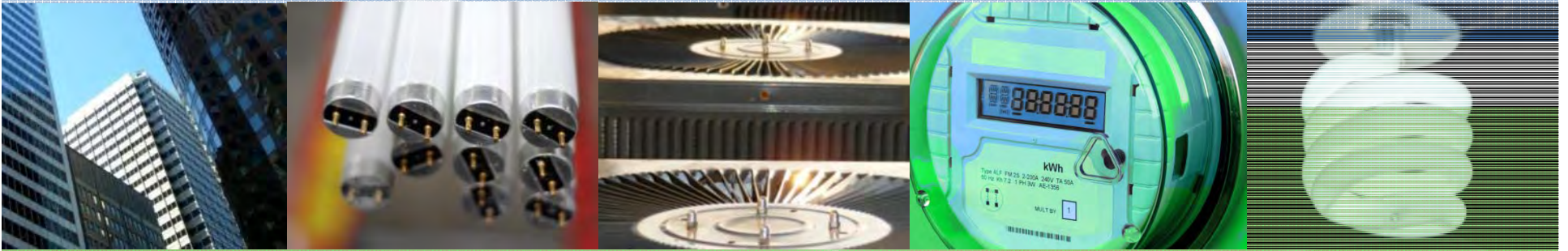


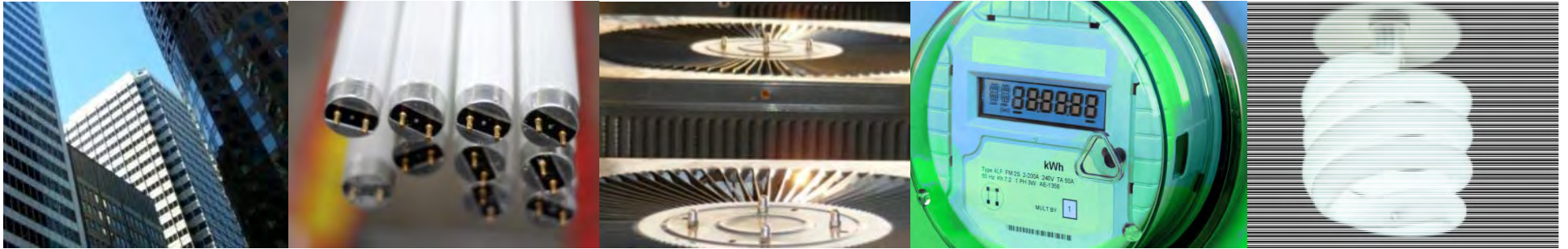
# APPLICATION OF EVAPORATIVE COOLING

March 19, 2014



 **Nexant**

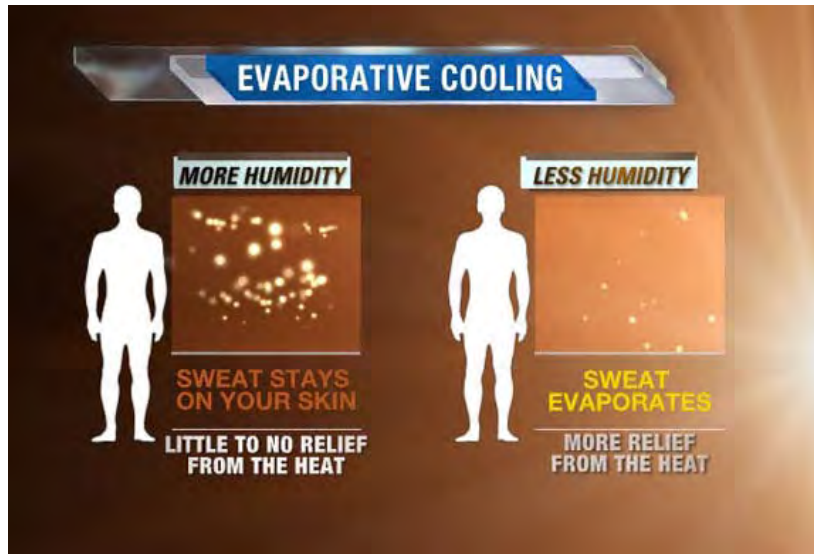




Back to Basics

# WHAT IS EVAPORATIVE COOLING?

# NATURE'S WAY OF COOLING



Heat of vaporization

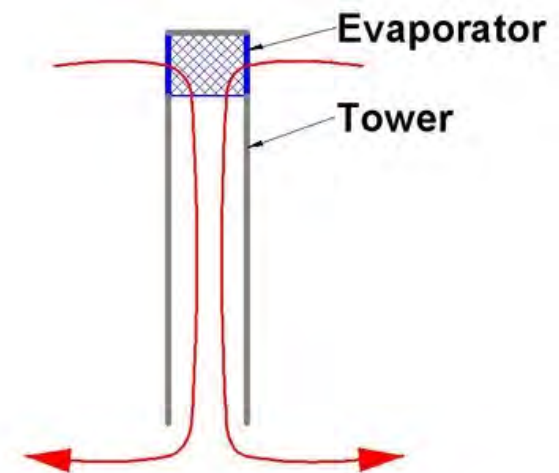


## EARLY ATTEMPTS TO AUTOMATE IT (I.E., MECHANICAL)

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1500 AD, Persian Wind Tower & Rain Cistern



