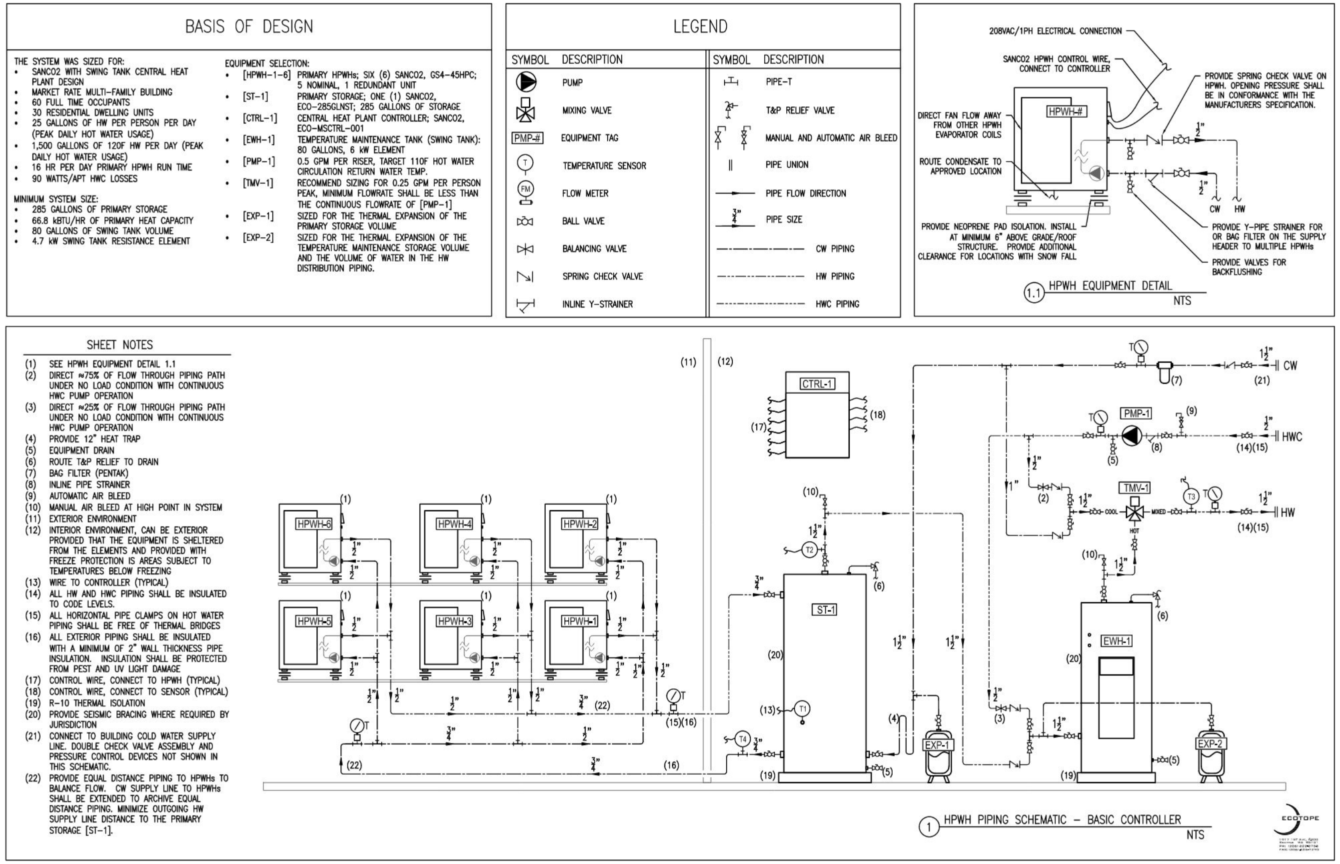
COMMERCIAL HEAT PUMP WATER HEATING:

ENGINEERING DEEP DIVE

Colin Grist, PE,
Ecotope, Inc.

D+R LEARN

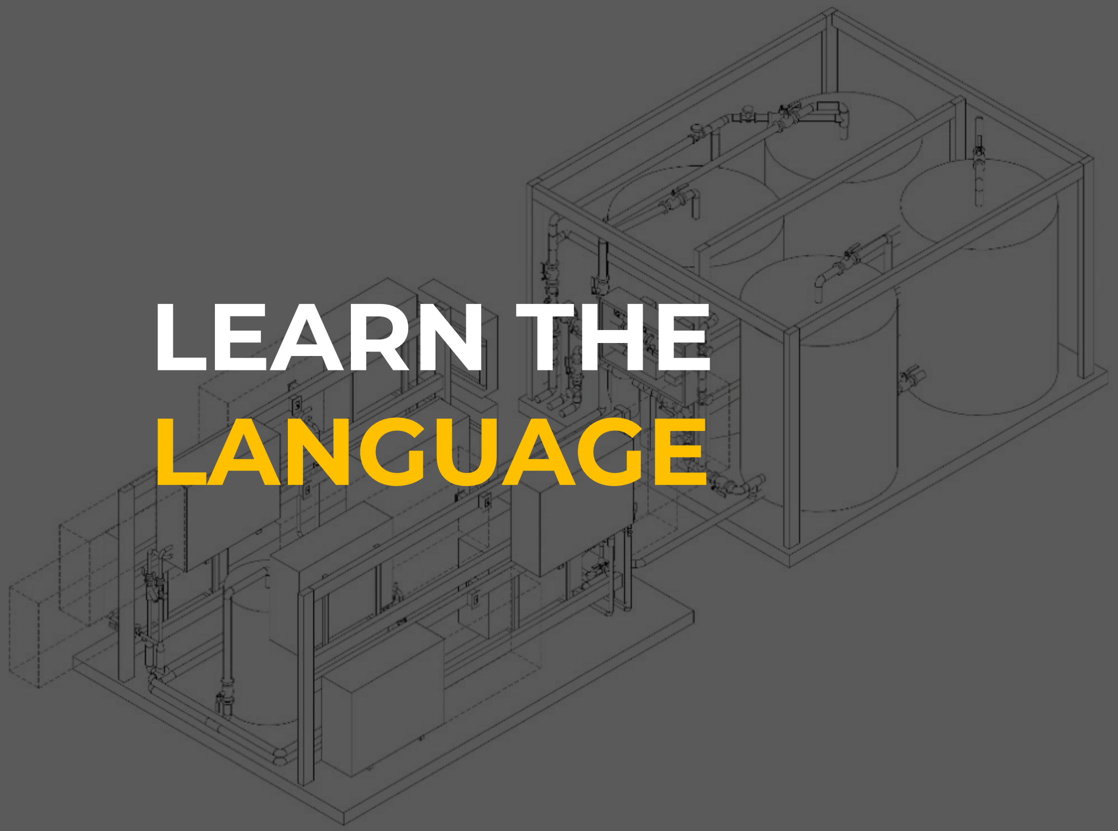
ECOTOPE



KEY QUESTIONS

- What policy drivers are **pushing for adoption?**
- What makes a **good CHPWH candidate?**
- What are the **key components of CHPWH systems?**

LEARN THE LANGUAGE



PRODUCT **TYPES:** LEARN THE **LANGUAGE**

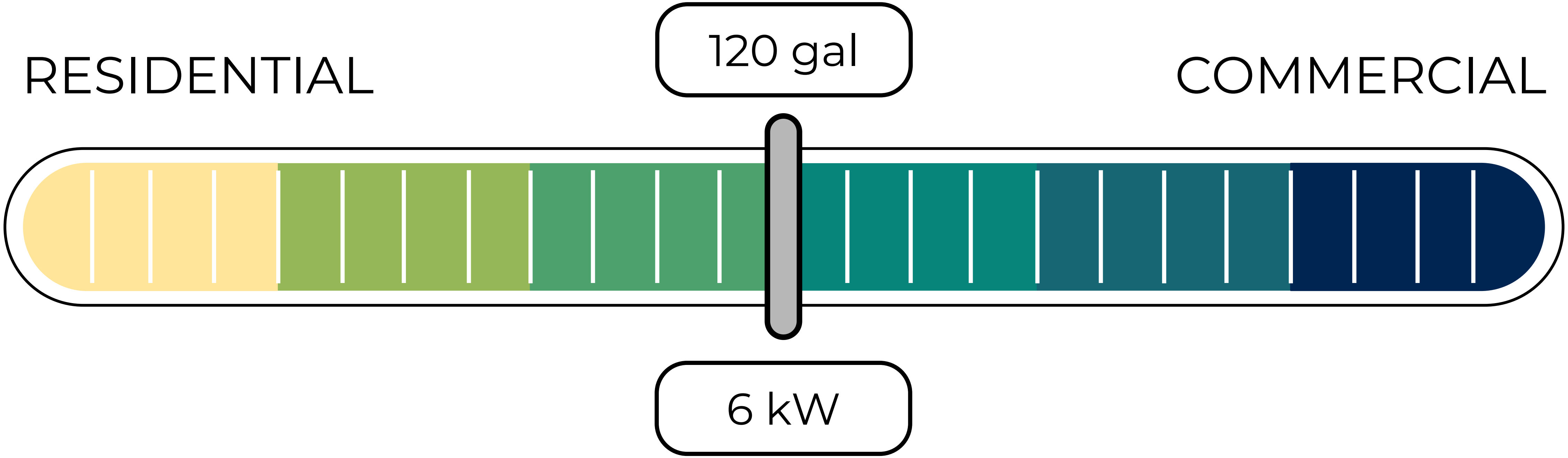
Unitary

- Compressor, tank, & controls in a single package.
- Typically small residential product.

Split System

- Compressor, and tank in two separate packages
- Both residential and commercial products available

RESIDENTIAL vs. COMMERCIAL **SYSTEMS**

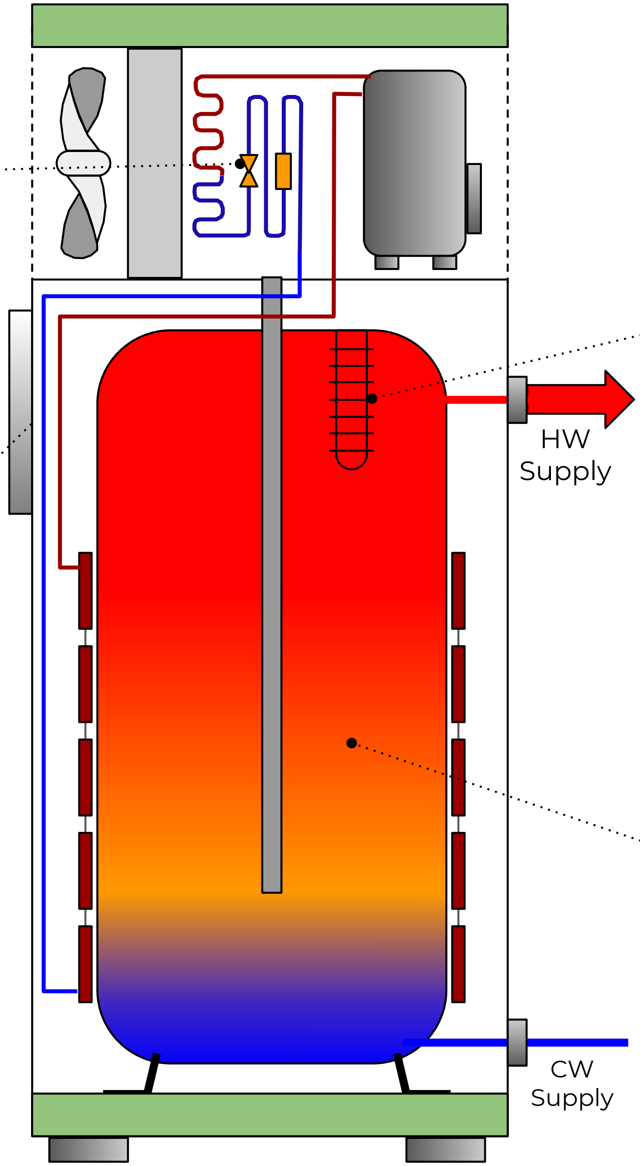


A **CHPWH system** serves more than 4 dwelling units or commercial loads requiring **≥ 120 gallons** of storage volume and/or **>6 kW** of input power.

HOW DOES IT **COMPARE?**

HEAT PUMP WATER HEATER


CONTROLS



TEMP. MAINT. SYSTEM


PRIMARY STORAGE

EXAMPLES OF **CHPWH SYSTEMS**

Small Commercial System

(closet installation serving 5 apts)

Large Commercial System

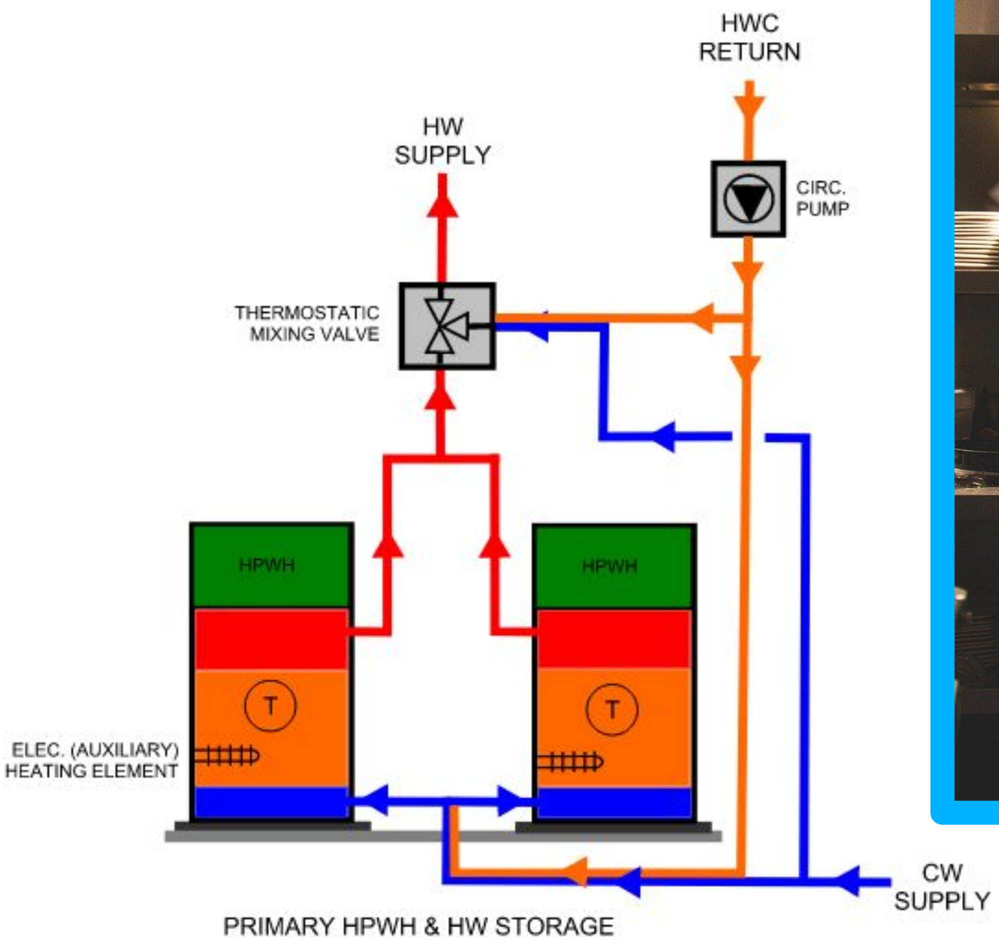
(basement installation serving 250 apts)

