

Monitored Performance from GEOExchange Water Heating at a Hotel

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Overview

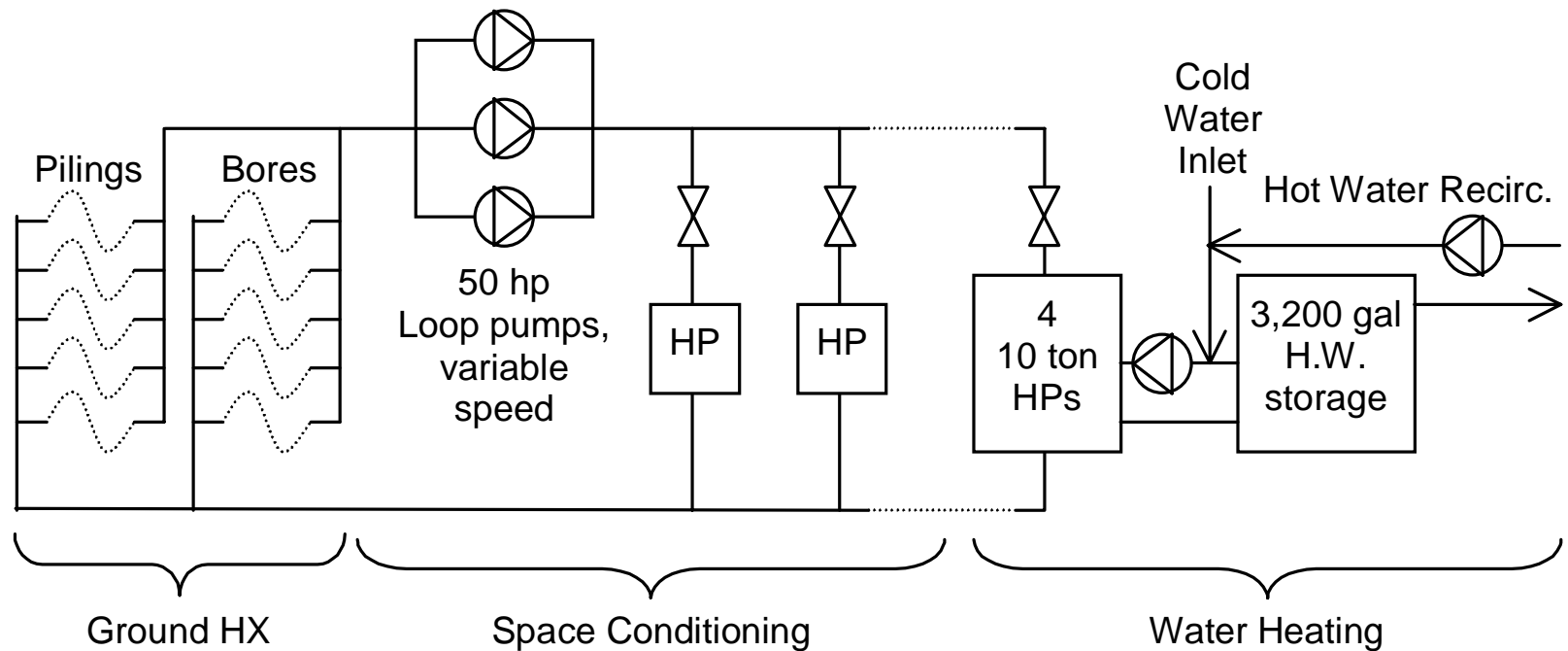
- System Description
- Water Use
- Energy Use
- Efficiency
- Experiences
- Impact on ground heat exchanger

Description

- Geneva, New York
(near Rochester)
- 149 rooms
100,000 sq. ft.
324 tons
- All-Electric
 - Space conditioning
 - Water heating
 - » Rooms
 - » Restaurant
 - » Laundry
- Ground HX used 67,000 ft of pipe in pilings and bore field