# ECONOMICAL...

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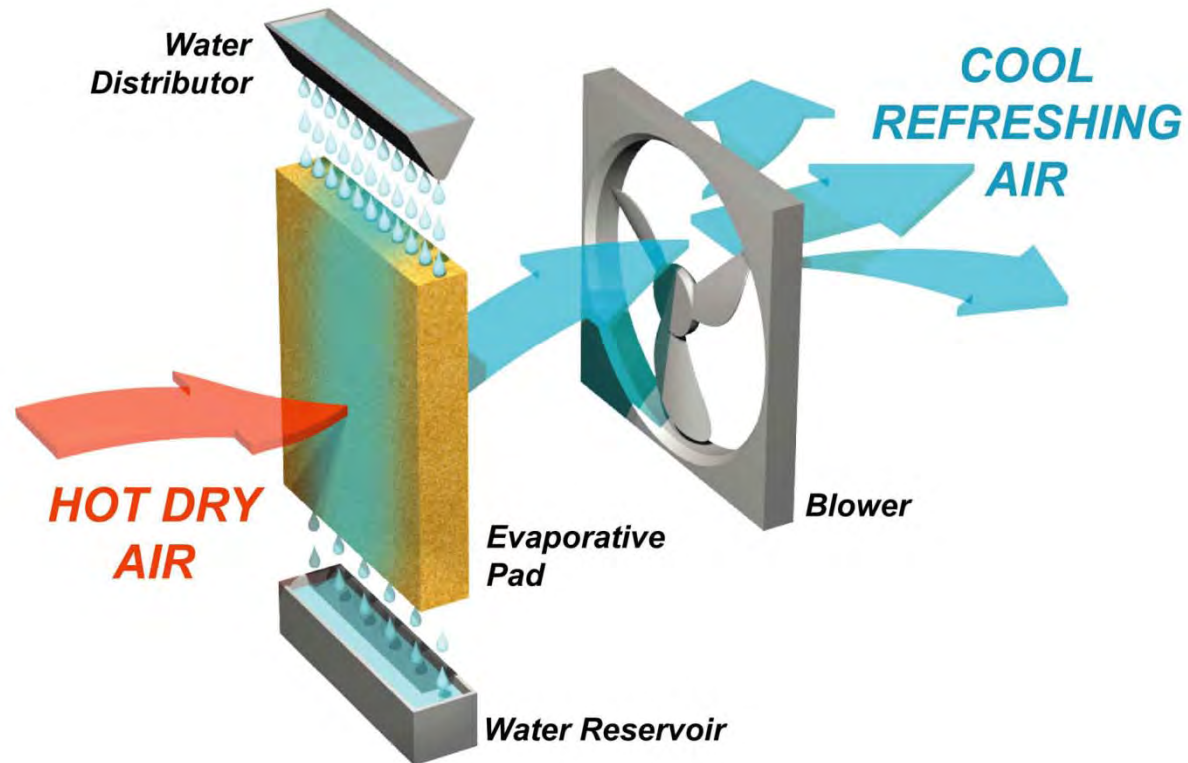




# DIRECT EVAPORATIVE COOLING SYSTEM

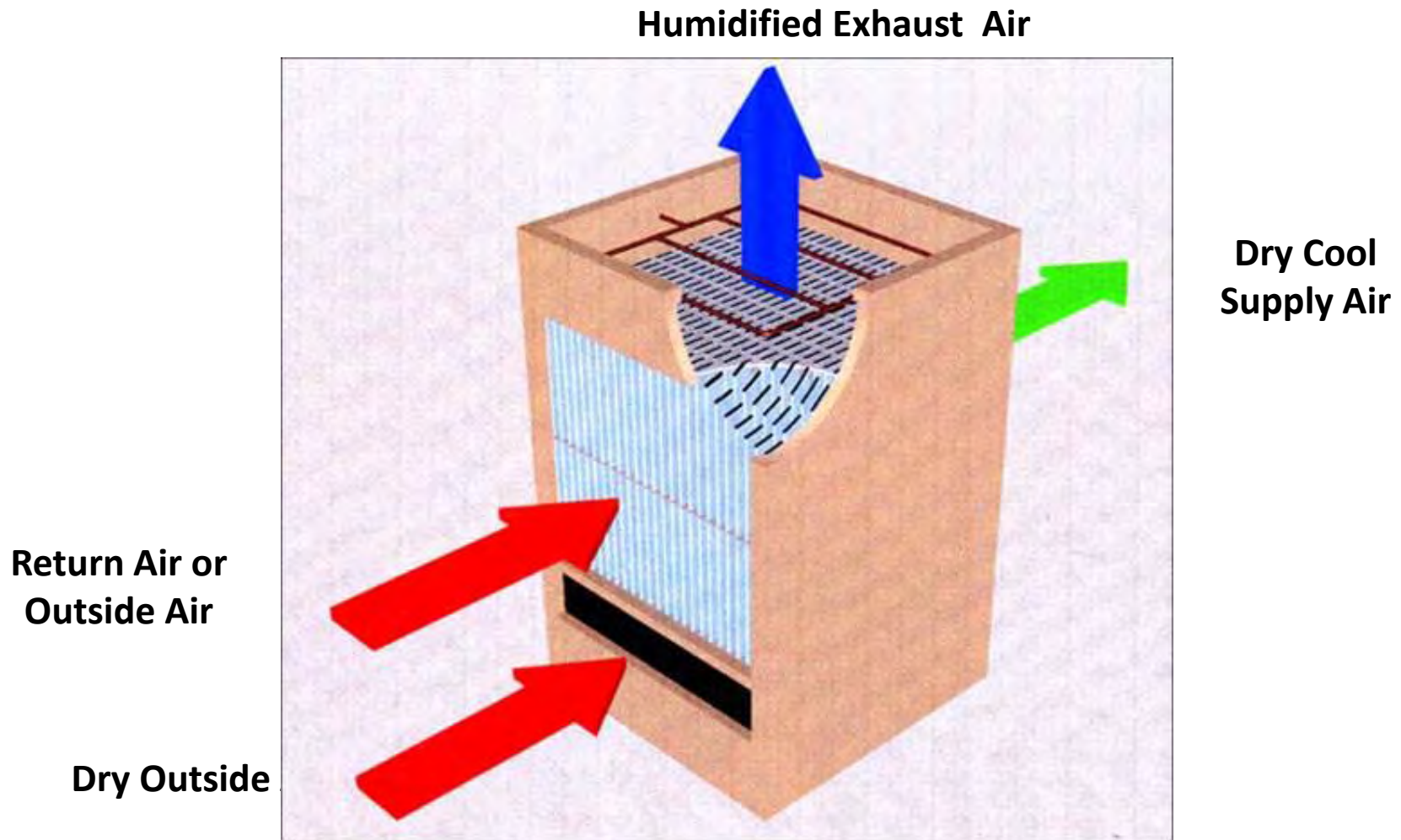
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## How **EVAPORATIVE COOLING** works



