# Optimizing Radiant Designs


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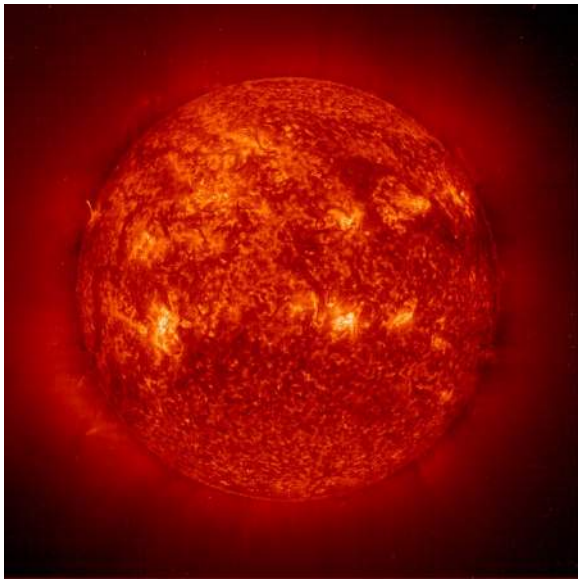
***Mechanical/Electrical Design***
***Energy Management Consulting***
***Sustainable Solutions™***

# Thermal Comfort

- Thermal Comfort Equation [P.O.Fanger] combines the effect of 6 parameters*:*
  - Metabolism [MET] (Activity Level)
  - Clothing level [Clo]
  - Air Temperature
  - Air Velocity
  - Air Humidity
  - Mean Radiant Temperature

# Radiant Systems

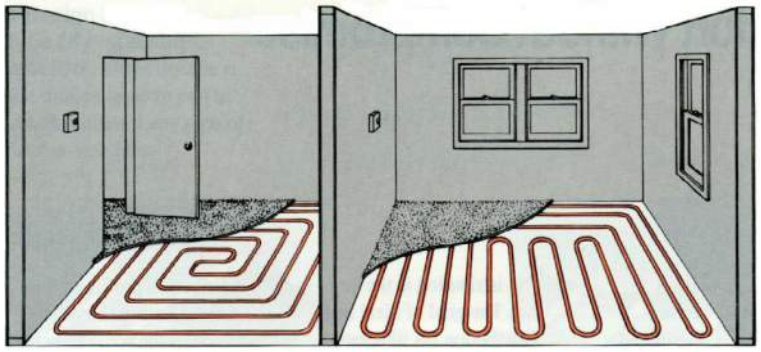
- Radiant Renaissance
  - Panels
  - Tubing

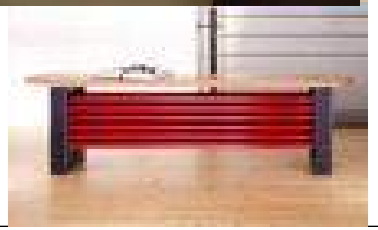


*Ancient radiant systems*

# Benefits

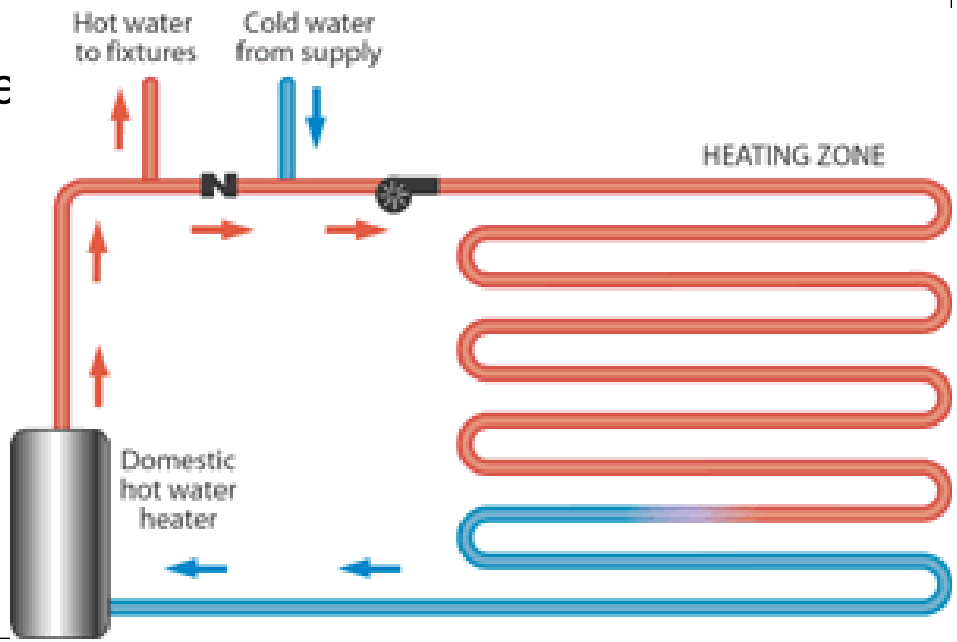
- Comfort (MRT)
- Clean, quiet & draft-free
- Aesthetics
- Efficiency - SWT
- Zoning
- Heat source independent
  - DHW heater
  - Solar
  - Boiler
  - Geo
- Separate treatment of ventilation load





# System Considerations

- Open or Closed?
- Considerations
  - Efficiency of operation
  - Cost Effective
  - Simplicity in installation and maintenance
  - Longevity
  - Solar heat compatible
  - Safety



