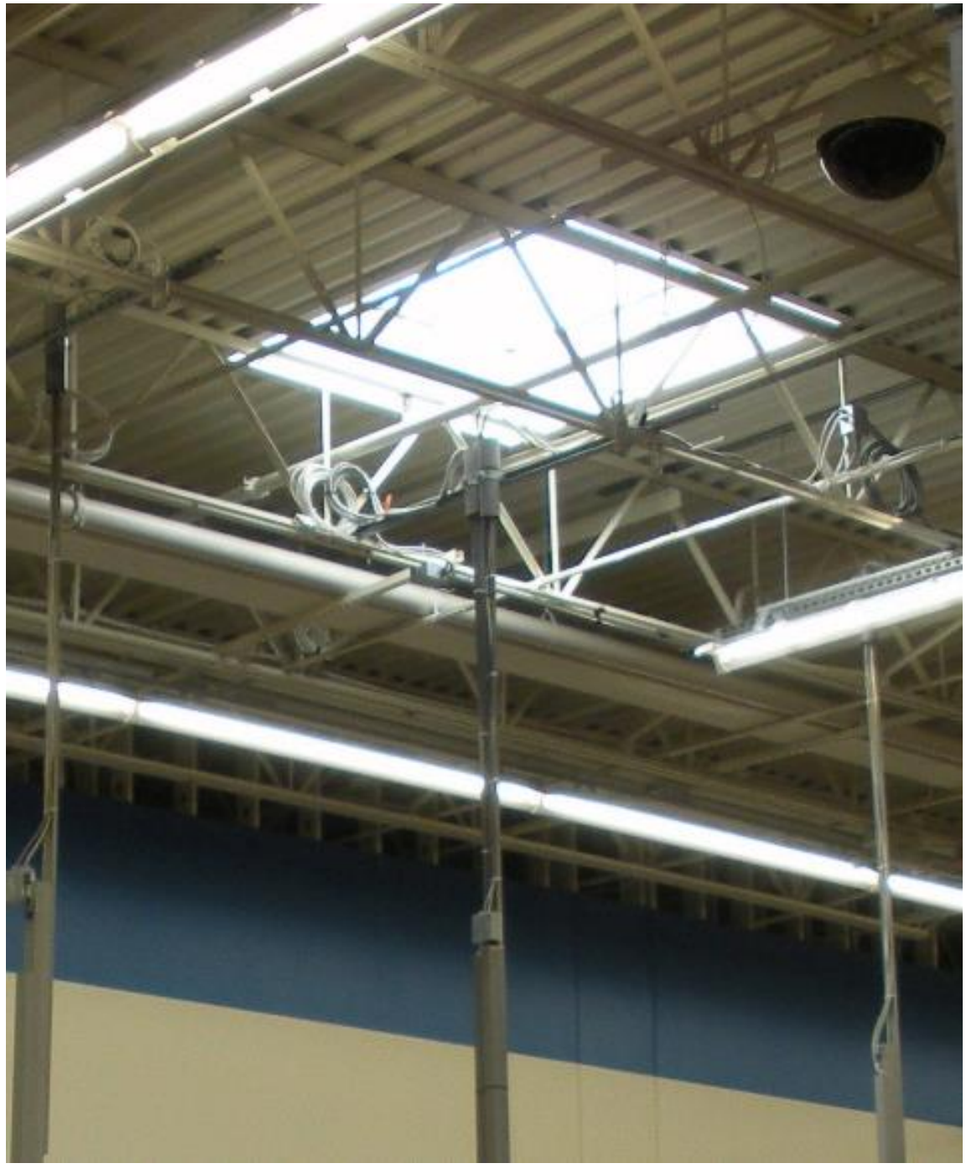
CASE STUDY: SALES FLOOR

WALMART SUPERCENTER PROTO FLUORESCENT VS LED ALTERNATIVES

Fixture	Lamp	Useful Life (hours)	Minimum Fixture Life[2]	Fixture Usable Lumens[3]	Initial Foot-candle Calculations			
					Horiz Avg	% Change[4]	Vert Avg	% Change[4]
16' Spacing - Skylights								
	T-8 32w (2-lamp profile for sales, 1-lamp profile for perimeter)	30,000	3 years	10752	54.6	N/A	27.4	N/A
	Integral LED	75,000	11.4 years	8400	52.0	-4.8%	26.13	-4.6%

CASE STUDY: SALES FLOOR

- LEDs initial cost was around 38% higher
- Calculated annual energy savings from LEDs and HVAC –This savings offset about one-quarter of the original cost
- Incorporated the Useful Life Difference and Minimum Fixture Life
- ROI determined to be 2.9 years.