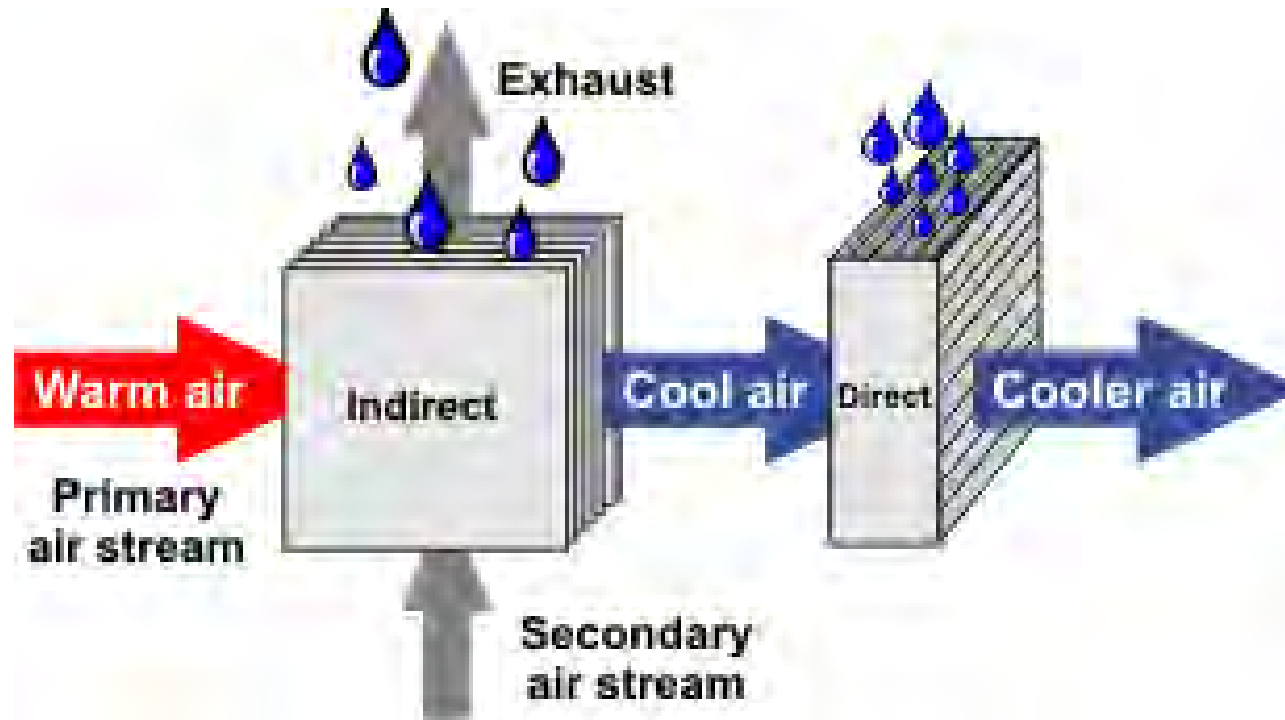
# INDIRECT EVAPORATIVE COOLING SYSTEM

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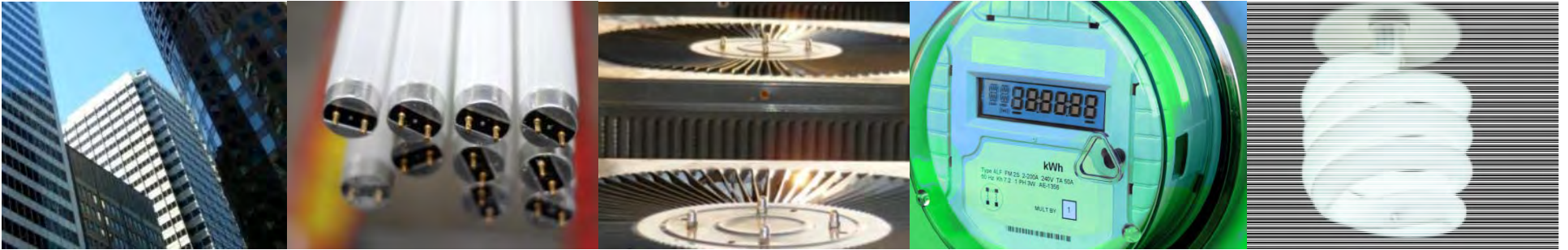


