



NY - G E O 2024
October 22 -23 | BROOKLYN, NY



Commercial Geothermal Heat Pumps for Domestic Hot Water

Moderator: Brendan Hall / *CHA Consulting*

Speakers:

- **Bob Brown / *WaterFurnace International***
- **Andrew Macaluso / *Watts Water***
- **Tyler Tjong / *SRS Enterprises***
- **Dan Breit / *Highmark***

Commercial Domestic Hot Water

- Bob Brown
- VP of Regulatory Affairs

WaterFurnace[®]
Commercial Solutions



Why Heat Pumps?

	Elec Heat DHW Sys	WF DHW Sys	Natural Gas Boiler
256 KBTU heating capacity per hour 1,800 run hours per year	83.75 kW/h	33.5 kW/h	3.2 therms/h
Efficiency	1.0 COP	2.5 COP	80% thermal eff
Power consumption per year	150,750 kWh	60,300 kWh (=2,058 therms)	5,760 therms
Operating cost* per year	\$15,075	\$6,030	\$5,472
Carbon Dioxide equivalent	107 metric tons	42.7 metric tons	120 metric tons
Environmental impact vs. WF DHW	90,450 kW over WF DHW	-	3,702 therms over WF DHW
Emissions impact over WF DHW	7,213 gal og gas wasted (=adding 13.9 passenger vehicles to the road each year)	-	8,653 gal og gas wasted (=adding 16.7 passenger vehicles to the road each year)

Significant operating cost savings compared to electric heat alternatives

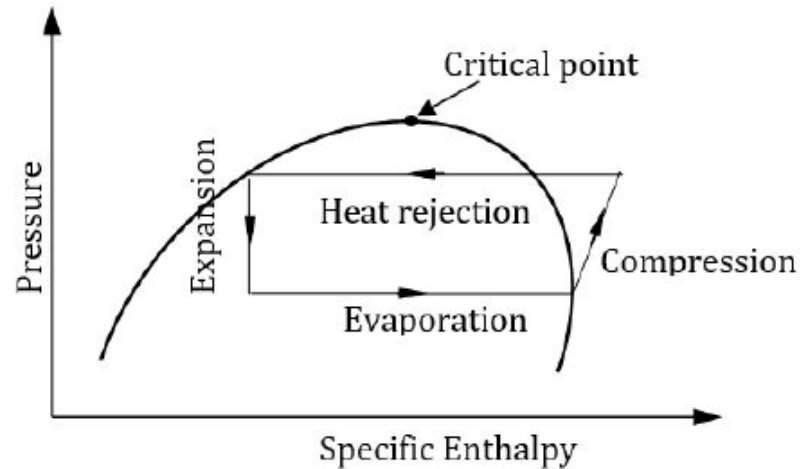
- Typical COP ranges from 2.5 to 4.0
- Simultaneous COP as high as 10.0!

*Utility rates: Electricity - \$0.10/kWh, Natural Gas - \$0.95/therm

<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>
<https://www.energy.gov/eere/temp/energy-cost-savings-calculator-commercial-boilers-closed-loop-space-heating-applications>

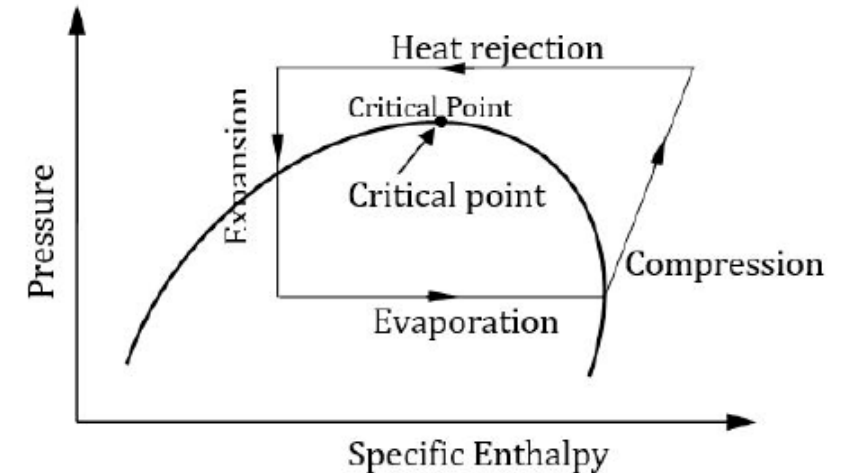
Synthetic Refrigerant vs CO2

Subcritical Cycle



- Efficient heat transfer via phase change under the dome
- Higher GWP / Non-flammable
- Lower GWP / Flammable
- Regulated substance
- Lower pressures / pressure ratios
- Simple cycles / high efficiency systems

Transcritical Cycle



- Exclusive to CO2
- Properties of CO2 improve supercritical heat transfer
- GWP = 1 / Non-toxic / Non-flammable
- Abundant resource
- High pressures / compression ratios (1885 psi / 10:1)
- Complex cycle / reliability concerns / unavoidable losses

DHW Heat Pump Supply Temp Trends

Transcritical CO2 / R-290 / R-454C

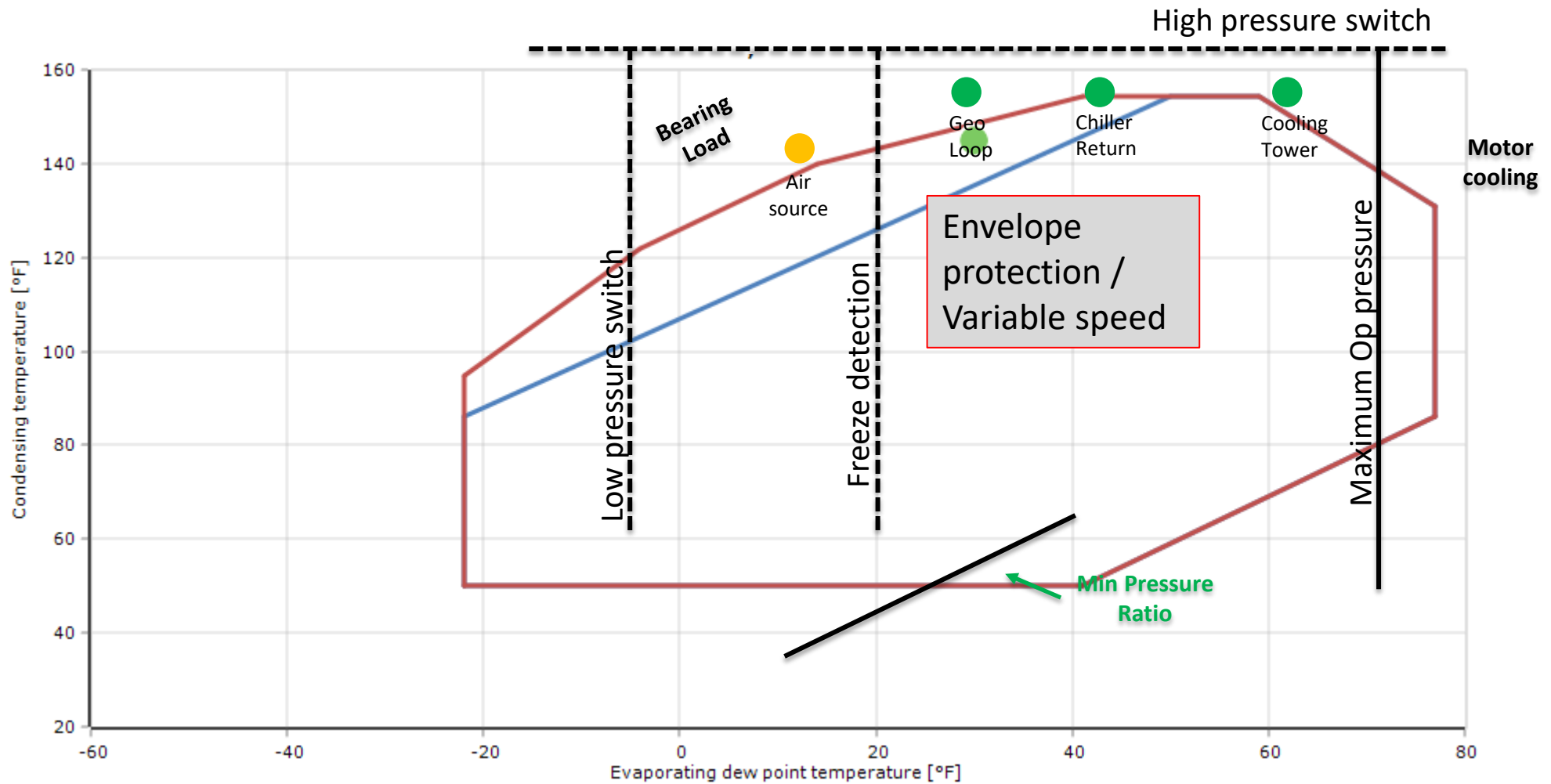
R-410A / R-454B / R-32

Leaving Hot Water Limit:

- Refrigerant type
- Load Flow Rate
- Source Temperature
- Compression cycle

Above 158 F	•• Disinfection Range
151 F	•• Legionellae die within 2 minutes
140 F	•• Legionellae die within 32 minutes •• Risk of scalding
Above 122 F	•• Legionellae can survive but do not multiply
68 F – 122 F	•• Legionellae growth range •• Ideal growth range is 95 F-115 F
Below 68 F	•• Legionellae can survive, but are dormant. •• Ideal for cold water storage, piping, fountains, etc.

DHW HP Operation & Reliability



Beneficial new Compressor Technologies

- **Liquid Injection**

- Leaving water temperature +140 F @ ground loop conditions
- Refrigerant cools compressor motor to extend operation envelope.

- **Vapor Injection**

- Leaving water temperature +140 F @ ground loop conditions
- Refrigerant cools compressor motor to extend operation
- Enhanced capacity up 25% and efficiency up 10% at high compression ratios over 2.