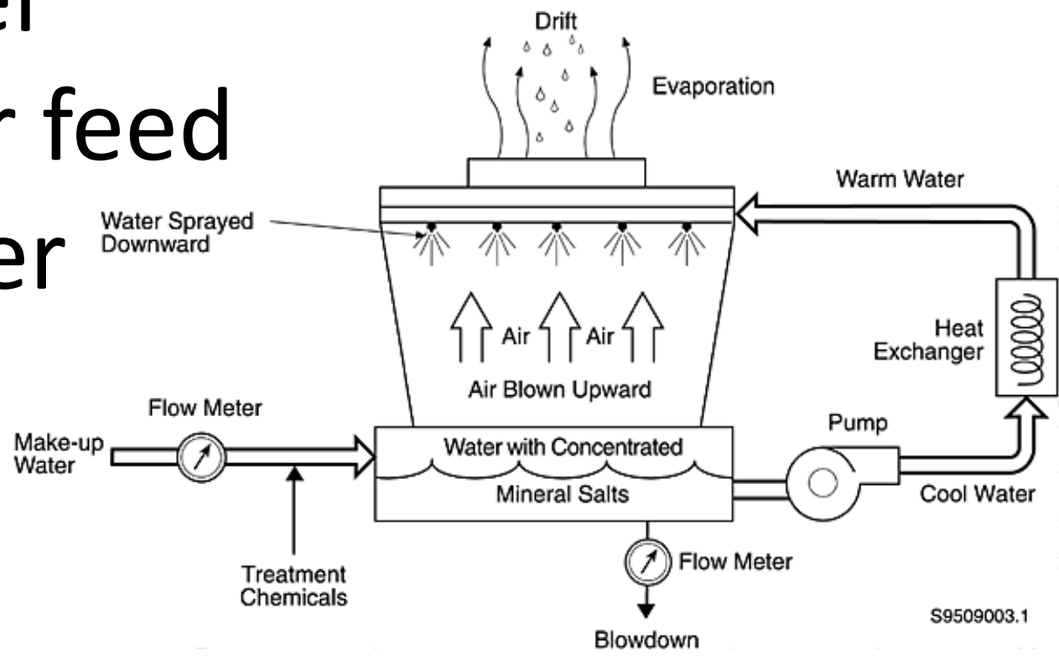
Trends with Water

COMMON RECOVERY SOURCES

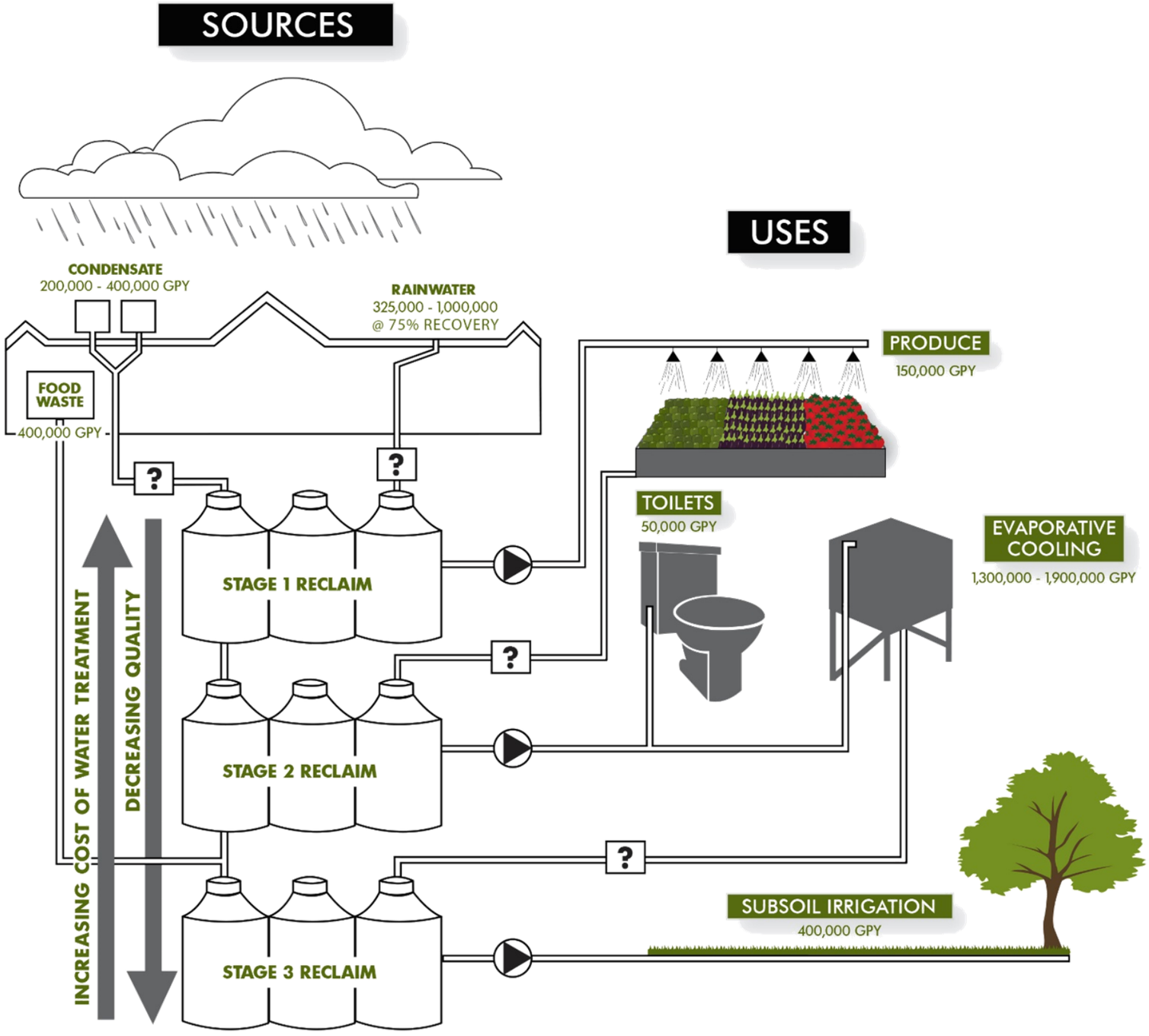
- Rain water
- Condensate
- Mister drains

COMMON USES

- Toilet flushing
- Irrigation
- Vehicle washing
- Cooling tower and/or boiler feed makeup water
- RO water