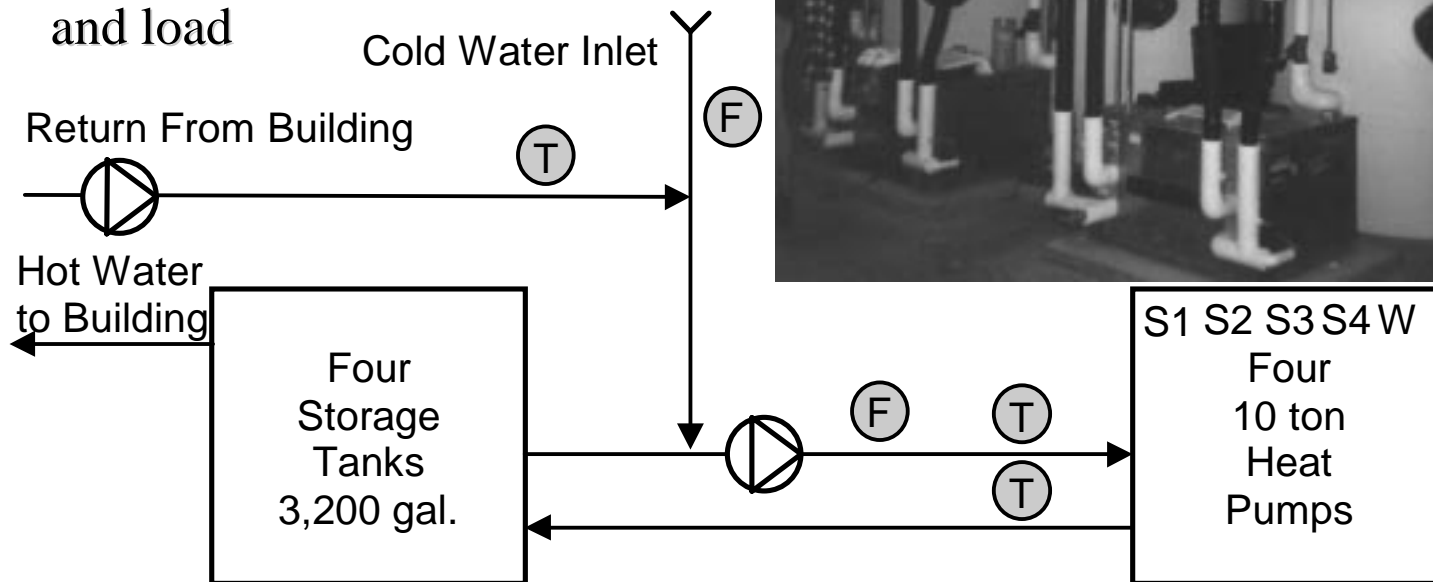
GX System Overview



- Water heating appears as four more heat pumps on system
- Adjustable speed drives and two-way valves limited pump power to 11 kW

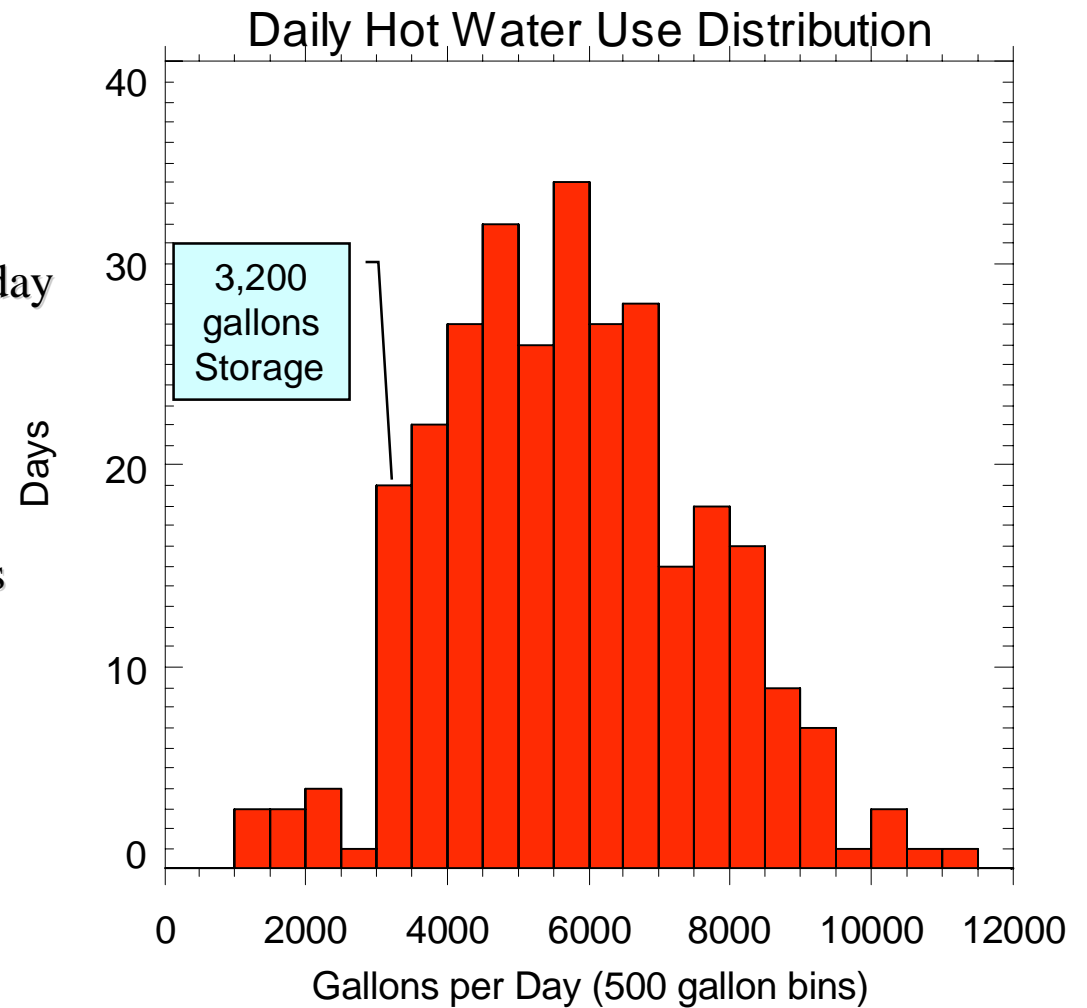
Water Heating

- 3,200 gallons of storage tanks (in parallel)
- (4) 10 ton heat pumps (in parallel)
- Measured hot water use, energy and load



