Building Efficiency: HEAT PUMPS & ELECTRIFICATION

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Heat Pump Fundamentals
Air-Source Heat Pumps (Incl. Cold Climate)
Water-Source Heat Pumps
Ground-Coupling (Geothermal)
  • Closed Loop
  • Open Loop
Outside Air Ventilation
BUILDING SECTOR GOALS

• MINIMIZE ENERGY USE
• INDOOR AIR QUALITY (HEALTHY BUILDINGS)
• DECARBONIZATION (ELECTRIFICATION)
First Law of Thermodynamics:
Energy can be neither created nor destroyed

Ratio of Useful Heat Movement per Unit of Energy Input = Coefficient of Performance (C.O.P.)
Heat Pumps “Pump” Heat from one place to another

Reversing Valve Reverses the Refrigerant Flow Between the Evaporator and Condenser
Temperature “Lift” (Carnot Efficiency)

30°F - 70°F (40° Delta)

75°F - 95°F (20° Delta)
Old style “Conventional” Heat Pumps use “Back-Up” electric heat when it’s cold out
COLD CLIMATE HEAT PUMPS

COLD CLIMATE AIR-SOURCE HEAT PUMP (ccASHP)
Variable Speed, Variable Flow Refrigerant (VRF)
100% Heat Capacity down to 5°F
Operation down to -13°F
OUTDOOR UNITS
INDOOR UNIT STYLES

A. FOUR-WAY CEILING RECESSED CASSETTE

B. CEILING SUSPENDED

C. CEILING CONCEALED DUCTED

D. WALL MOUNTED

E. VERTICAL AIR HANDLER

F. ONE-WAY CEILING RECESSED CASSETTE

G. FLOOR-STANDING EXPOSED

H. FLOOR-STANDING CONCEALED
ccAir Source Heat Pumps

Cooling

EER ~ 15
SEER ~ 23

Heating at 47°F

COP ~ 4
HSPF (Zone 4) ~ 12
HSPA (Zone 5) ~ 9

EER: Energy Efficiency Ratio
SEER: Seasonal Energy Efficiency Ratio
HSPF: Heating Seasonal Performance Factor

Typical Values for Mitsubishi Hyper-Heat 3-Ton Unit
WATER-SOURCE HEAT PUMPS

Water to Air – Cooling Cycle

Water-to-Air Heat Pumps Use Energy from Fluid Systems Instead of the Outside Air
Water to Air – Heating Cycle
Typical Horizontal and Vertical WSHP Units
Water-Source Heat Pump System

- Cooling tower
- Air separator
- Expansion tank
- Plate-and-frame heat exchanger
- Boiler
- Pumps
- Water distribution loop
- Heat pumps
**Water Loop Temperatures:**

Cooling - 86°F  
Heating - 68°F

EER ~ 15 to 18*
COP ~ 5 to 6*

* Typical Ratings for Trane Axiom VSV/VSH Variable Speed 2- 5 Tons at Full Load.
Closed-loop Heat Exchanger
Mean Earth Temperature = 55°F (New Jersey)
In winter, the heat pump transfers the heat from the ground to warm the home.

55° - 70°F

In summer, the heat pump transfers the heat from the home into the ground.

75° - 55°F
Ground-Coupled Closed Loop Temperatures:

- **Cooling**: 77°F
  - EER ~ 18 to 22*

- **Heating**: 32°F**
  - COP ~ 4*

* Typical Values for Trane Axiom VSV/VSH Variable Speed 2- 5 Tons at Full Load.

** Requires Glycol/Brine
OPEN-LOOP HEAT PUMPS
Hydrology Matters
Supply Well & Return Wells
Open Loop Temperatures:

Cooling - 59°F  EER ~ 25 to 33*

Heating - 50°F  COP ~ 5*

* Typical Values for Trane Axiom VSV/VSH Variable Speed 2-5 Tons at Full Load.
Tightly sealed homes need outside air for indoor health.
DEDICATED OUTSIDE AIR SYSTEM (DOAS) DESCRIPTION

A CITY MULTI DOAS with reheat capability consists of:
- One PEFY-AF1200CFMR Indoor Unit
- One PURY-P120TK(1J)(1H)MU or PURY-P120YK(1J)(1H)MU Outdoor Unit
- One CMB-P106NU-G or CMB-P108NU-G Branch Controller
- One wired remote controller
- Three CMY-R160C-J Joint Adapter

Note: CITY MULTI DOAS can only be a one-to-one, stand-alone HVAC system.
Greenest Office Building in the World: The Edge
NET-ZERO ENERGY

AQUIFER THERMAL ENERGY STORAGE

18°C  6°C  130 MTR
HEAT PUMPS & ELECTRIFICATION
Q&A

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