



NY - G E O 2 0 2 6

March 24-25, 2026 | Brooklyn, NY



Heat Pump Performance & Commissioning

Speakers: Zachary Fink / *ZBF Geothermal & NY-GEO Board*
Dan Flaherty / *CDM Smith*
Dalton Hill-Whitson / *Unilux HVAC*

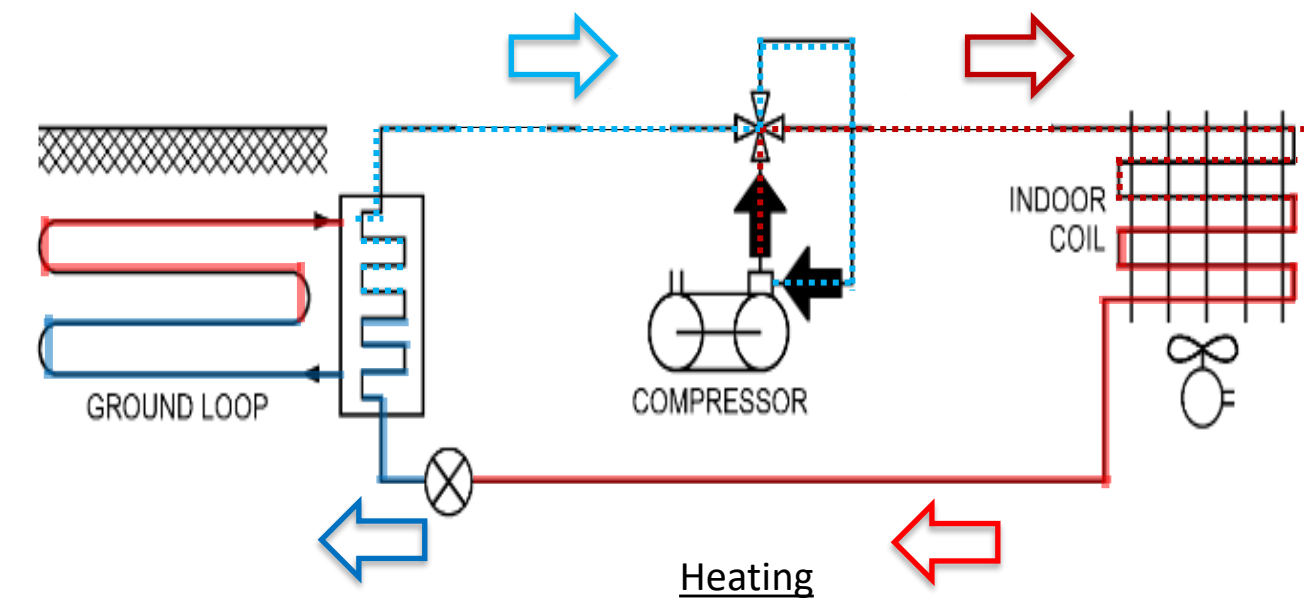
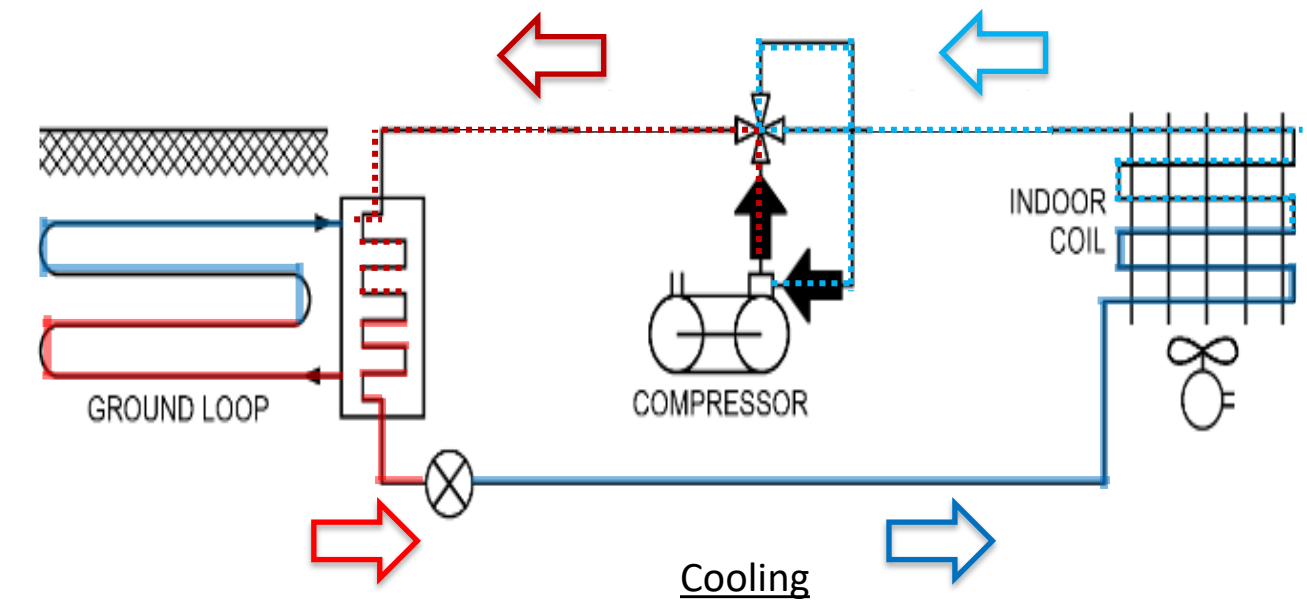
Learning Objectives