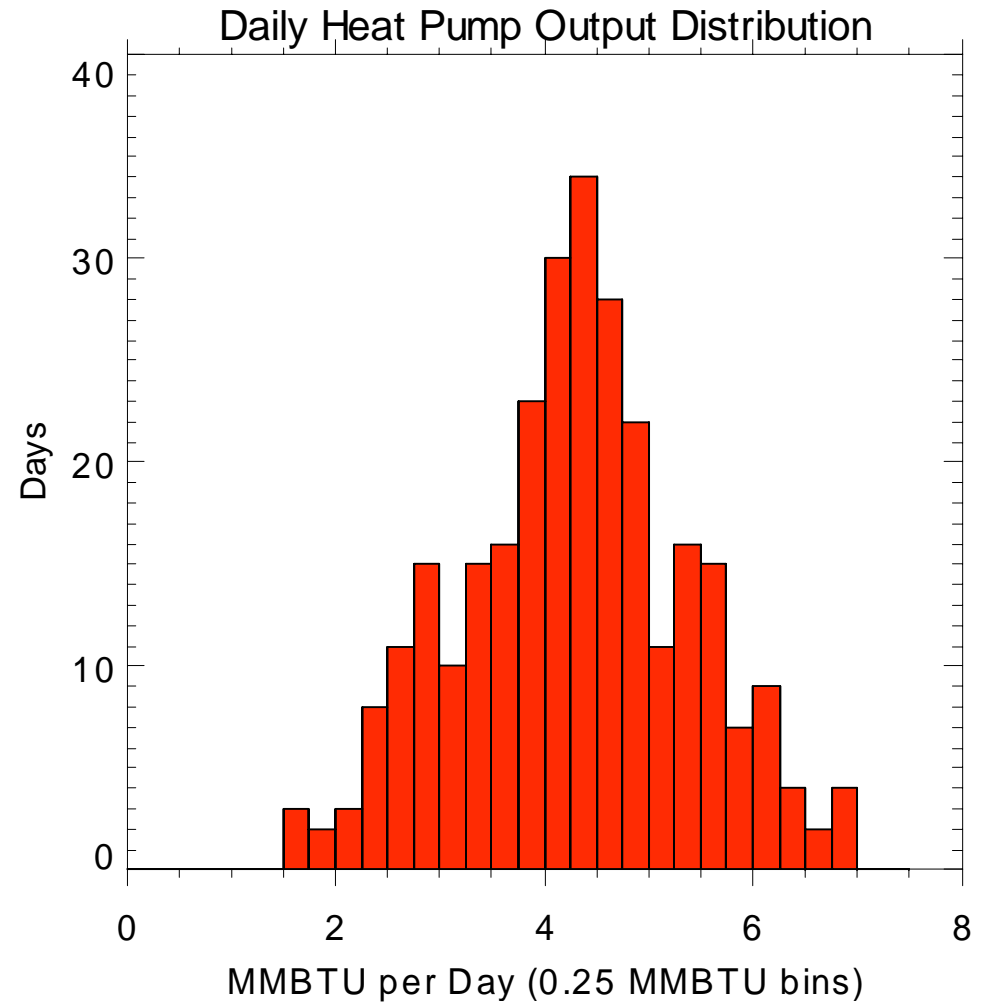
Water Use

- Average
 - 5,800 gal/day
- Range
 - 3,000 - 9,000 gal/day
- Maximum
 - 11,100 gal/day
- Annually
 - 2.1 million gallons



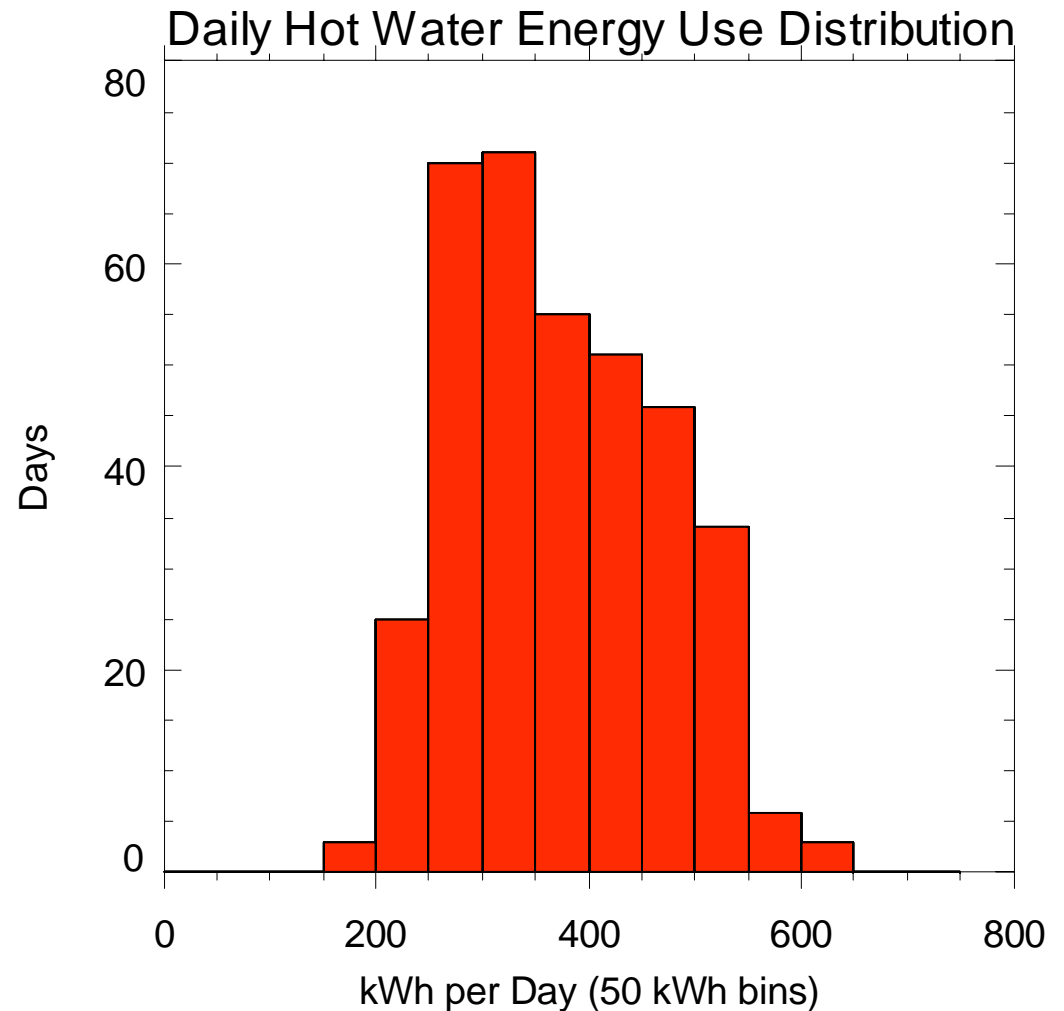
Heat Pump Output

- Average
 - 4.3 MMBTU/day
- Range
 - 2 - 7 MMBTU/day
- Annually
 - 1,528 MMBTU
 - 1,232 in 291 days



