Advanced Heat Reclaim Systems

Harrison Horning, PE, CEM
Delhaize America - Hannaford

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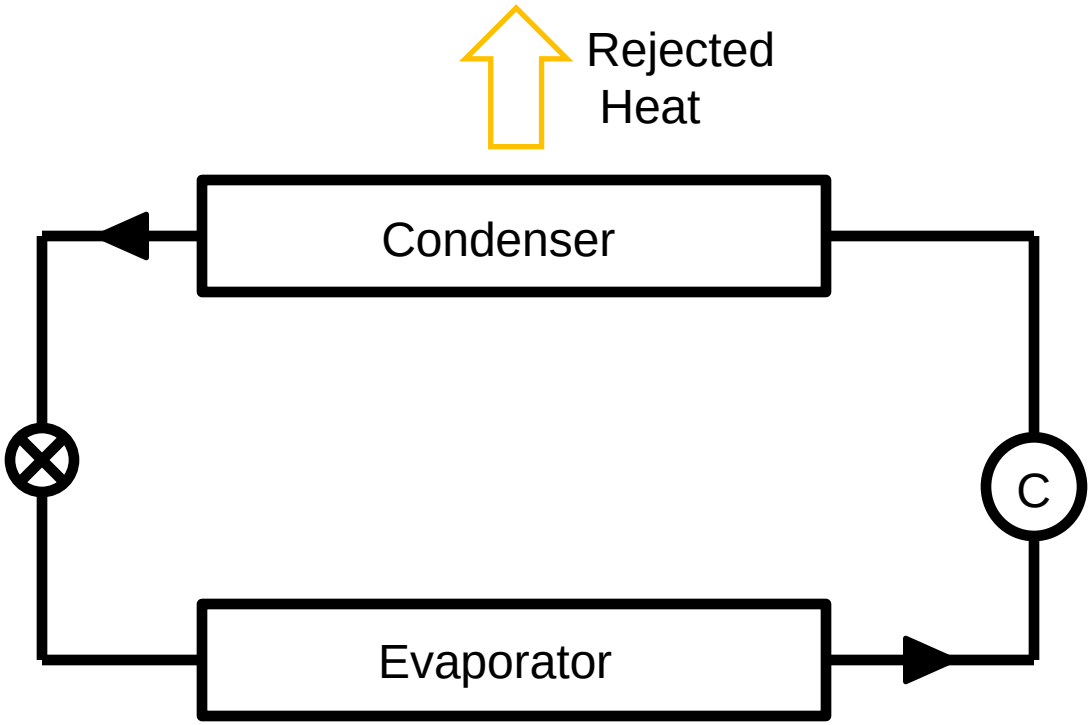
Outline

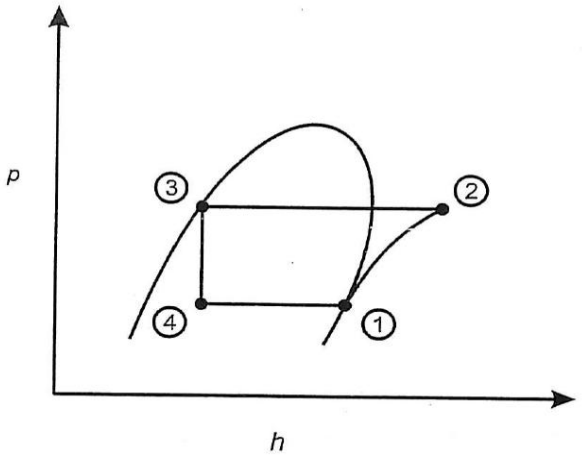
- Basic refrigeration cycle
- Conventional “series” heat reclaim
- Full-condensing “parallel” heat reclaim
  - Direct
  - Hydronic
- Water-cooled condensing heat reclaim
- Results