1. The importance of properly commissioning condenser water building loops.
2. Key factors that lead to actual performance being different from calculated performance in a condenser water loop.
 1. How do you manage these factors?
3. The importance of properly commissioning in-suite ground-source heat pump equipment.
4. Key factors that lead to actual performance being different from calculated performance with in-suite ground-source heat pumps.
 1. How do you manage these factors?



Heat Pumps

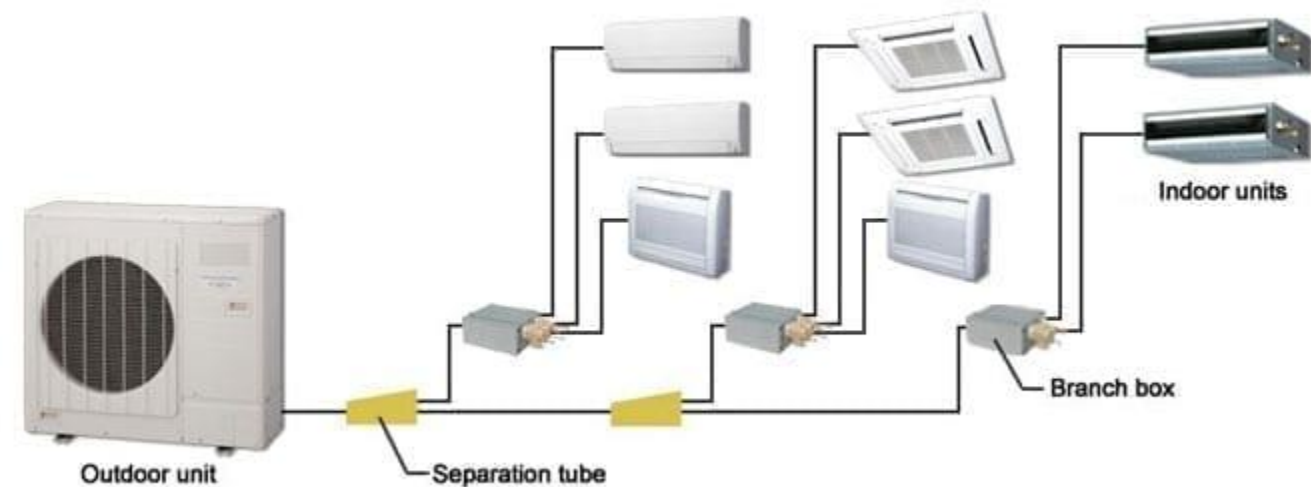
- Heat pumps reverse the vapor-compression cycle to heat and cool a building.
- The simple manipulation in this the circuits shown use a 4-way valve to reverse refrigerant flow.



Space Conditioning Heat Pumps

Air Source

- Air is the heat source/sink



Water/Ground Source

- Water is the heat source/sink



Coefficient of Performance (COP)