# COMBINATION INDIRECT DIRECT COOLING SYSTEM

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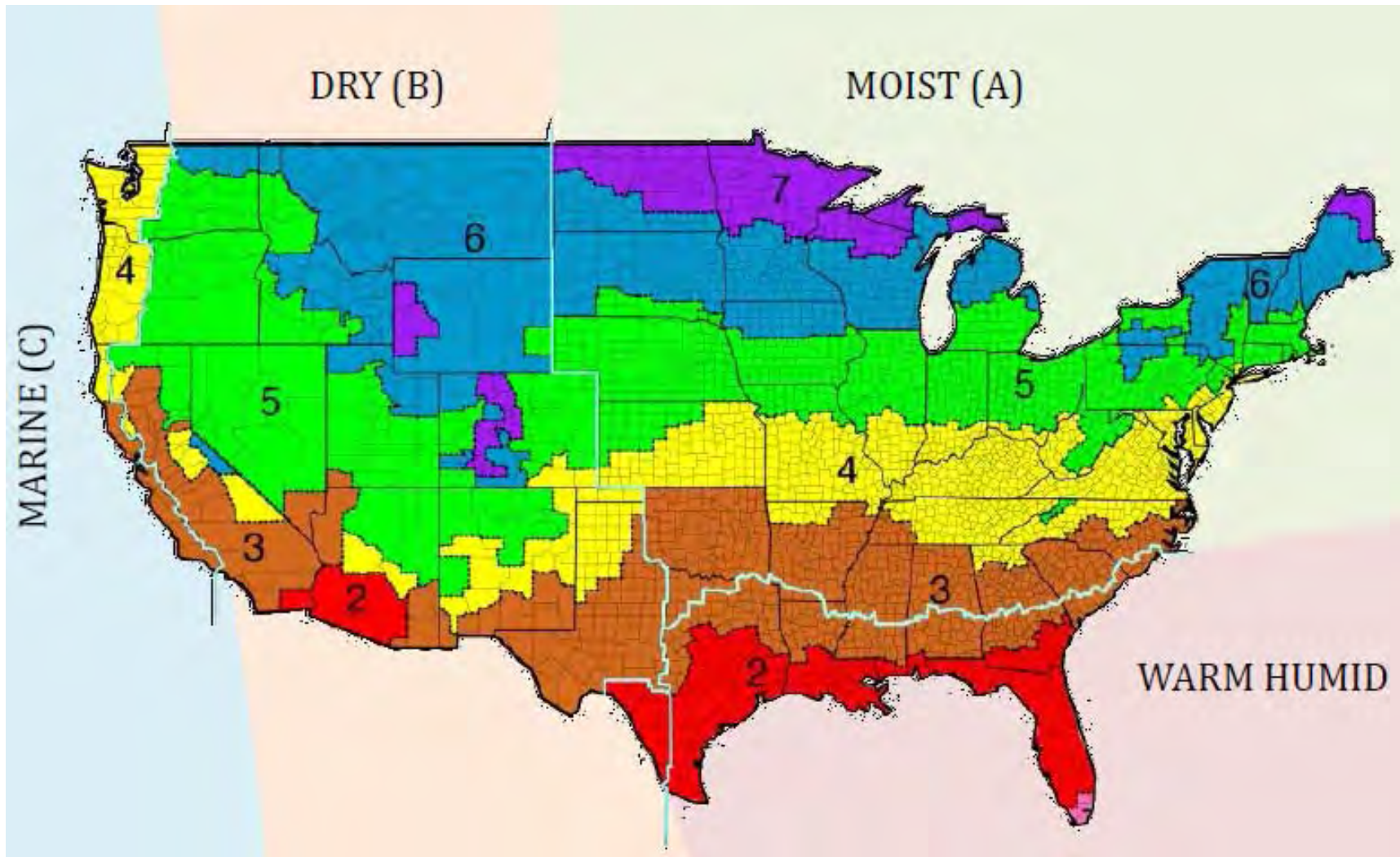






# APPLICATION

# WHERE DOES EVAPORATIVE COOLING WORK



## DIRECT EVAPORATIVE COOLING

---

- Most common form of evaporative cooling and considered “older technology”
- Mostly used in residential, commercial kitchens, and warehouses or where comfort requirements are more relaxed
- High airflow requires larger ductwork
- Relieve air/pressurization required
- Effectiveness (WB depression) 65-95%
  - Difference between design DB/WB
  - Typical temperature drop of 30F
  - May not meet cooling needs on design days (i.e., SAT = 55F)
  - Adds humidity to air





## INDIRECT EVAPORATIVE COOLING

---

- Most common application: waterside economizers and starting to show up in the residential market in the last decade
- Does not add humidity to the air
- Great for year round cooling loads when the outside air wetbulb temperature < 52F



## INDIRECT/DIRECT EVAPORATIVE COOLING

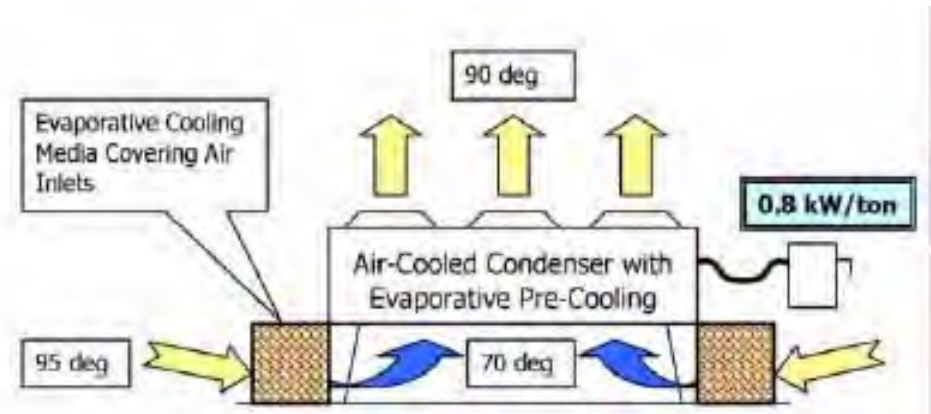
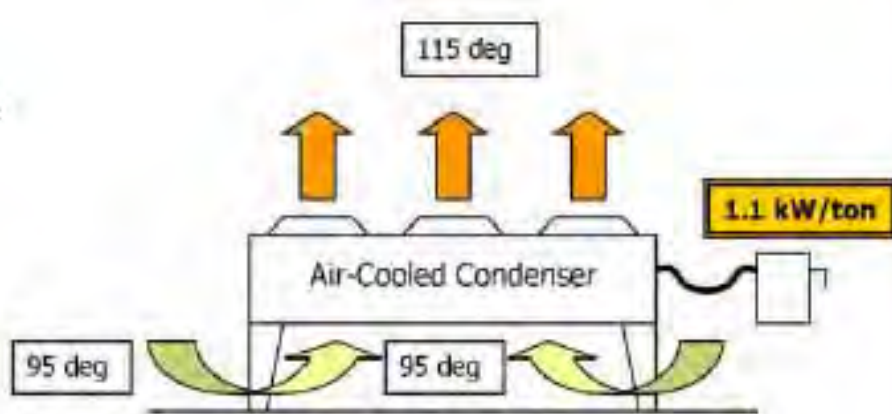
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- What happens when you combine both?
- Impact of coils combined to condition a space
  - Denver, CO
    - Dry Bulb 94°F
    - Wet Bulb 63°F
  - Indirect SAT = ~70F, WB = ~55F
  - Direct SAT = 55F, WB 55F (100% saturated)
  - Mixed with sensible heat loads, space temp = 74F (RH = 50%)