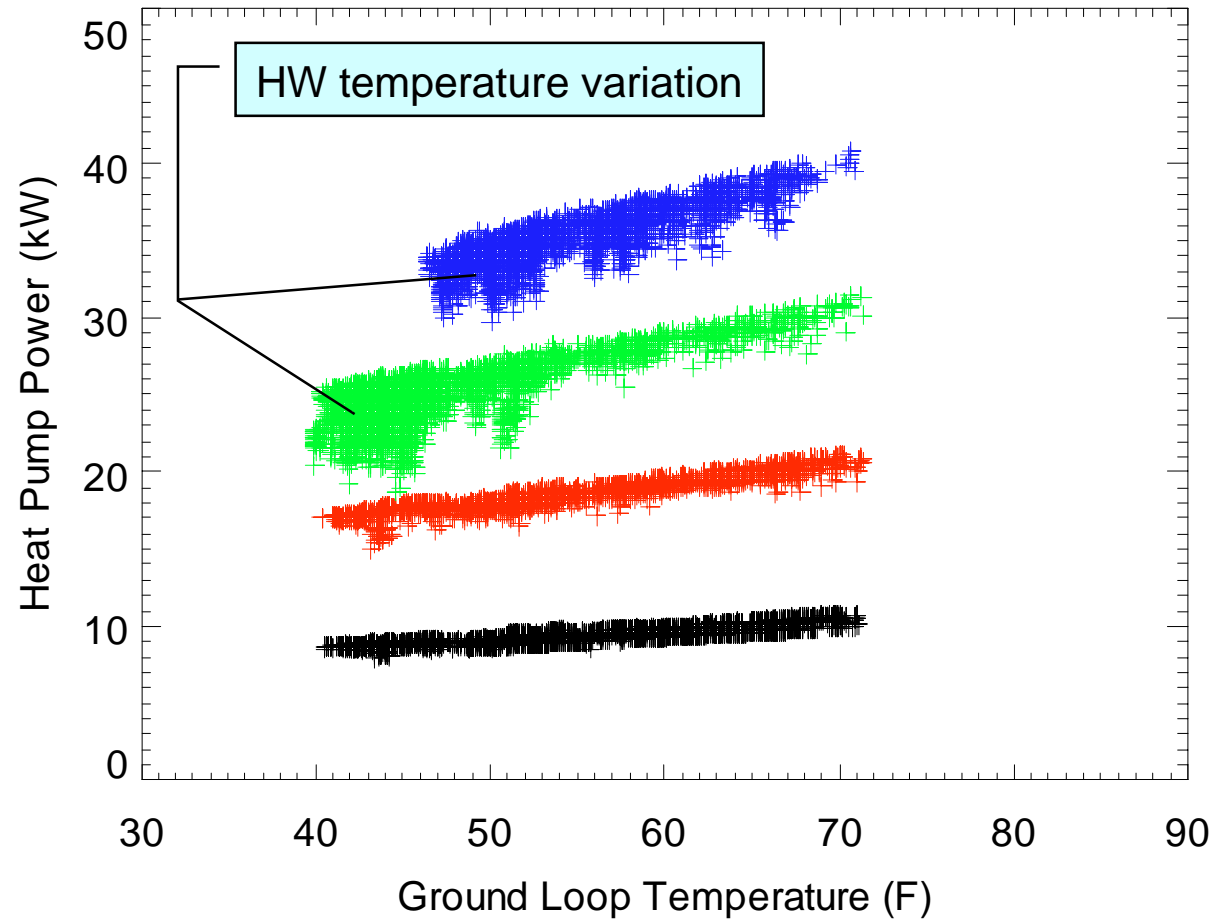
Electricity Use

- Average
 - 370 kWh/day
- Range
 - 200 - 600 kWh/day
- Annually
 - 136 MWH
 - 8.4% of total building energy
 - 3.3 HP COP (heat pumps only)