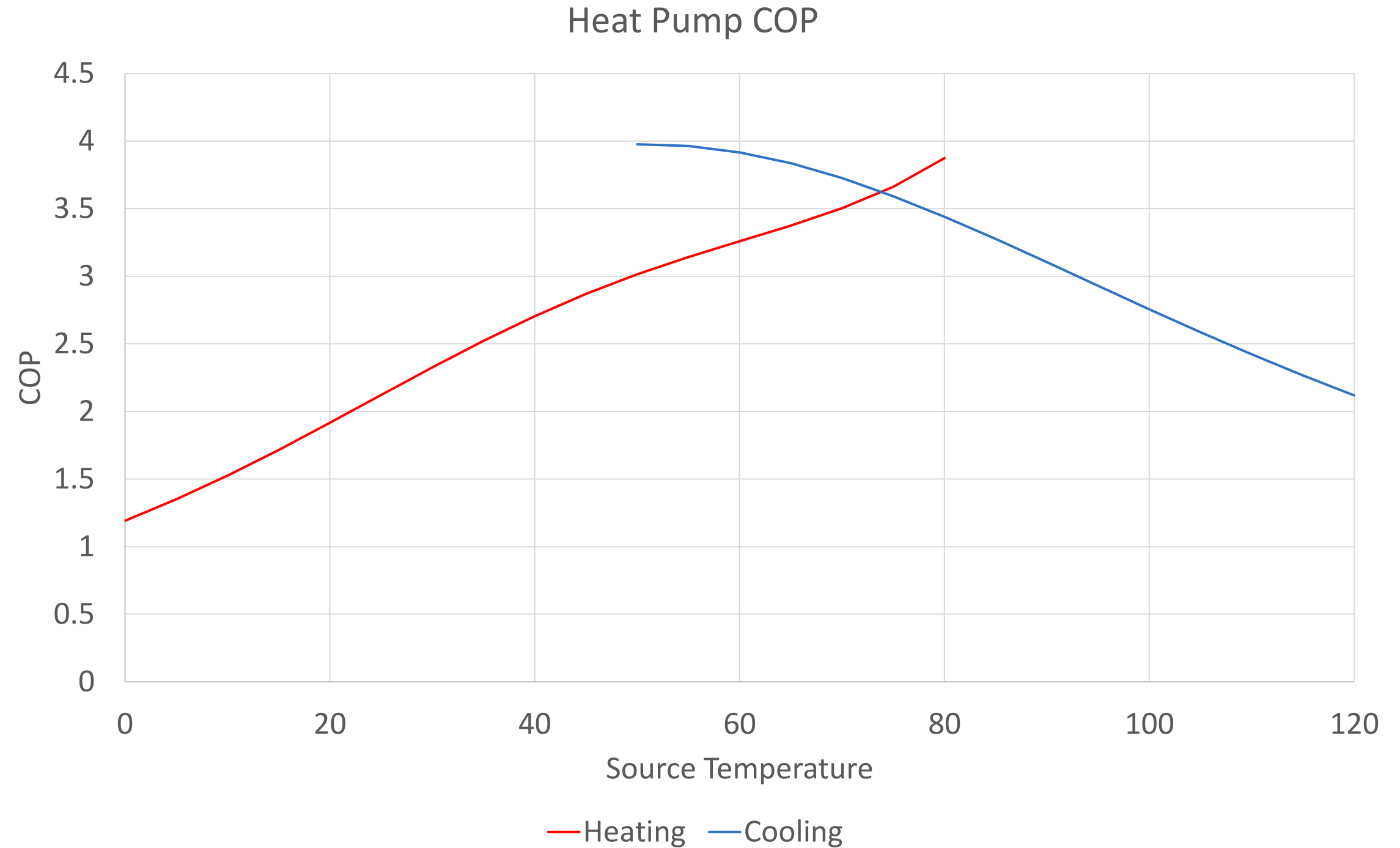
$$COP = \frac{\textit{Heat Transferred}}{\textit{Electricity Consumed}}$$

- Heat Transferred is amount of heat absorbed by the evaporator coil and rejected to the condenser coil
- Energy Consumed is amount of electricity required by system to move heat from the evaporator to the condenser by:
 - Compressor
 - Evaporator fan/pump
 - Condenser fan/pump