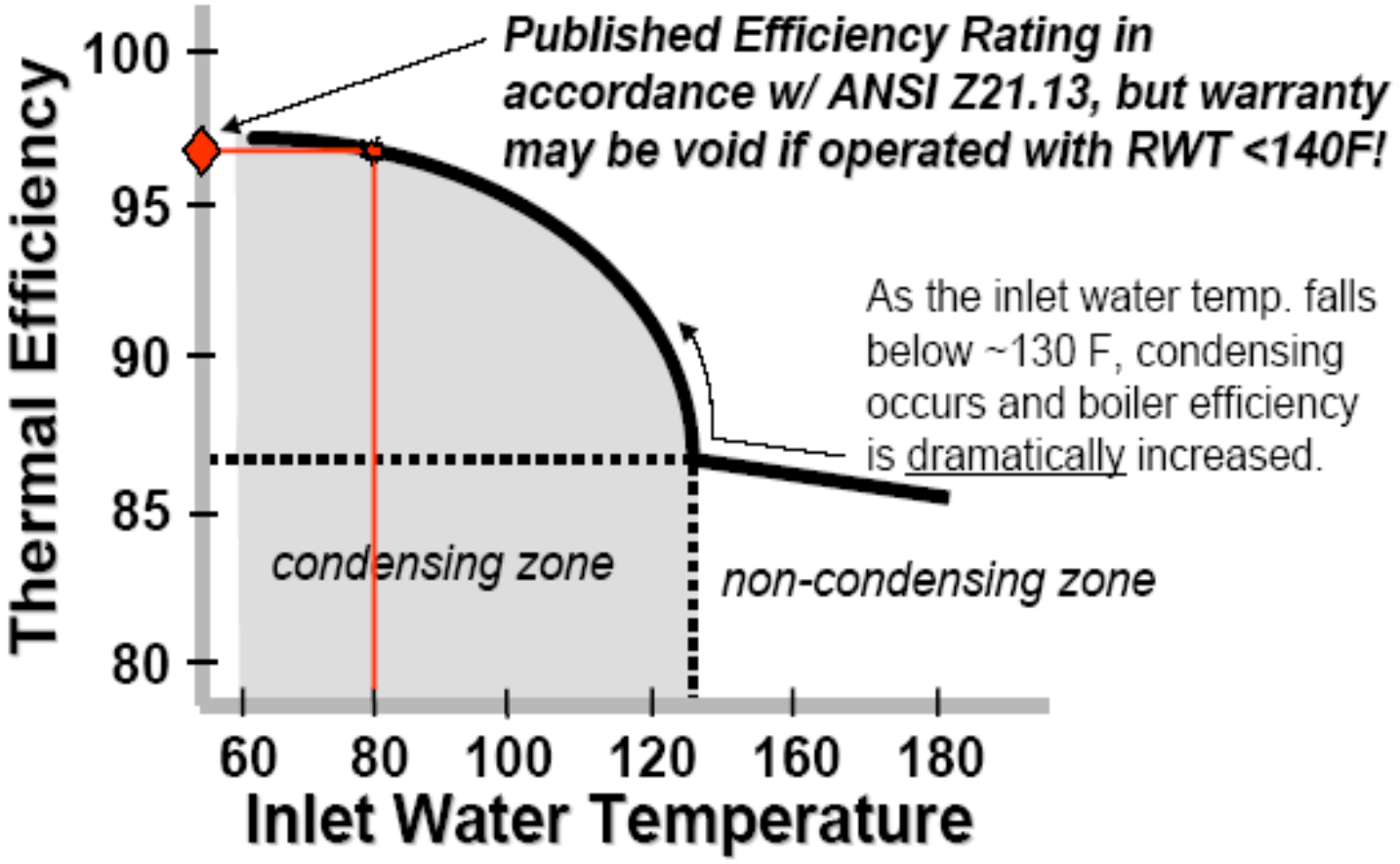
# High Performance Heating System

- Maximize System Efficiency
- Maximize Boiler Efficiency
- Minimize Installation Cost

# Maximizing System Efficiency

- **Increase Differential from 20°F to 40°F (or more)**
- **Result:** Smaller pipe size
  - Lower pump horse power (cost and consumption)
  - Improved /operation of valves & terminal units means better control over room temperatures
  - Lower return water temps to condensing boiler means higher boiler efficiency
- **Variable Speed Pumps**
- **Result:** Energy Efficient, Better room temperature control