DHW Turf Issues: Mechanical vs Plumbing

- **Mechanical**

- Understands heat pumps / refrigeration cycle
- Understands BAS / controls
- Wins when DHW connected to chilled water return / ground loop

- **Plumbing**

- Understands load calculations
- Typically fixture based with adjustments for the application
- Familiar with DHW tank/piping system
- Wins when the job isn't connected to the mechanical equipment



Electrifying water heating: Science vs Finesse

Fixture Demand

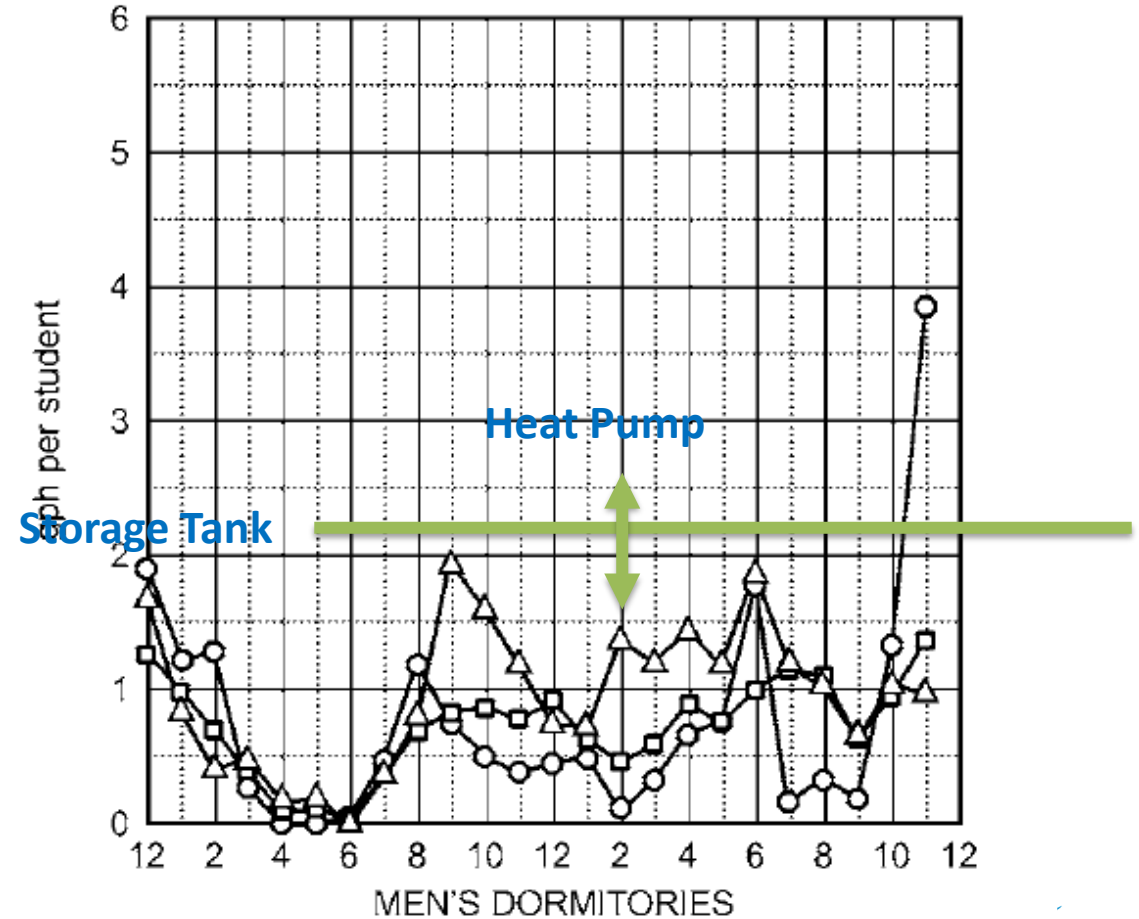
- Summation of all fixtures installed
- Uses fixture total to estimate diversity of demand
- Can allow oversizing
- **Designers tend to develop their own usage profiles**

TABLE 1 HOT WATER DEMAND PER FIXTURE FOR VARIOUS TYPES OF BUILDINGS
(GALLONS [LITERS] OF WATER PER HOUR PER FIXTURE, CALCULATED AT A FINAL TEMPERATURE OF 140°F [60°C])

Fixture	Apartment	Club	Gymnasium	Hospital	Hotel	Industrial Plant	Office Building	Private Residence	School	YMCA
Basins, private lavatory	2 (7.6)	2 (7.6)	2 (7.6)	2 (7.6)	2 (7.6)	2 (7.6)	2 (7.6)	2 (7.6)	2 (7.6)	2 (7.6)
Basins, public lavatory	4 (15)	6 (23)	8 (30)	6 (23)	8 (30)	12 (45.5)	6 (23)		15 (57)	8 (30)
Bathtubs	20 (76)	20 (76)	30 (114)	20 (76)	20 (76)		20 (76)		30 (114)	
Dishwashers ^a	15 (57)	50-150 (190-570)		50-150 (190-570)	50-200 (190-760)	20-100 (76-380)		15 (57)	20-100 (76-380)	20-100 (76-380)
Foot basins	3 (11)	3 (11)	12 (46)	3 (11)	3 (11)	12 (46)		3 (11)	3 (11)	12 (46)
Kitchen sink	10 (38)	20 (76)		20 (76)	30 (114)	20 (76)	20 (76)	10 (38)	20 (76)	20 (76)
Laundry, stationary tubs	20 (76)	28 (106)		28 (106)	28 (106)		20 (76)		28 (106)	
Pantry sink	5 (19)	10 (38)		10 (38)	10 (38)		10 (38)	5 (19)	10 (38)	10 (38)
Showers	30 (114)	150 (568)	225 (850)	75 (284)	75 (284)	225 (850)	30 (114)	30 (114)	225 (850)	225 (850)
Service sink	20 (76)	20 (76)		20 (76)	30 (114)	20 (76)	20 (76)	15 (57)	20 (76)	20 (76)

DHW Heat pump System Sizing Basics

- **Size the storage tanks for peak demand**
 - Adding storage less costly than adding heat pumps
 - Use back-up heat on finishing tank
- **Size the heat pump for daily usage**
 - 12-16 hours of run time
 - Source temperatures impact output capacity
 - Use heat pumps with multiple stages of compression
 - Use lead/lag for equal run time
 - Lower inlet temperatures improve efficiency





R-744 Heat Pump Water Heating

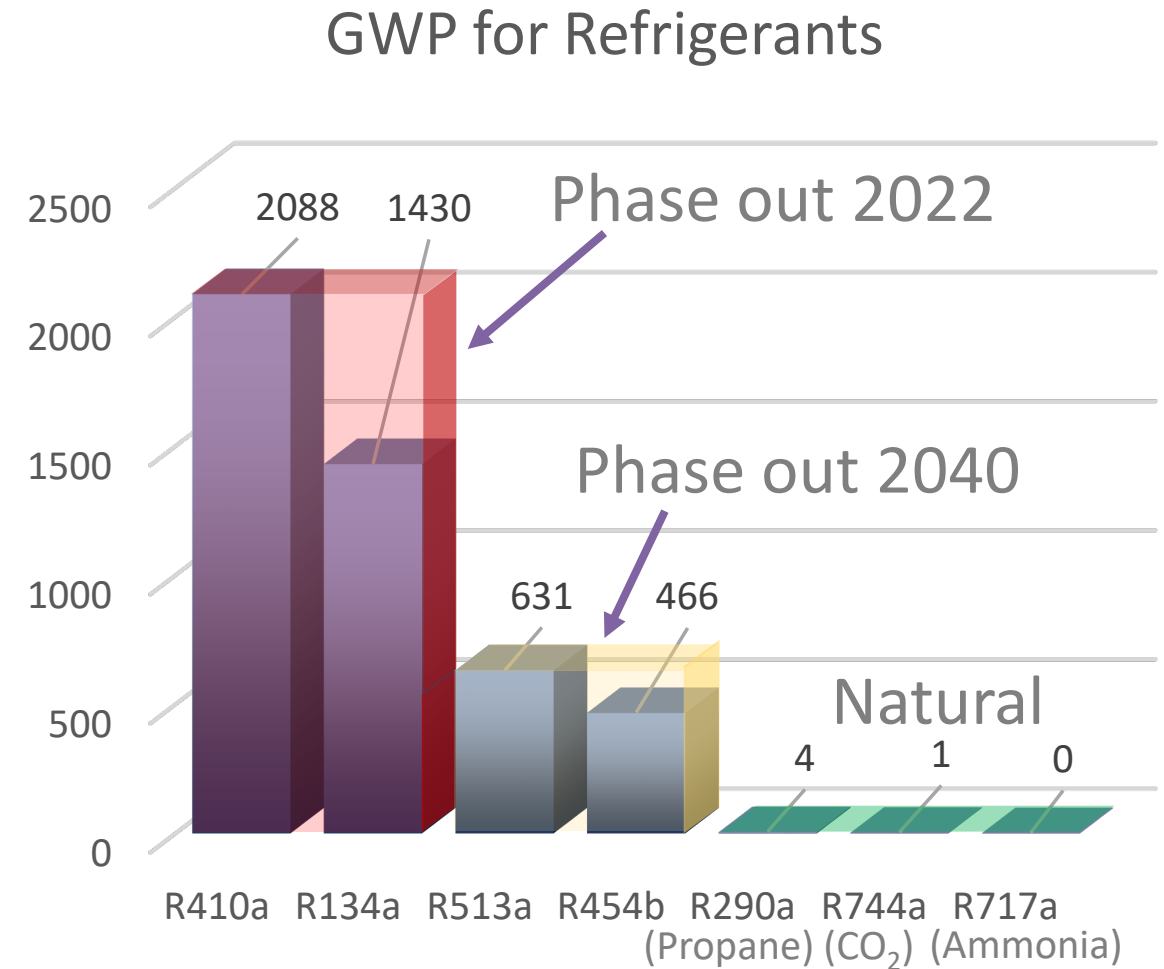
Presented By:

Andrew Macaluso, Sr. Product Manager

andrew.macaluso@wattswater.com





Benefits of R-744

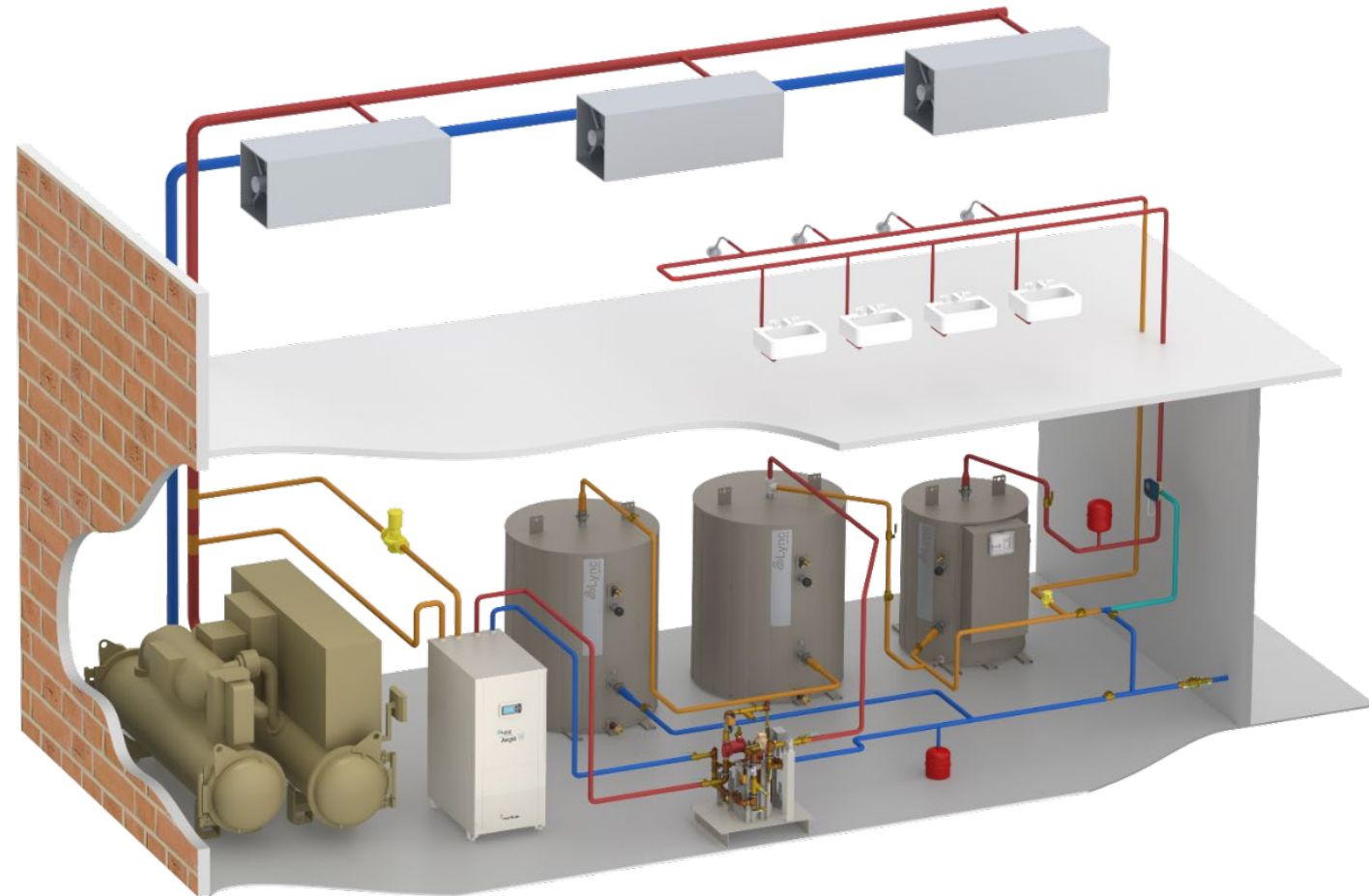
- Future proof
- Non-toxic, non-flammable, GWP = 1
- Higher temperatures possible
 - Higher temps → smaller storage
 - Pathogen mitigation
- Operator friendly
 - Sealed appliance
 - No specialized operational training required for site staff
 - No need for monitoring and evacuation
- NYC FC 606.1.1 “shall not be treated as an A1 refrigerant,” not limited to 15 HP



Aegis Domestic Water Heat Pump

End-to-end CO₂ heat pump solution bringing single point responsibility & accountability to domestic water applications

-  Environmentally Friendly
-  Energy Efficient
-  Footprint Savings
-  Simplifies Designs



Aegis Domestic Water Heat Pump



Largest capacity domestic water heat pumps on the market

- Aegis A 250, 350, 500 (14, 25, 35 HP)
 - Also available with cool recovery options
- Aegis W 250, 350, 500 (14, 25, 35 HP)

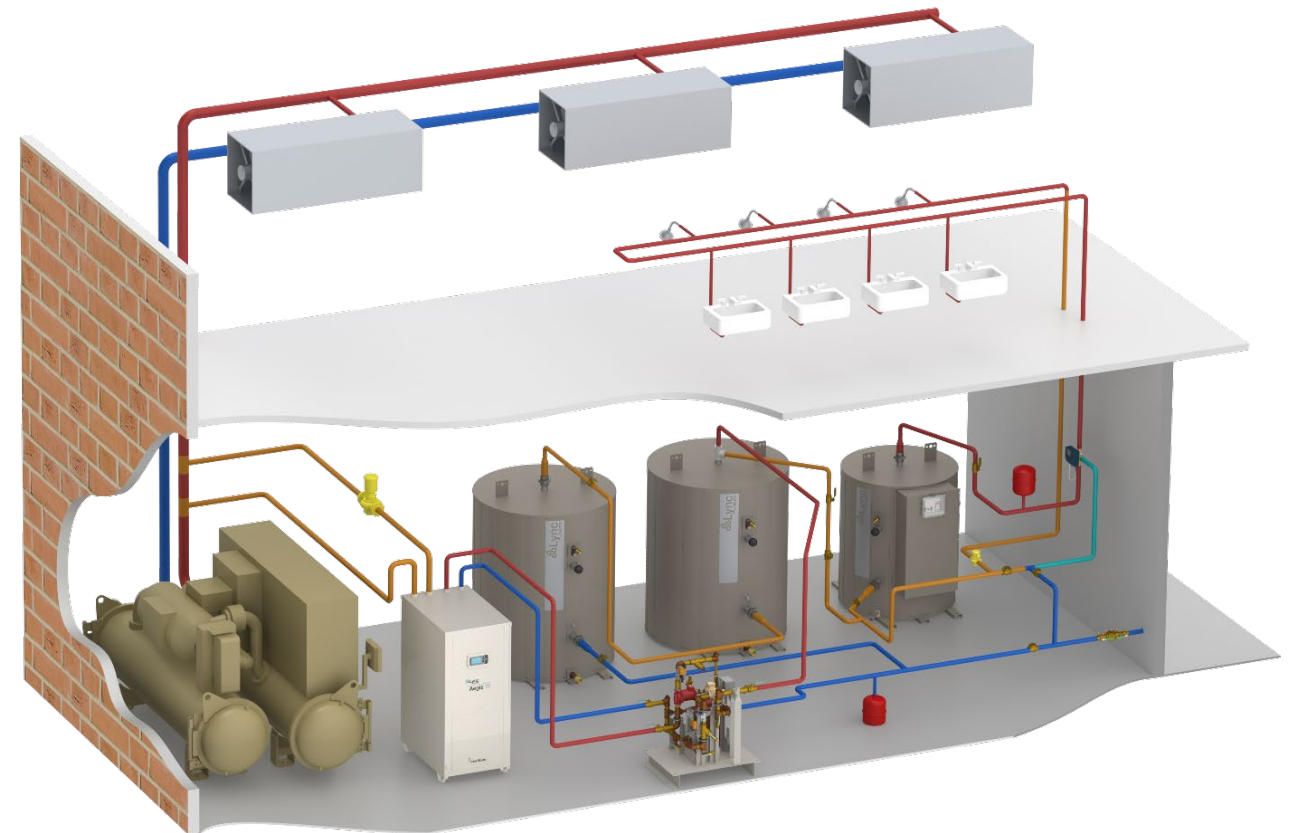
Elevated supply temperatures allow design flexibility and load sharing

Wide operating parameters increase annual efficiency and reduce reliance on backup heating sources

Natural refrigerant and high COPs (efficiency) make the AEGIS an optimal solution for electrification initiatives

Water Source Applications

- Easiest retrofit
 - No large coils
- No concerns about winter temperatures
- Applications include
 - Geothermal
 - Process applications
 - Chilled water loops
- Reduce temperatures to chiller
 - Increased performance on both sides!
- TER – **Total Energy Ratio**
 - Includes cooling effect
- Talk to the mechanical team!



1515 Surf Ave

- Reduced equipment from 14 to 7 units
 - R-744 exempt up to 50 HP
- No concerns about refrigerant indoors
- Higher storage temperatures reduced storage requirements
- Collaboration with GA Fleet, Robco Specialties, ZBF Geothermal
- Similar benefits for 25 Stewart Ave, Williamsburg



System Solutions



- Engineered Solutions
 - Heat Pump systems
 - Water Heater Skid systems
 - Water Quality Skid systems
 - New Disruptive Solutions
- Pre and Post Sale Services



Plumbing Products



- Water Heating
 - Natural gas
 - Steam
 - Electric
 - Oil
- Water Heating Skid Systems



Hydronic



- Space Heating
 - Gas Fired Boilers
 - Indirect Water Heating
 - Combination Plants
- HVAC Skid Systems



Leak Detection



- Wireless water leak detection systems

Water Quality



- Conditioning
- Disinfection
- Filtration
- Instrumentation
- Scale Prevention

WQ Monitoring



Providing Complete Solutions for Customers

Geothermal Hot Water Heat Pump Solutions



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SAMSUNG

- SRS Heat Pump Partners
 - Samsung HVAC
 - Nyle Water Heating Solutions
 - Multistack

nyle
water heating
systems

 **MULTISTACK**[®]
Originators. Innovators. Never the Imitators.

DVM S Water

SAMSUNG



DVM S Water - 1Ø

SAMSUNG



DVM S Water®
1 Ø - 3 to 4.5 tons
HP

- Available in 3.2, 4, and 4.5-ton capacities
- Multi-family projects – boiler/chiller or ground loop
- Single-family projects - ground source
- Compact – fits in small closets
- Low Sound – 47-49db
- Supports up to 9 indoor units
- Water Temps:
 - From 50°F to 113°F
 - From 14°F to 50°F with anti-freeze

DVM S Water - 3Ø

SAMSUNG



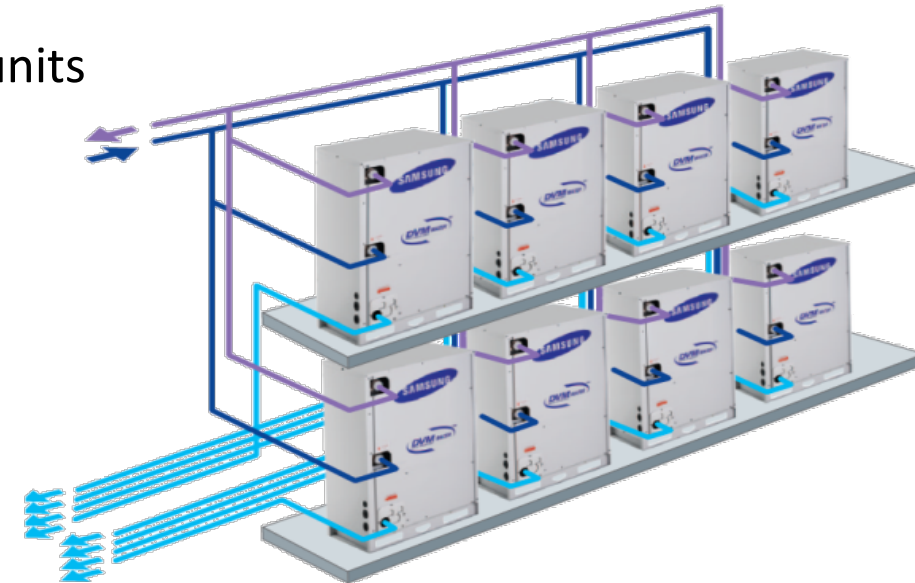
**DVM S Water
3 Ø - 6 to 34 tons
HP & HR**