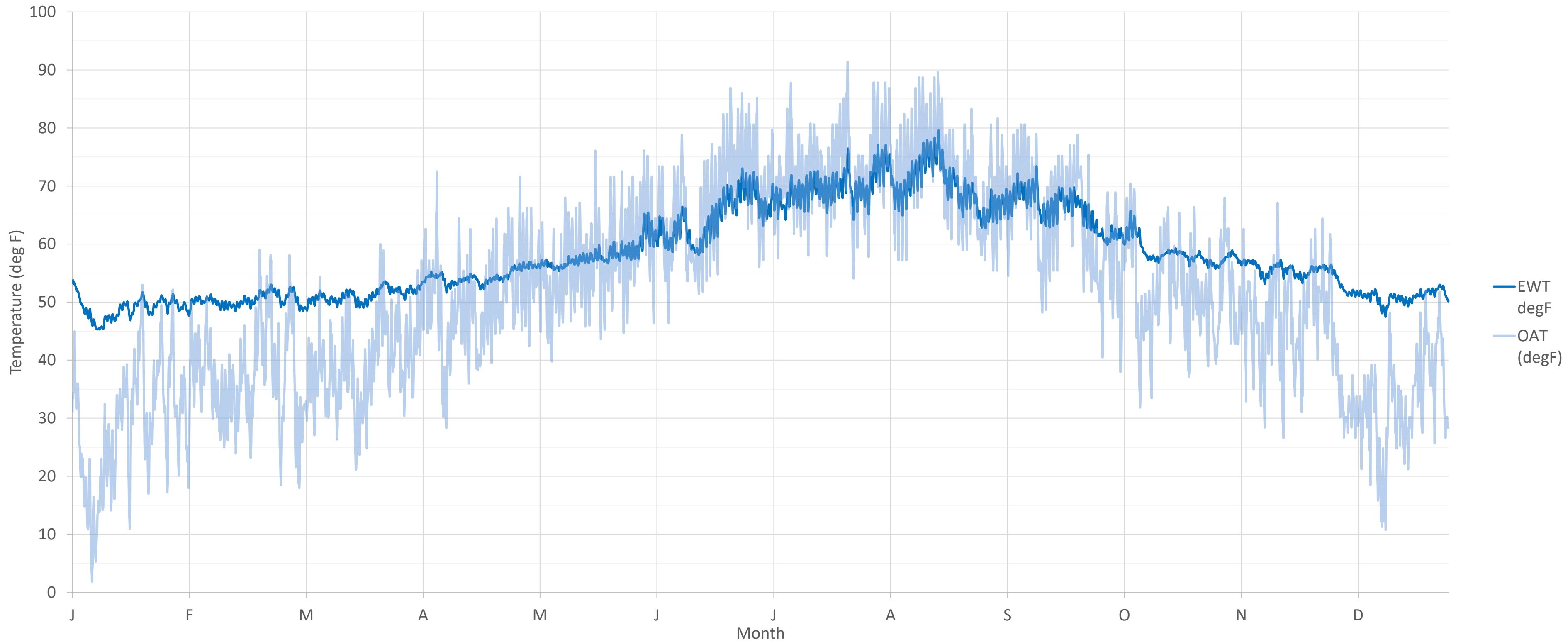


Coefficient of Performance (COP)

- Source Conditions
 - Dry Bulb/Wet Bulb
 - Ground Water Temperatures
- Load Conditions
 - Dry Bulb/Wet Bulb
 - Hot/Chilled Water Temperatures
- Part Load Factor



ASHP vs GSHP Source Temperatures



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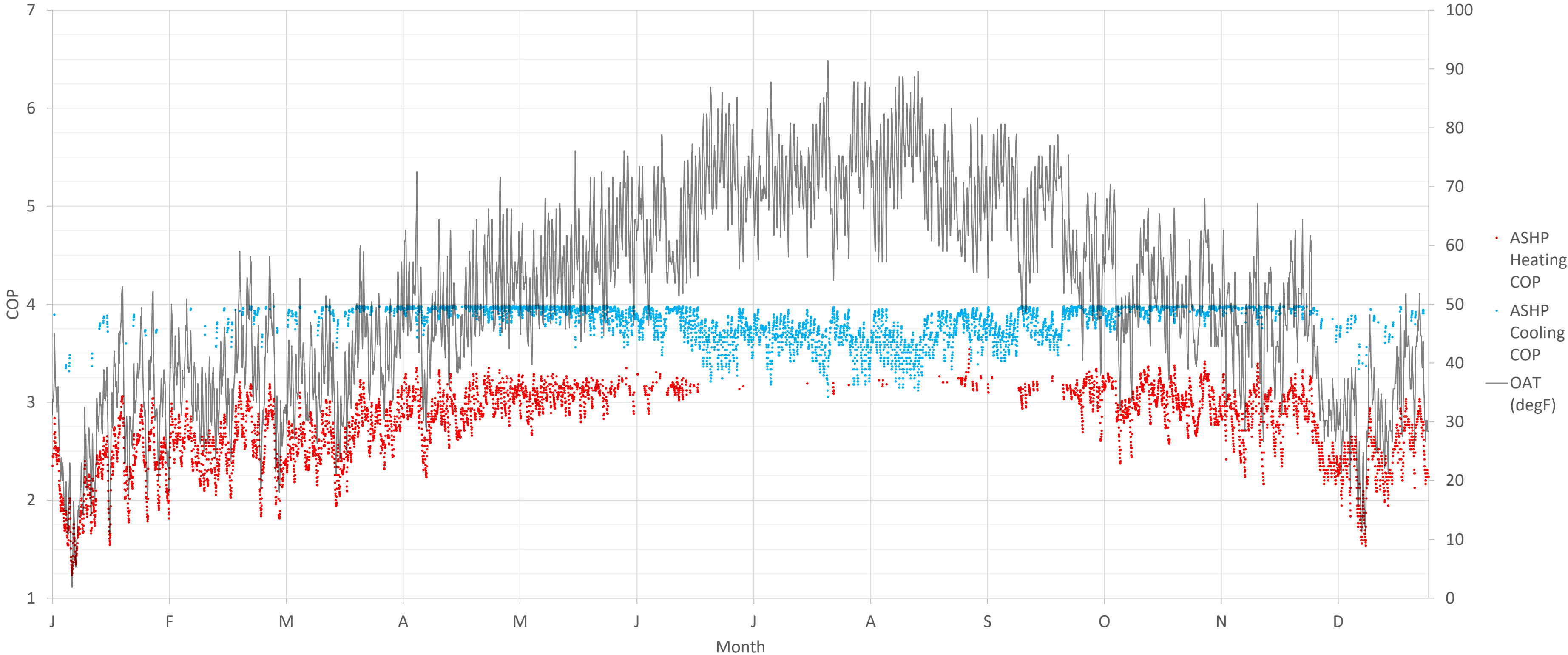