# Boiler Efficiency



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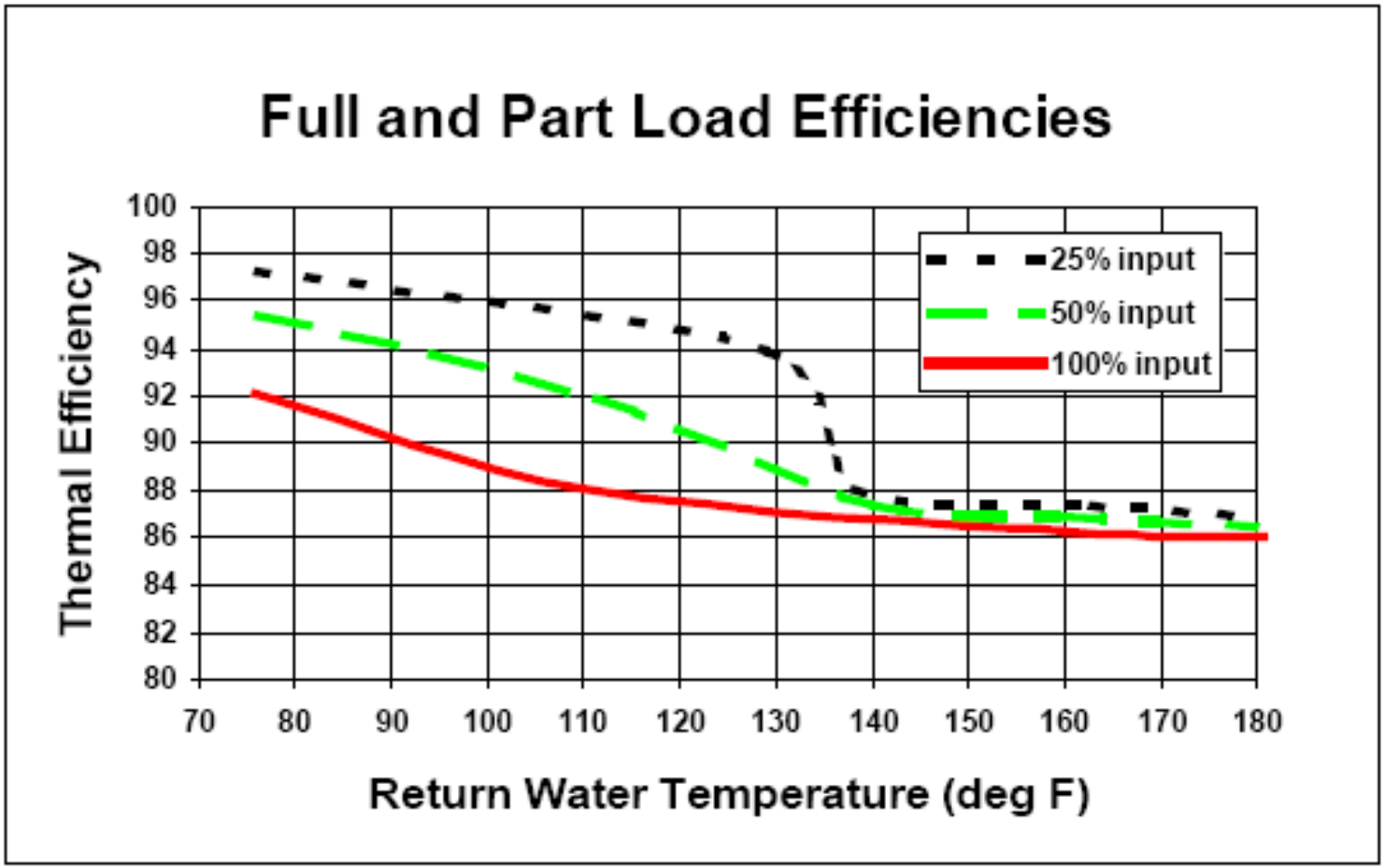

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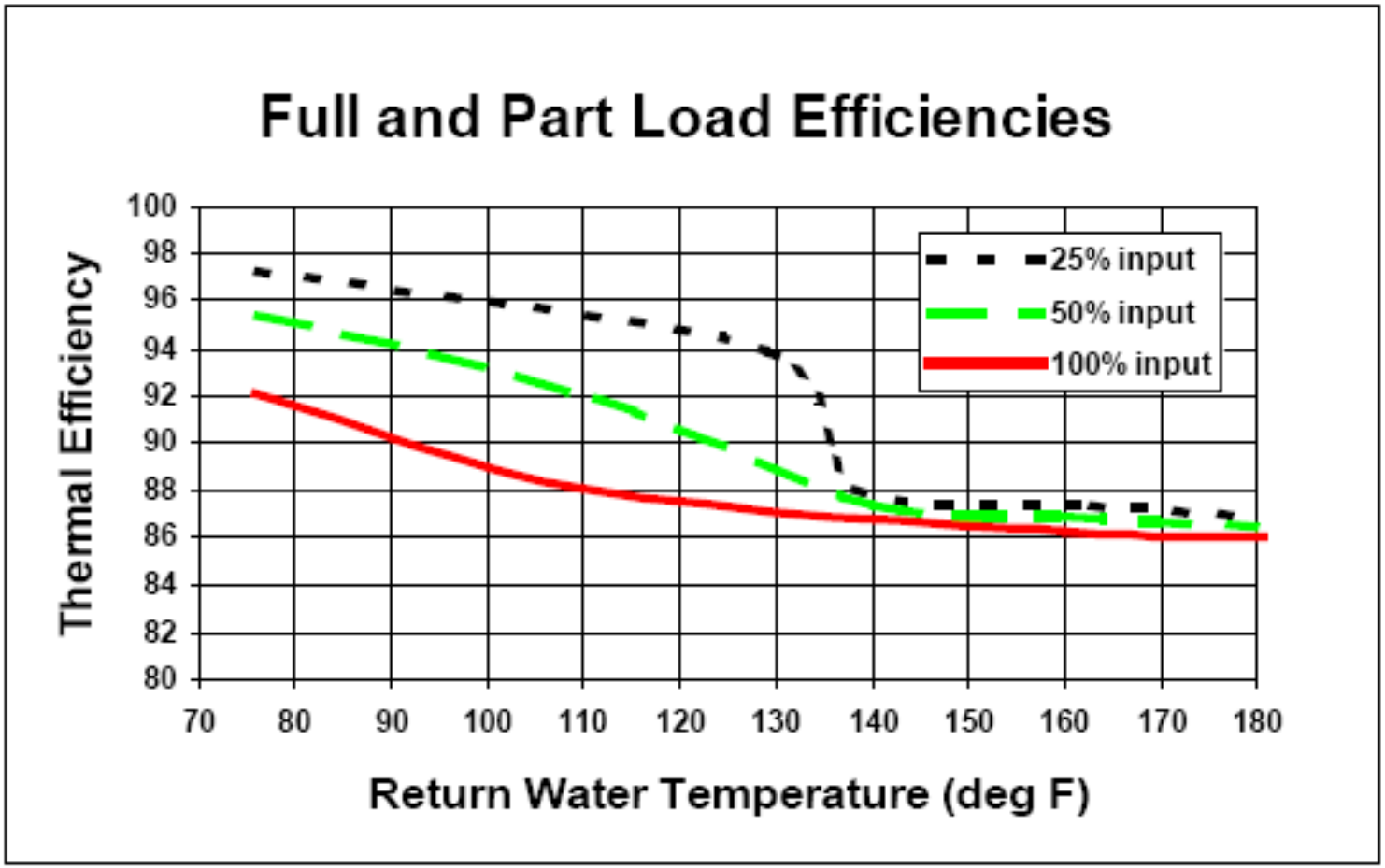