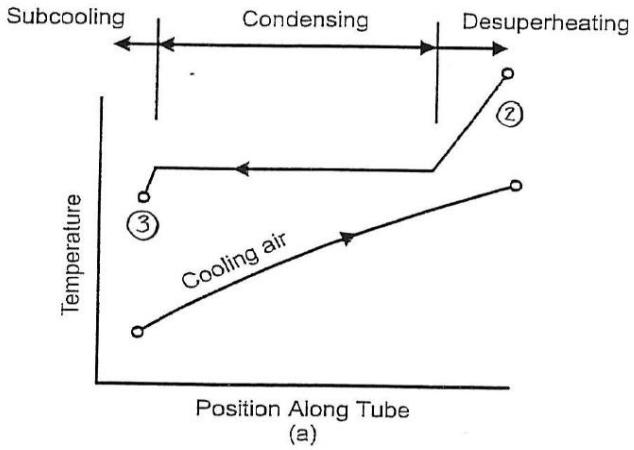
Basic Refrigeration Cycle

- No heat reclaim



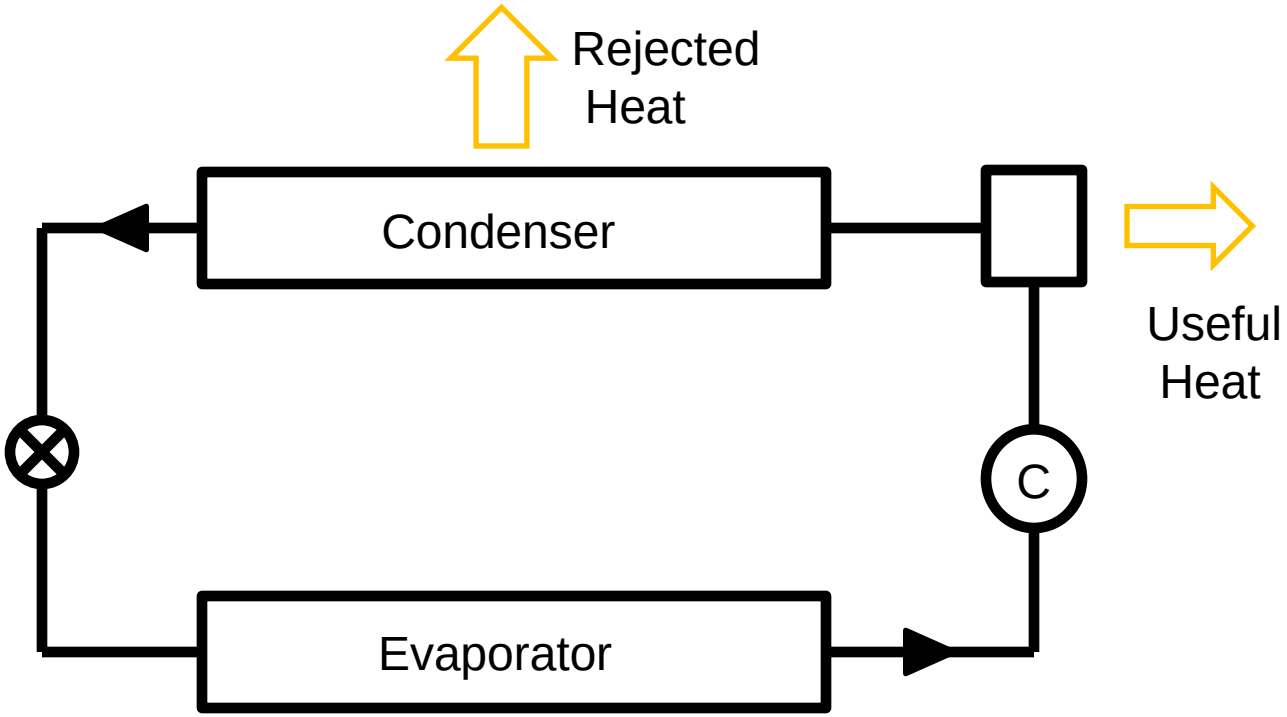
Superheat & Latent Heat of Vaporization





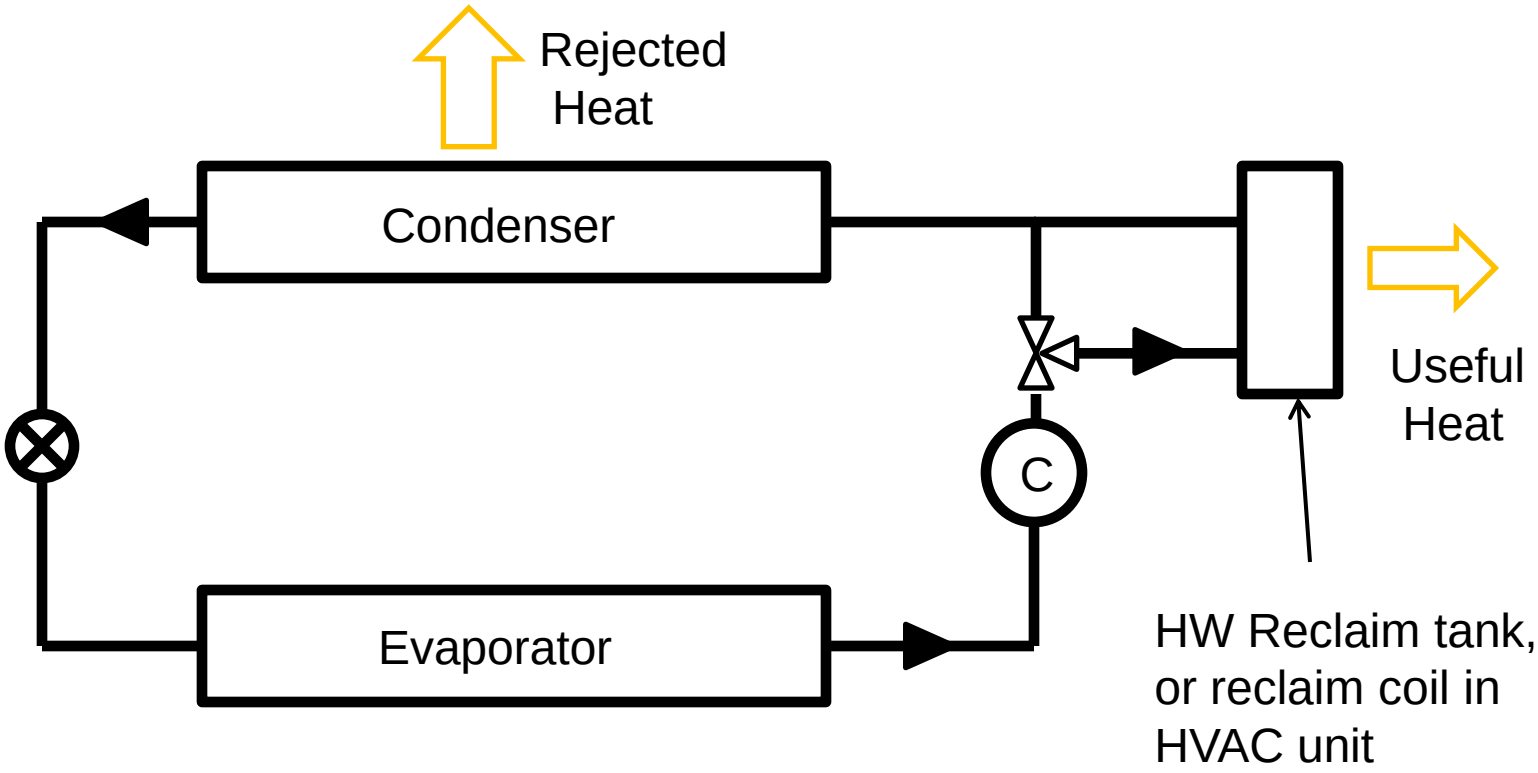
De-superheater

- Captures superheat
- How to control?



Conventional “Series” Heat Reclaim

- Captures superheat+ to water or air, when needed
- Controlled by 3-way valve; on/off logic



Conventional “Series” Heat Reclaim

Pros:

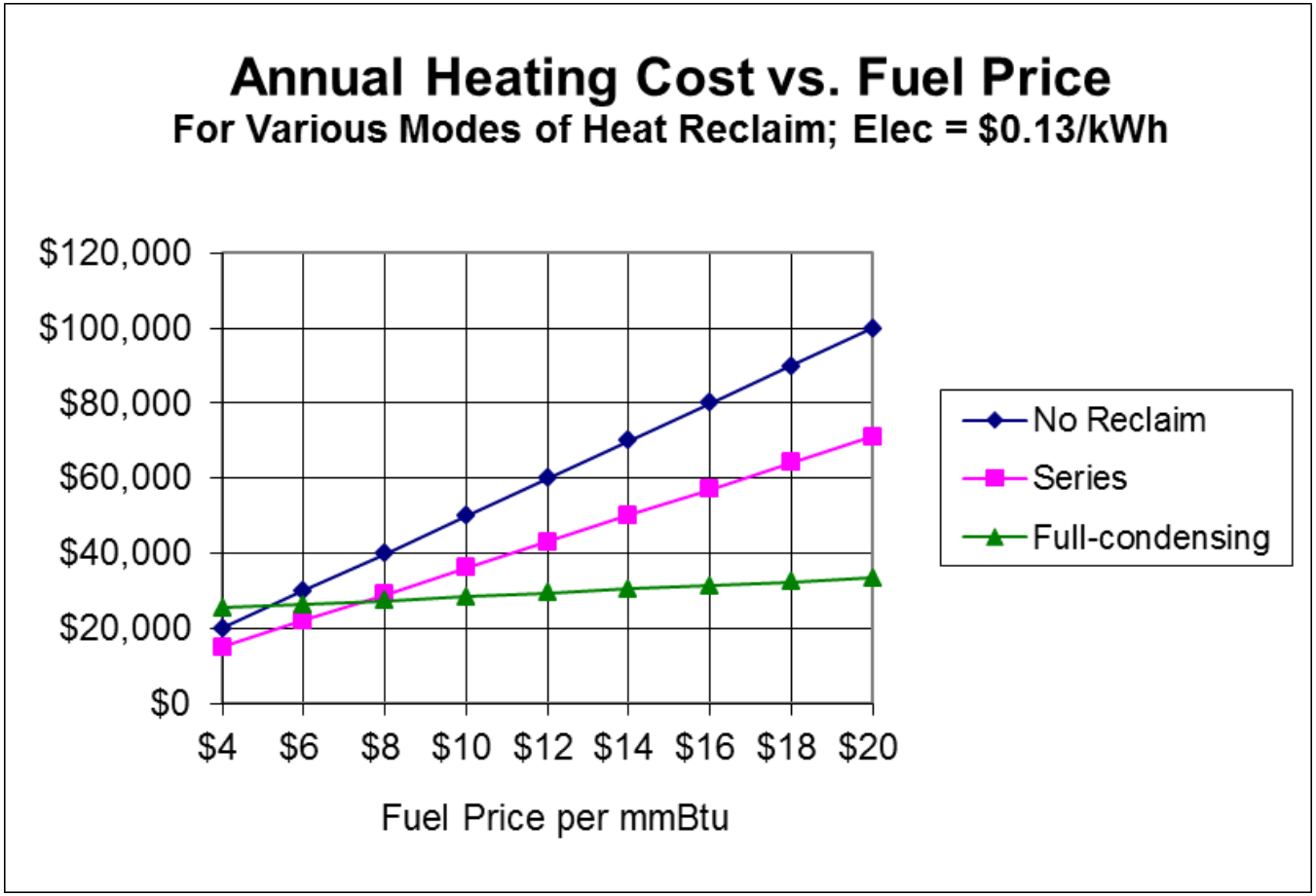
- Captures superheat+
- Controllable (on/off)
- Temperatures can be compatible with water and air heating systems
- “Free” heat
- Traditional

Cons:

- Doesn’t capture full latent heat of vap.
- Hard to know how much condensing occurs
- Can interfere with floating head strategy (so is it really “free”?)

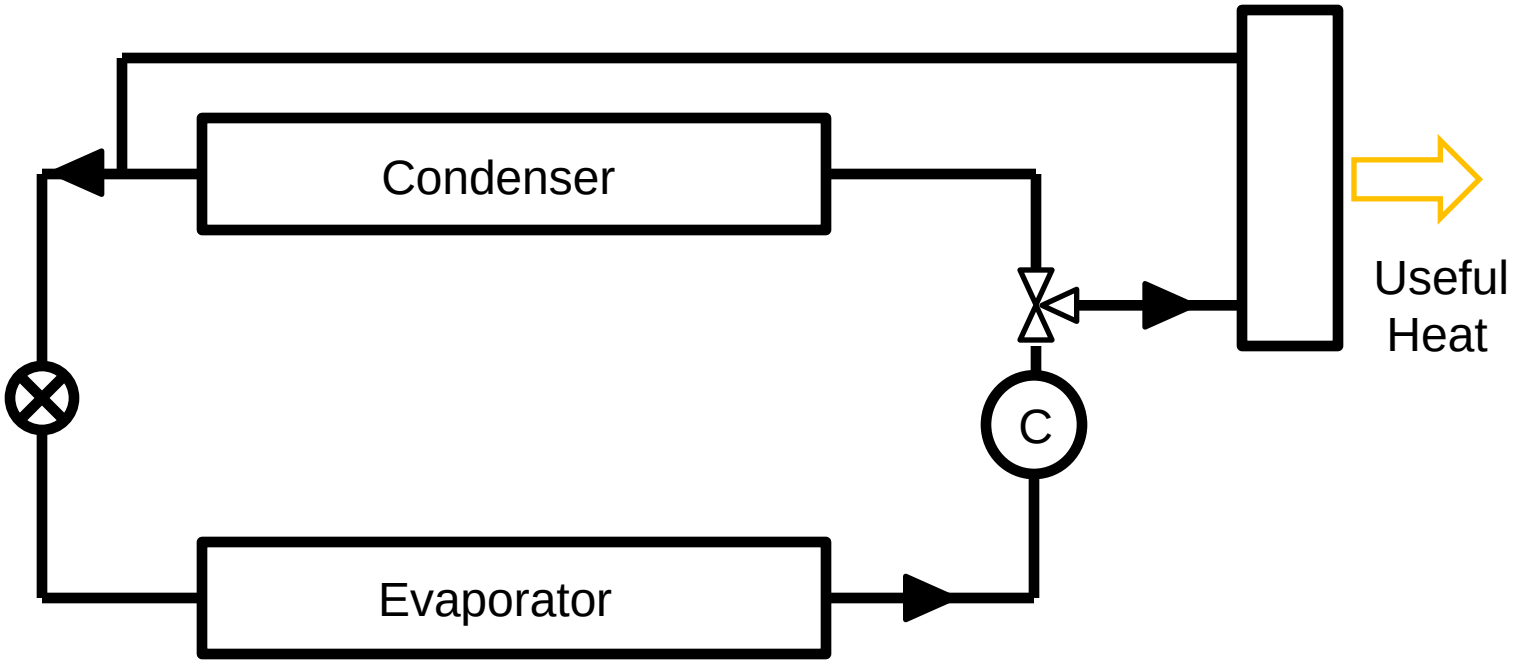
Economics

4,000 mmBtu Annual Space Heating Load; Maine Weather



Full-Condensing “Parallel” Heat Reclaim

- Captures full heat of rejection; direct or hydronic
- Controlled by 3-way valve; either/or logic