Calculating COP

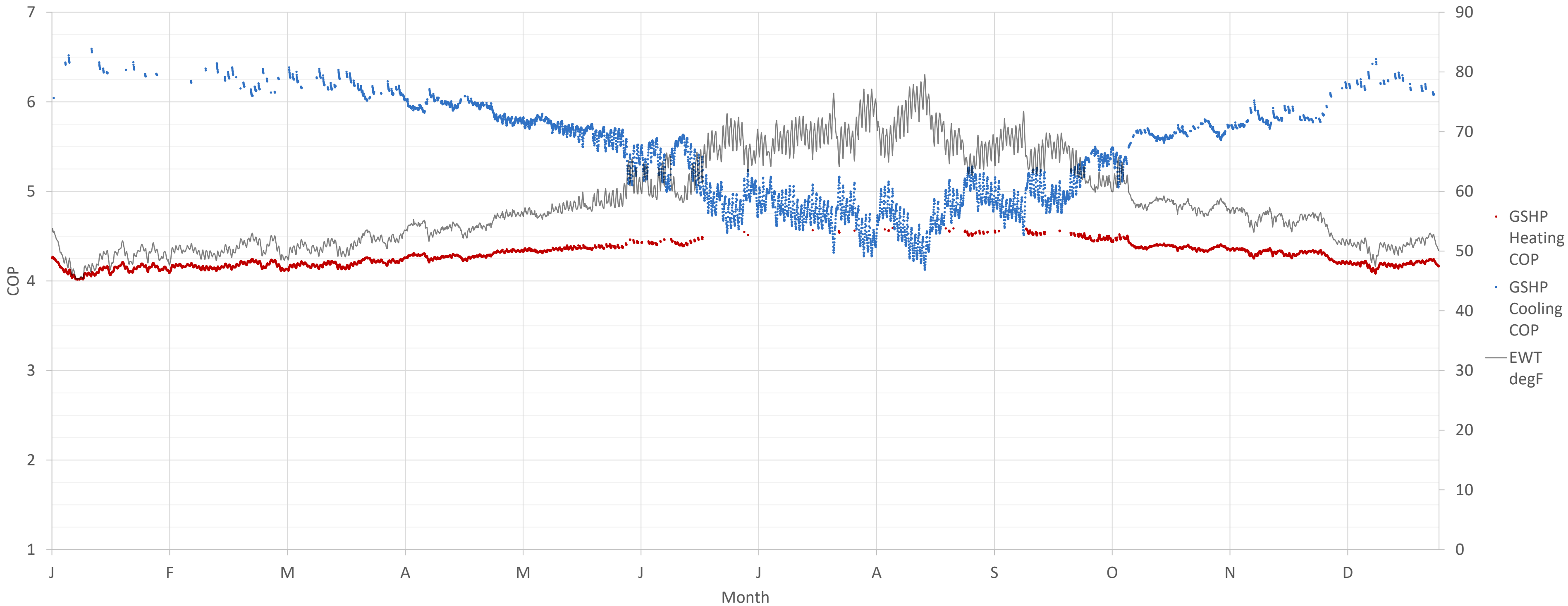
- Air Source
 - Procedures as described in *ANSI/ASHRAE/IES Standard 90.1-2019 Performance Rating Method Reference Manual*.
 - Heating: Electric Heat Pump Heating Efficiency Adjustment Curve
 - Cooling: Direct Expansion Cooling Efficiency Temperature Adjustment Curve
 - Held indoor dry bulb/wet bulb constant.
- Water Source
 - Published manufacturer data.
 - Held indoor dry bulb/wet bulb constant.