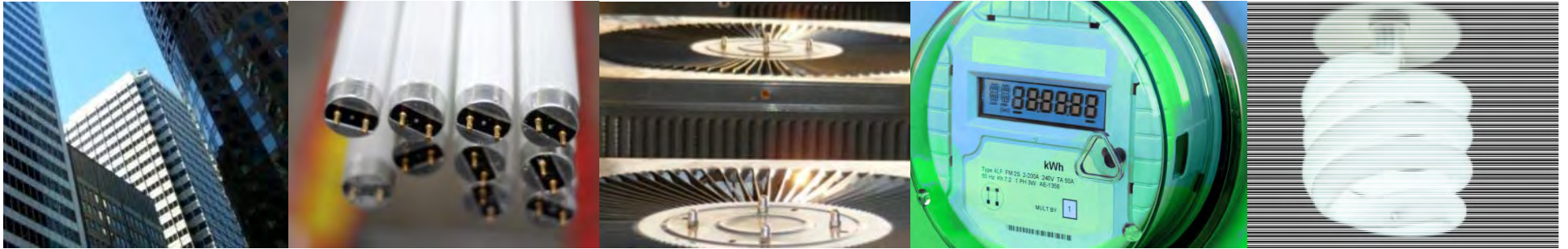
# EVAPORATIVE CONDENSING

- Combining direct evaporative cooling with air cooled condensers
- Before & after market retrofit on air cooled chillers and packaged equipment
- Great for reducing peak demand
- If there's capacity issues this can help



Photos courtesy of Cypress LTD





Customer Messaging

# **BENEFITS OF EVAPORATIVE COOLING**

## ECONOMICAL BENEFITS OF EVAPORATIVE COOLING

---

- Efficiency Works Rebates
  - Direct or Indirect or Hybrid \$0.20/CFM
  - DX: <5.4 tons, \$100/ton, >5.4 tons, \$150/ton
- Savings are \$37-\$42/ton/year
  - Midsized Utility Rate (\$0.087/kWh blended)
  - 750 cooling hours of use per year (Std. Business Hrs.)

Ton	DX-Rebate	Annual Energy Use (kWh)	Direct Evap Cooling Rebates	Annual Energy Use (kWh)
5	\$500	3,000	\$2,320 @ 11,600 CFM	857
10	\$1,500	6,522	\$4,640 @ 23,200 CFM	1,713
15	\$2,250	10,385	\$7,000 @ 35,000 CFM	4,284
30	\$4,500	22,314	\$14,000 @ 70,000 CFM	8,567

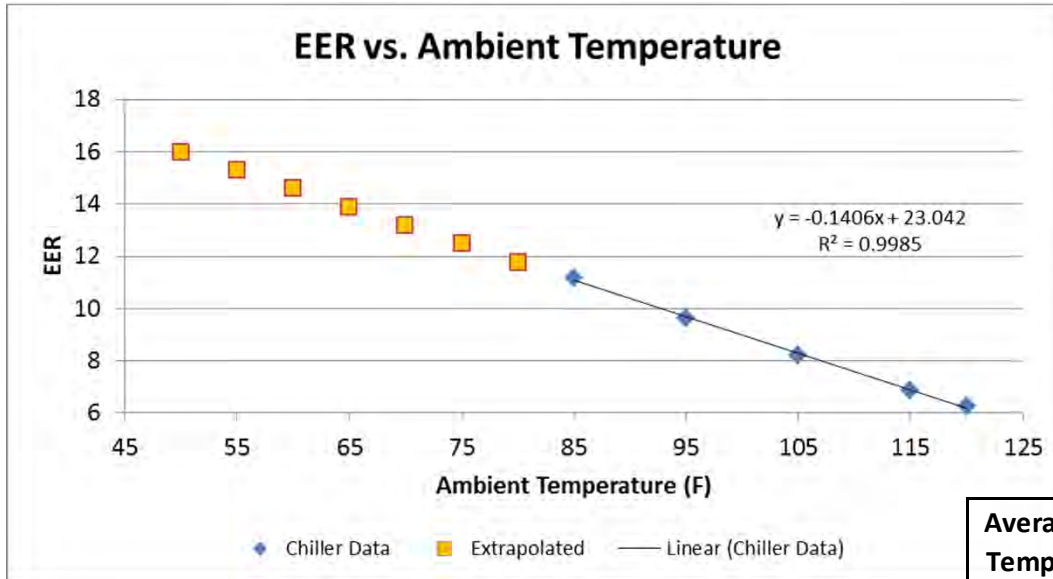
## NON ECONOMICAL BENEFITS OF EVAPORATIVE COOLING

---

- Humidifies Air
  - Humidity is good for the skin
    - Reduce the need for body lotions
  - Humidity is good for the respiratory system
    - Reduce or eliminate bloody noses
  - Humidity increases the life of electronics
    - Electric insulators last longer
- Allows for Open Windows
  - Better indoor air quality
  - Less respiratory CO<sub>2</sub> buildup



# ECONOMICAL BENEFITS OF EVAPORATIVE CONDENSING



Average Roof Temperature (F) (Dry Bulb +10)	EER Before Evap	EER With Evap	Hours Per Year (Fort Collins)	kWh/Ton Savings	kW/Ton Demand Savings
107.5	7.9	11.6	3	2	0.529
102.5	8.6	11.9	17	7	0.428
97.5	9.3	12.3	57	17	0.343
92.5	10.0	12.6	136	40	0.355
87.5	10.7	13.0	274	61	0.294
82.5	13.1	14.7	343	44	0.183
77.5	13.9	14.8	353	29	0.131
72.5	14.5	15.0	561	32	0.098
67.5	14.9	15.0	757	30	0.077
62.5	15.0	14.9	796	24	0.066

## ECONOMICAL BENEFITS OF EVAPORATIVE CONDENSING

---

- Installed Costs \$190-250/ton
  - Values courtesy of Xcel Energy
- Typical Energy Savings
  - 286 kWh/ton/yr
  - \$25/ton/yr savings based on mid-sized blended rate of \$0.087/kWh
- Efficiency Works Rebate
  - Evaporative Condensing \$100/ton

# LET'S TAKE A QUIZ

---





## Q1 - TRUE OR FALSE, WEATHER CONCERNS

---

Question: Evaporative cooling systems are limited by weather in producing effective cooling.