Full-Condensing "Parallel" Heat Reclaim

Pros:

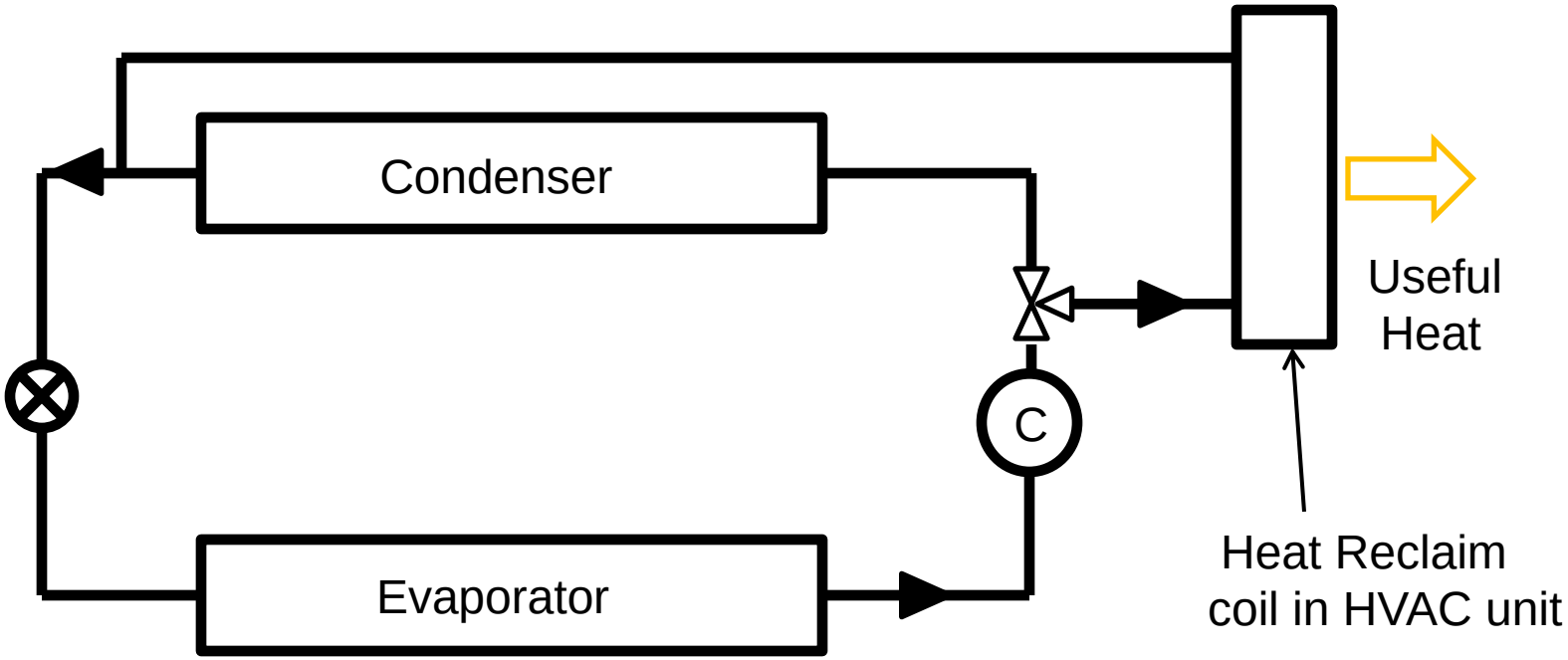
- Captures 100% of heat of rejection
- Controllable (but not like typical HVAC)
- Reclaimed heat can be more economical than purchased fuel
- Flexible; air or glycol

Cons:

- Lower temperatures
  - Too low for water htg
  - Requires more coil area and cfm for space heat
- HVAC coil sizing and zoning can be tricky
- Charge management can be challenging
- Higher up-front cost

Full-Condensing “Parallel” Heat Reclaim

DIRECT = Refrigerant piped to HVAC coil(s)