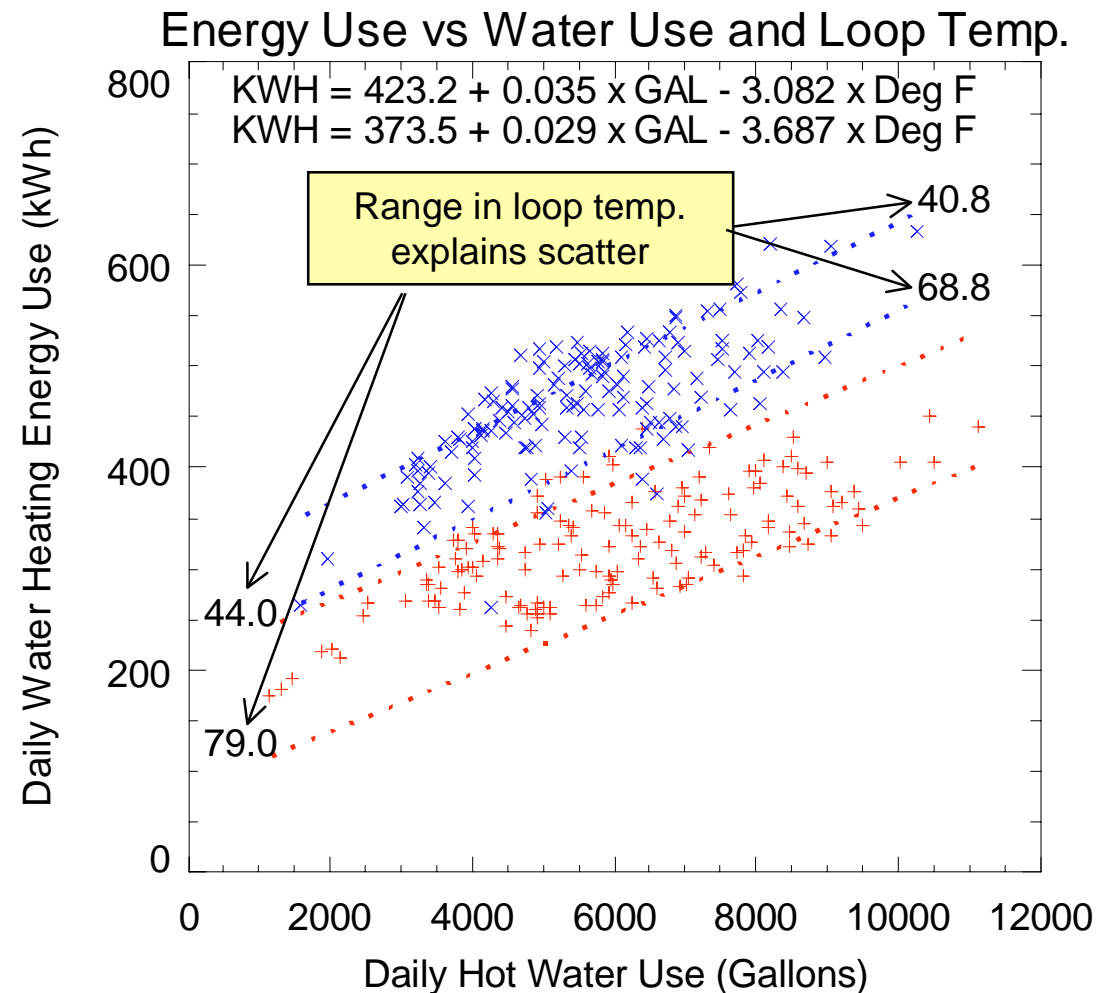
Heat Pump Power

Heat Pump Power Variation with Loop Temp.



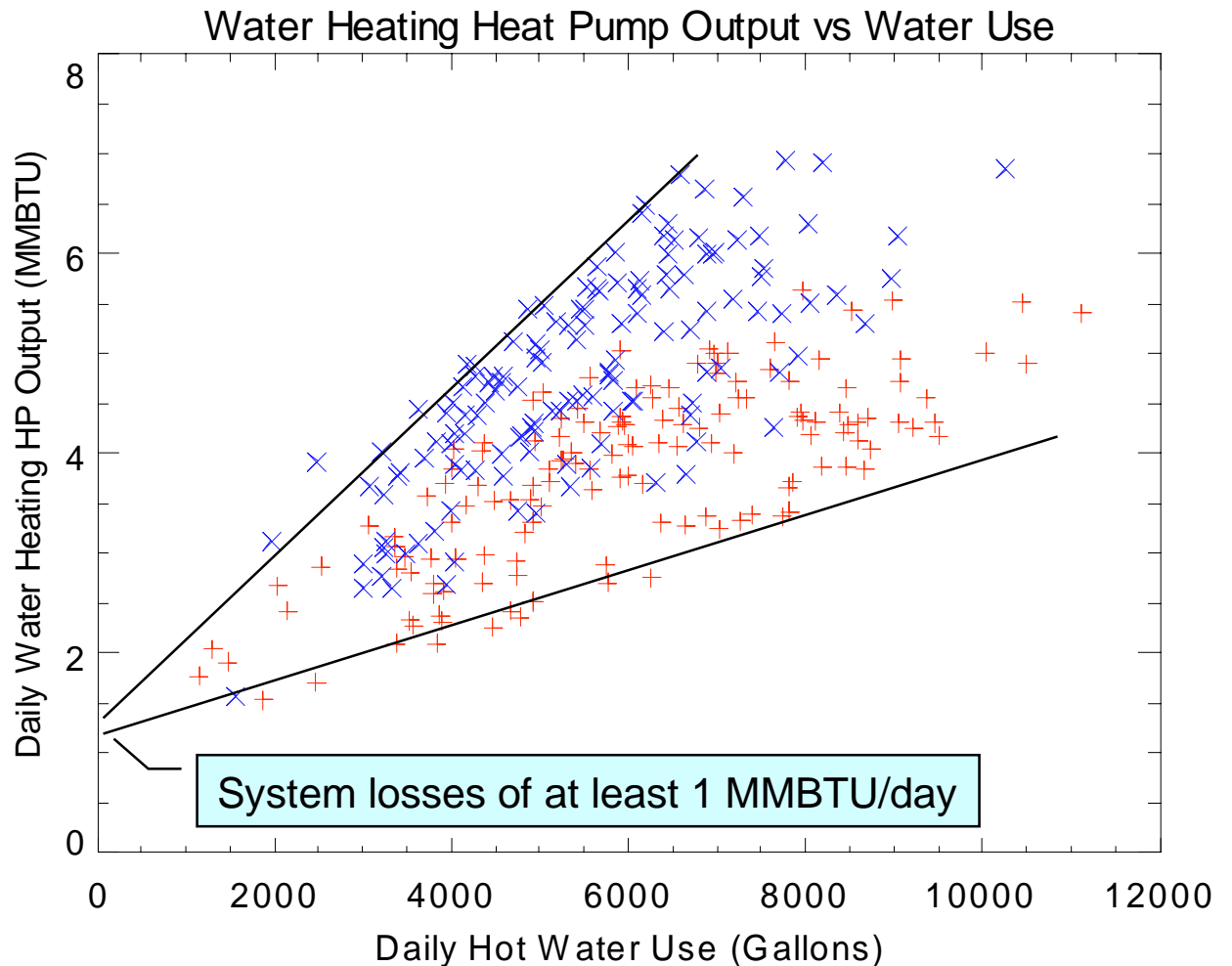
Electricity Use

- 40-80 F loop
- Storage set point increased 15 F to 130 F
- Losses cost 80 to 300 kWh/day depending on loop temp.
 - At least 21%