Calculated ASHP COP vs Ambient Temperature



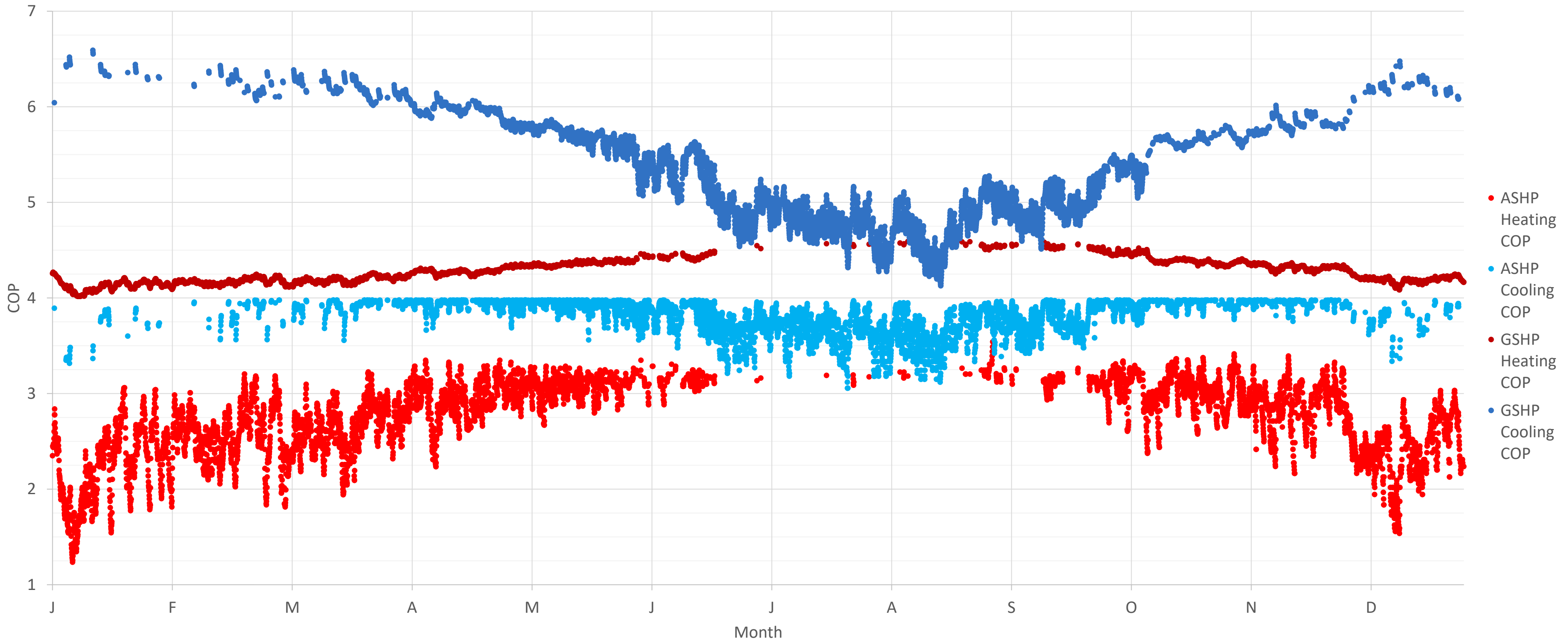
Calculated GSHP COP vs Geothermal Supply Temperature



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Calculated ASHP COP vs GSHP COP



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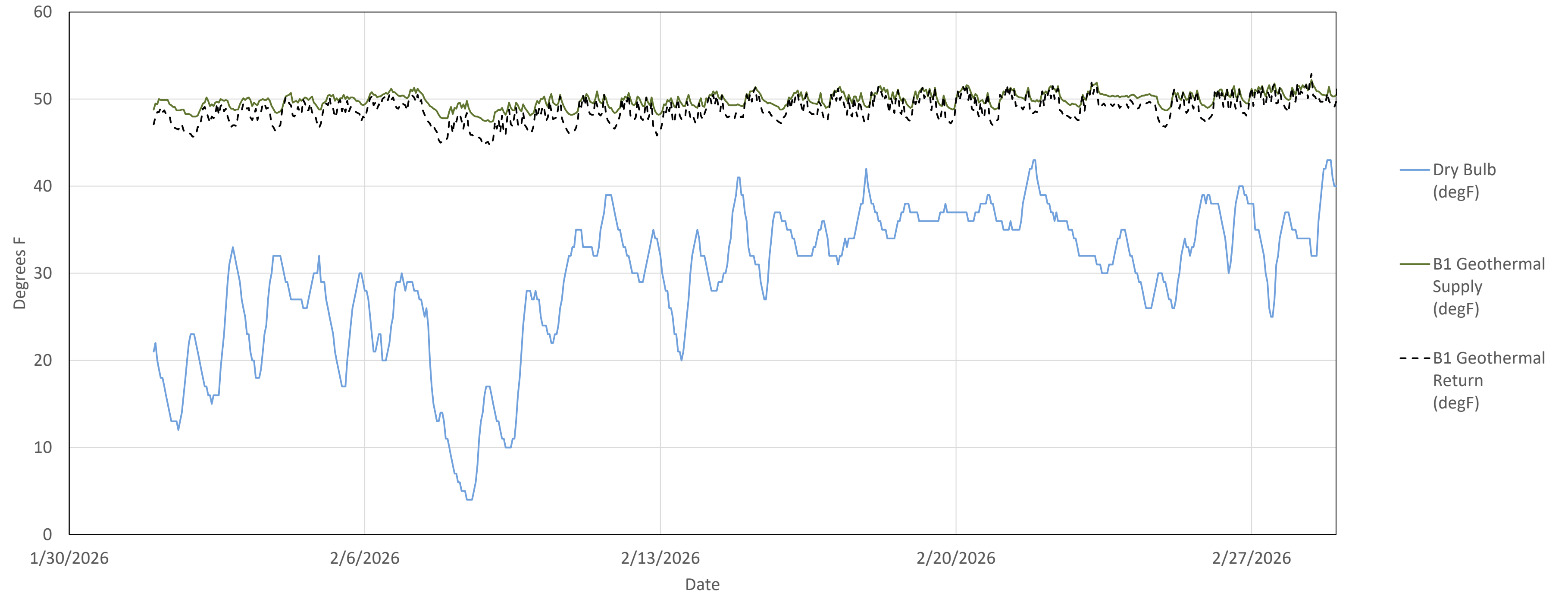
Actual GSHP Data