Heat Reclaim Coils for HVAC

TYPICAL REFRIGERANT HEAT RECLAIM SYSTEMS

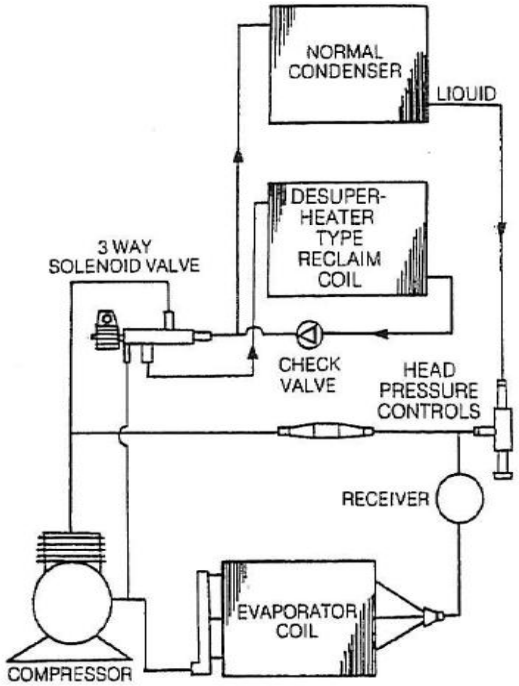


FIG.1 SERIES CONDENSER

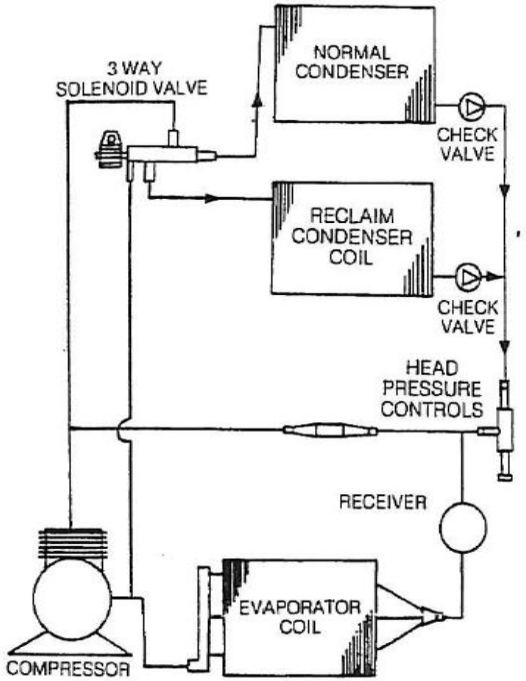
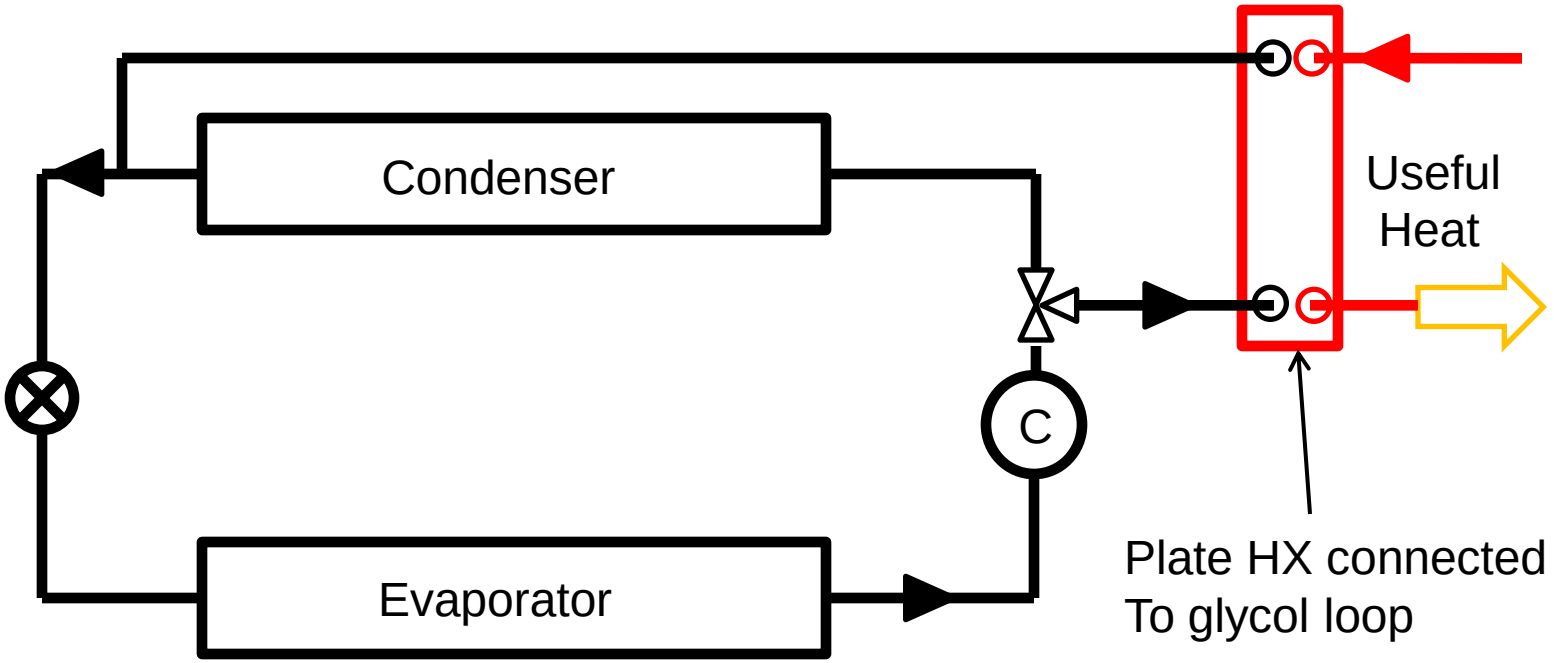


FIG. 2 PARALLEL CONDENSERS

Ref. KeepRite Tech Bulletin K70-KHR-PDS-11

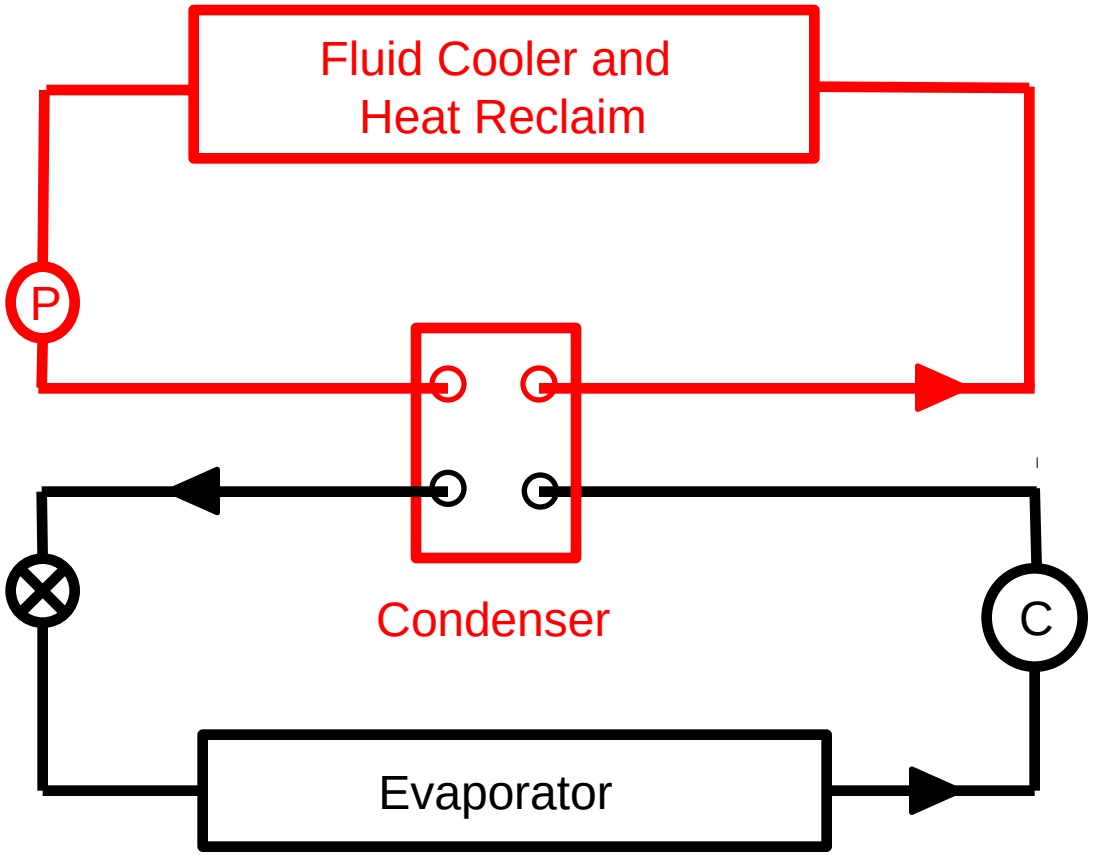
Full-Condensing “Parallel” Heat Reclaim

HYDRONIC = HX and glycol loop



Water-Cooled Condensing Heat Reclaim

- Captures full heat of rejection to water /glycol, full-time



Why pursue water-cooled condensing?