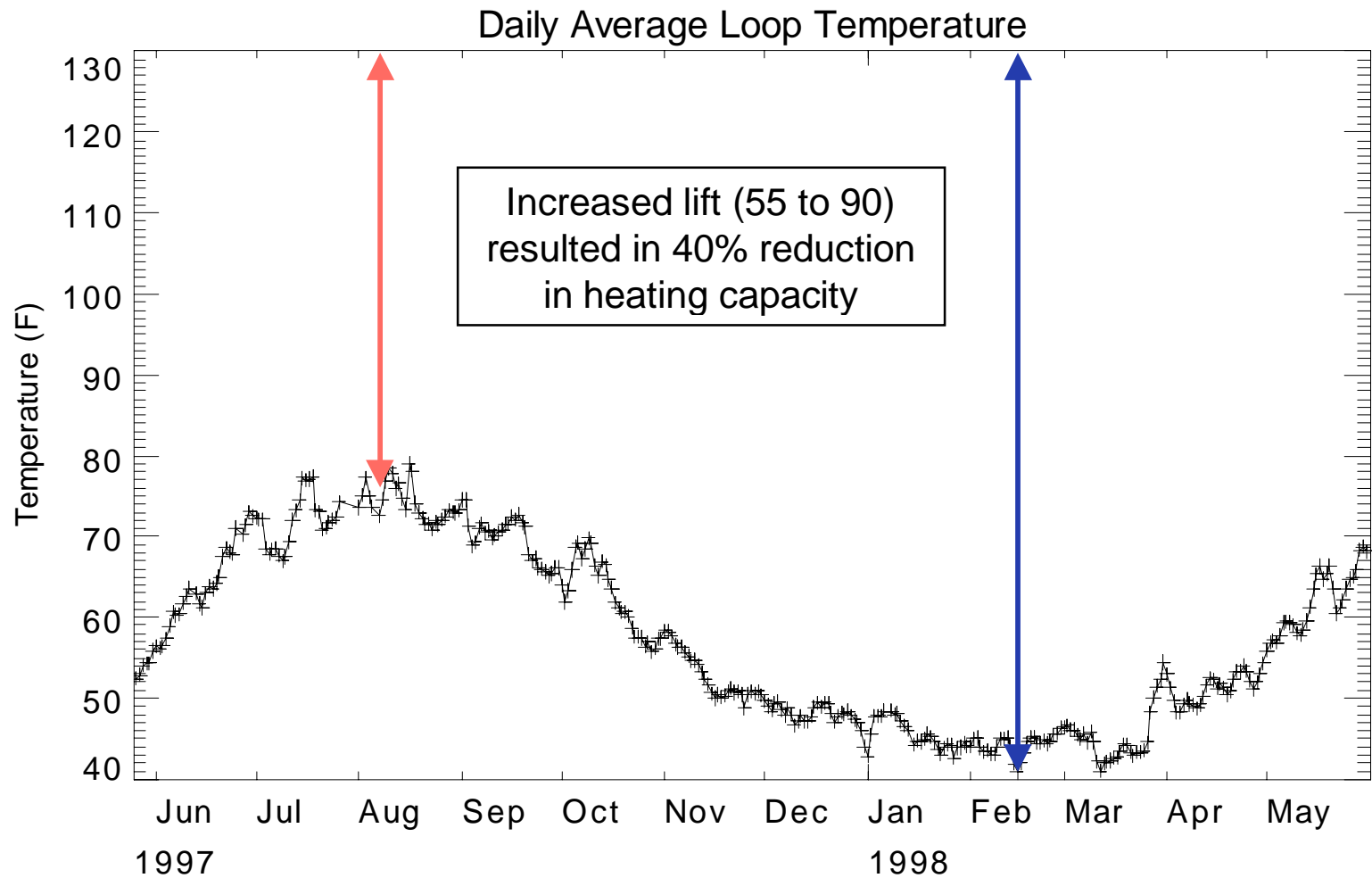


Standby/Recirc. Losses

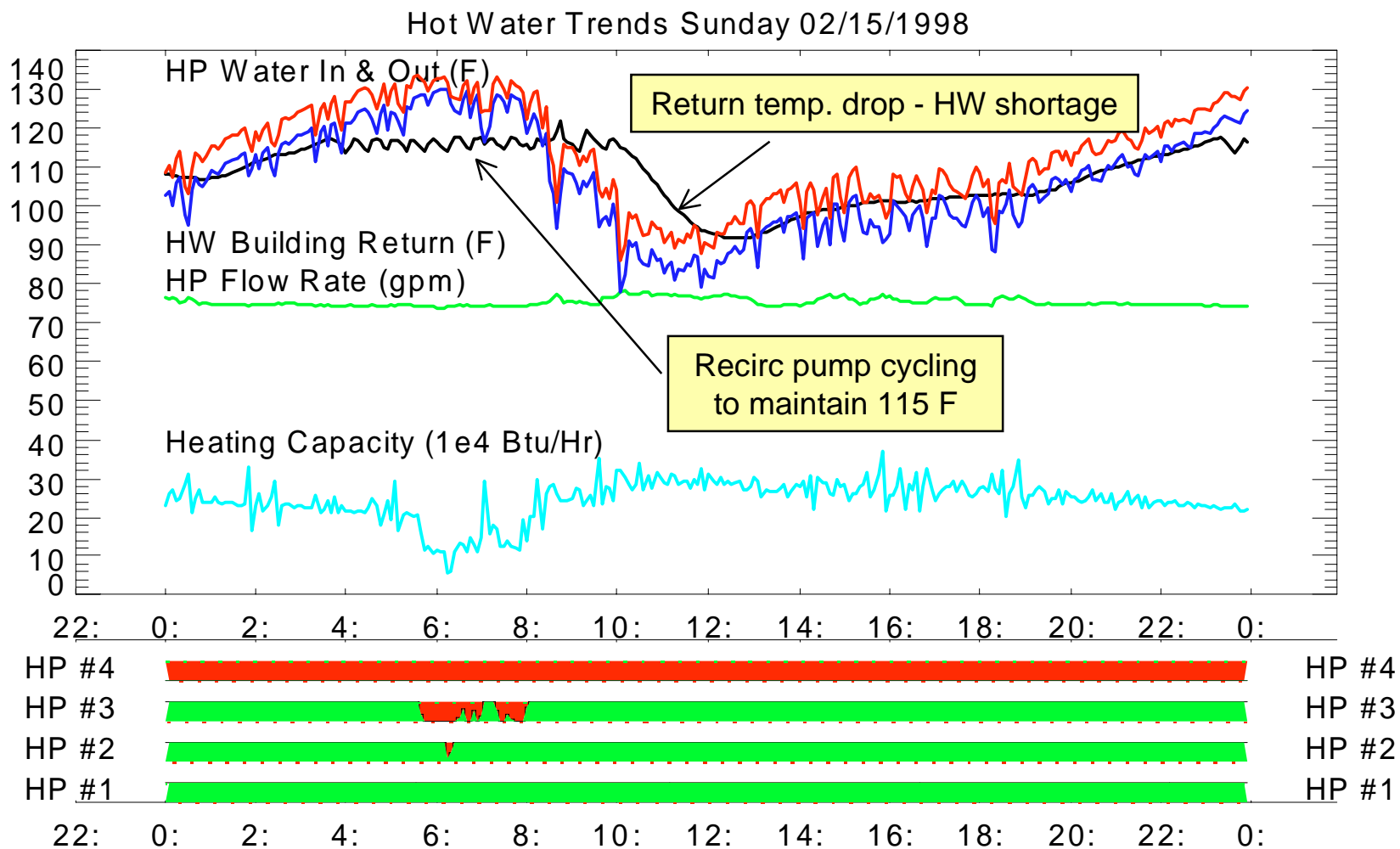
- Standby and recirculation losses at least one million BTU/day
- 1,231 MMBTU/291 days of output
- 24 % loss at 1