- Building 1
 - Location: Queens, NY
 - Primary Use Type: Residential
 - Size: 8 Story
 - System Type: Closed Loop U-bends
 - Loads on Geo: Heating, Cooling, DHW

- Building 2
 - Location: Brooklyn, NY
 - Primary Use Type: Residential
 - Size: 26 Story
 - System Type: Closed Loop U-bends
 - Loads on Geo: Heating, Cooling, DHW



Building 1 – Below 99.6% Design Point

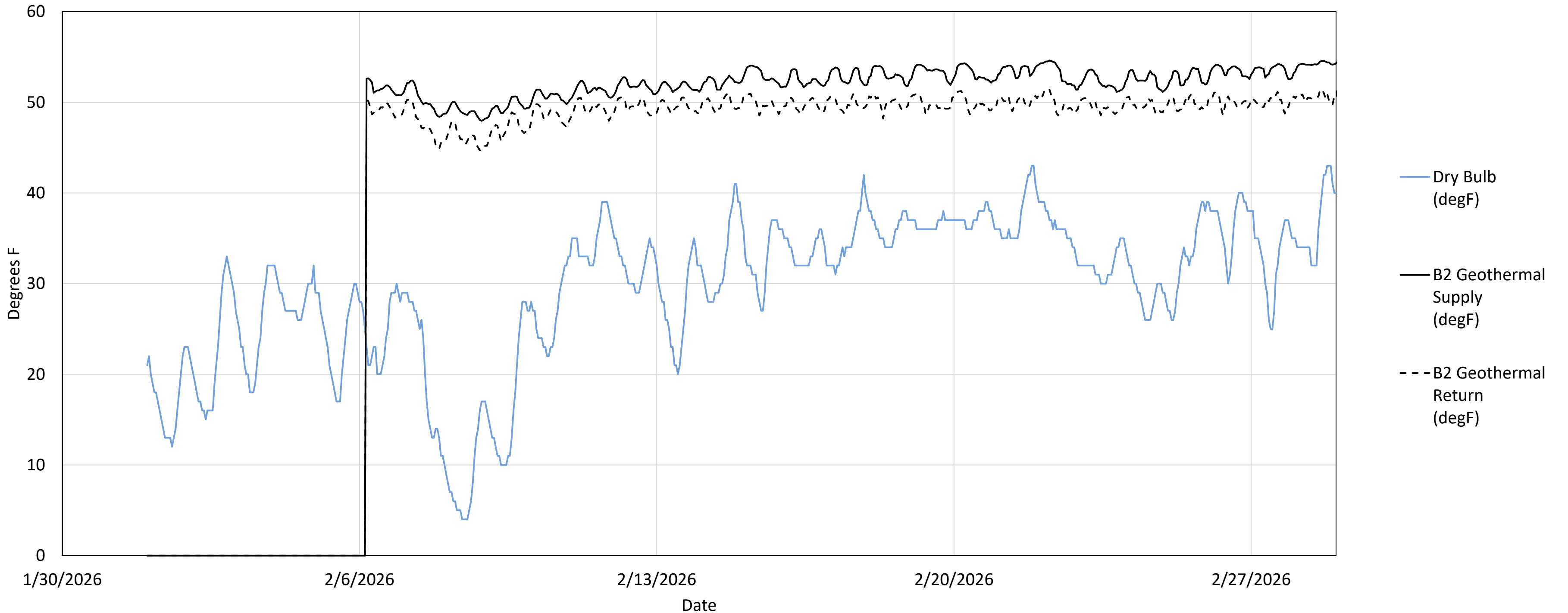


Building 1 – Below 99.6% Design Point

- 99.6% Heating Dry Bulb Temperature: 13.5 °F
- Observed Ambient Dry Bulb Temperature: 4.0°F
- Observed Geothermal Supply Temperature: 47.4°F
- Observed Geothermal Return Temperature: 44.7°F
- DHW COP: 3.42
- Heating COP: 4.1
- Cooling EER: 28.8



Building 2 – Below 99.6% Design Point



Building 2 – Below 99.6% Design Point

- 99.6% Heating Dry Bulb Temperature: 13.5 °F
- Observed Ambient Dry Bulb Temperature: 4.0°F
- Observed Geothermal Supply Temperature: 48.0°F
- Observed Geothermal Return Temperature: 48.0°F
- DHW COP:
- Heating COP: 4.1
- Cooling EER: 28.5



Impact of DHW of Building Loop

- Borefield temperatures are more impacted by DHW than outdoor air temperature
- DHW loads are typically greater than the heating load of the building on a super cold day



Importance of Commissioning GSHP Building Condenser Water Loop

1. Performance

1. Commissioning a building condenser water loop ensures that the system is operating properly and within the specified performance laid out by the engineer and geothermal consultant.
2. Commissioning ensures that everyone has done their scope correctly

2. Longevity of equipment

1. Proper commissioning ensures that the loop and equipment will be operating within specified conditions – allowing it to perform and last longer.