- Climate change concerns; need to reduce emissions
  - Reduced charge on high side; 600 vs. 1,000 lbs/rack
  - Stable operation allows for receiver level monitoring
- Easier to pipe reclaimed heat to remote HVAC units (e.g., front lobby/vestibule, back room); can displace more purchased fuel
- Economics work in cold climates; approx. 4 year payback on incremental investment in northern New England

Water Cooled Condensing Heat Reclaim; Similar to Full-Condensing plus…

Pros:

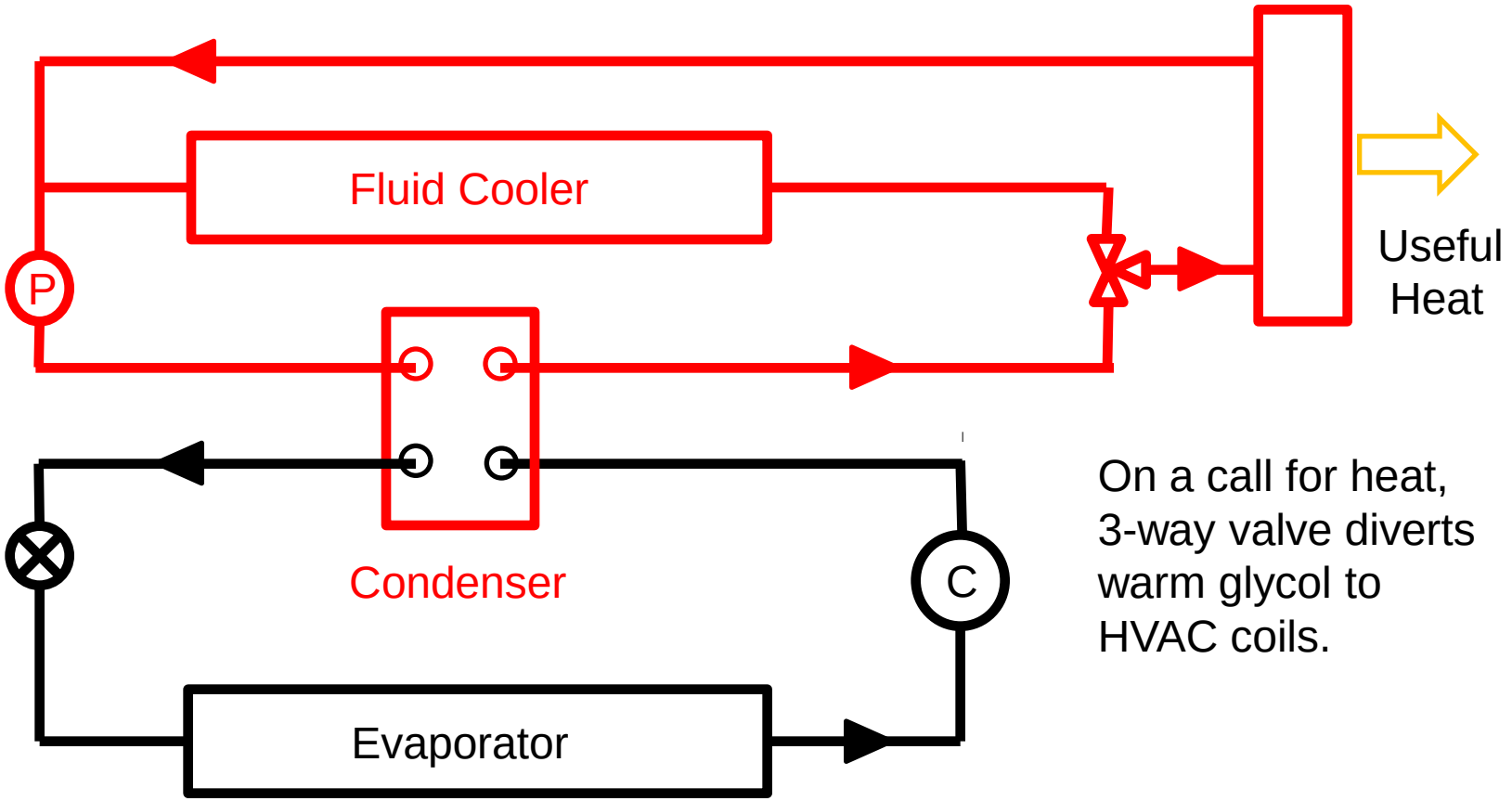
- Reduced charge/leaks and better charge mgt
- Can pipe to all HVAC coils to displace purchased fuel

Cons:

- Higher up-front cost to equip and pipe all racks and HVAC units

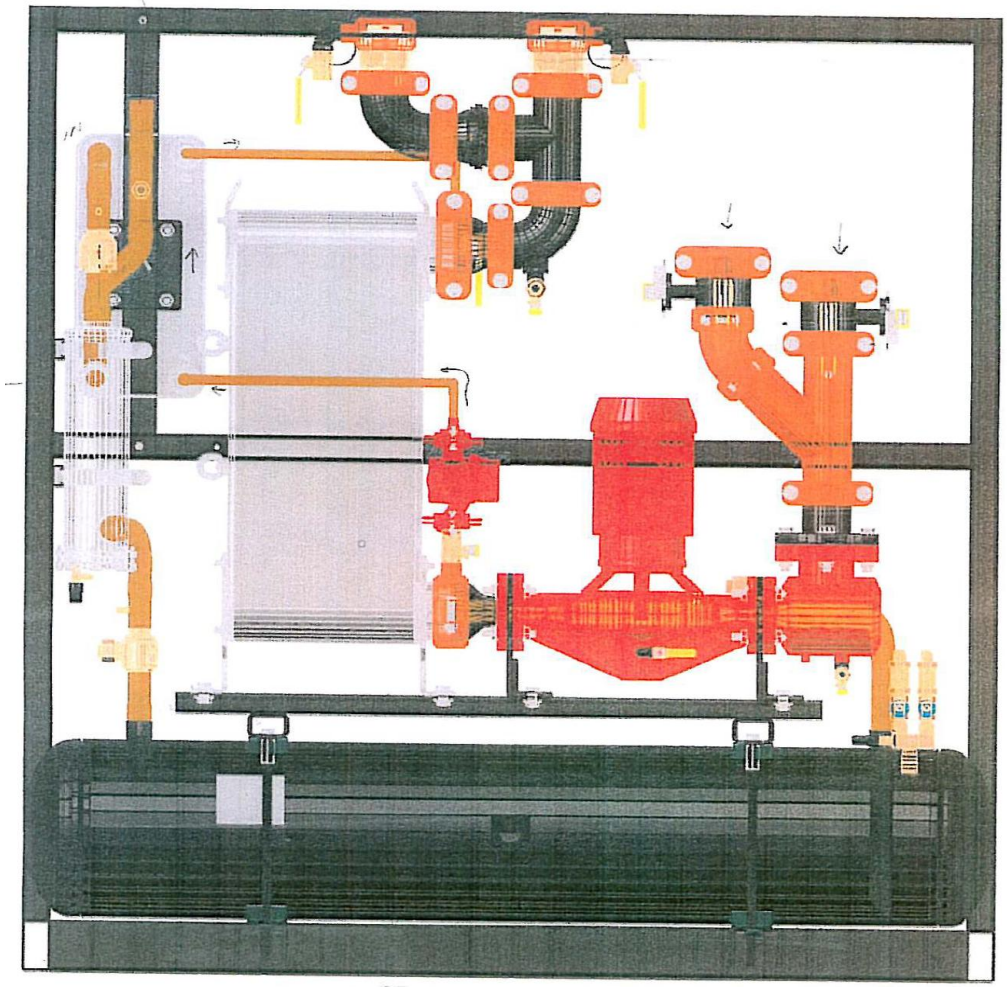
Water-Cooled Condensing Options

- 3-way valve to glycol reclaim coils in parallel

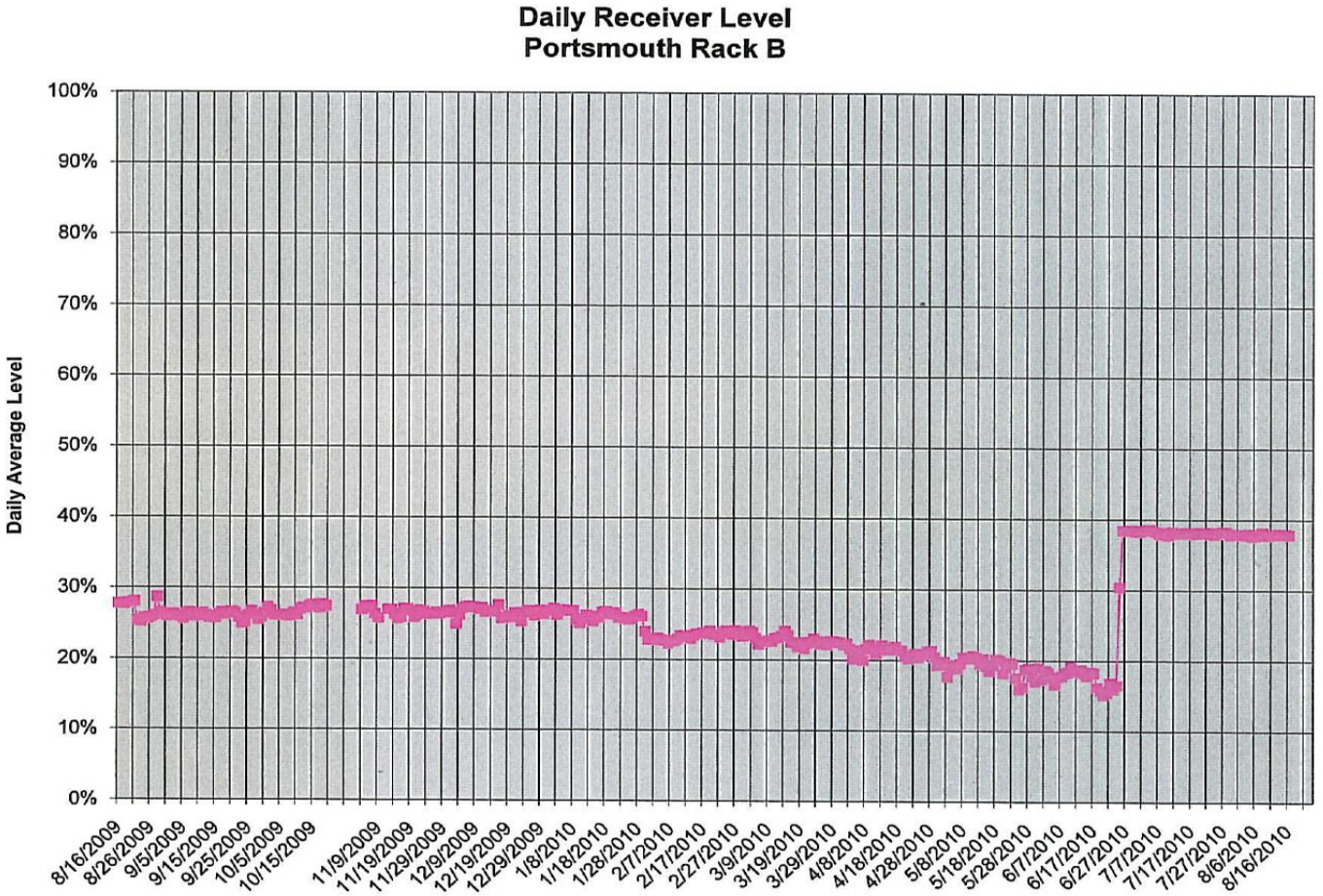


On a call for heat, 3-way valve diverts warm glycol to HVAC coils.