- 35% loss at 1.5
- Different storage set points (red/blue)
- Scatter from loop temp seasonal variation



Loop Temperature Impact

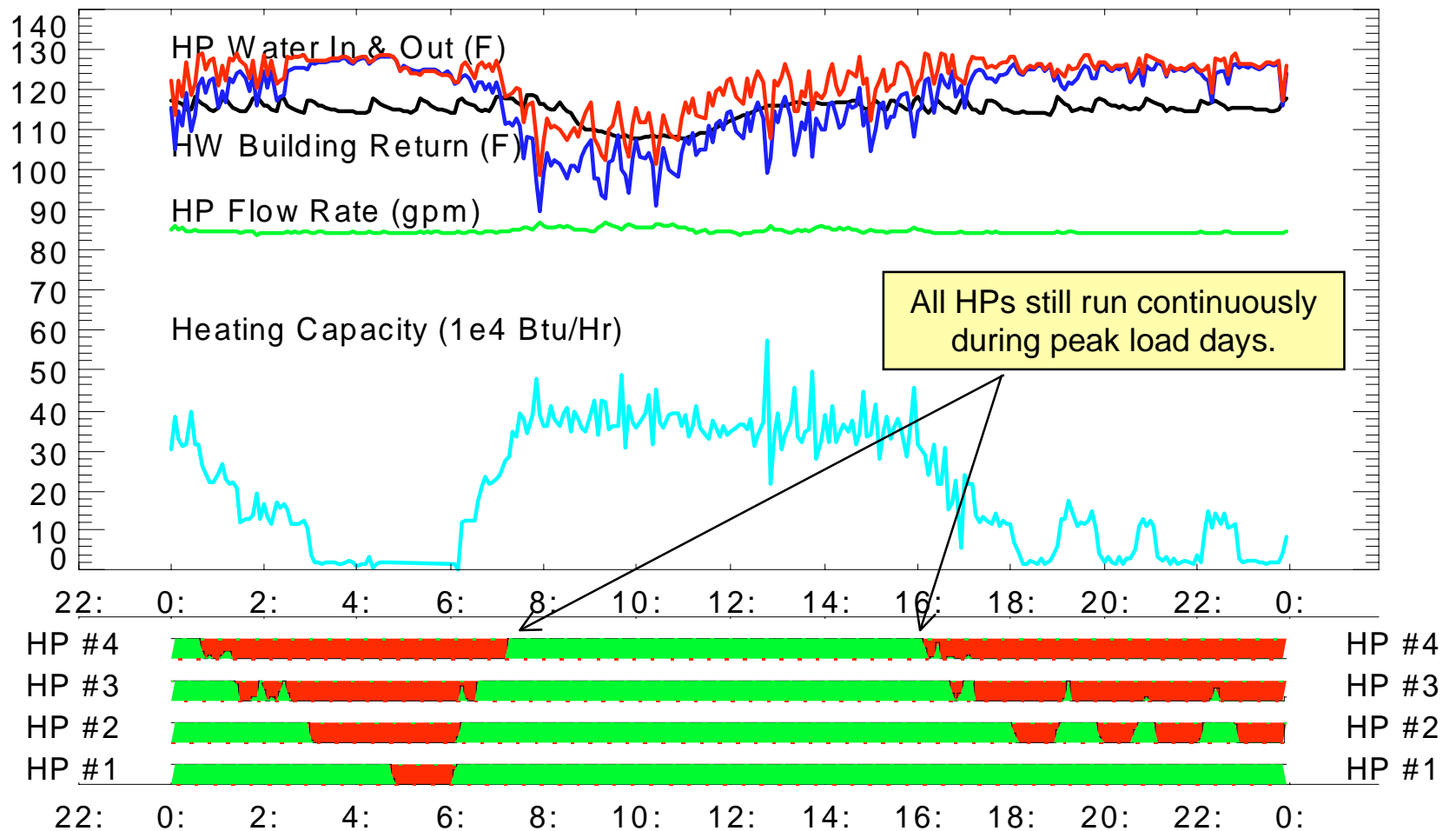


Control - Only 3 heat pumps (30 tons)