Multiple Commercial Systems

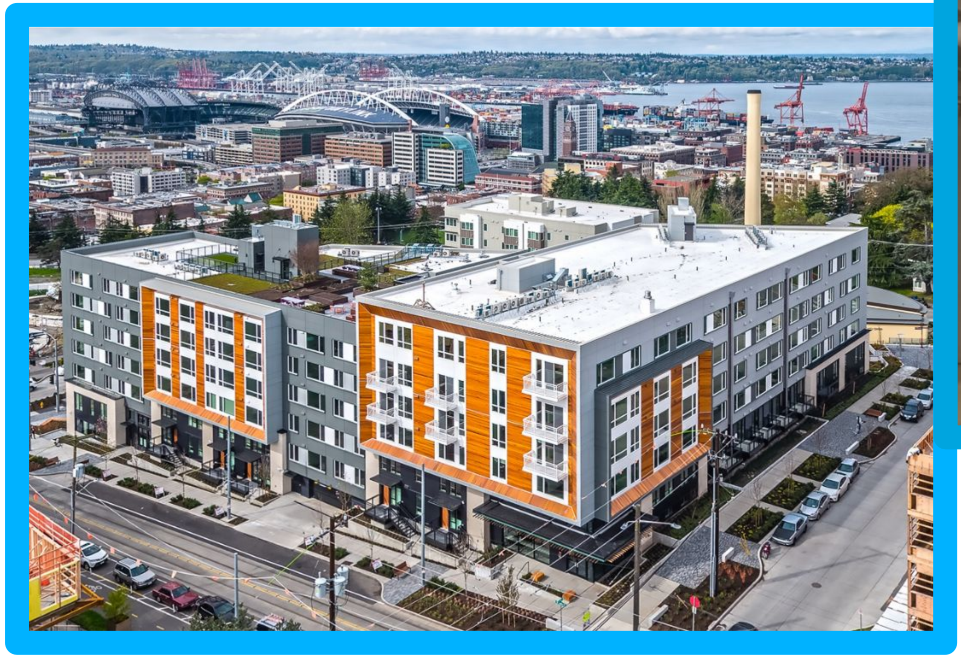
(residential equipment serving 4-5 apts)

Multiple Sizes, Types, & Configurations

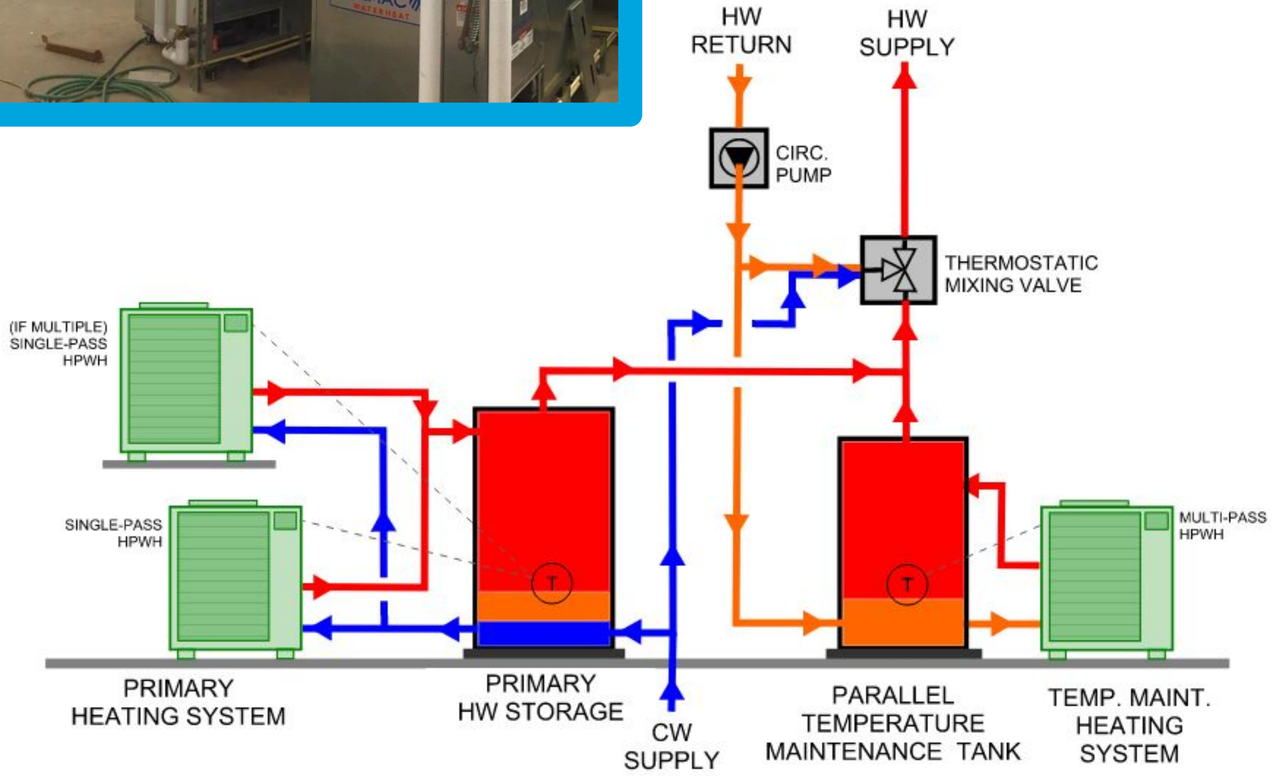
SMALL COMMERCIAL **SYSTEM**



LARGE COMMERCIAL **SYSTEM**

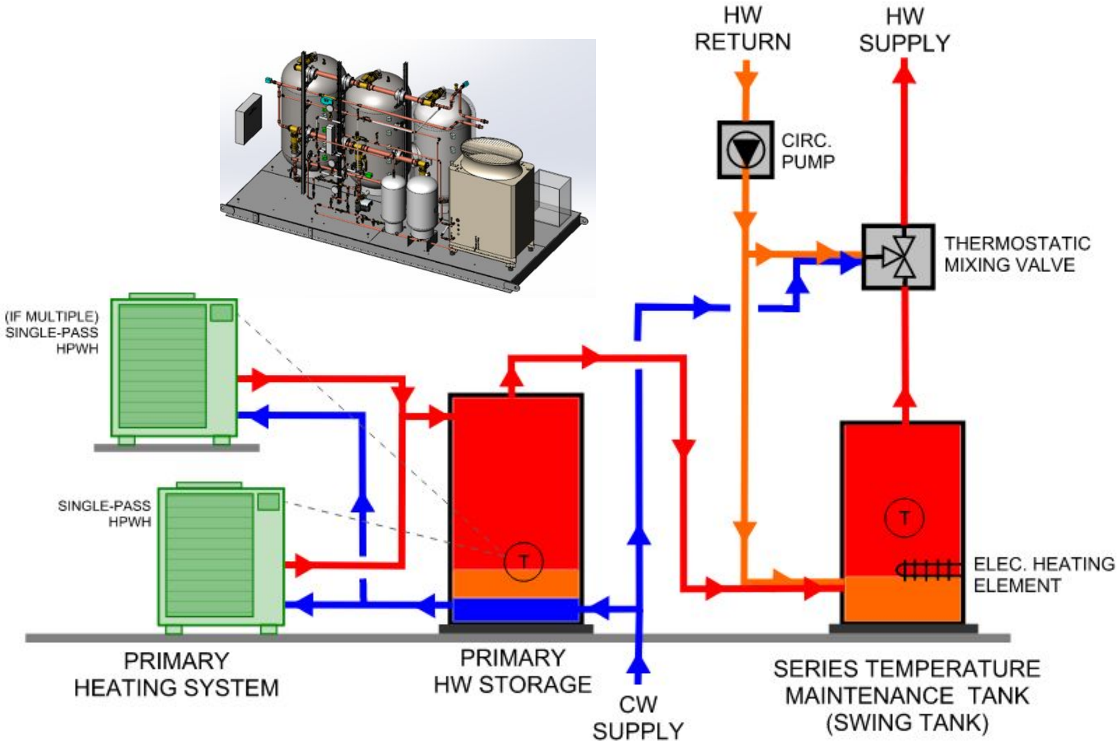


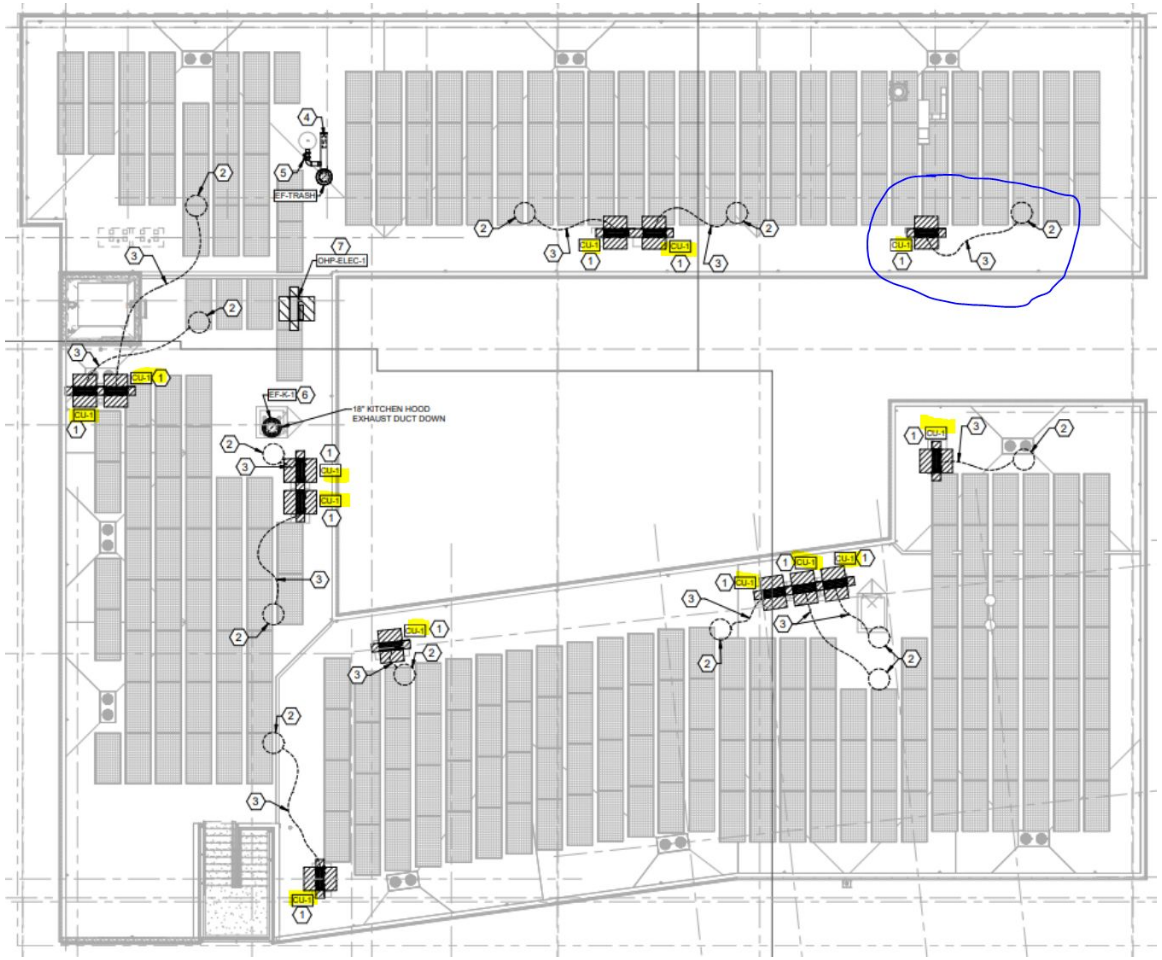
- Commercial equipment; engineered system
- 200 units
- Dedicated heating system:
    - Single pass primary HPWH
    - Multi pass temperature maintenance system



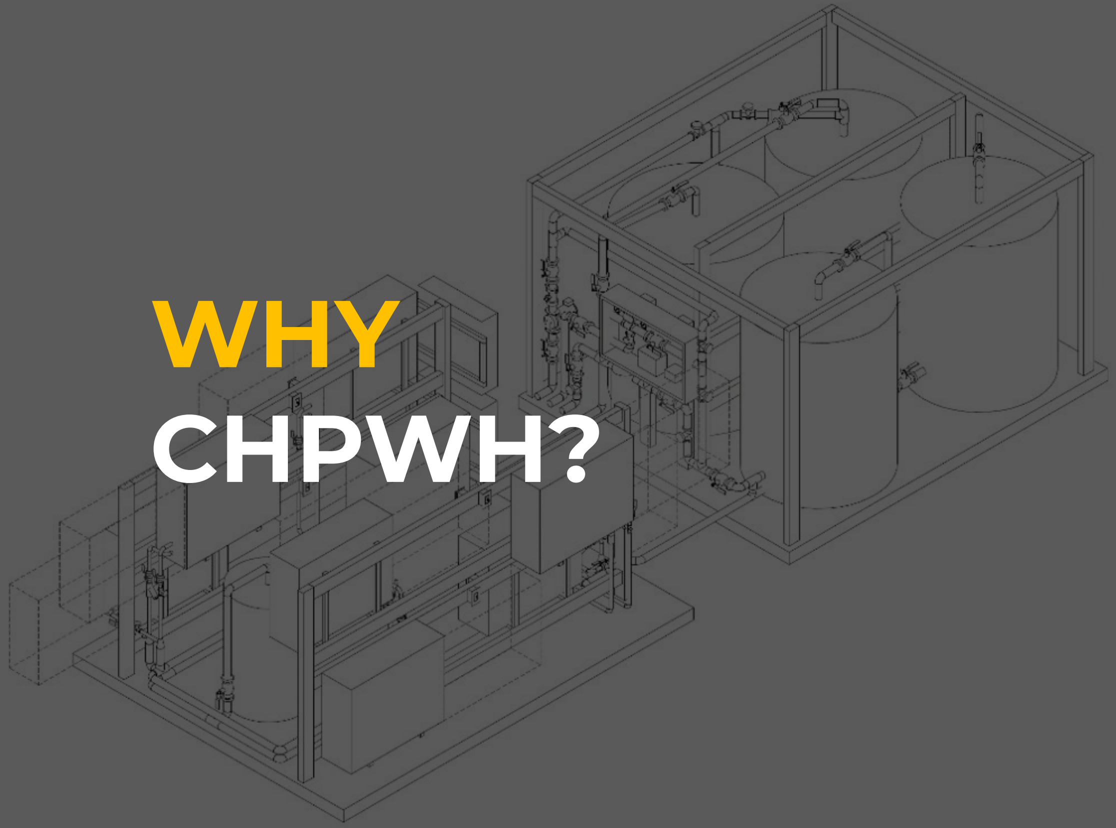
MULTIPLE COMMERCIAL **SYSTEMS**

- Smaller residential equipment used in a commercial application
- 100 units
- Multiple central/commercial HPWH systems





WHY CHPWH?