Hydronic Module



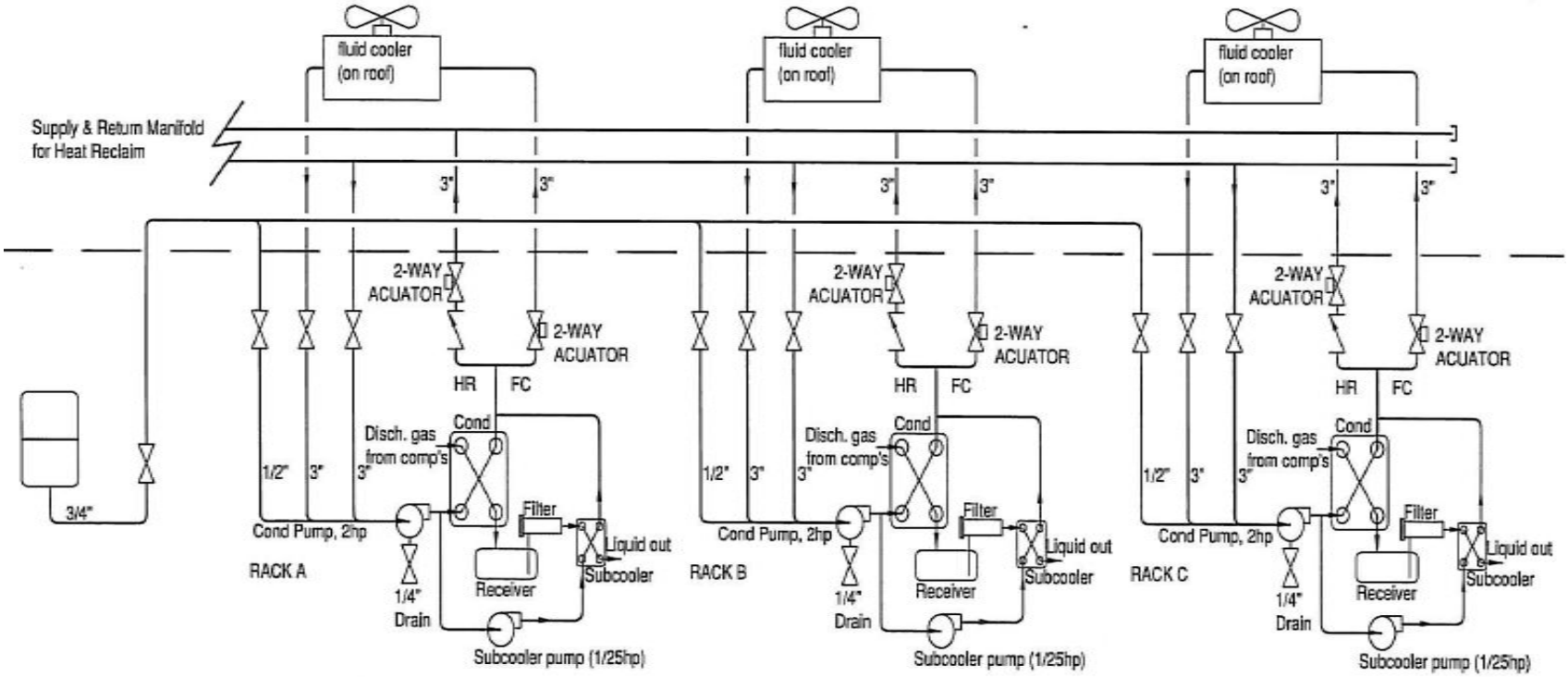
Receiver Level Monitoring



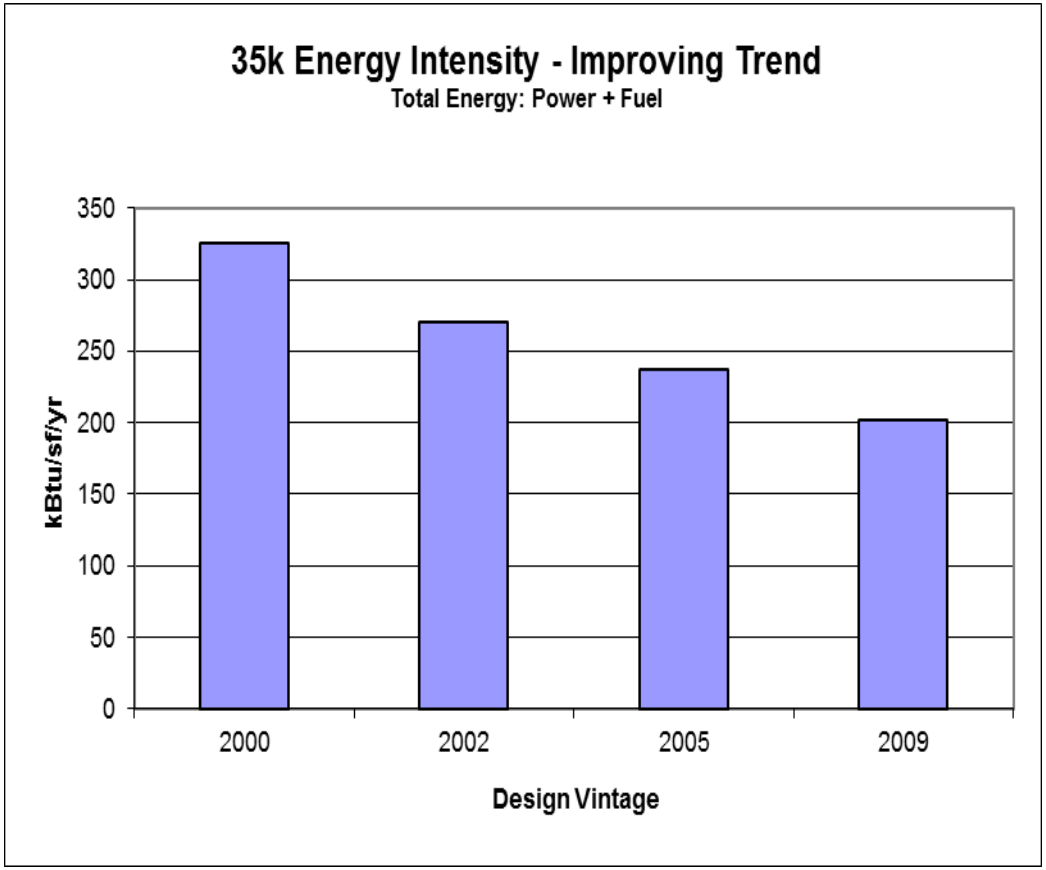
Integrating HR with HVAC

- Bigger coils and higher airflow (cfm) due to lower delta-T
- HR supply controlled by 3-way valve at rack
- HR loads can be:
  - Dedicated system per rack (on/off), or
  - Common HR loop (stages)
- HVAC zoning and control is different!

Hydronic System Layout



Performance Data



2000: No heat reclaim.

2002: Added full-condensing heat reclaim to “cold aisles”.

2005: Added series HR to dedicated outside air unit.

2009: Water-cooled condensing heat reclaim from all racks (3 or 4) to all HVAC units.

References

- *ASHRAE Journal*, February 2010, “Heat Recovery in Retail Refrigeration”, Richard Royal, P.E.
- KeepRite Tech Bulletin K70-KHR-PDS-11