WATER RECOVERY OPPORTUNITIES



RAINWATER CONCERNS

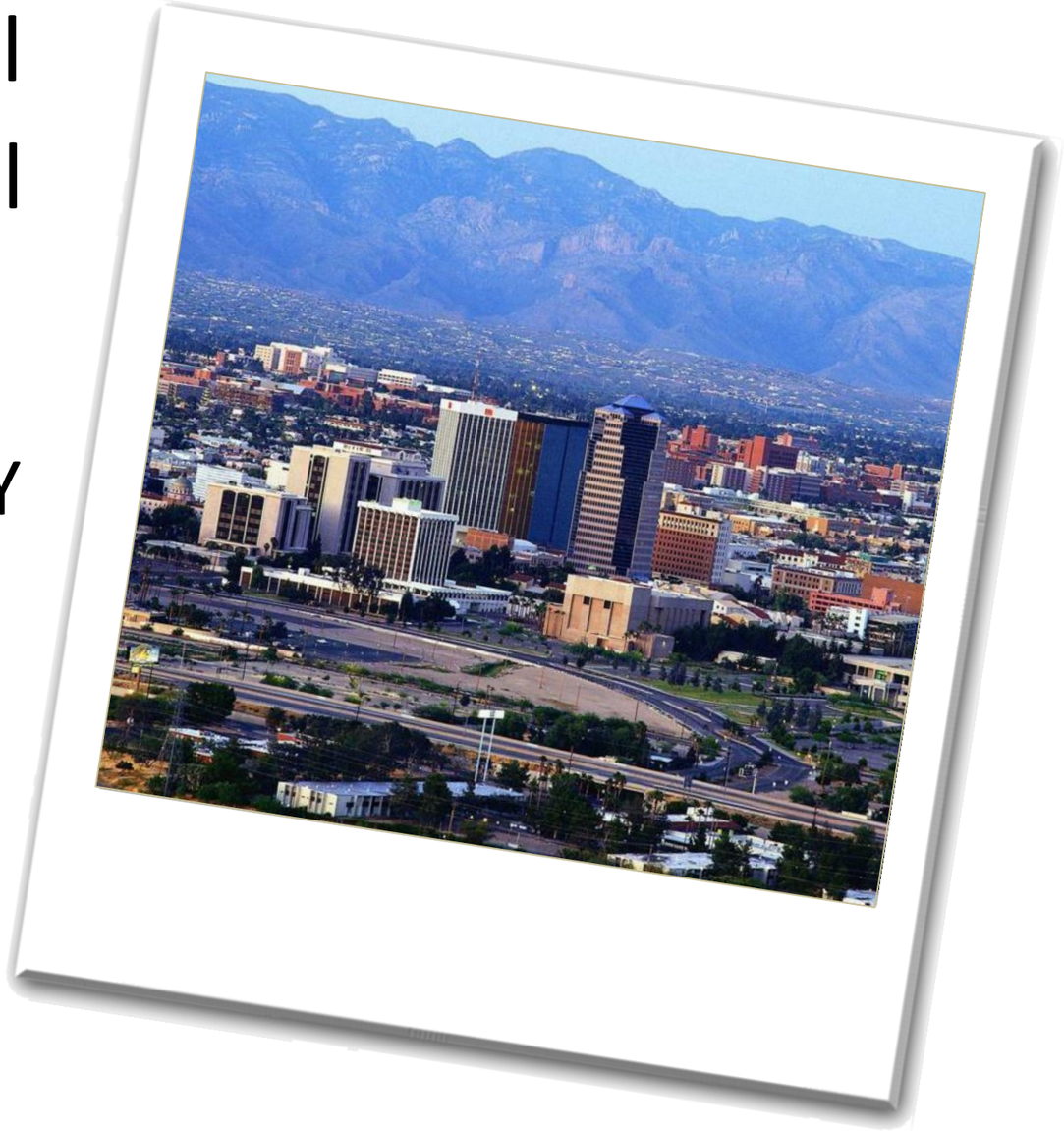
- Requires routine maintenance/ cleaning of roof
- Some of the water must be thrown away to pre-wash the roof
- Intermittent nature of rain events creates storage needs
    - Storage is relatively costly

CONDENSATE CONCERNS

- Condensate pans must be routinely cleaned
- Water is low in Total Dissolved Solids (TDS), but can be high in biological growth