Answer: **True**

Reason: As water content increases in the air, the less effect evaporation has in cooling. In Colorado, this accounts for approximately 50 hrs of a 900 hr cooling year.

Solution: Higher air flow

More Effective Media

Combination Indirect and Direct system

FYI: *Usually when it rains, the cooling load drops on the building (i.e., this could be False)*

## Q2 - TRUE OR FALSE, BLACK MOLD

---

Question: Evaporative cooling systems are more likely to develop black mold than AC systems.

Answer: **False**

Reason: Black mold is developed as a result of a plumbing problem.

If the condensate drain of an AC system is plugged or leaking, black mold will form in the cabinets just like an evaporative cooler with a ruptured supply line.

Solution: Similar to AC systems, contractors and installers should offer service contracts to customers to help ensure the equipment is operating appropriately.

### Q3 - TRUE OR FALSE, MOUNTING PRACTICES

---

Question: Evaporative cooling units can only be installed on the roof, exterior wall or window.

Answer: **False**

Reason: There are new manufacturer models that allow for installation to be outside on the ground, inside a mechanical room or inside an attic space.

Solution: Coolerado® and OASys® make units that install with connection to furnace ducting and RTUs.

Interior units installed with drain pans and ducted outside air supply.



## Q4 - TRUE OR FALSE, NOISE CONCERNS

---

Question: Evaporative Cooling units are noisier than an AC/furnace combination or RTU.

Answer: **False**

Reason: They are about the same. Noise is a ducting problem, not a unit problem.

Solution: Proper duct design: sizing, diffuser selection, and use of elbows to dampen noise.

## Q5 - TRUE OR FALSE, AIR QUALITY & ALLERGENS

---

Question: Evaporative Cooling systems maintain better air quality and eliminate more allergens than an equivalent AC system.

Answer: **True**

Reason: Evaporative Cooling Equipment particle filtration: **1.0 – 3.0  $\mu\text{m}$**

Typical filtration: **3.0 – 10.0  $\mu\text{m}$**

Pollen = 10 – 100  $\mu\text{m}$

Mold Spores = 10 – 30  $\mu\text{m}$

Tobacco Smoke = 0.01 – 3  $\mu\text{m}$

Auto Emissions = 1 – 200  $\mu\text{m}$

## Q6 - TRUE OR FALSE, MAINTENANCE

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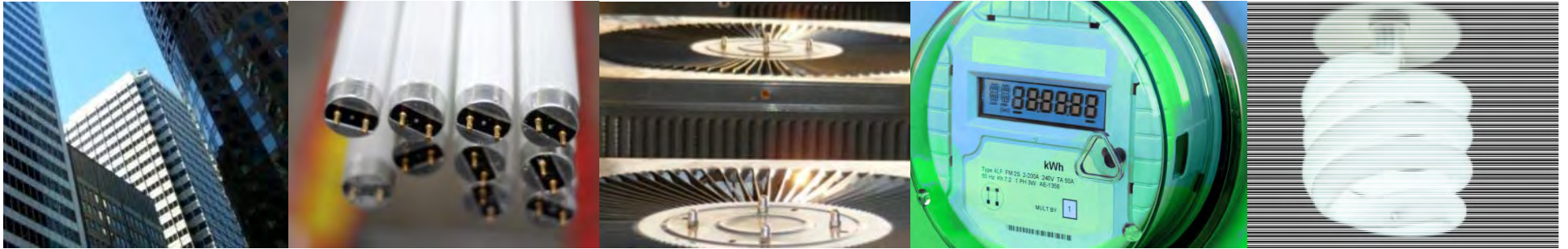
Question: Evaporative Cooling systems require more maintenance than an AC system.

Answer: **True**

Reason: Owners will need to drain water and add insulation for the winter months. Cleaning debris from the inlets of the unit will also be required annually.

Solution: Contractors & installers may offer service contracts to perform maintenance every 6 months. Good opportunity to identify repair work.





Customer Messaging

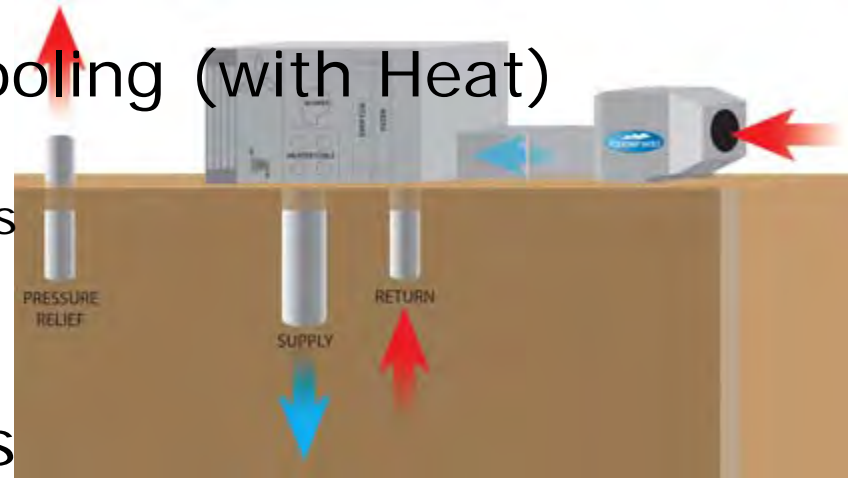
# AVAILABLE PRODUCTS

## AVAILABLE PRODUCTS

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- Package Evaporative Cooling (with Heat)