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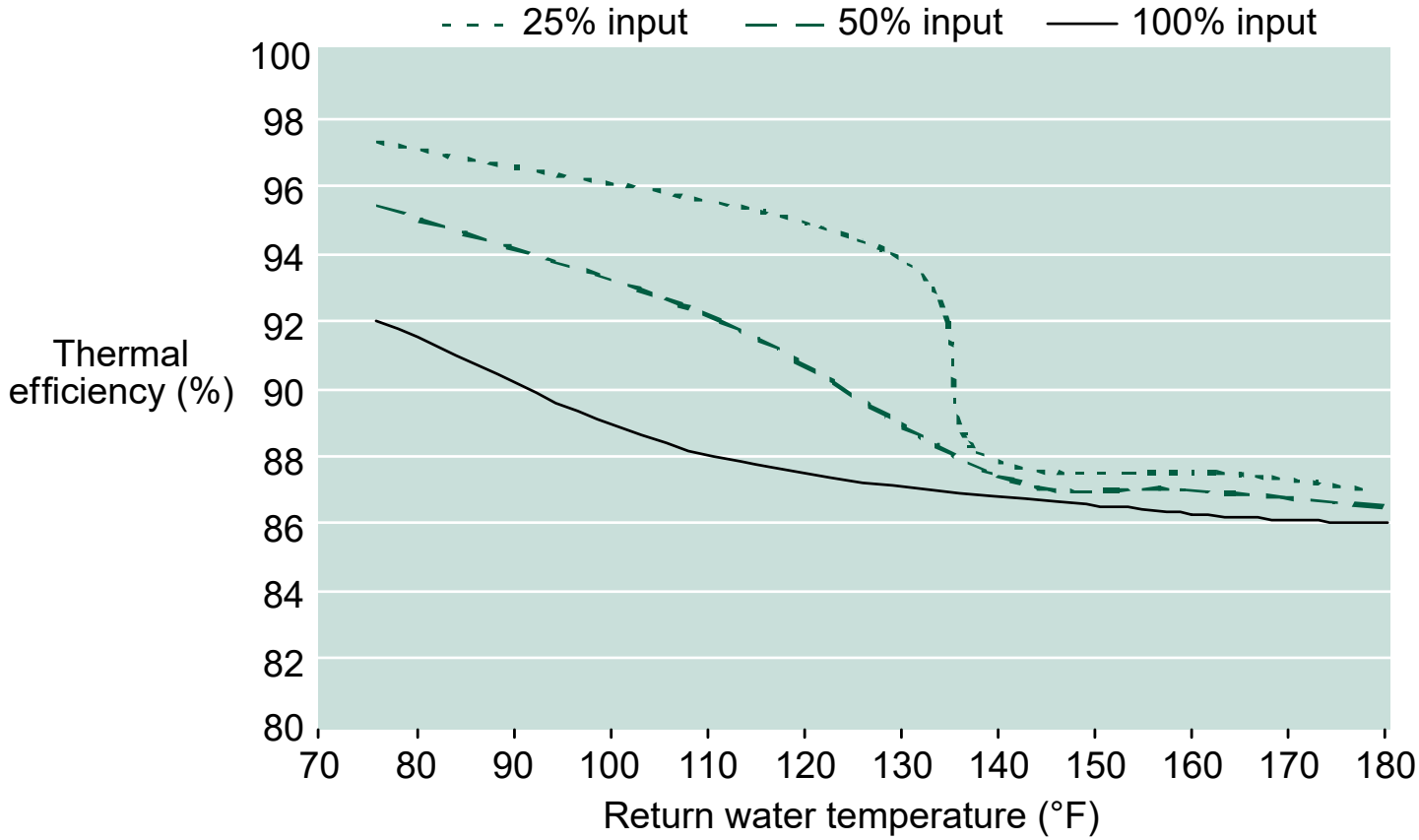