CASE STUDY: TUCSON, AZ

- Cost of Water = $3.29 / 1,000 Gal
- Cost of Sewer = $5.10 / 1,000 Gal



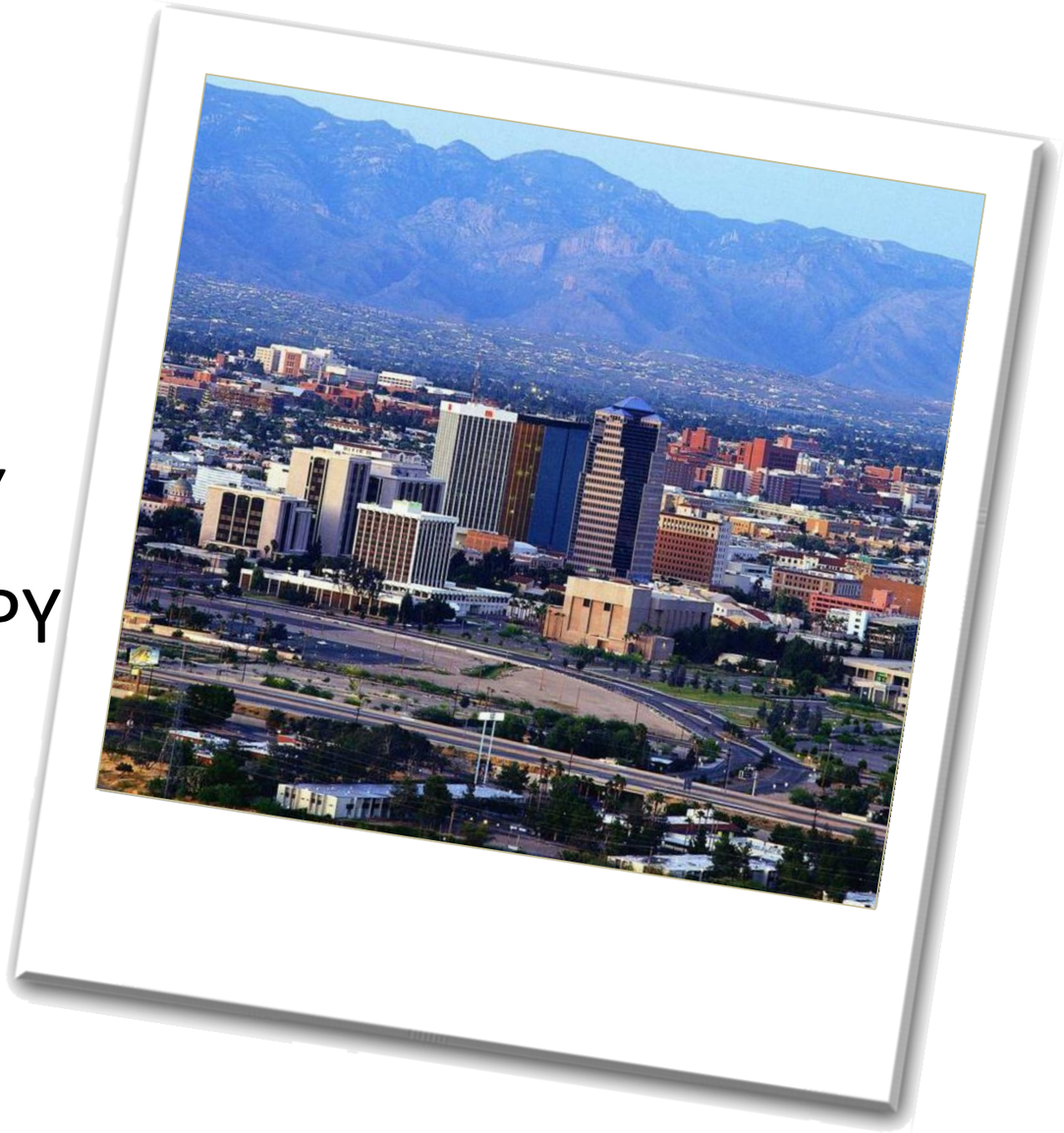
Uses

- Evaporative Cooling = 1,900,000 GPY
- Misters = 150,000 GPY
- Toilets & Urinals = 50,000 GPY
- Landscape = 400,000
- **TOTAL = 2.5 Million GPY**

CASE STUDY: TUCSON, AZ

Sources for water reclamation

- Rainwater recovery = 430,000 GPY
- Condensate recovery = 175,000 GPY
- Produce mister drains = 100,000 GPY
- TOTAL available reclaim = 705,000 GPY
- 705,000 / 2,500,000 = **28% Water Savings**



CASE STUDY: TUCSON, AZ

Sewer Diversion

- Produce Misters = 100,000 GPY
- Cooling Tower = 310,000 GPY
- TOTAL = 410,000 GPY

CASE STUDY: TUCSON, AZ

Combined savings

- 705,000 Gal @ $3.29/1,000 Gal = $2,319.45
- 410,000 Gal @ $5.10/1,000 Gal = $2,091.00

TOTAL Savings = $4,410 per year

“THE SECRET OF CHANGE IS TO FOCUS ALL OF YOUR ENERGY, NOT ON FIGHTING THE OLD, BUT ON BUILDING THE NEW.”

—Socrates

Thank You

Q & A