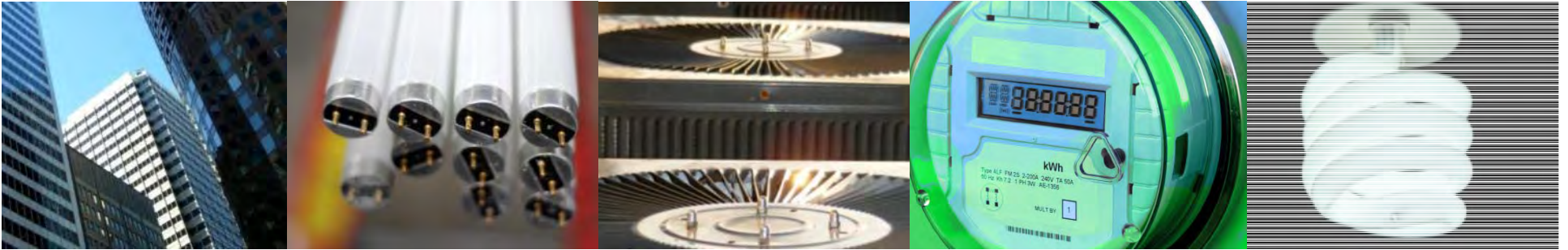
- Off the Shelf
  - Sterling RTUs 10-40 tons
- After Market Retrofit
  - Coolerado



- Evaporative Condensers

- Off the Shelf
  - Aeon Patented Evaporative Cooled Condenser; >35 tons
  - Trane IntelliPak™ Rooftops with Evaporative-Cooled Condensers; 24-116 tons
  - McQuay Evaporative Condenser Rooftop System 75 to 150 tons
- After Market Retrofit
  - Cypress LTD (see photo)





What you need to know

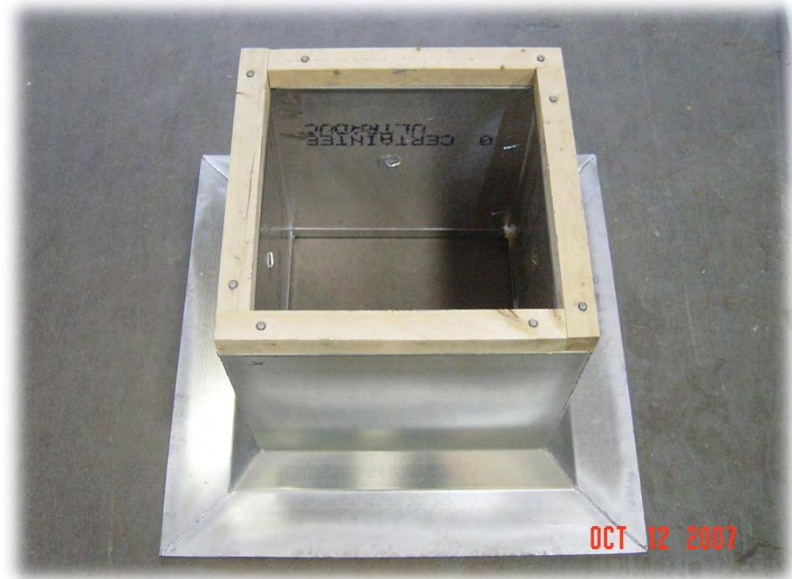
# **BEST PRACTICES**



## THINGS TO CONSIDER – ROOF INSTALLATIONS

---

- Roof curbs
- Use a roofing contractor
  - Roof warranties are worth \$1,000's - \$10,000's
- Dedicated drains
- Water line from mechanical room not the hose bibb
- Reinforced water supply pipe (pipe in a pipe)
- Electrical in a conduit
- Follow manufacturers instructions



## THINGS TO CONSIDER – ROOF INSTALLATIONS

---

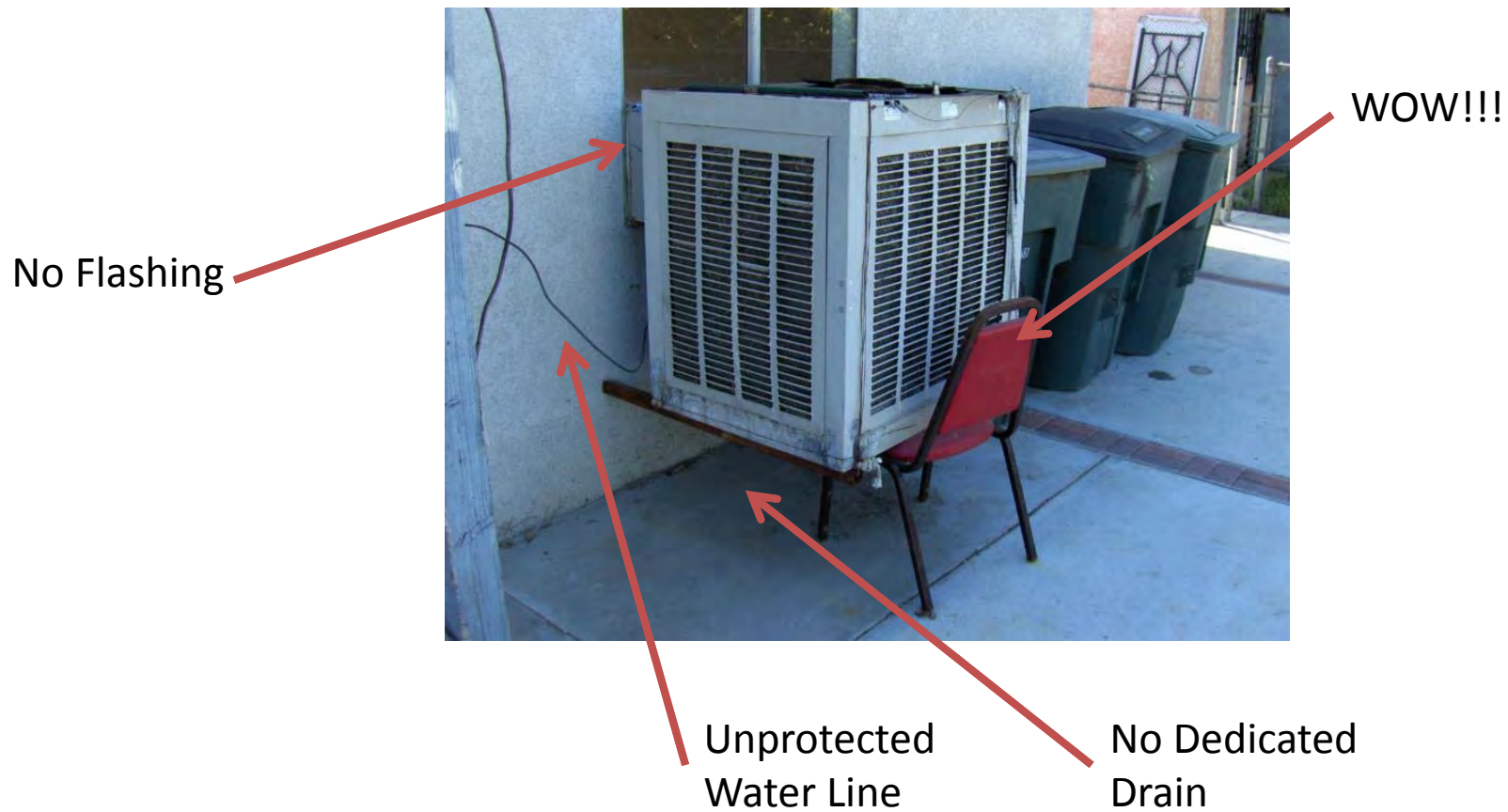
- Attach to structural header
  - Top of wall or window header
- Triangular supports
- Dedicated drains
  - Landscaping features
  - Field drains
- Use a siding contractor
  - Properly seal penetrations
- Water line from mechanical room
- Reinforced water supply pipe
  - Pipe-in-a-Pipe
  - Mount rigidly to wall
- Electrical in a conduit
  - Mount rigidly to wall
- Follow manufacturers instructions