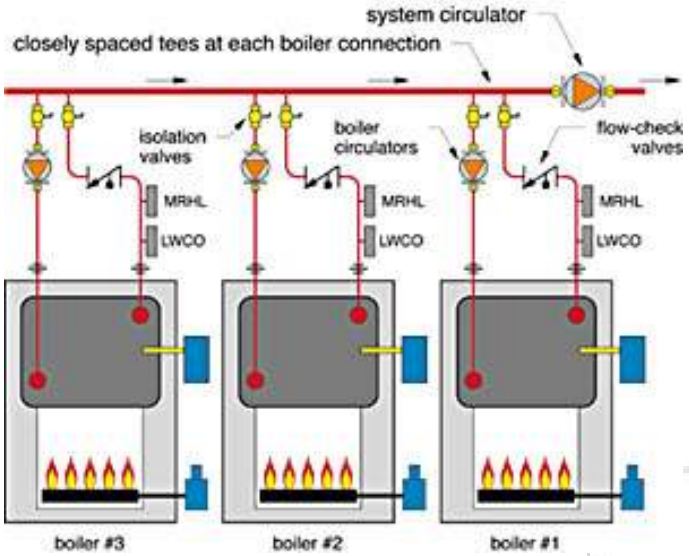

Source: AERCO [10]