How to Commission GSHP Systems: Building Condenser Water Loop

1. Clean water is essential for operation

1. Remove all debris from water system – dirt, sediment, fibers. These should be caught in riser system strainers/filters and cleaned regularly/multiple times while starting up.
2. Treat water accordingly – in addition to cleaning dirt and debris, water should be treated for:
 1. Scale Control – Treat water with chemical scale inhibitors and manage water acidity
 2. Corrosion Control – Protect all piping and tubing from corrosion with solutions

2. Introduction of Glycol

1. Glycol is critical for ground-source heat pumps due to low condenser water temperatures. Prevent ice accumulation/freezing with a specified level of Glycol (typically we see ~25%)
2. How much Glycol needs to be in the system?
3. Who is introducing Glycol to the system?

3. Proper water conditions (Temperature & Flow) are crucial

1. Performance

1. Maintaining specified temperatures and flows ensures specified operation and performance
2. Operating outside these conditions can impact system performance.

2. Longevity of equipment

1. Keeping operation within engineer and manufacturer specification ensures equipment lasts



Importance of Commissioning GSHP Equipment: Performance

1. Maximize resident comfort
2. Maximize energy efficiency and building performance
3. Prevent waste energy
4. Get actual performance as close to calculated design performance as possible
 1. Water flow will impact performance
 2. Water temperature will impact performance
 3. Water quality will impact performance
5. Reduce strain on equipment



Importance of Commissioning GSHP Equipment: Longevity

1. Reduce maintenance costs
2. Maximize operational life expectancy to prolong replacement costs
3. Issues that impact equipment operational life expectancy:
 1. No/low flow – can cause refrigerant pressure or freezing issues
 2. Too much flow – can increase stress on system components overtime (valves, circuit setters, etc.)
 3. EWT too low – can lead to freezing issues as well as performance issues
 4. EWT too high – can increase stress on system components overtime (compressors, etc.) as well as performance issues



Get the Best Performance with Proper Commissioning

1. Pre-Commissioning

1. Ensure ground loop and building condenser loop are operational and commissioned appropriately
 1. Water treatment has been performed
 2. Pump are running and there is adequate/specified flow
 3. Temperatures are appropriate for in-suite equipment
 4. Riser system is free of all trapped air

2. Manufacturer Start Up

1. Proper unit with correct water, power and control connections
2. Ensure riser valves are open and riser openings are properly sealed
3. Thermostat/controls are configured properly
4. Motor and valves operate properly
5. Document water temperature, flow and report on heating EAT/LAT & cooling EA/LAT

3. Third Party Commissioning Agent

1. Final commissioning and building handover



Assessment Learning Evaluation

1. What are the key benefits of proper commissioning of the building condenser water loop?
2. What are some key considerations to keep in mind when commissioning a building condenser water loop?
3. What are the key benefits of proper commissioning of the in-suite ground-source heat pumps?
4. What are some key considerations to keep in mind when commissioning in-suite ground-source heat pumps?



Speaker Bio: Dalton Hill-Whitson

- Unilux HVAC, VP Sales
- 10 years in multi-family HVAC Industry
- Multiple ground source heat pump manufacturers

Unilux HVAC is a leading North American manufacturer of residential high-rise HVAC systems since 1972. Offering both vertical stack and horizontal ground-source heat pump systems, Unilux HVAC is a premier supplier to North America's top multi-family developers – and a top choice for engineers, contractors and residents alike. Unilux HVAC supplies the North American market with 15,000+ ground-source heat pumps ever year.

In 2025, Unilux HVAC's parent company, VAST Industrial Corp., acquired The Whalen Company.



Speaker Bio: Zachary Fink

- ZBF Geothermal
- 18 years in the geothermal HVAC Industry
- Designer of multiple geothermal projects including 13 multifamily buildings currently operating in NYC

ZBF Geothermal is a design/build contractor focusing on high performance geothermal systems. Our sister company ZBF Geothermal Consulting focuses on designing geothermal system for multifamily buildings. ZBF assists with the project from inception to long term operation, including helping to design the system to maximize available state, federal, and local incentives



Speaker Bio: Dan Flaherty

- CDM Smith, Geothermal Discipline Leader
- 25 years in the HVAC industry
- Engineer of Record for multiple district geothermal projects and stand-alone geothermal projects.

Dan has 25 years of experience in management, design, and analysis of HVAC, piping, mechanical, and energy systems for industrial, commercial, educational, municipal, and utility facilities. He served as the project technical leader on the Eversource Energy, Con Edison, and National Grid geothermal pilot projects in Massachusetts and New York. Additionally, Dan is the engineer of record for several multifamily single building geothermal systems.





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