- Heat Pump or Heat Recovery is field Configurable
- Available in 6, 8, 10, 16, and 20-ton capacities.
- Connect up to 3 units for system capacities up to 34 tons
- 208/230 and 460 VAC
- Uses standard DVM S indoor units

6, 8, 10 ton



16, 20 ton

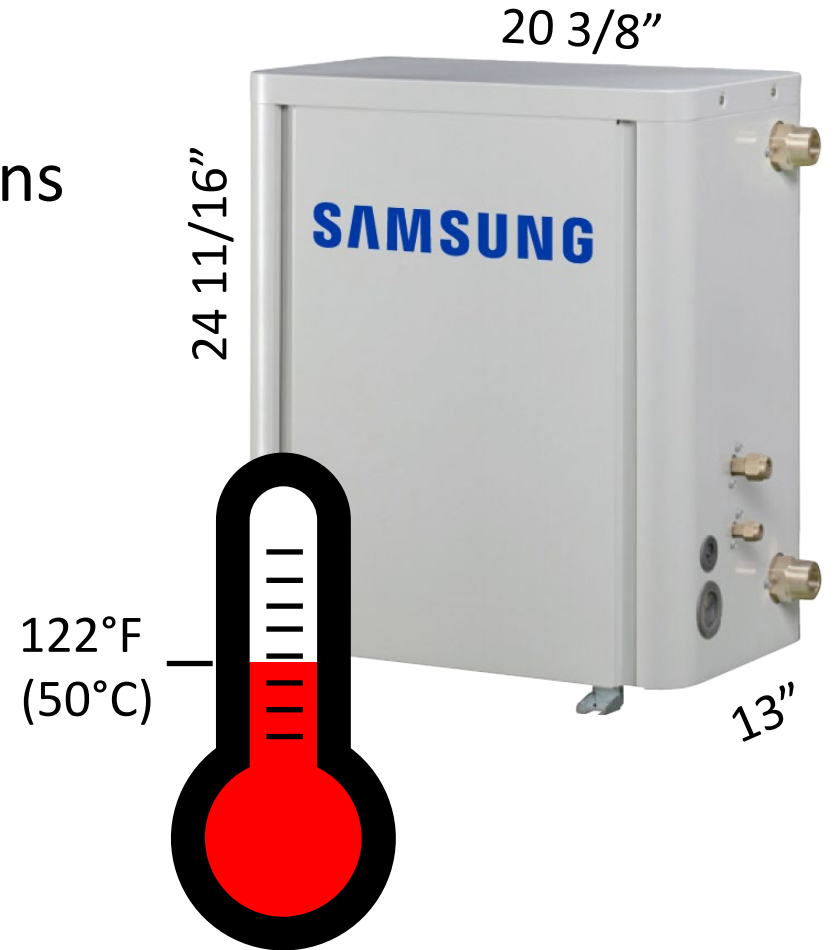


Hydro Unit Line Up

SAMSUNG

- HE – Medium Temperature
- Nominal 36, 48, 96, and 144K Btu/h Options
- Provides hot water up to 122°F (50°C)

Model	Heating Capacity (Btu/h)
AM036CNBDCH/AA	40,000
AM048CNBDCH/AA	54,000
AM096CNBDCH/AA	108,000
AM144CNBDCH/AA	172,000

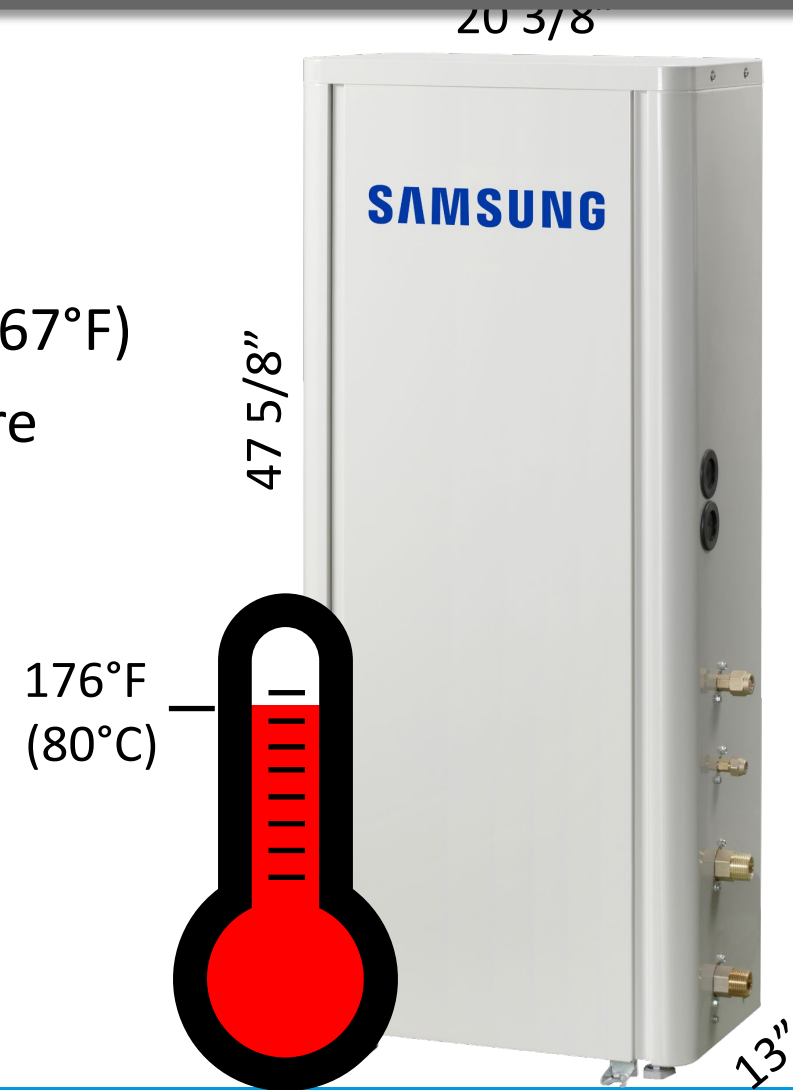


Hydro Unit Line Up

SAMSUNG

- HT – High Temperature
- Nominal 48 and 72K Btu/h options
- Provides hot water up to 176°F (Max set point 167°F)
- Secondary refrigerant cycle to boost temperature
- Up to 3 HT models per refrigerant system

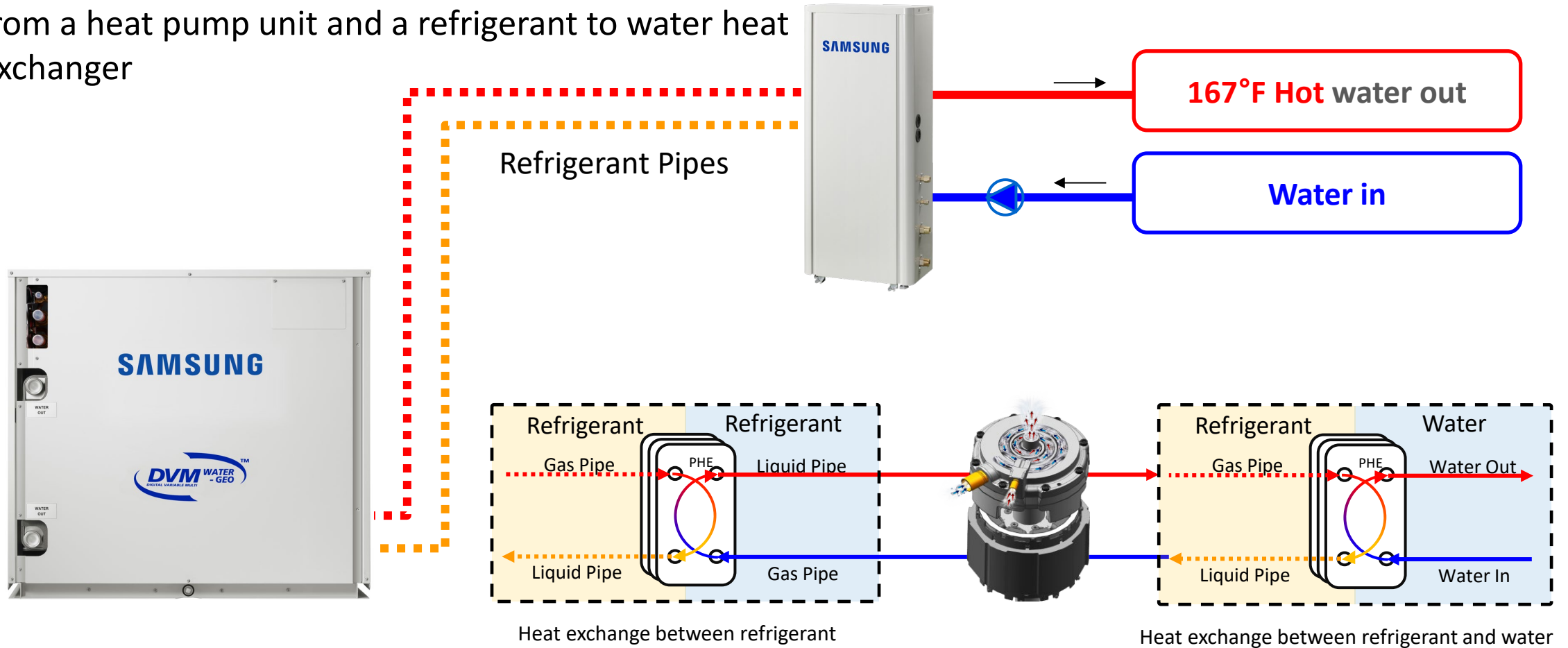
Model	Heating Capacity (Btu/h)
AM048CNBFCB/AA	54,500
AM072CNBFCB/AA	86,000