WHY **CHPWH?**

- Global, federal & state policies
- Codes & standards
- Capture incentives & rebates
- Lower operating costs
- Energy efficiency measures
- Societal changes

SEATTLE COMMERCIAL **ENERGY CODE**

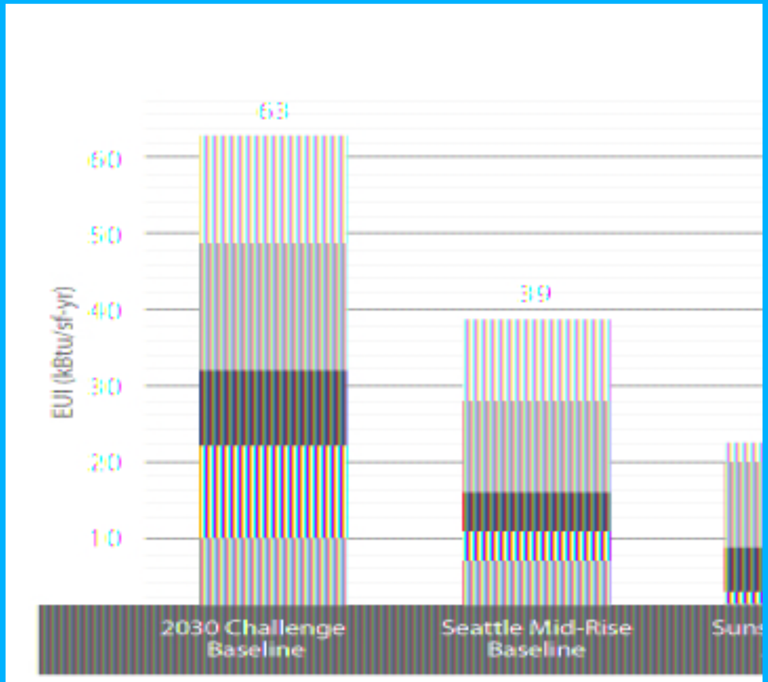
C404.2.3
Group R-1 and R-2* occupancies w/ central service water heating systems.

Service hot water shall be provided by an **air-source heat pump water heating system**, not fossil fuel or electric resistance.

***R-1 and R-2**: Multifamily greater than 3 stories; any hotel/motel

SUNSET **ELECTRIC**

70% Reduction in DHW Energy



EUI= Energy Use Intensity
(Energy Use/Total Building Area)

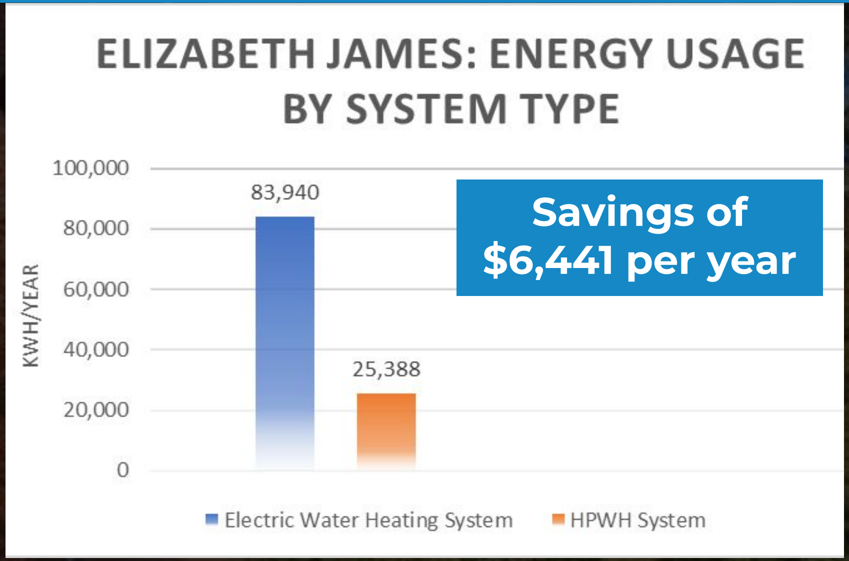
- 67,000 ft^2
- 92 apartments
- R-134a air-source heat pump water heaters in parking garage

ELIZABETH JAMES

60 senior facility low-income units

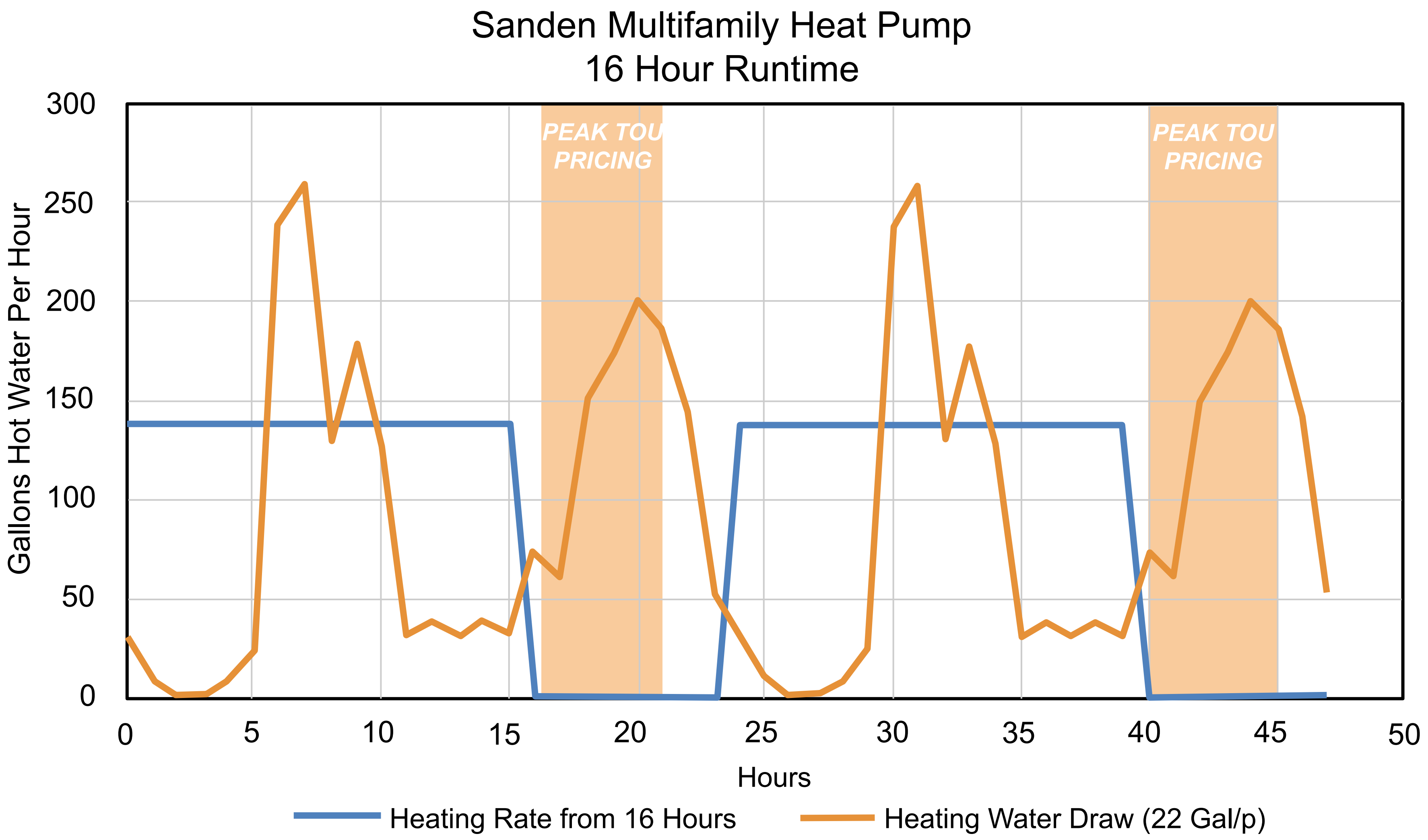
4 CO_2 Sanden Units (retrofit)