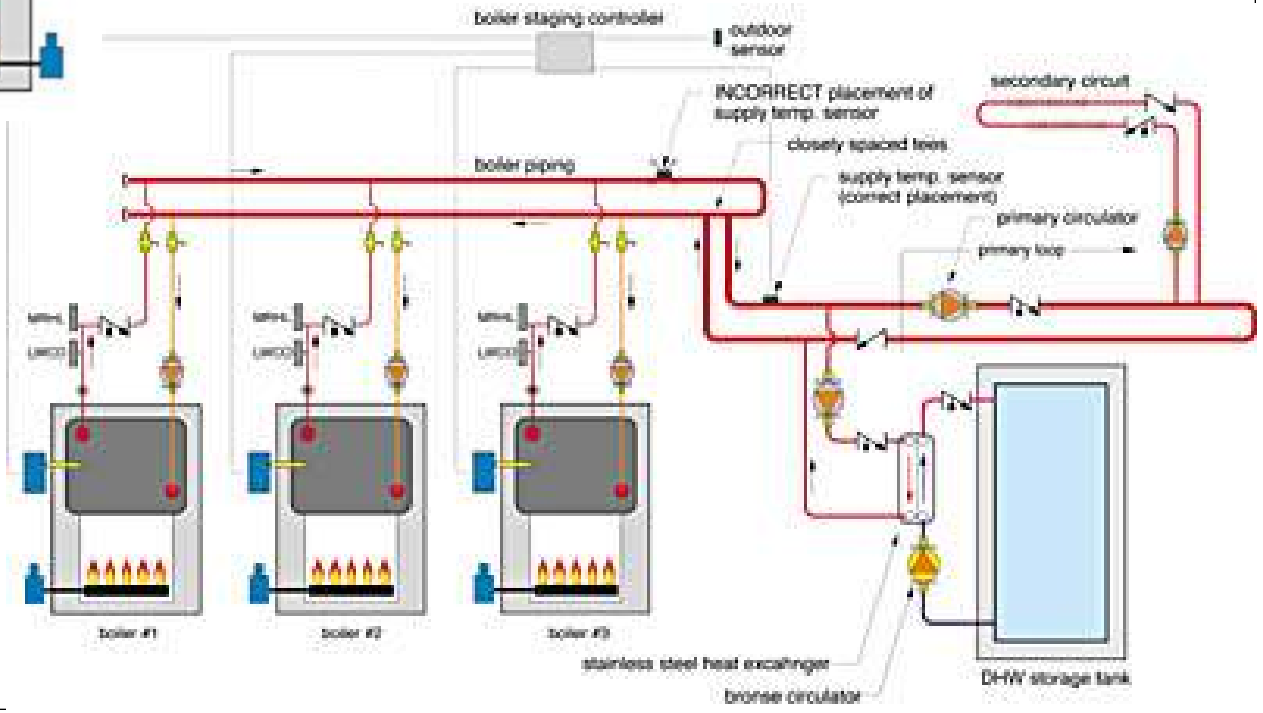
# Boiler Efficiency

**How Can I Achieve 90%+ Average Seasonal Efficiency?**

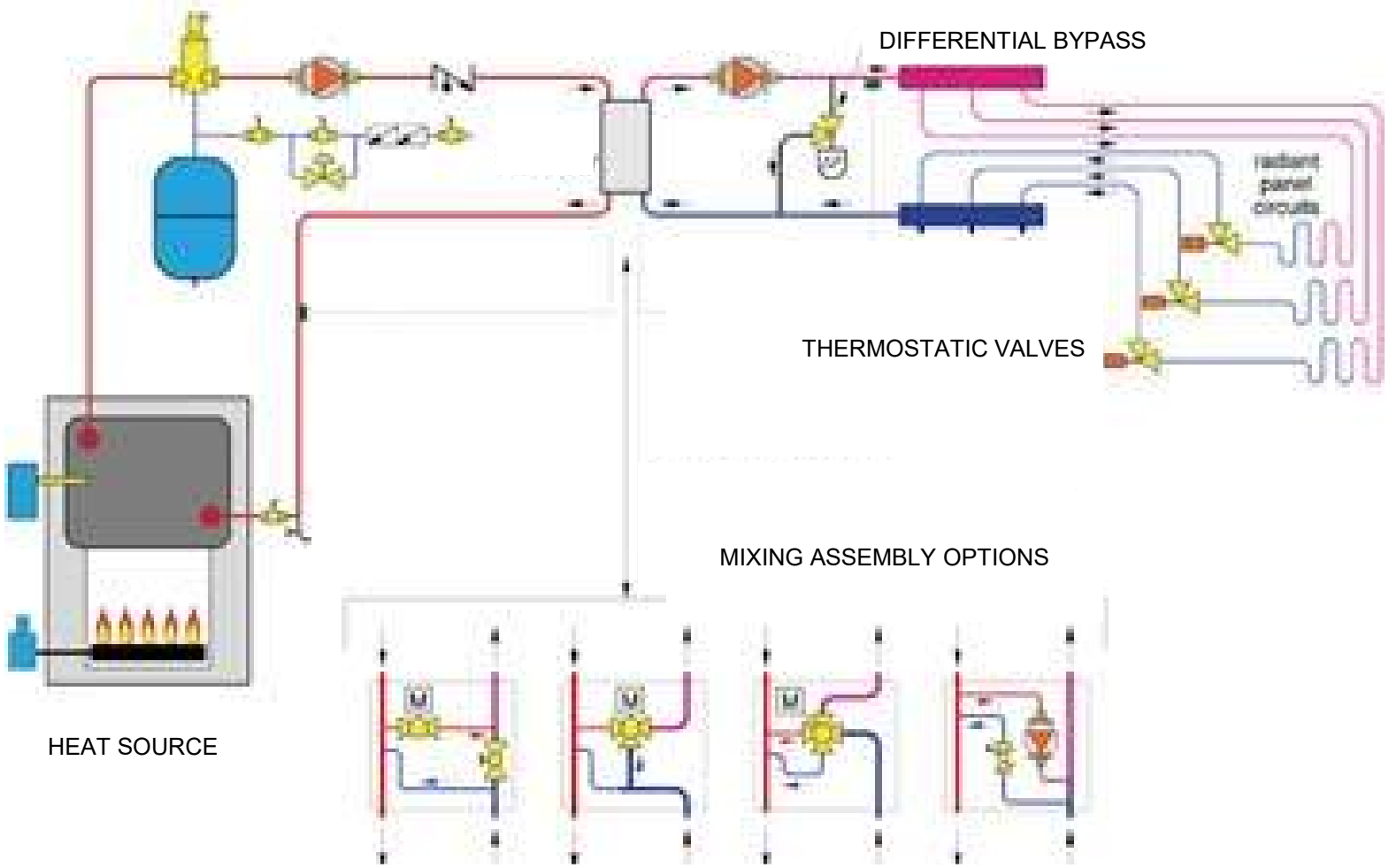
- **Boiler must condense water vapor in flue gas under operating conditions**
- **Must reduce cycling losses by modulating boiler input at partial load conditions**
- **Must design the system to take advantage of boiler and controls technology**