Hydro Unit Basics

SAMSUNG

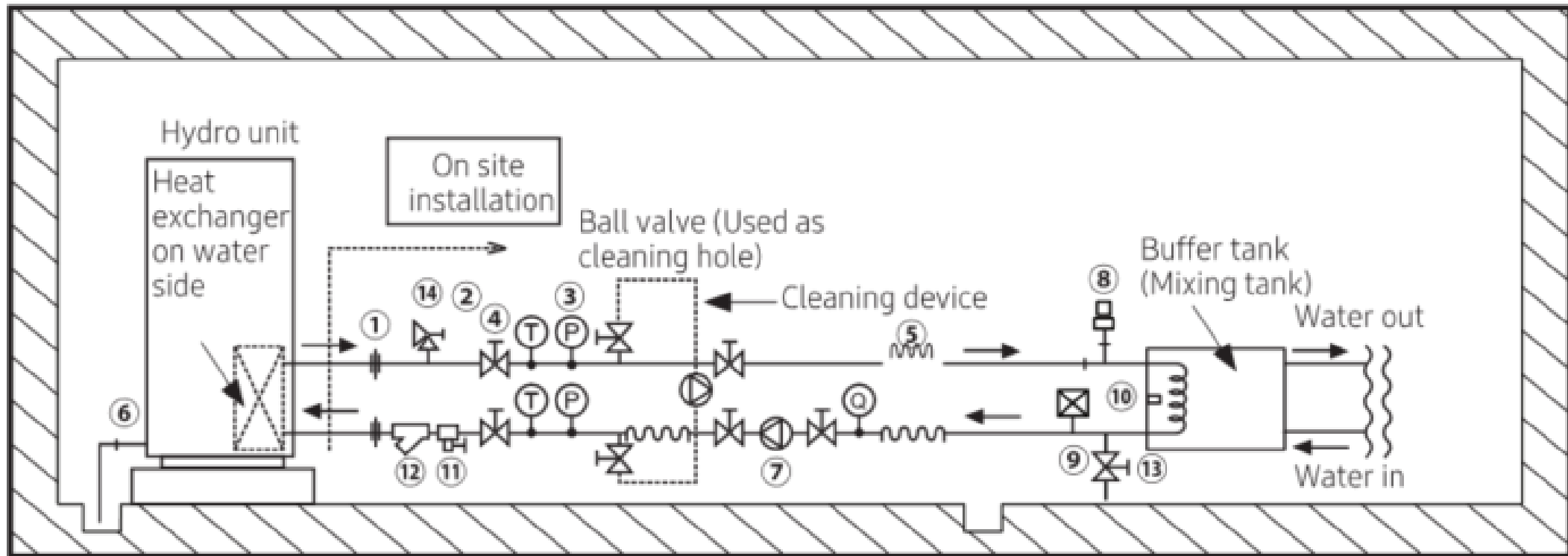
- Supply hot water by using high temperature refrigerant from a heat pump unit and a refrigerant to water heat exchanger



Typical Piping

SAMSUNG

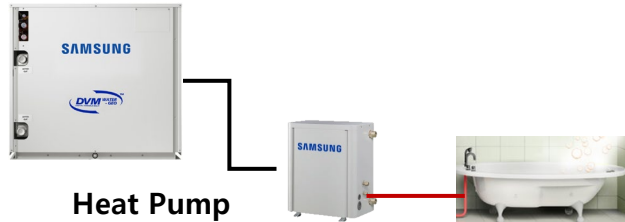
- Indirect tank required for domestic water heating



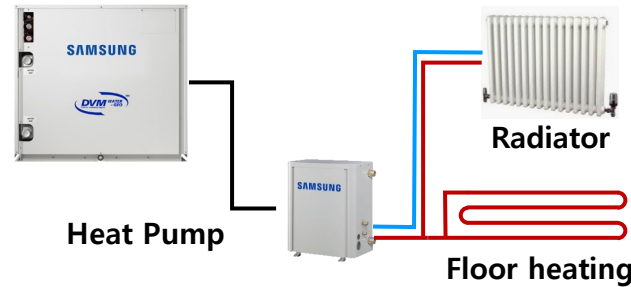
Typical Applications

SAMSUNG

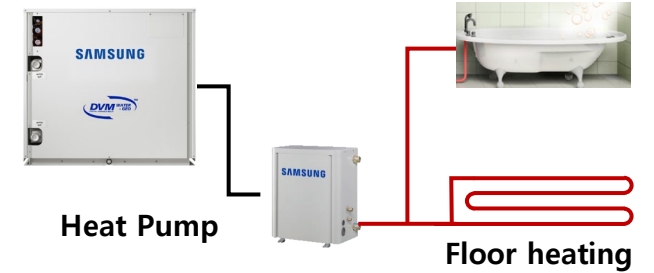
Hot water



Radiant Heating/Cooling

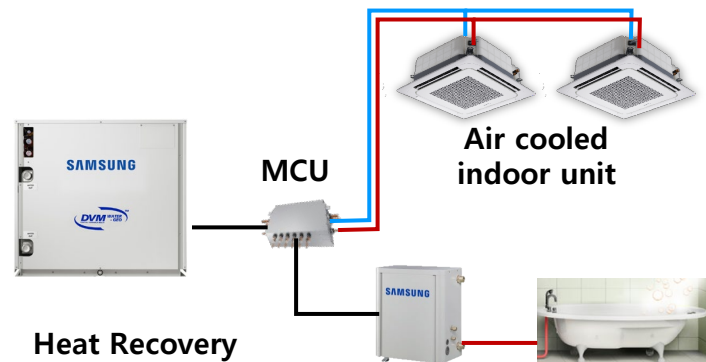


Radiant Heating + Hot water



HR Hydro Solution

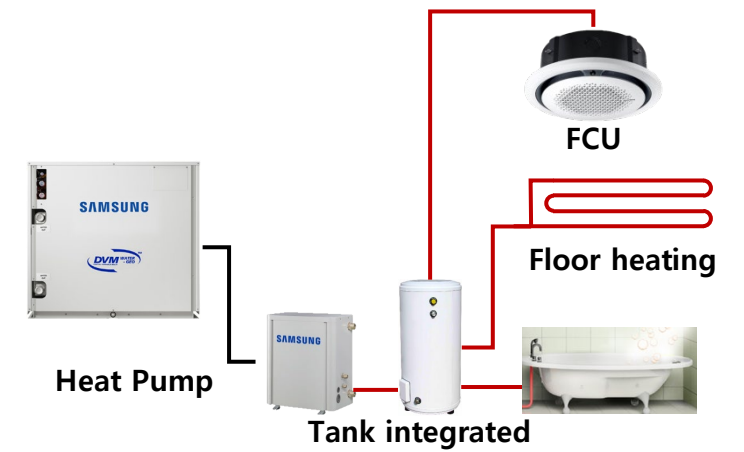
Air-cooled unit Heating/Cooling + Hot water



Fan Coil Unit Heating/Cooling



Hot water + Thermal storage



Heat Pump Water Heating Solutions



Diverse Environments



AIR-SOURCE

C and E-Series

Outside Air

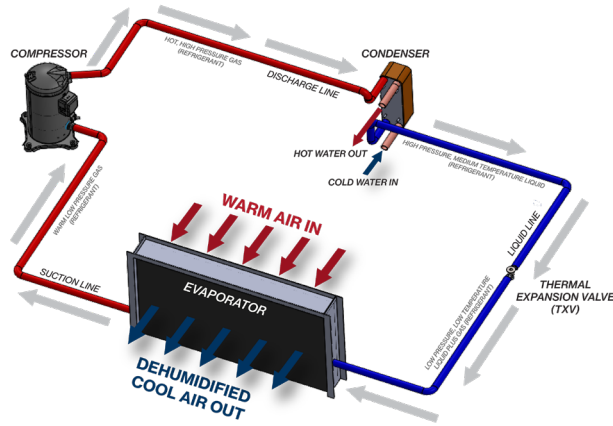
-15°F-120°F

Exhaust Air Recovery

35°F - 75°F

Hot Mechanical Spaces

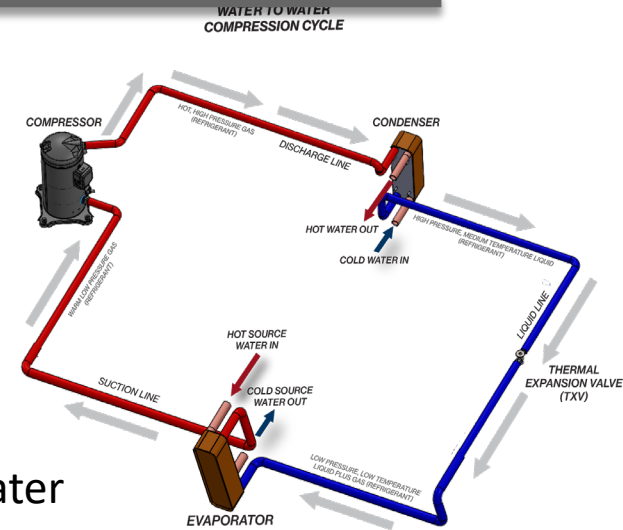
80°F - 120°F



WATER-SOURCE

CW and CWM-Series

- Geothermal
- 30°F - 60°F
- Condenser/Chilled Water
- 55°F - 75°F
- Hydronic Hot Water
- 90°F - 120°F
- Wastewater (Energy Recovery)
- ~65°F



The C-Series Water-Source

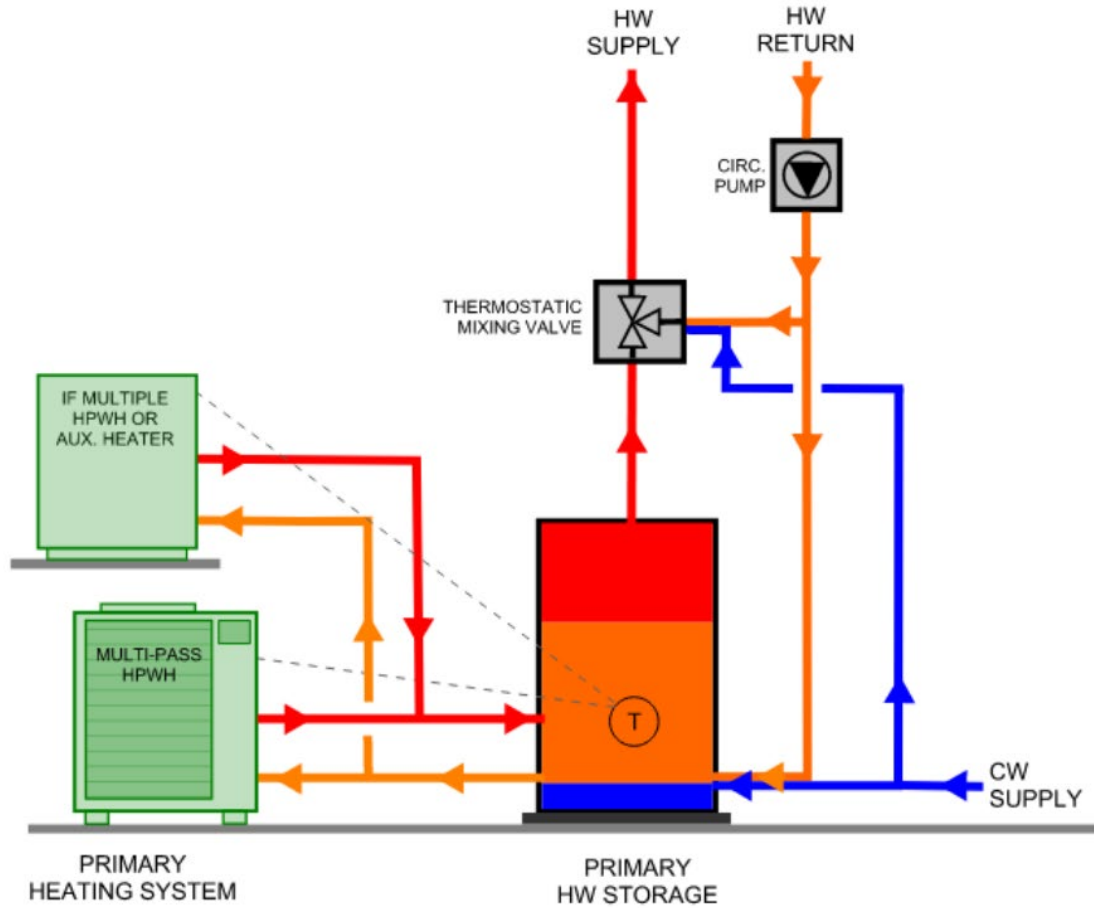
- Domestic Hot Water Solution – DHW Heat Exchanger
- Integral Circulator
- R-513A Refrigerant
- Single-Pass and Multi-Pass
- 125, 185 MBH Nominal Capacities
- Modular Systems at 270MBH Capacities up to 1,350MBH
- 30°F Minimum Source Temperature with Antifreeze
- 160°F Maximum Hot Water Temperature – Most Models
- Sizing tool available