Zero GHG emissions

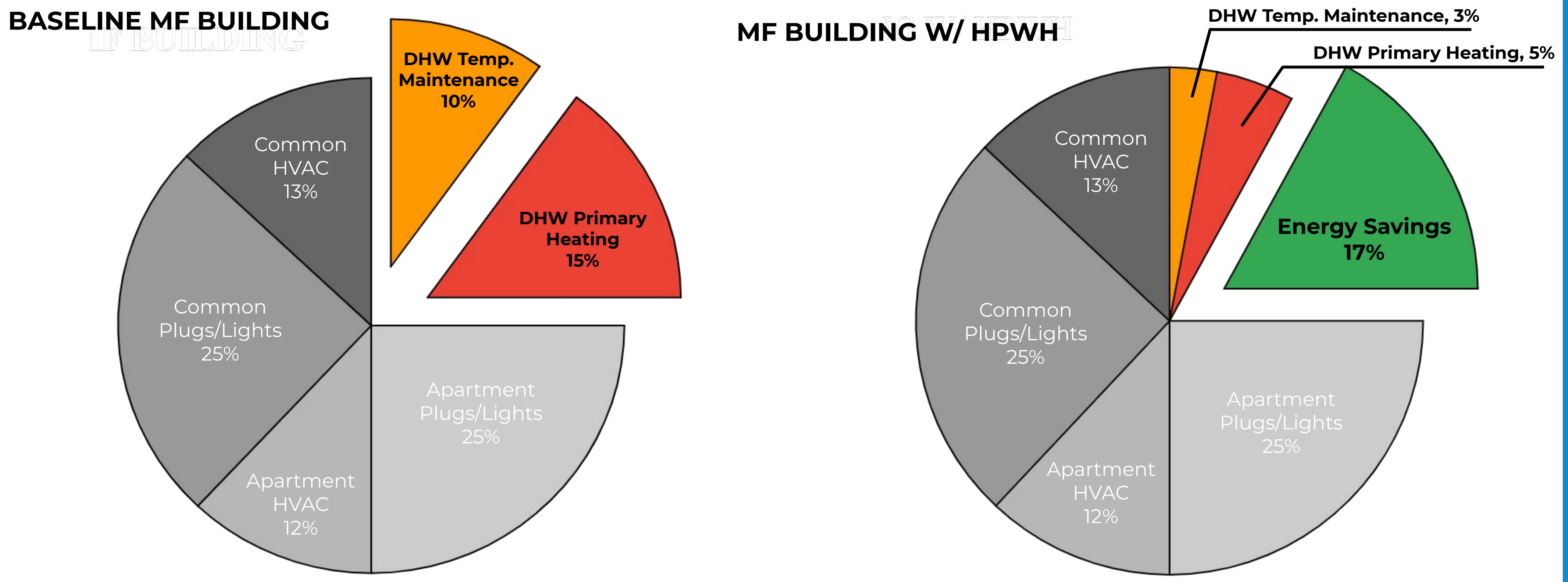


70% Reduction in DHW Energy

WHY **CHPWH:** TOU RATES & GRID **FLEXIBILITY**

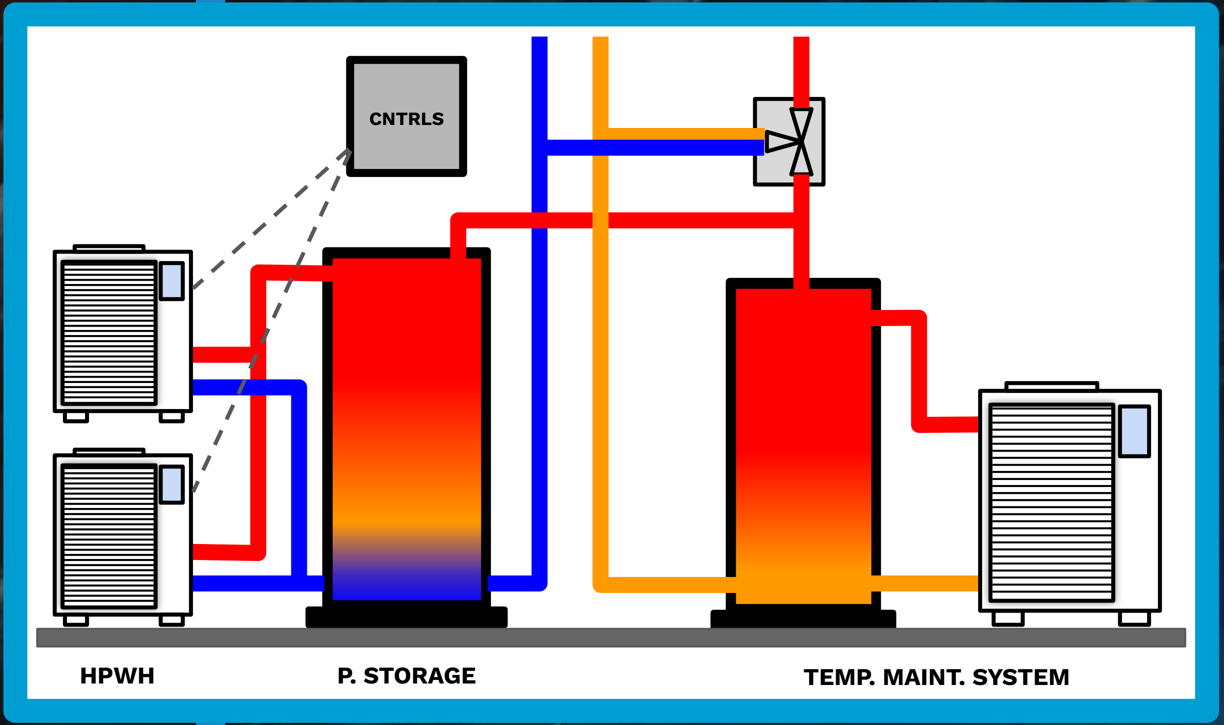


WHY **CHPWH?**

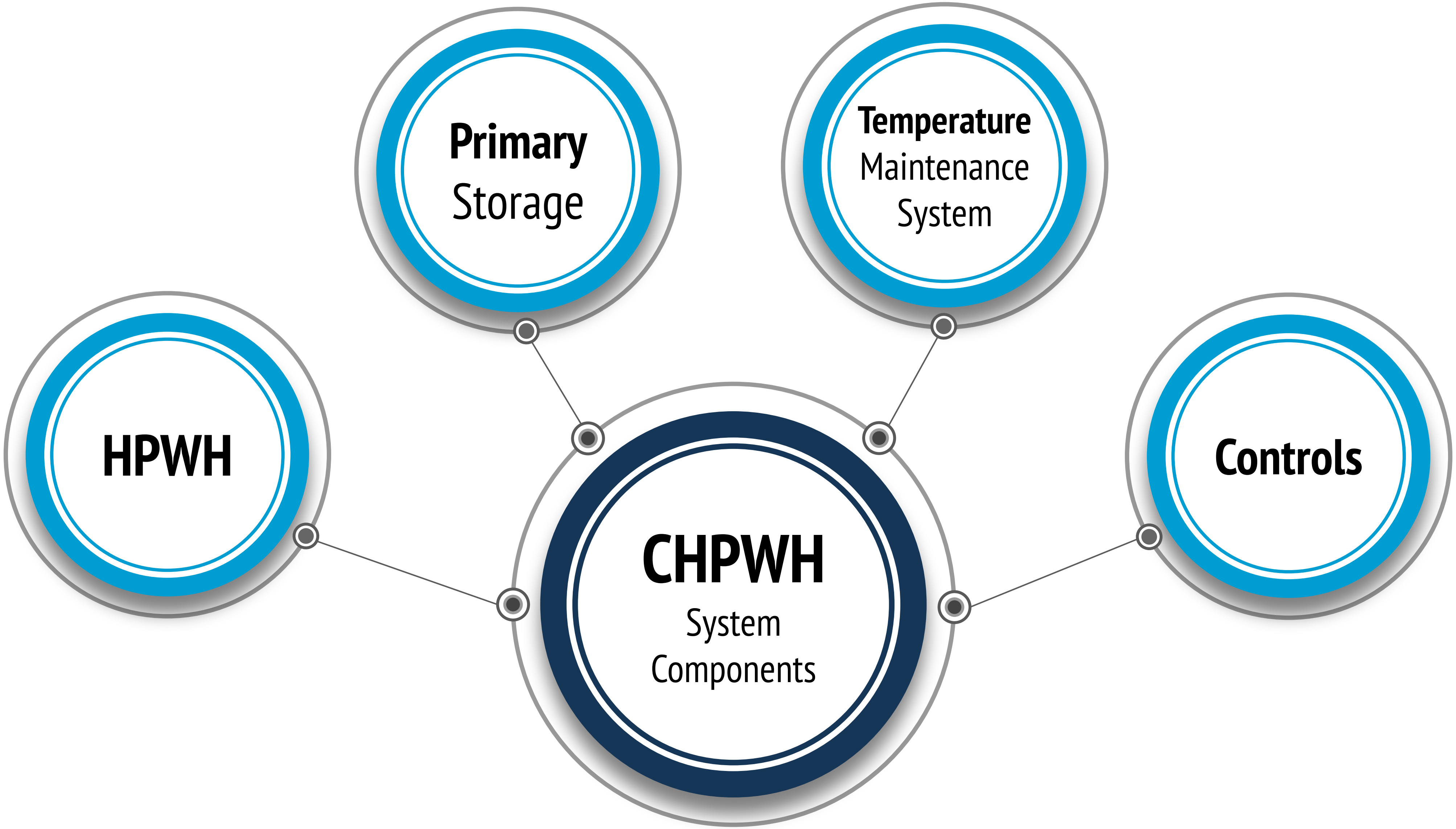


- DHW represents 25% of annual building use
- CHPWH systems cut energy usage down by 3x