# Boiler Piping



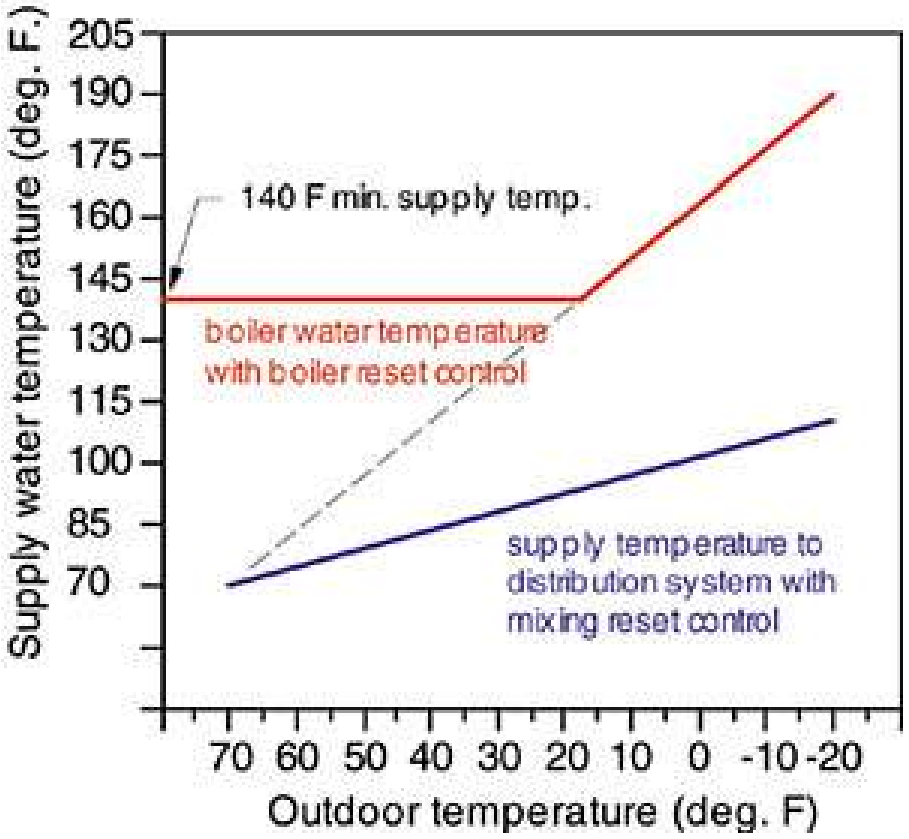



# System Piping



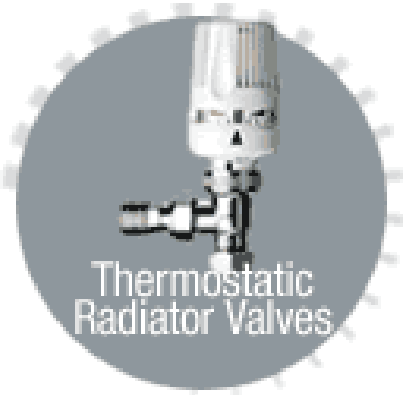
# System Controls

- Outdoor Reset
- Check your boiler type



# System Controls

- Electric or Non-Electric?
- Considerations
  - On-off vs. modulating control
  - Individualized control
  - Continuous, centralized circulation




# Controls


Temperature settings for Oventrop Thermostats:

0= Valve shut off

*= Frost protection valve opens when room temp. falls below 43 deg. F.

1= Approx. 53 deg. F

2= Approx. 61 deg. F

3= Approx. 68 deg. F

4= Approx. 75 deg. F

5= Approx. 82 deg. F

# Other Efficiencies

Multi-Load Systems

Use multiple boiler when wide load range exists (high intermittent demand for DHW)

Series primary loop when water supply temps of secondary loads vary

Use parallel primary-secondary piping when the water supply temps of secondary circuits are similar

Minimize water temperatures wherever possible

# Domestic Water Heating

Domestic Priority whenever possible

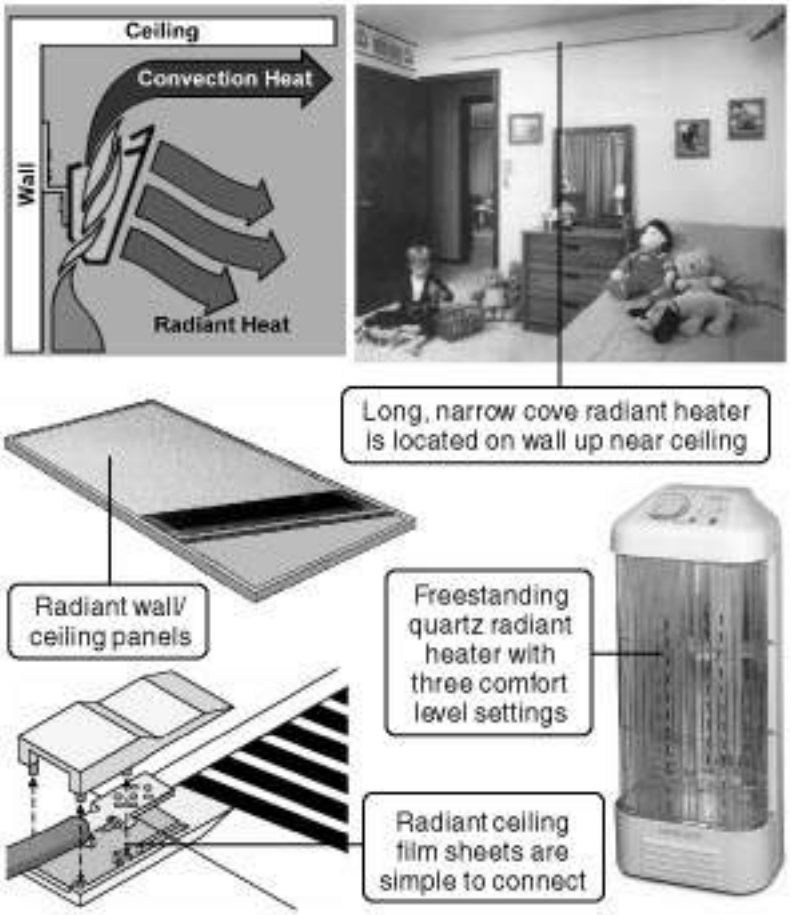
Brazed-Plate HX for large, sustained DHW loads

Check valve on supply and return to DHW

# Fuel Source

## Electric or Hydronic?

- Installation size
- Backup or Primary?
- Anticipated use patterns
- Source flexibility desired