Round Jacketed	Square Jacketed	Swing Tanks
80 – 940 Gallons	1,250 – 2,500 Gallons	119-Gallon
No Element	No Element	12 kW Element
ASME Construction		
Glass-Lined or Cement-Lined		
Custom Tank Configurations Stainless Steel Custom Port Sizes & Locations		

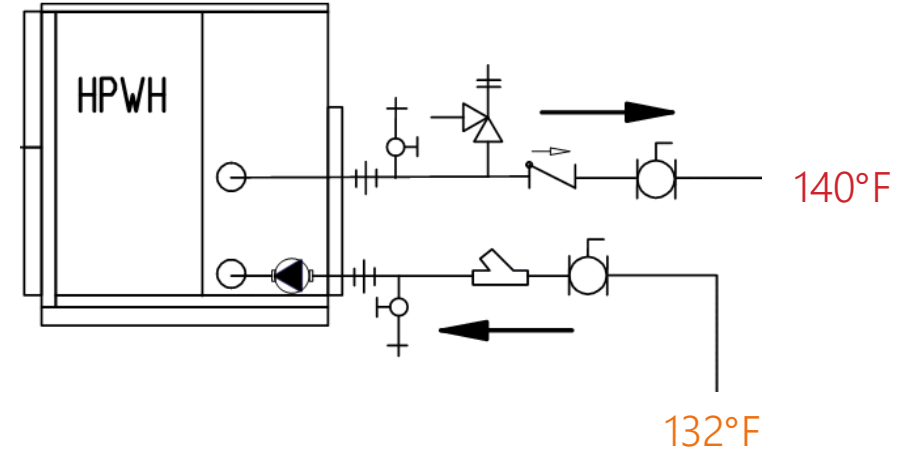


1st Gen: Multi-Pass Configuration

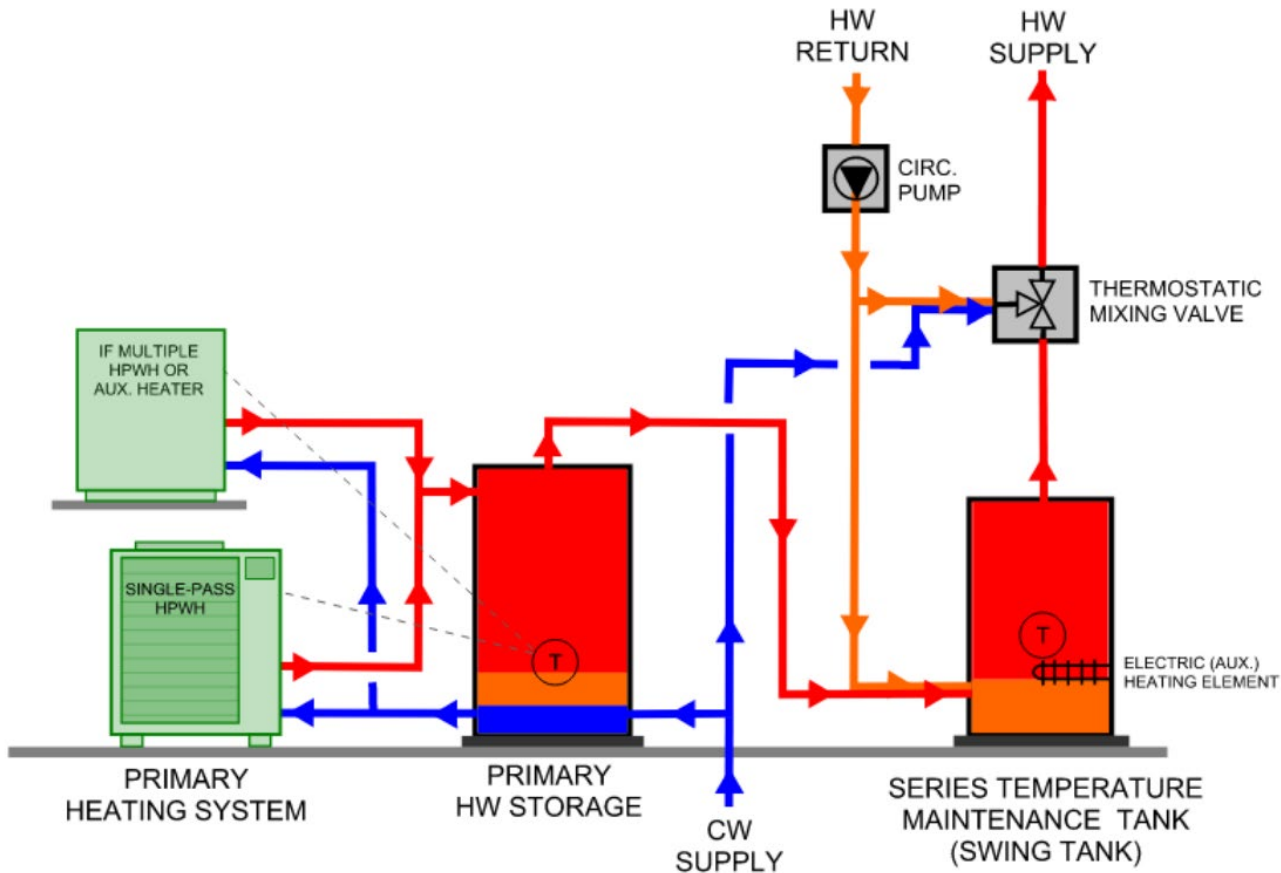


HIGH GPM FIXED FLOW

VARIABLE OUTPUT CAPACITY

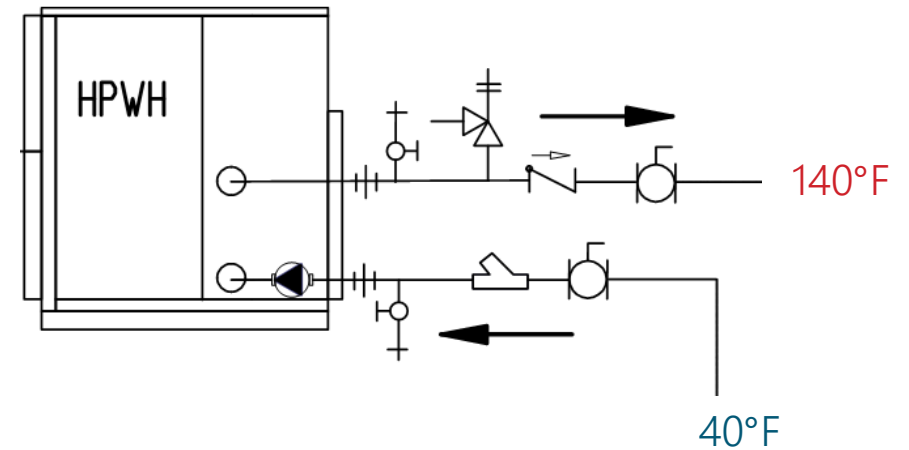


2nd Gen: Single-Pass Configuration



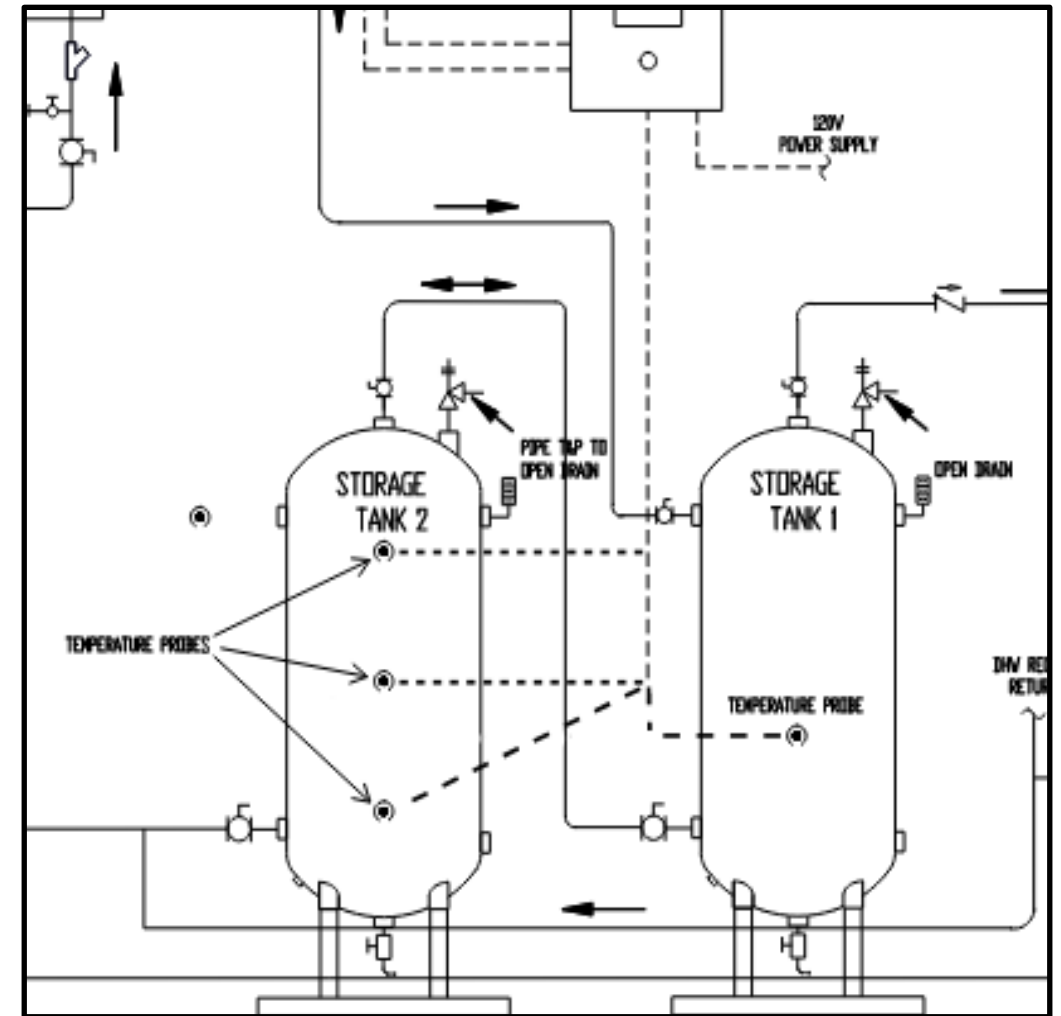
VARIABLE FLOW

FIXED OUTPUT TEMPERATURE



3rd Gen: Return To Primary

- Multi-Pass Style Piping Simplicity
- Single-Pass Responsiveness
- More Temp Sensors
- Backup Systems Downstream
- Make Up Recirc Loss @ COP > 2.0







MULTISTACK[®]

Originators. Innovators. Never the Imitators.