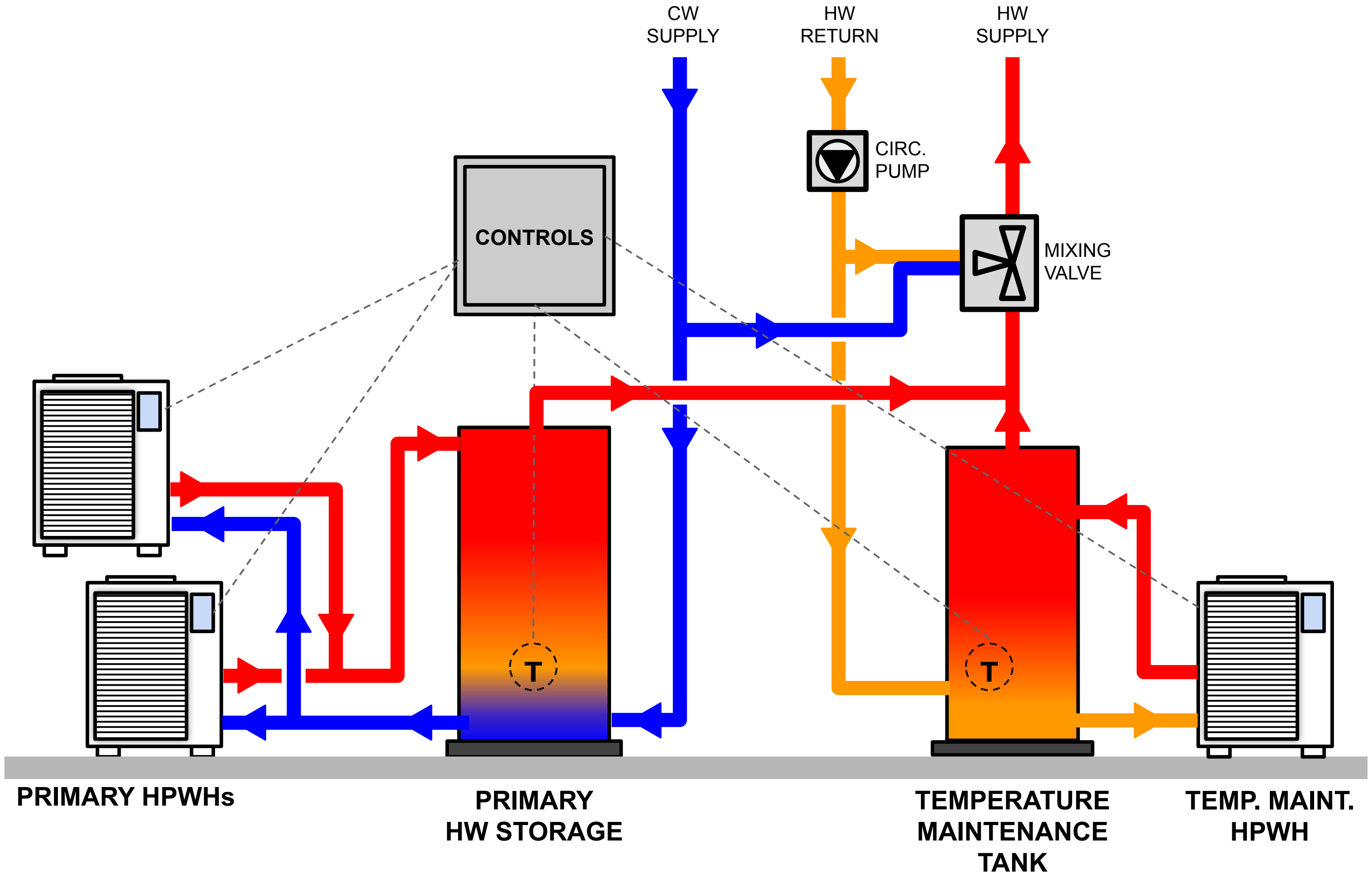
CHPWH SYSTEM COMPONENTS



FOUR **CHPWH SYSTEM COMPONENTS**

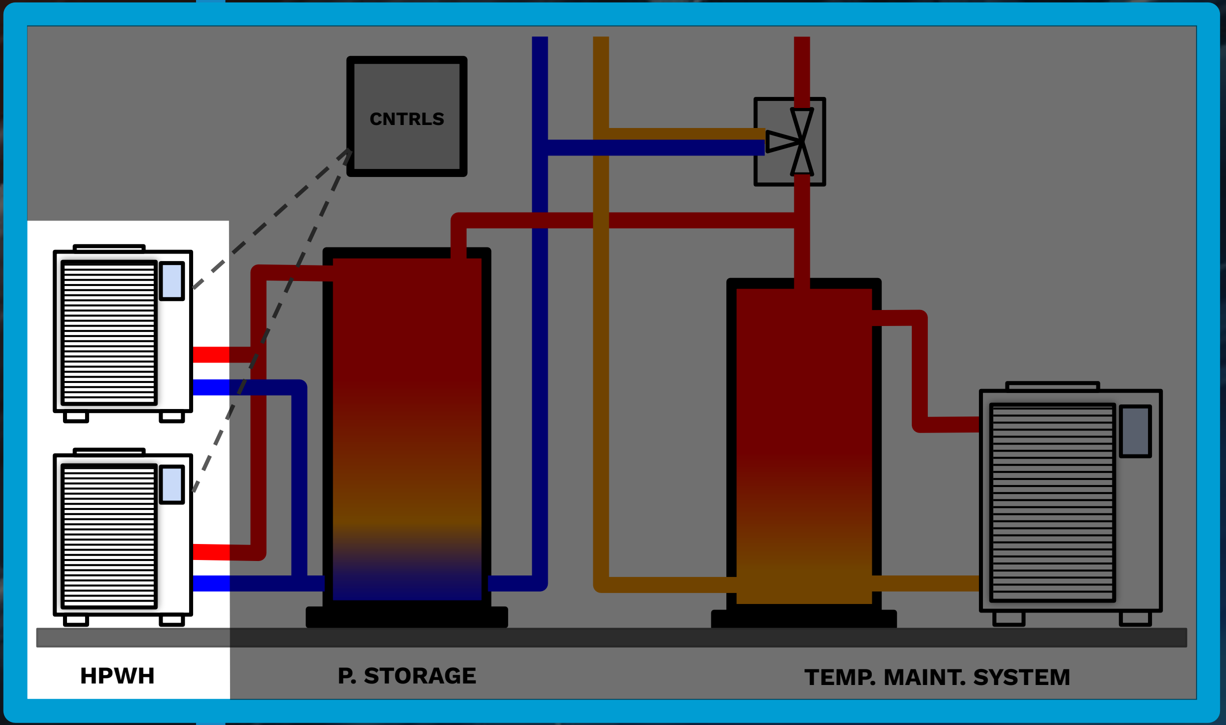


FOUR **CHPWH SYSTEM COMPONENTS**

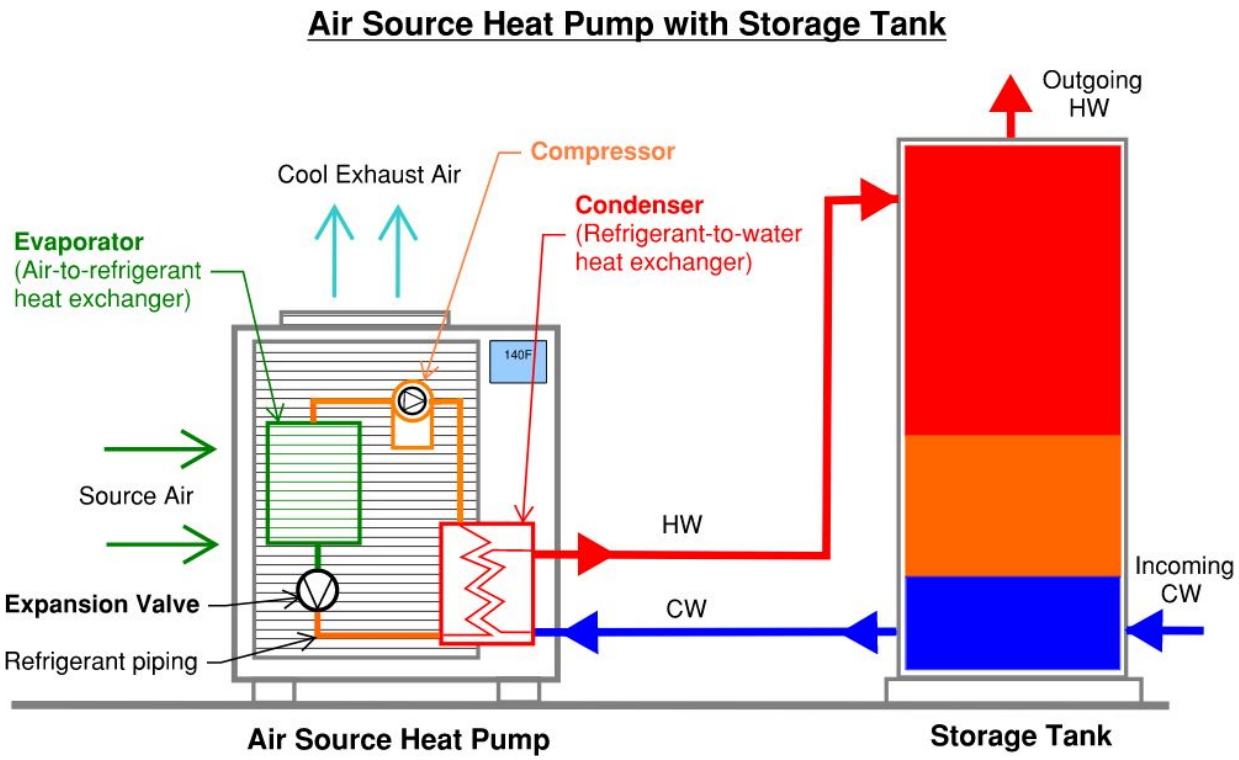


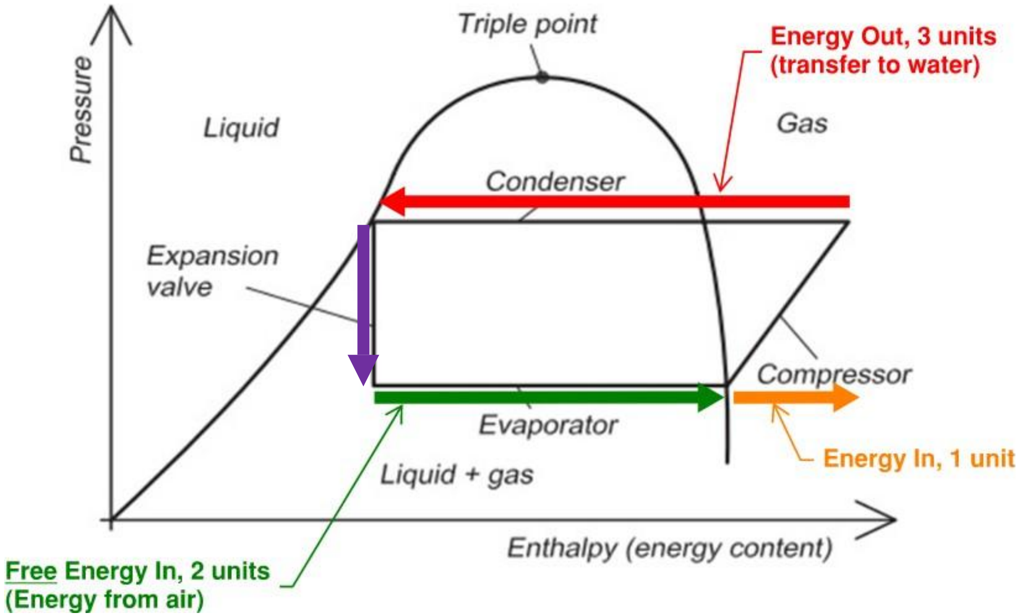
- Primary heat pump water heater (HPWH)
- Primary HW storage tank
- Temperature maintenance system
- Controls

COMPONENTS:
HPWH

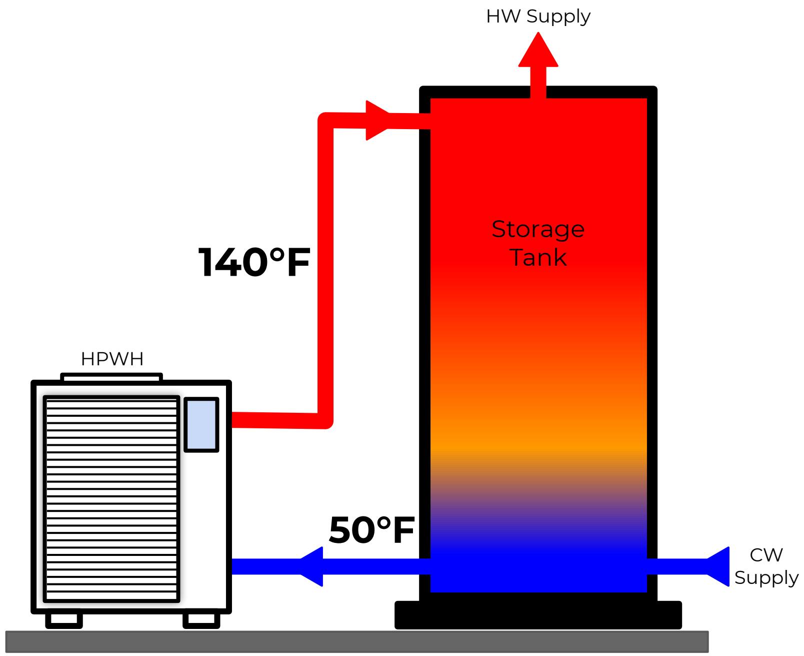


HOW **HEAT PUMPS** WORK





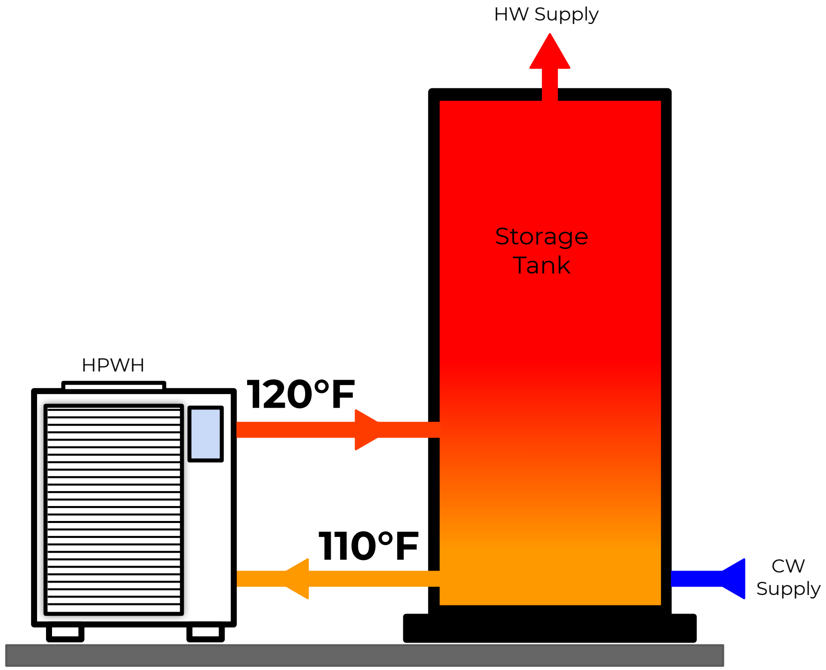
TWO TYPES OF **HEATING CYCLES**



SINGLE-PASS

Heats water to working temp. in single pass

(*usually for primary heating load*)



MULTI-PASS

Heats water to working temp. in multiple passes

(*typical temperature maintenance systems*)

AVAILABLE PRODUCTS

Multi-Pass Unitary
Residential/Small Commercial
R-134a

Single-Pass
CO_2/R-744

Single- or Multi-Pass
R-134a

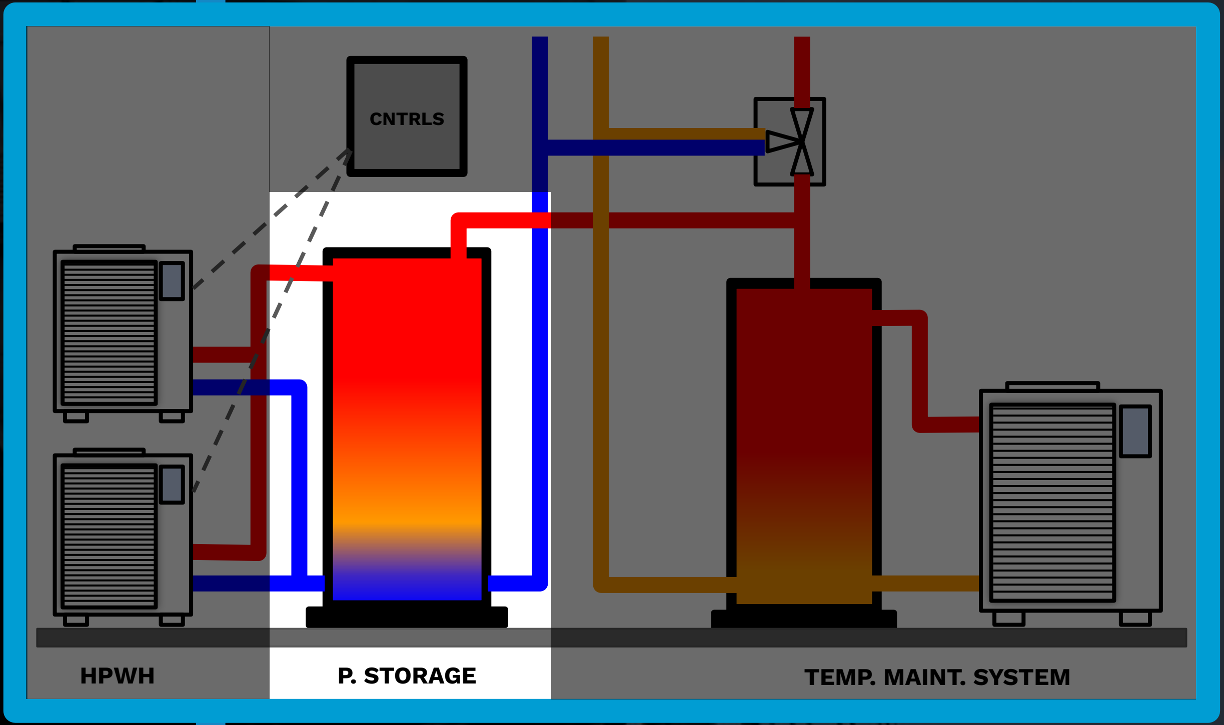
HPWH **CONSIDERATIONS**

Nyle
(10 - 30 ton)

Rheem
(> 1 ton)

- Air source / heat source
- Heating cycle (single pass / multipass)
- Electrical connection
- Water connections
  (freeze protection required?)
- Condensate management
- Maintenance and access
- Sound level, noise considerations