# BEST PRACTICES – ON GRADE INSTALLATIONS

---

What is wrong with this picture?



## THINGS TO CONSIDER – ON GRADE INSTALLATIONS

---

- Pad Mounted Support
- Dedicated drains
  - Landscaping features
  - Field drains
- Use a siding contractor
  - Properly seal penetrations
- Reinforced water supply pipe
  - Mount rigidly to wall
- Electrical in a conduit
  - Mount rigidly to wall
- Follow manufacturers instructions





## THINGS TO CONSIDER – INTERIOR INSTALLATIONS

---

- Proper support
  - Floor
  - Wall
  - Ceiling
- Single Inlet / Single Outlet Units
- Dedicated drains
- Drain Pans 2 ½" deep minimum
- Reinforced water supply pipe
  - Mount rigidly to wall
- Electrical in a conduit
  - Mount rigidly to wall
- Follow manufacturers instructions
- Ducting needs to be sized for evaporative cooling



## THINGS TO CONSIDER – EVAPORATIVE CONDENSING

---

- Efficiency Works requirements
  - Pre-cools the air entering the condenser of a rooftop unit or air-cooled chiller with mist or an evaporative media
  - Products must provide a warranty for the condensing coils of at least 3 years
- Other things to strongly consider
  - Water is available on the roof or near equipment
  - Mechanical or chemical water treatment
  - Size of equipment
  - Ease of equipment access by contractor
  - Controls that limit water use based on outside air wetbulb and compressor use
  - If sump is used, it has periodic purge controls

## MESSAGE TO THE CUSTOMER – PROS AND CONS

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Pros – Reduce peak cooling demand for both

- Evaporative Cooling
  - Less energy by 1/4 – 1/3 over an AC system
  - Installation costs can be less than or equal to AC systems
  - Better Air Quality
  - Humidity control available with indirect equipment
  - **It is simple technology**
- Evaporative Condensing
  - Improve equipment efficiencies by 20% on average
  - Improve capacity issues
  - Help protect coils from damage and debris buildup
  - Enhances life of equipment

Cons

- Weather can hinder performance
- Requires more maintenance and contractor should recommend a service contract

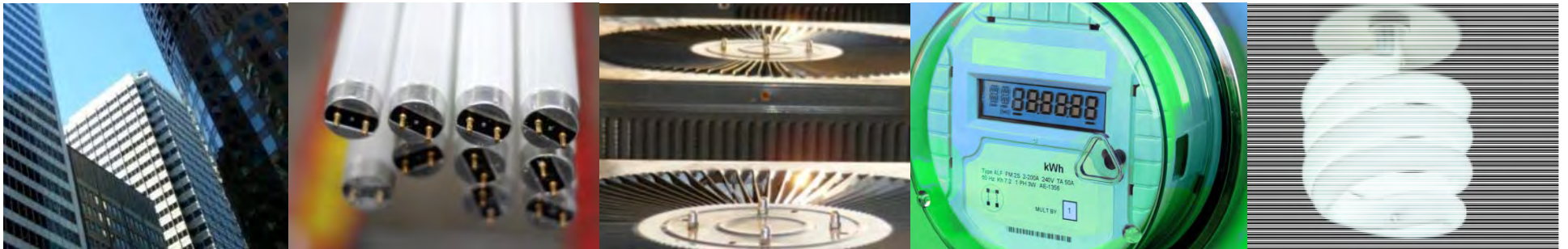
## SUMMARY – HOW CAN THE CONTRACTOR ADD VALUE?

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- Help with customer understanding
  - Benefits of Evaporative Cooling/Condensing
  - Precautions of Evaporative Cooling/Condensing
  - Explain latest technologies (ducting, controls, humidity control, water treatment, **life cycle** cost benefits)
- Properly size to meet weather conditions and customer needs
- Properly install to prevent installation related problems
- Recommend Service Contracts
  - Bi-annual start-up and winterization
  - Repair and service equipment and components



# THANK YOU



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