# Boilers

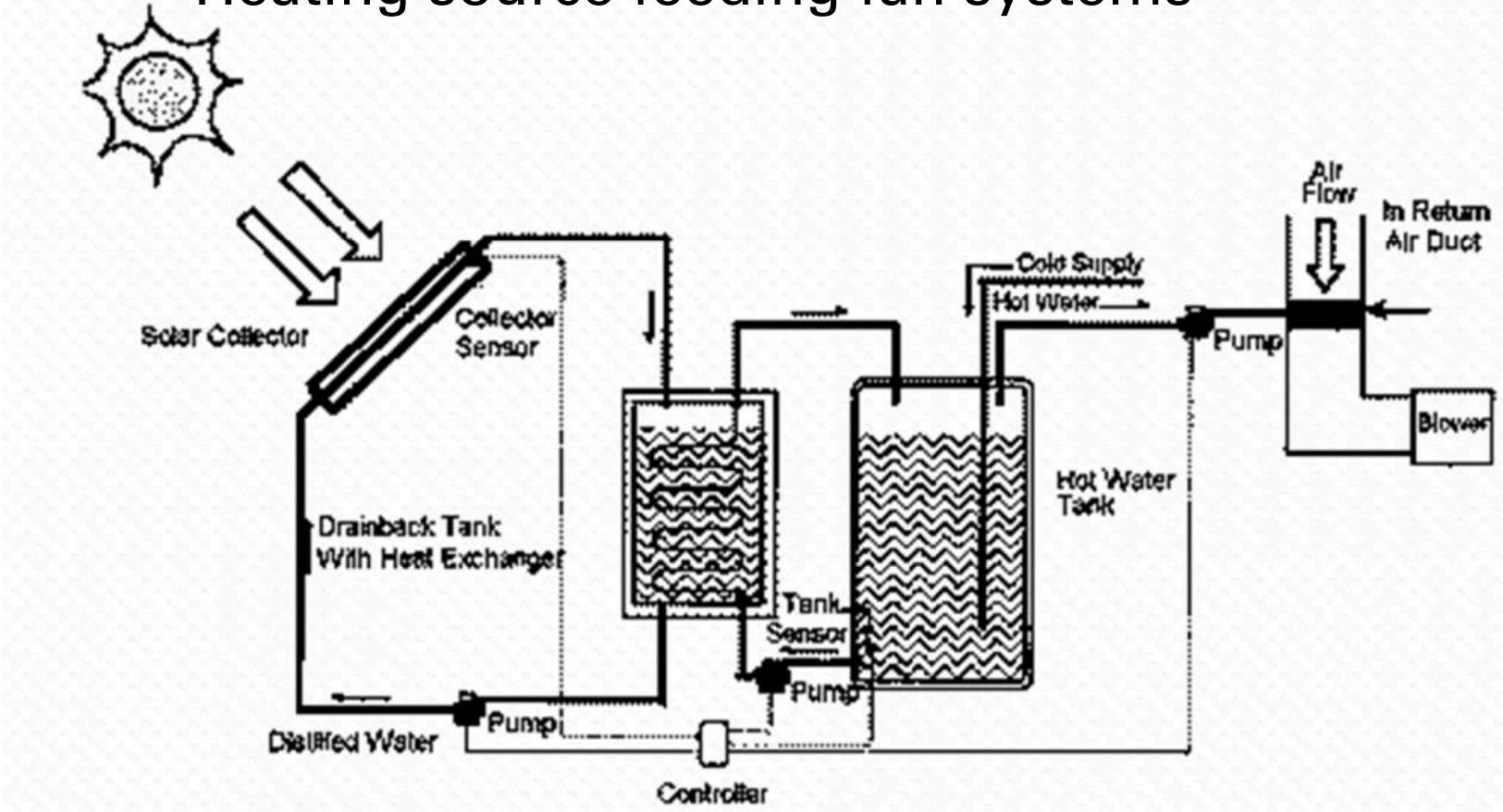
- How low can you go?
- Delta T
- Similar to furnaces in types
- Size for largest load
  - space or DHW

# Cooling

- Barriers
  - Lack of familiarity
  - Past moisture control problems

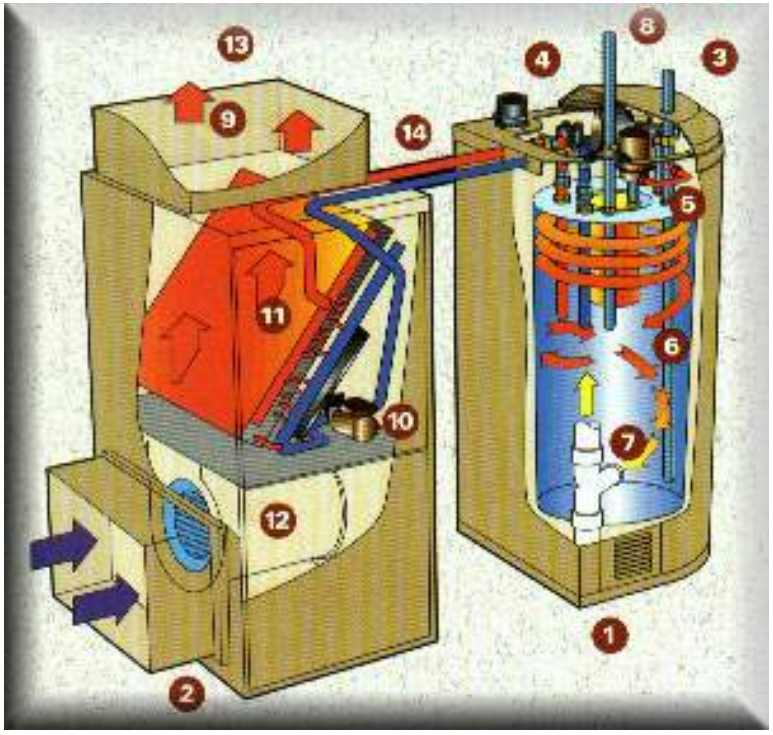
# Systems – Combination

- Air-Water
  - Heating source feeding fan systems



# Systems – Combination

- Air-Water
  - Packaged combination systems




  - Geothermal feeding radiant heating/air-side cooling

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Residential Mechanical Systems

# Systems – Hydronic