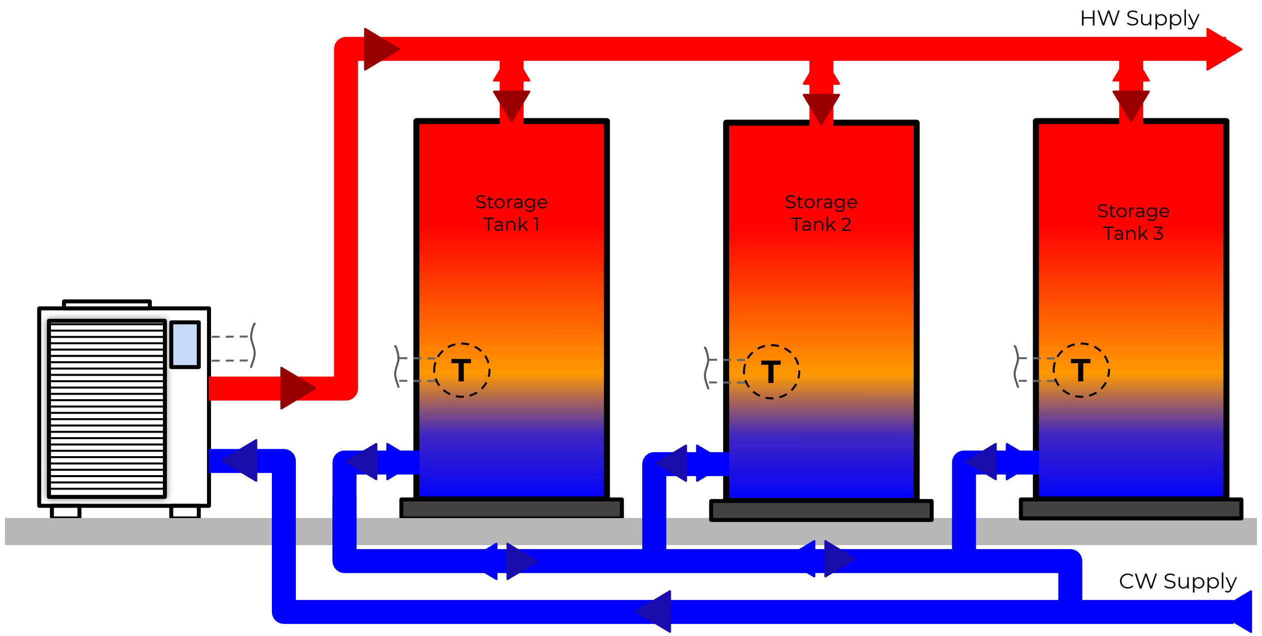
COMPONENTS:
PRIMARY STORAGE



PRIMARY **STORAGE TANK(S)**

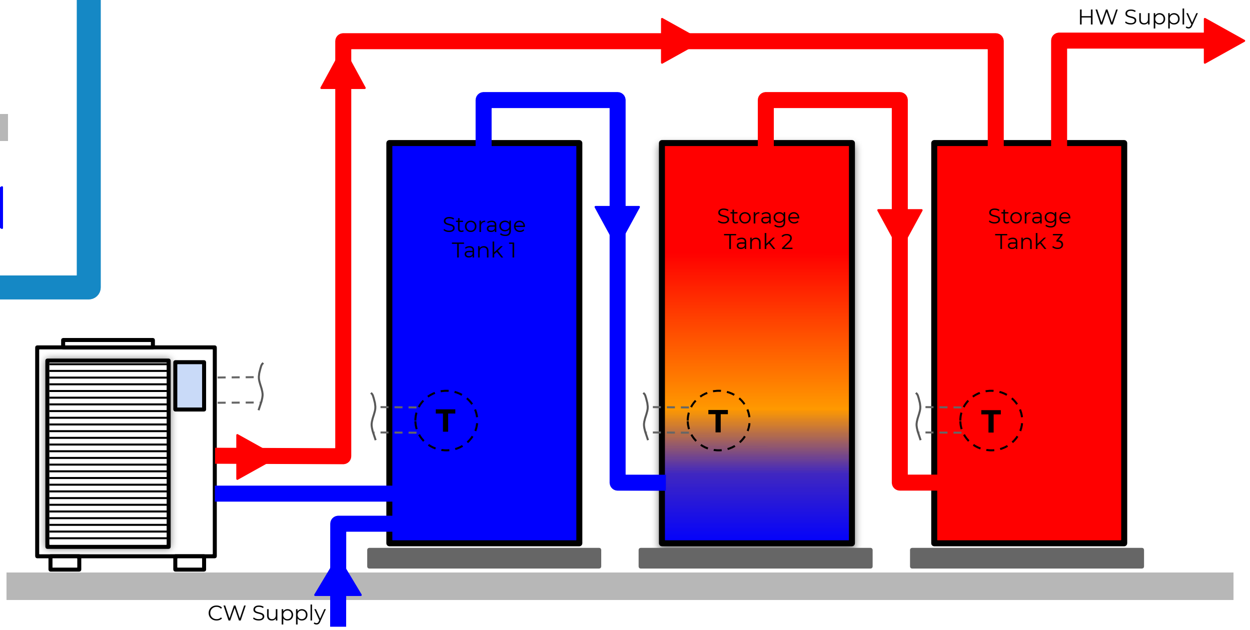
A BATTERY BANK

PRIMARY STORAGE **PLUMBING**

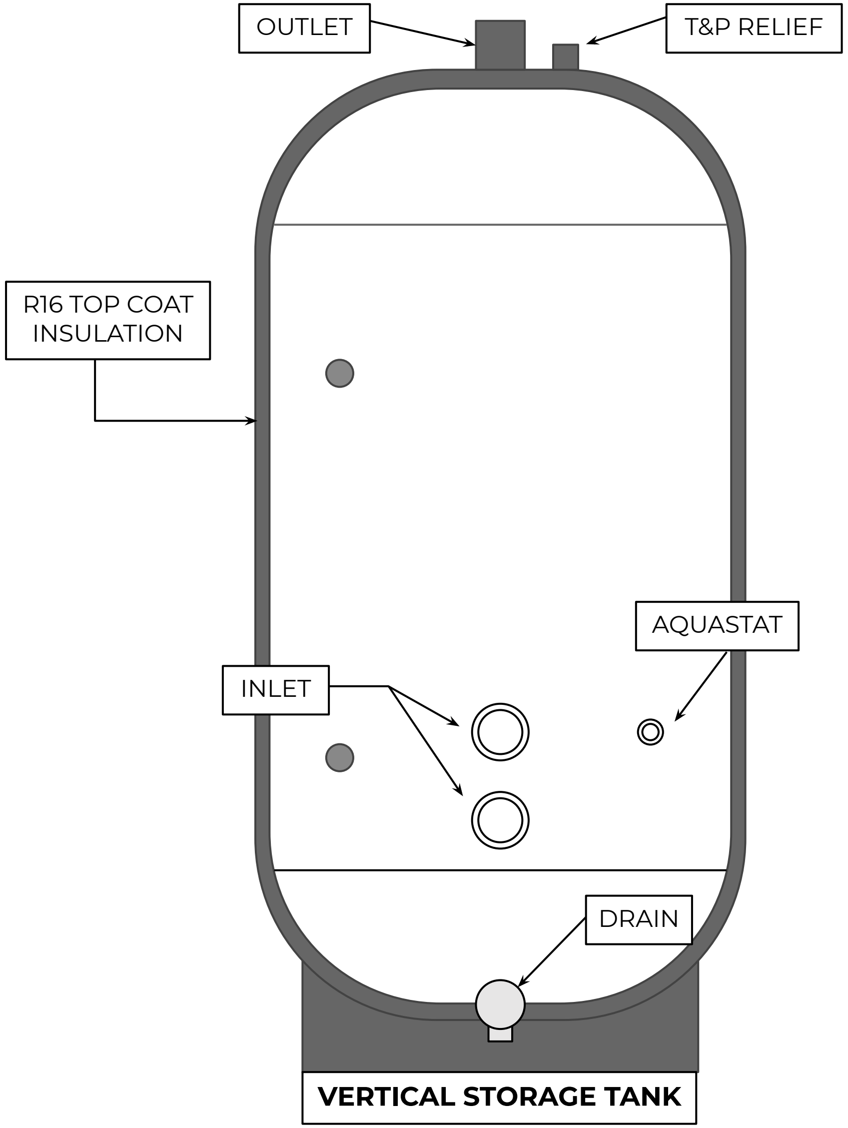


IN PARALLEL

IN SERIES

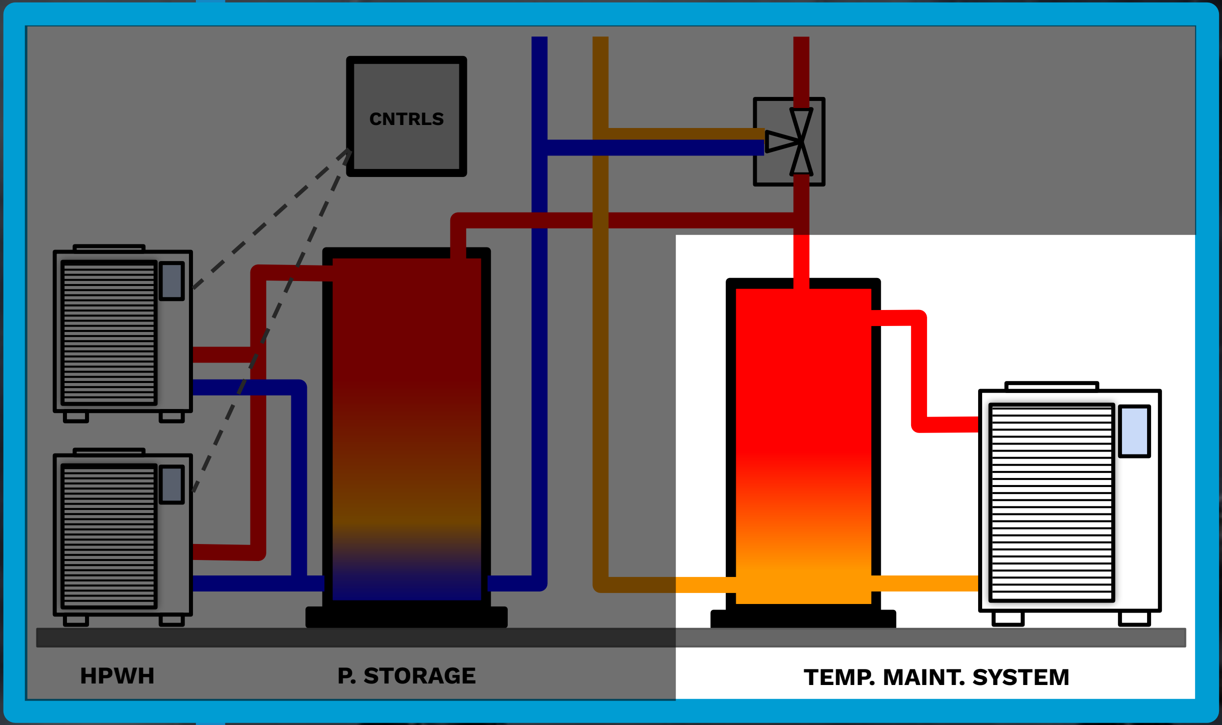


HW STORAGE **CONSIDERATIONS**



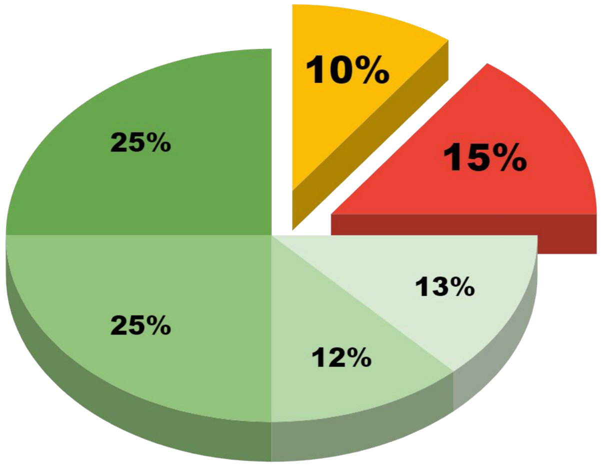
- Physical space, room & door size
- Vertical is better than horizontal
- Multiple tanks, series or parallel?
- Height of control sensor(s)
- Pipe connections, size & location
- Insulation level
- Thermal isolation
- Maintenance & access

COMPONENTS: TEMPERATURE MAINTENANCE

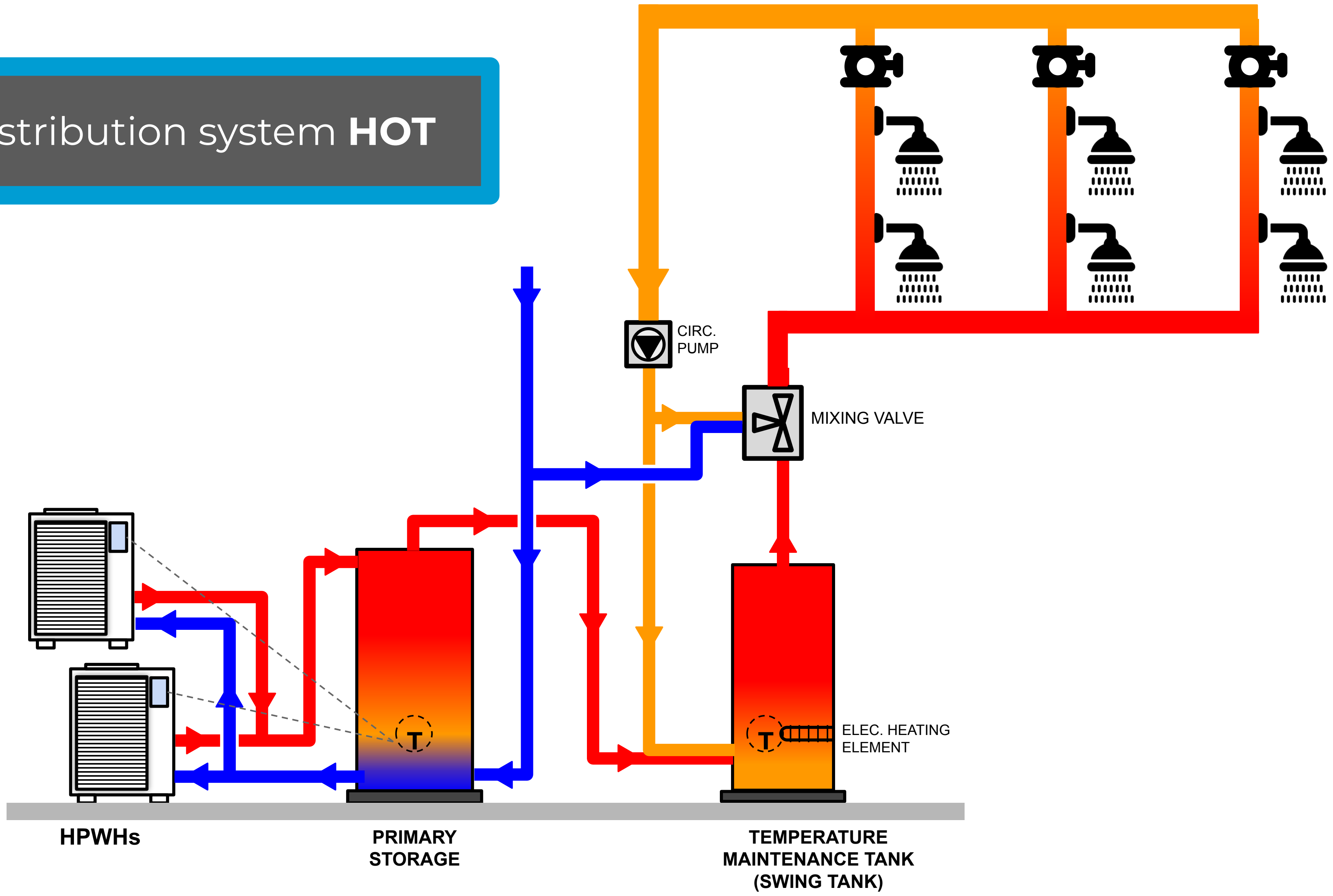


TEMPERATURE MAINTENANCE **SYSTEM**

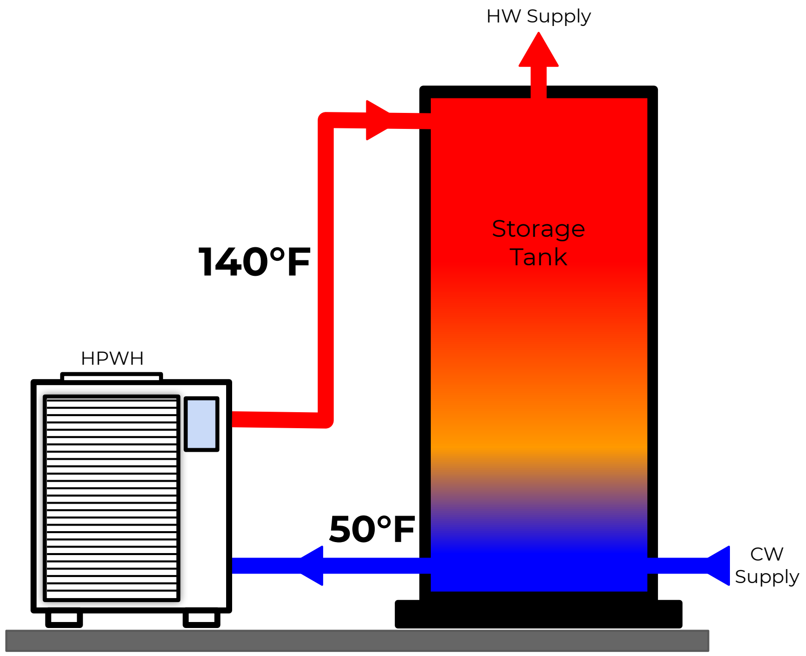
Keeping the water in the distribution system **HOT**