- Central plant geothermal solutions.
- Modular design.
- Low GWP refrigerants.
- Domestic solutions to be available soon.



- **COMMERCIAL
GEOTHERMAL HEAT
PUMPS**

—DOMESTIC HOT WATER

• October 2024

INTRODUCTION TO HIGHMARK



Pioneering innovative building-efficiency technologies since 2013



Supporting sustainability, electrification, decarbonization and cost savings



Offering services throughout the New York City metro area

• HEAT RECOVERY

• WHY?

- Utility Rates
- Operational Costs
- Footprint

• 1. HARVEST AND RESUSE HEAT GENERATED WITHIN THE BUILDING

- Thermal Loops
- Exhaust Air
- Wastewater

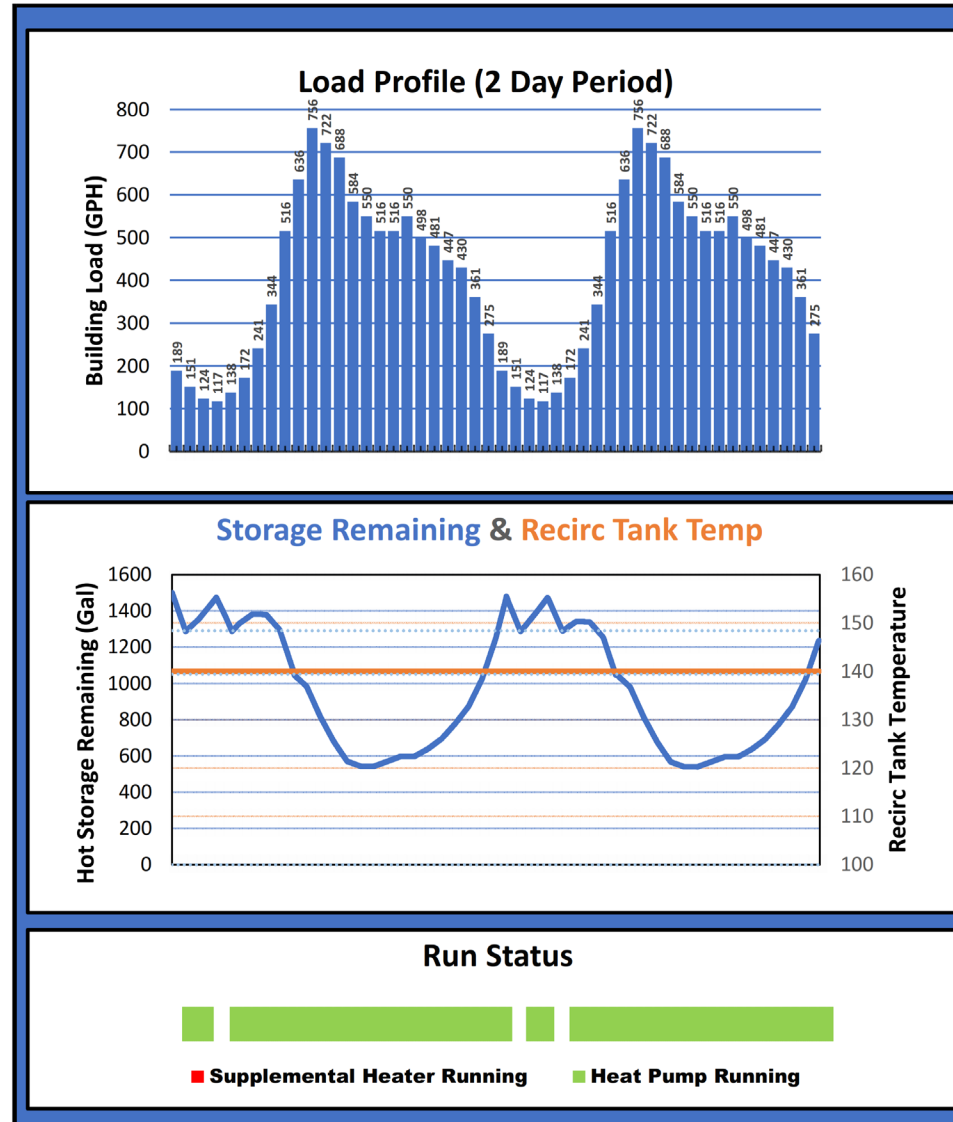
• 2. EXTRACT HEAT FROM EXTERNAL SOURCES

- Geothermal
- Centralized Sewer
- Air-Source



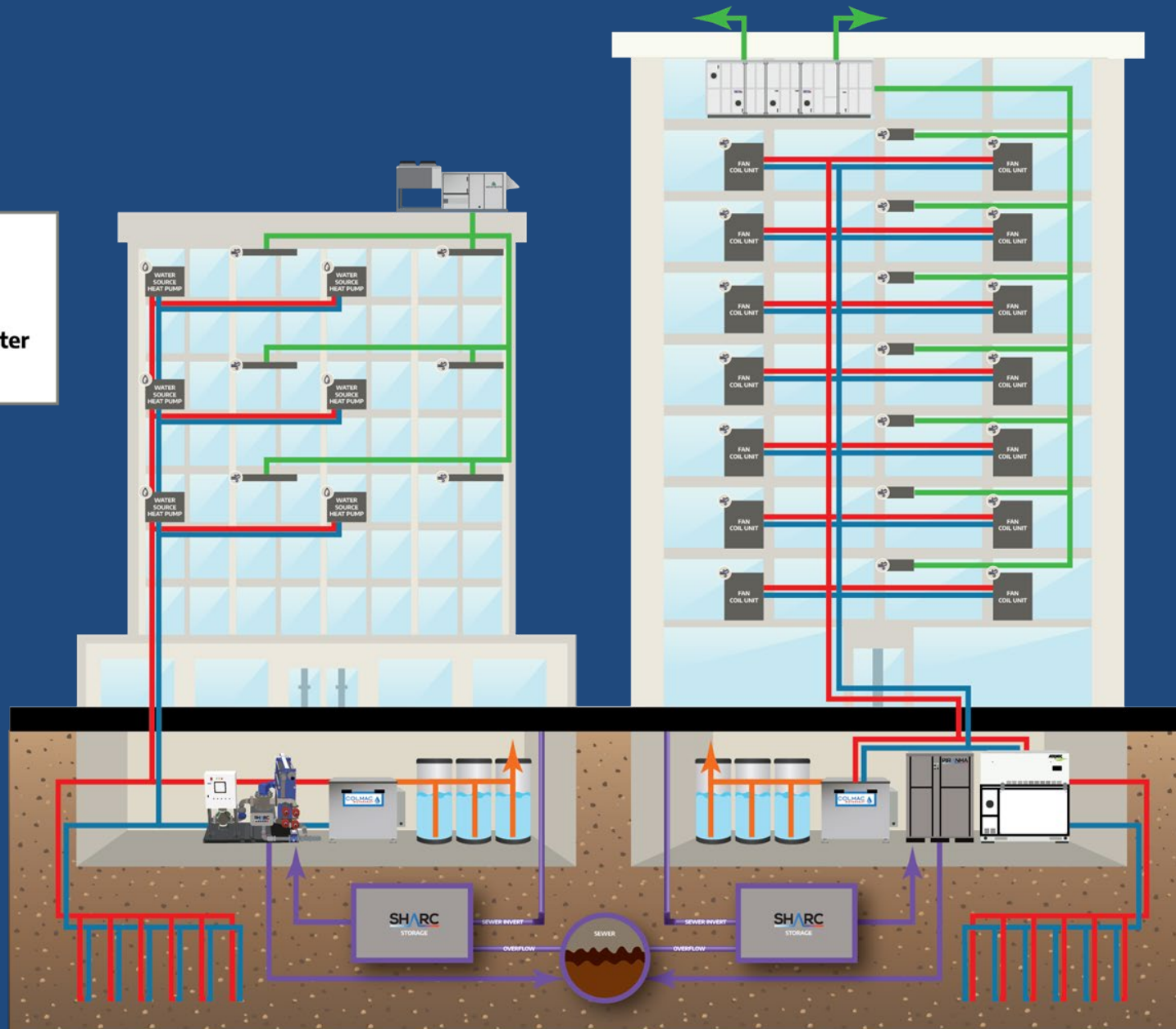
• DOMESTIC WATER HEAT PUMP SIZING

Building Variables	
Configuration Type: Series	
Daily Usage:	10,000
Makeup Temp:	40
Tempered Temp:	120
Recirc GPM:	10.0
Recirc Delta T:	10
Building Type:	Updated Apartment
Unit Type:	CxW
Storage Variables	
Storage Volume:	1,500
Heat Pump	
HP Output Temp:	140
HP Recovery Rate (Total):	500 GPH
Stage 1 Storage Drained:	14% 1 Unit
Stage 2 Storage Drained:	30% 1 Unit
Supplemental Heater	
Supplemental BTUH:	0
kW:	0
Supplemental ON Temp:	0
Supplemental OFF Temp:	0
Results	
HPWH Run Time Per Day:	18.6 hr
Supp. Run Time Per Day:	0 hr
Min Swing Temp:	140 °F
Min. Water Temp To Bldg:	120 °F