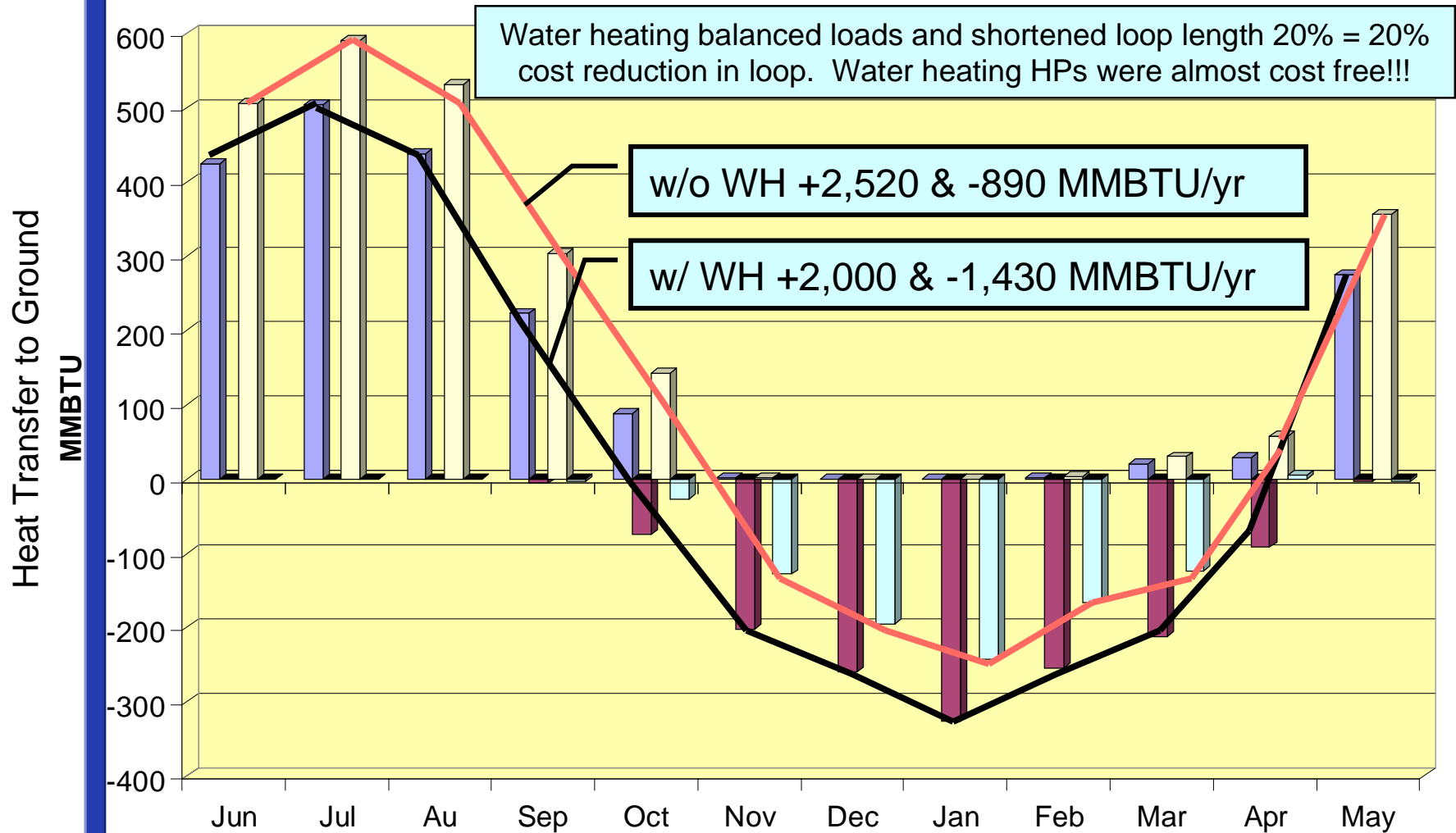


Control - 4 heat pumps (40 tons)

Hot Water Trends Sunday 04/05/1998



Water Heating Loop Impact



Summary

- Annual heat pump COP of 3.3
- Water heating energy less than 10% of total use.
- System losses around 1/4 to 1/3 of total HP output
- Storage capacity of 1/2 to 1/3 of daily loads
- Heat pumps operated continually during day time
 - Sundays in winter have highest loads and lowest capacity
 - Loop temperatures ranged from 40 - 80 F
 - Storage set point at 130 F
 - No electric resistance

Summary

- Designer must understand:
 - Hot water loads (guest room diversity & laundry)
 - Recirculation losses
 - Heat pump capacity
 - » recovery ability
 - » operation at minimal loop temperature (must talk to loop contractor)
- Water heating reduced the ground heat exchanger size
 - Cooling dominated loop design
 - WH improved loop load balance between heating and cooling seasons
 - 20% reduction in loop length = 20% reduction in loop cost
 - » water heating heat pumps almost paid for by loop cost savings
- Building designed as integrated system to minimize costs