ENERGY USAGE IN MULTIFAMILY MIDRISE

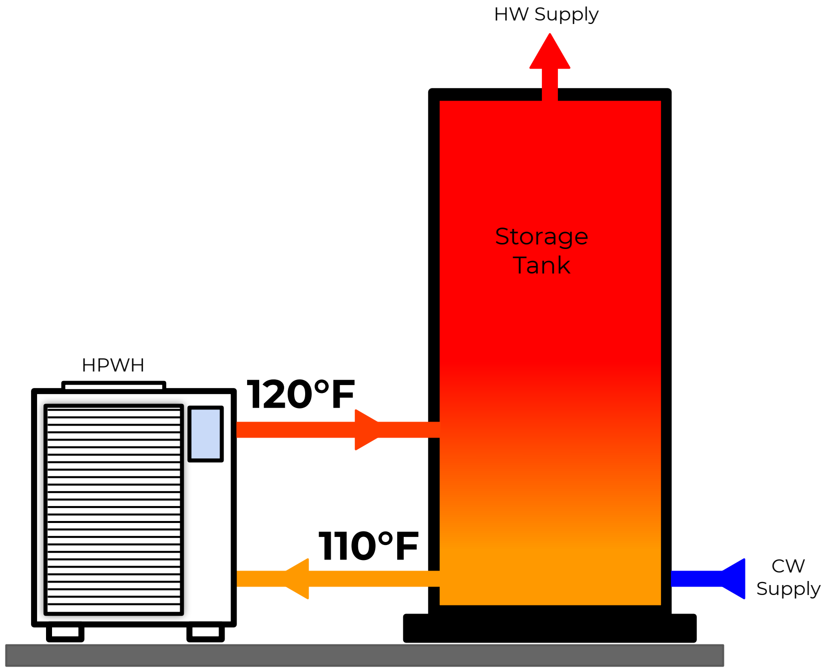


TWO TYPES OF **HEATING CYCLES**



SINGLE-PASS

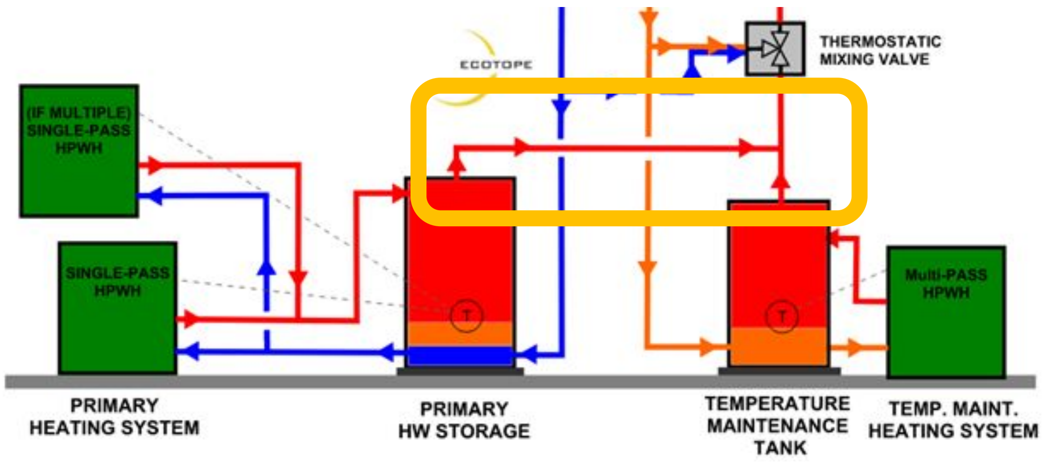
Heats water to working temp. in single pass
(*usually for primary heating load*)



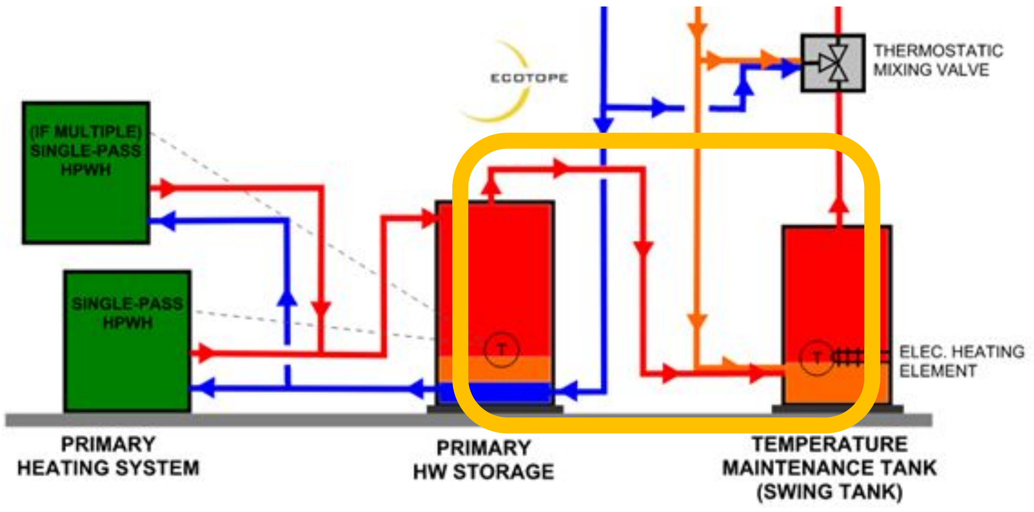
MULTI-PASS

Heats water to working temp. in multiple passes
(*typical temperature maintenance systems*)

TWO RELIABLE TEMPERATURE MAINTENANCE REHEAT STRATEGIES

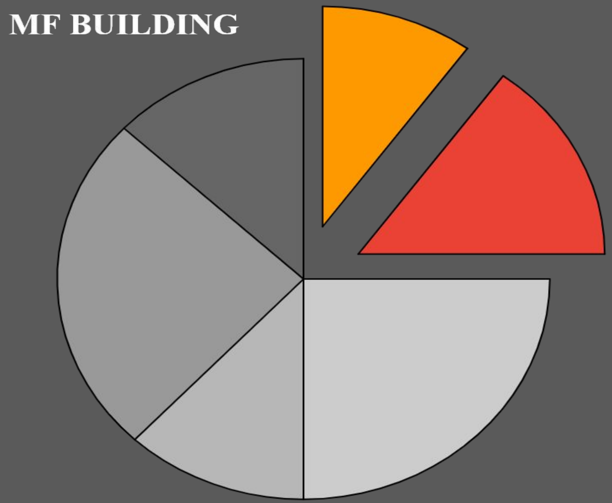


"Parallel Loop Tank"



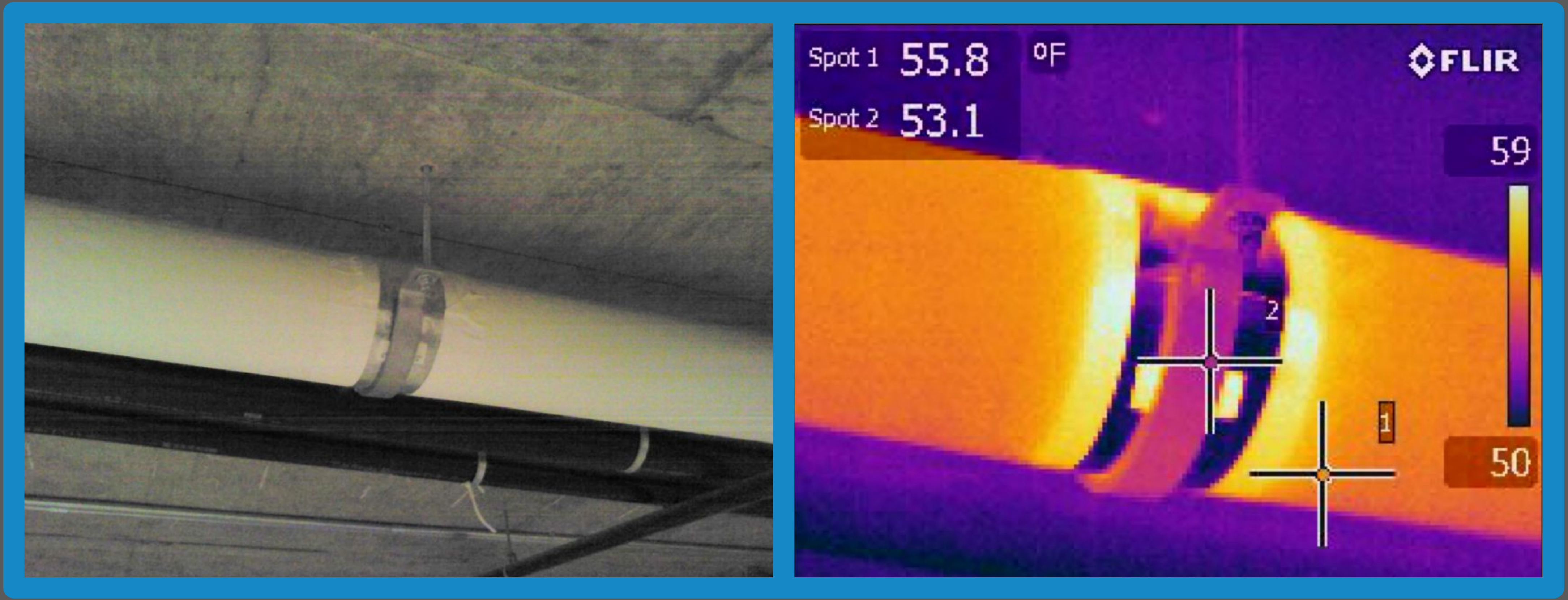
"Series Loop Tank" or "Swing Tank"

TEMPERATURE MAINTENANCE: **HW CIRCULATION**



A SMALL CONSTANT LOAD THAT **ADDS UP**

OPTIONS FOR REDUCING THE **TEMPERATURE MAINTENANCE LOSSES**



GOOD EXAMPLE: PIPE CLAMP ACTS AS A THERMAL BREAK

OPTIONS FOR REDUCING THE **TEMPERATURE MAINTENANCE LOSSES**

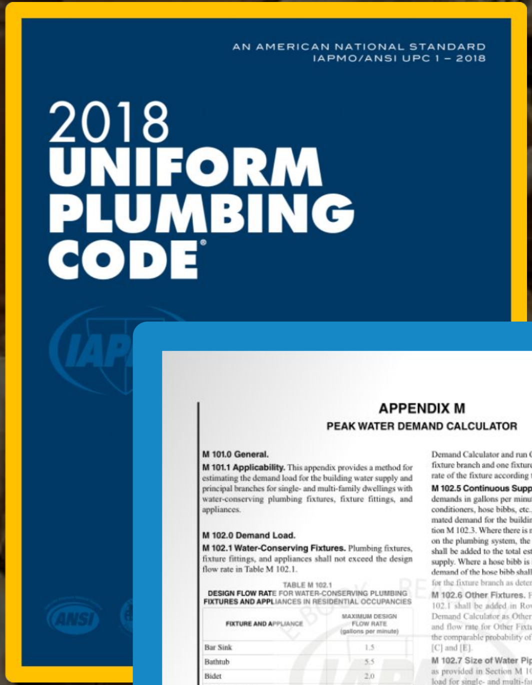
GOOD

BAD

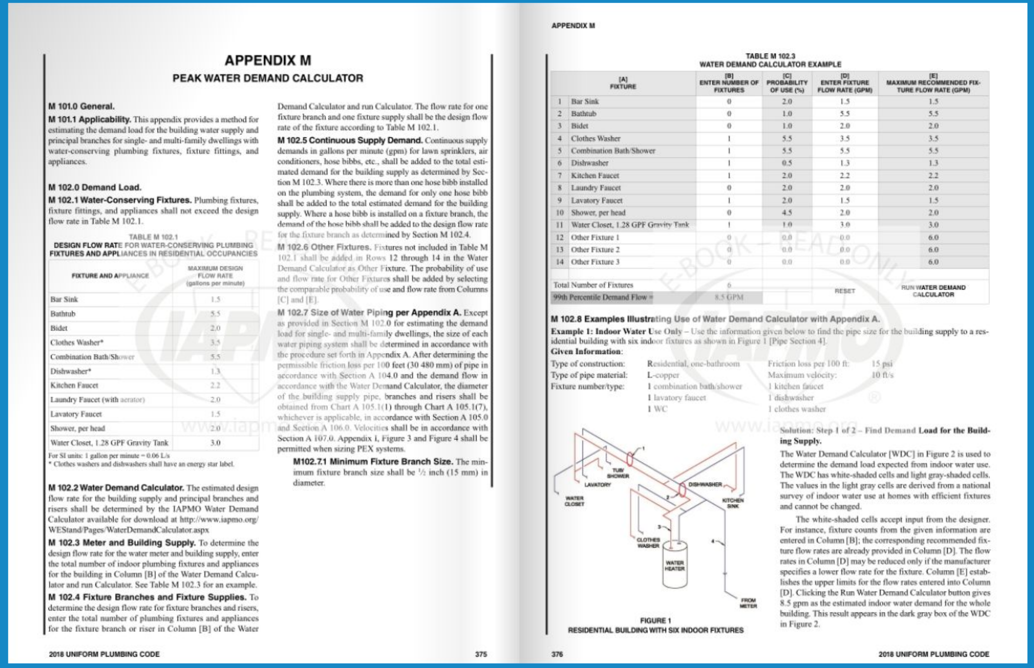
HIGH EFFICIENCY **PLUMBING DISTRIBUTION SYSTEMS**

APPENDIX M SIZING
(UPC 2018)

- Reduces pipe size in building
- Reduces volume of water & associated losses
- Jurisdiction dependent in CA

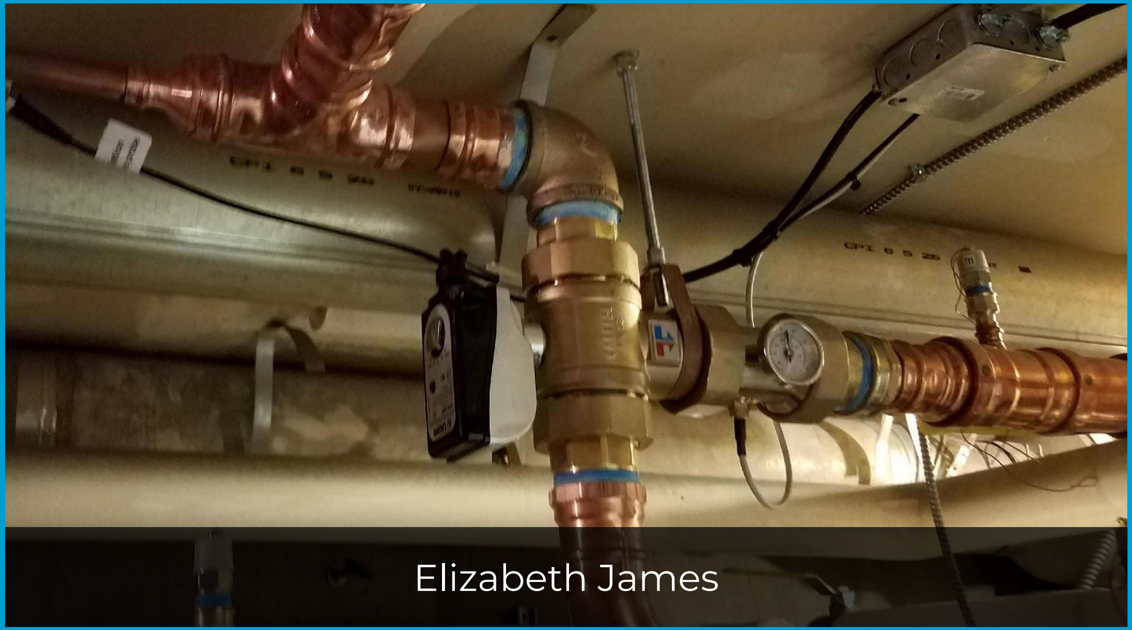


Sizing Method	Flowrate (GPM)	CW main
Appendix A	260	4"
Appendix A + C	205	3.5"
Appendix M	54	2"