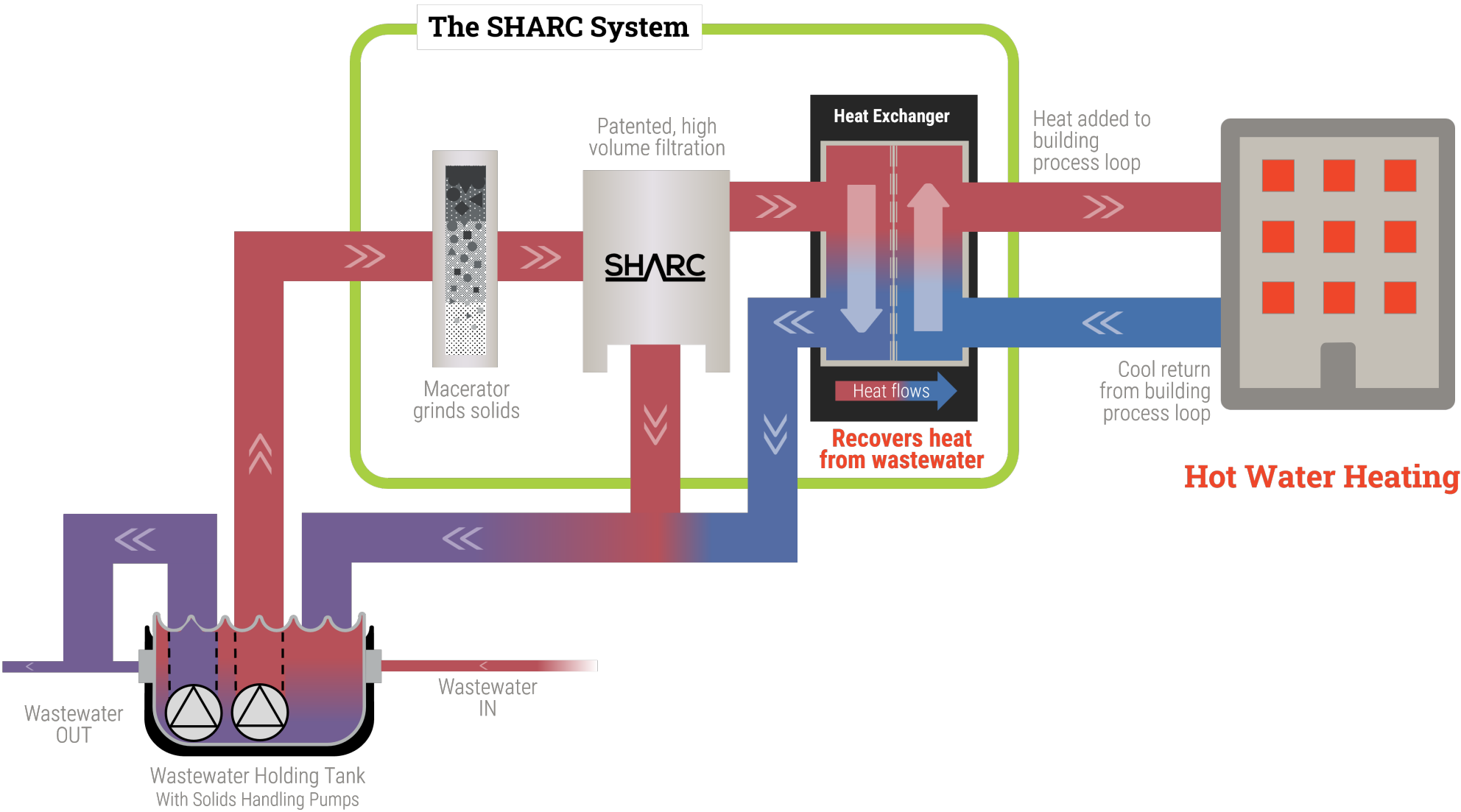


GEO THERMAL

- Hot water
- Cold water
- Air
- Domestic water
- Sewage



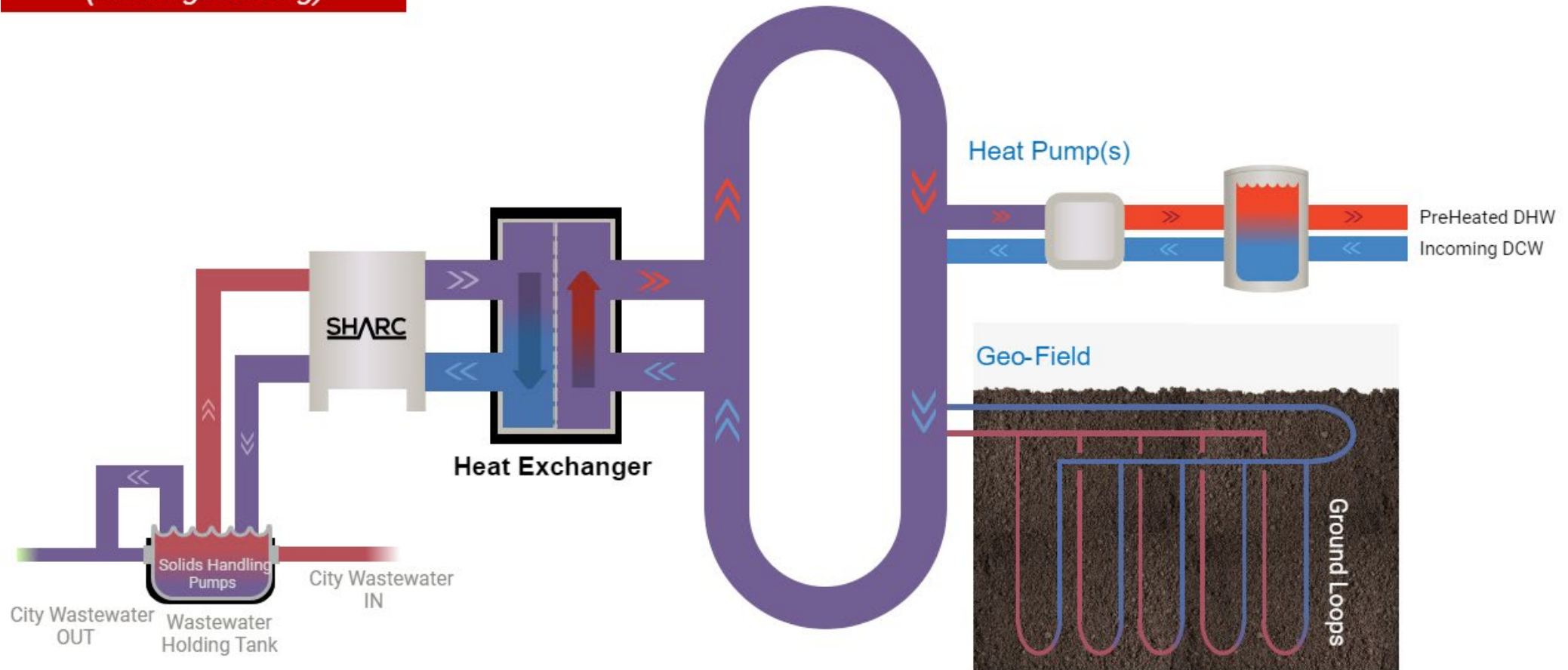
WASTEWATER HEAT RECOVERY

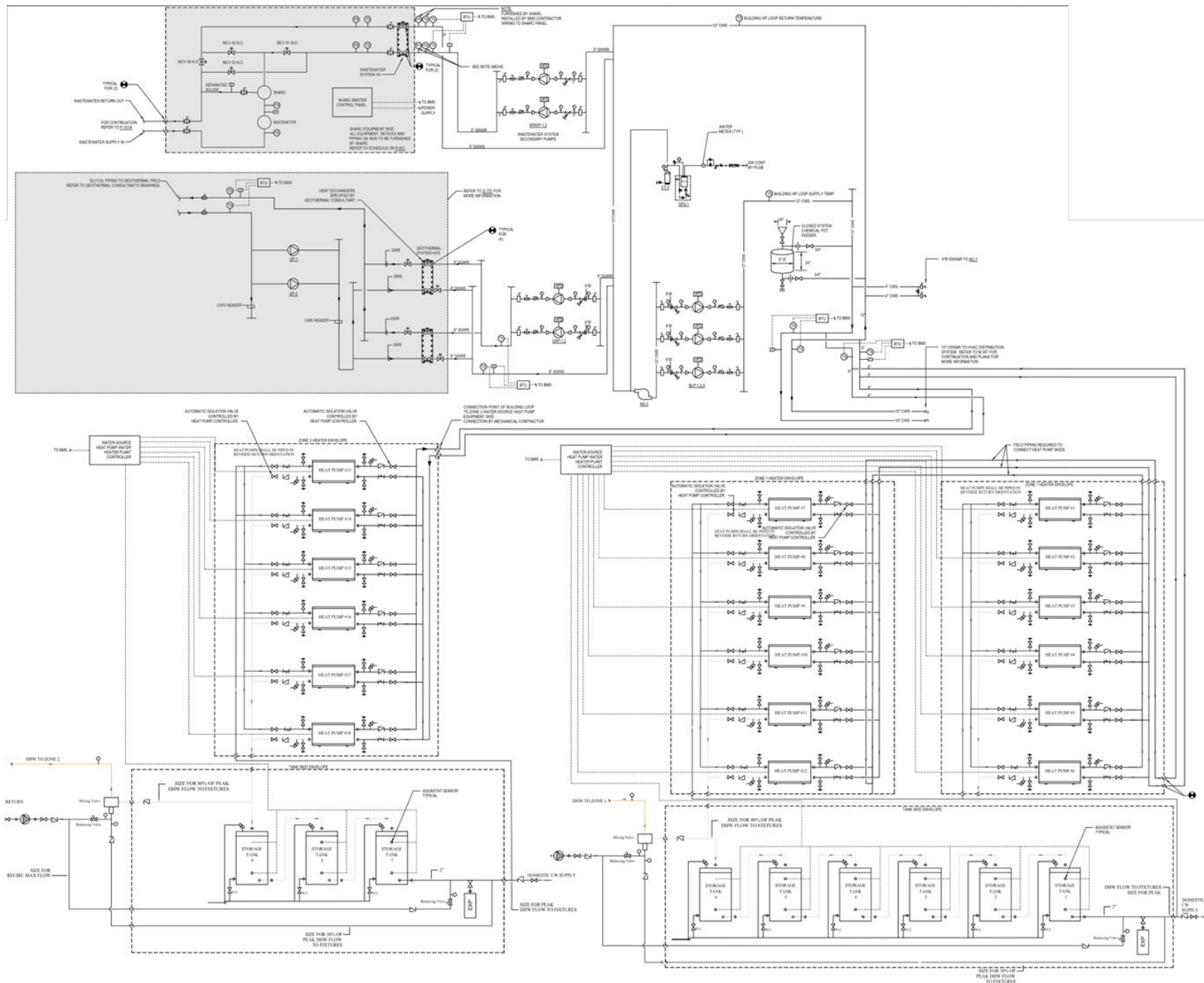


• GEOTHERMAL + WASTEWATER HEAT RECOVERY



How SHARC Works
*Geothermal-Paired Multi-Use
(Heating/Cooling)*







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Questions

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