THERMOSTATIC MIXING VALVE **SIZING**

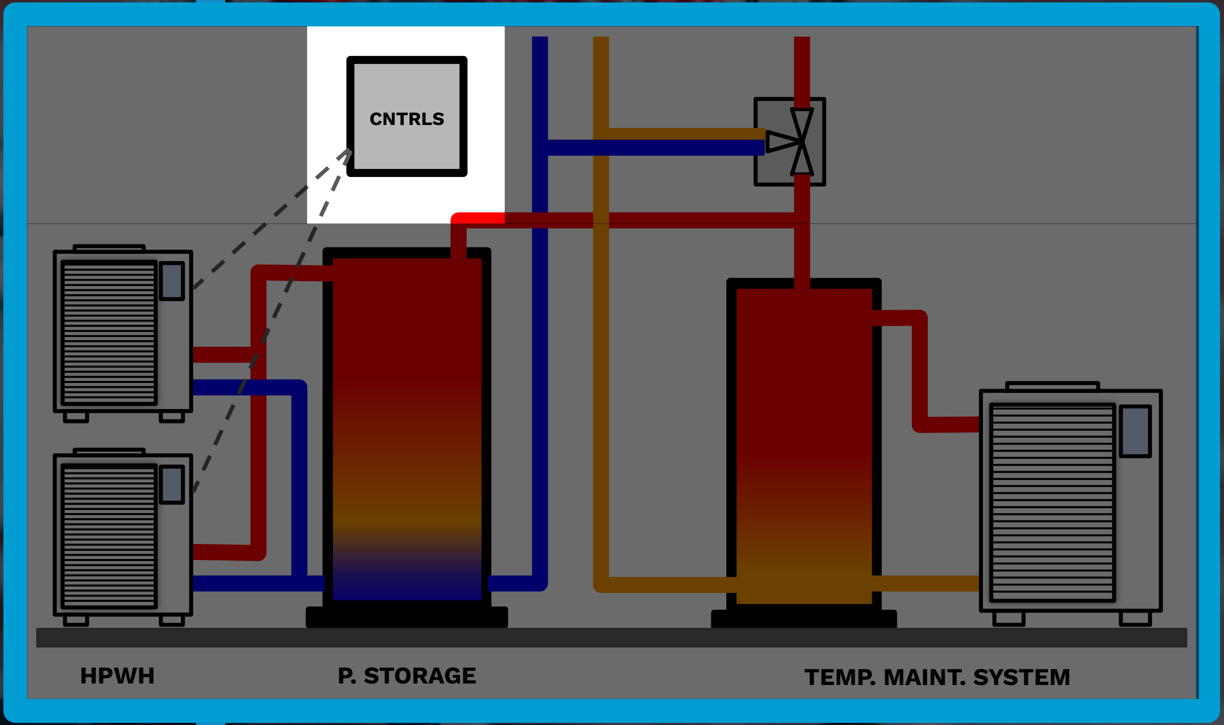
Jackson Apartments



Elizabeth James

Requires **accurate sizing** for DHW load.
Response time is **essential**.

COMPONENTS:
CONTROLS



CONTROLS **OPTIONS**

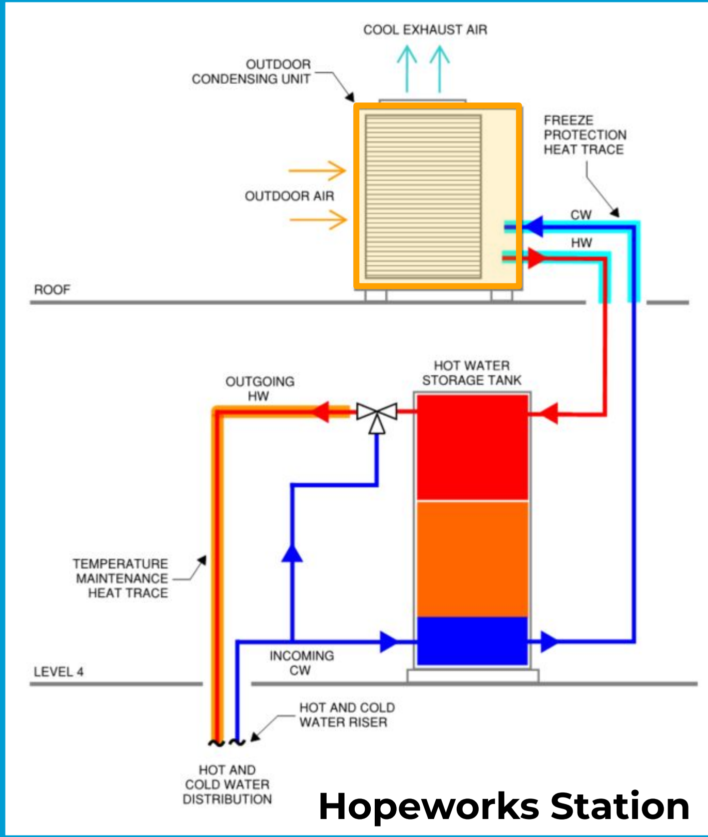
Equipment communicates through **CONTROLS** to fulfill design intent.

Third Party Controls

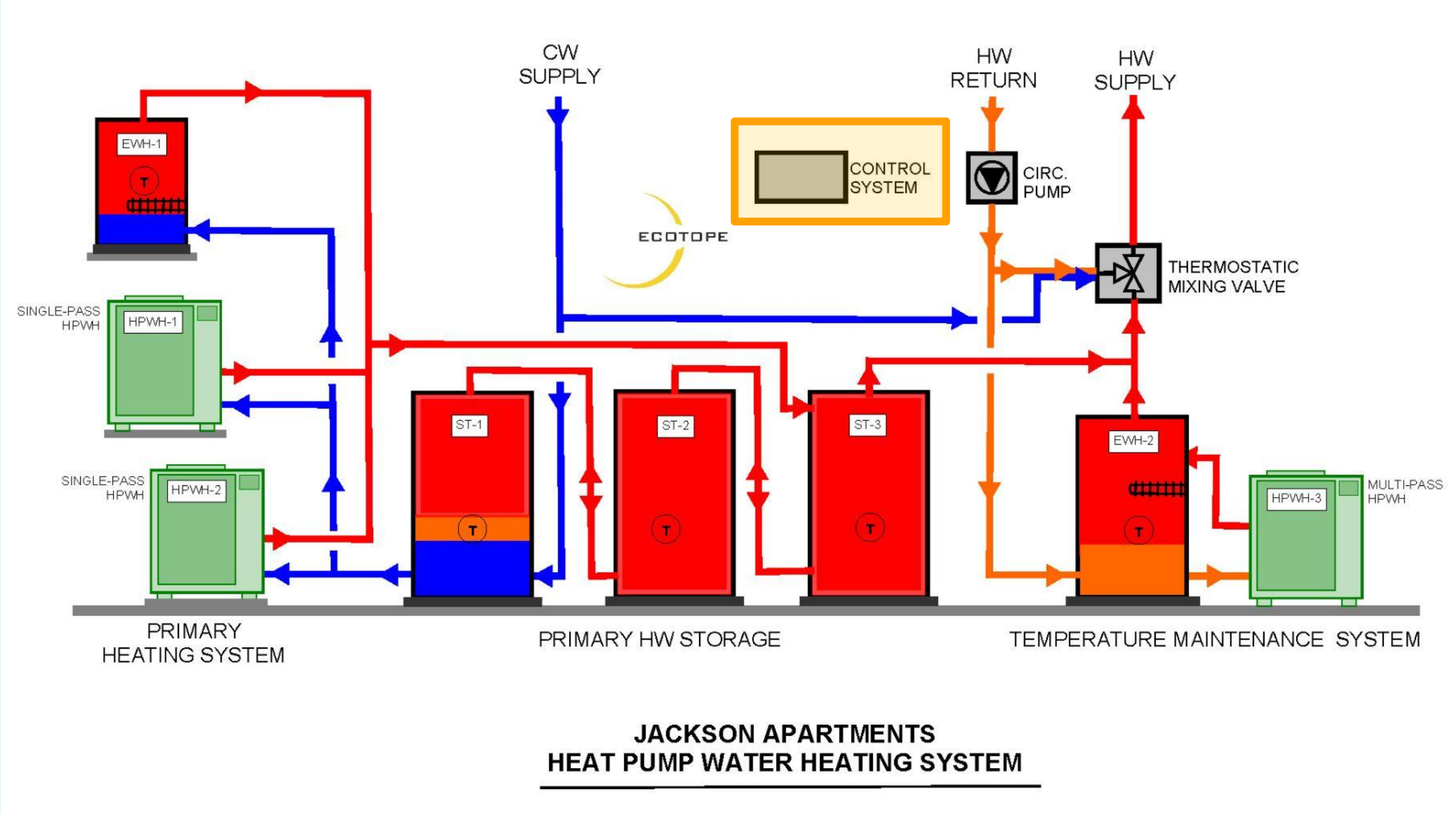
Internal Controls

CONTROL **OPTIONS**

Controls can be **INTERNAL** or **THIRD PARTY**

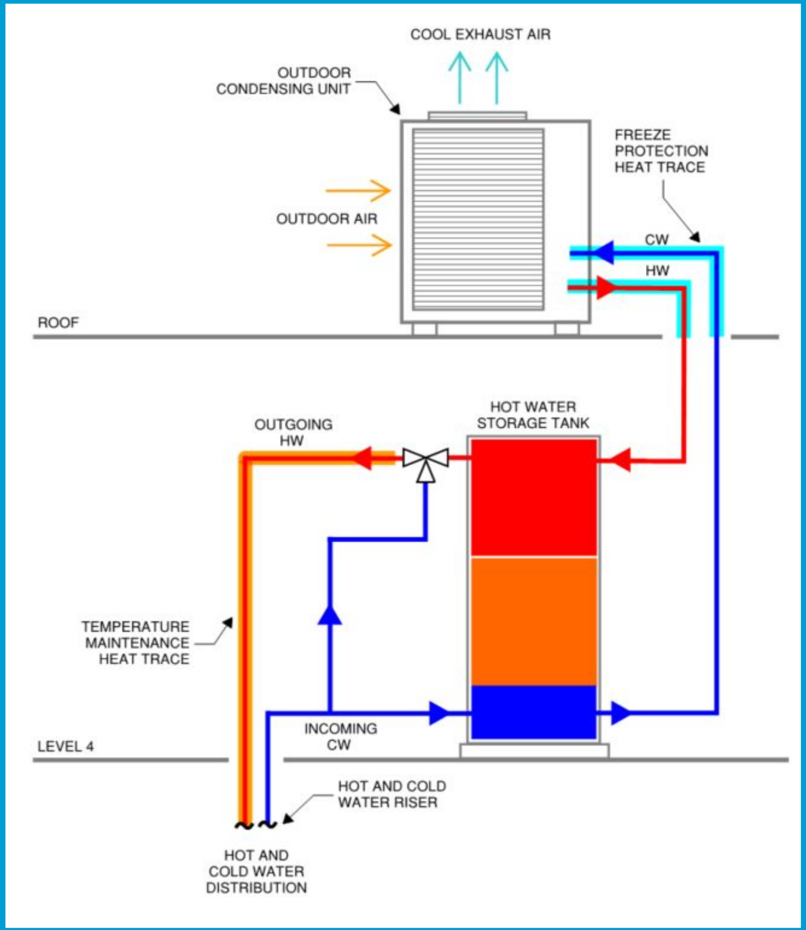


INTERNAL



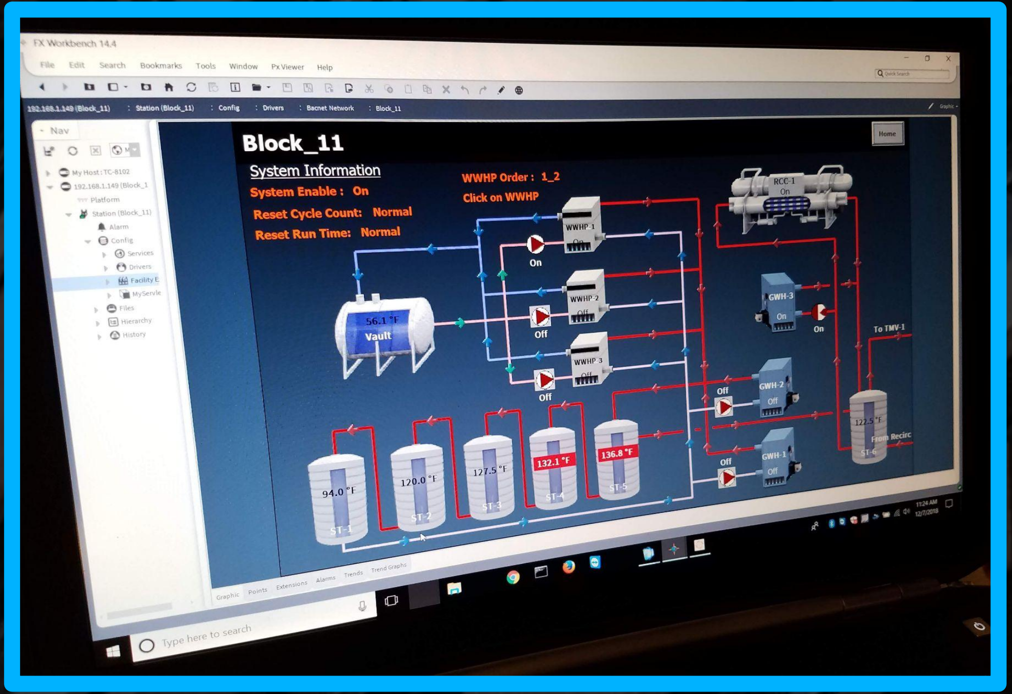
THIRD PARTY

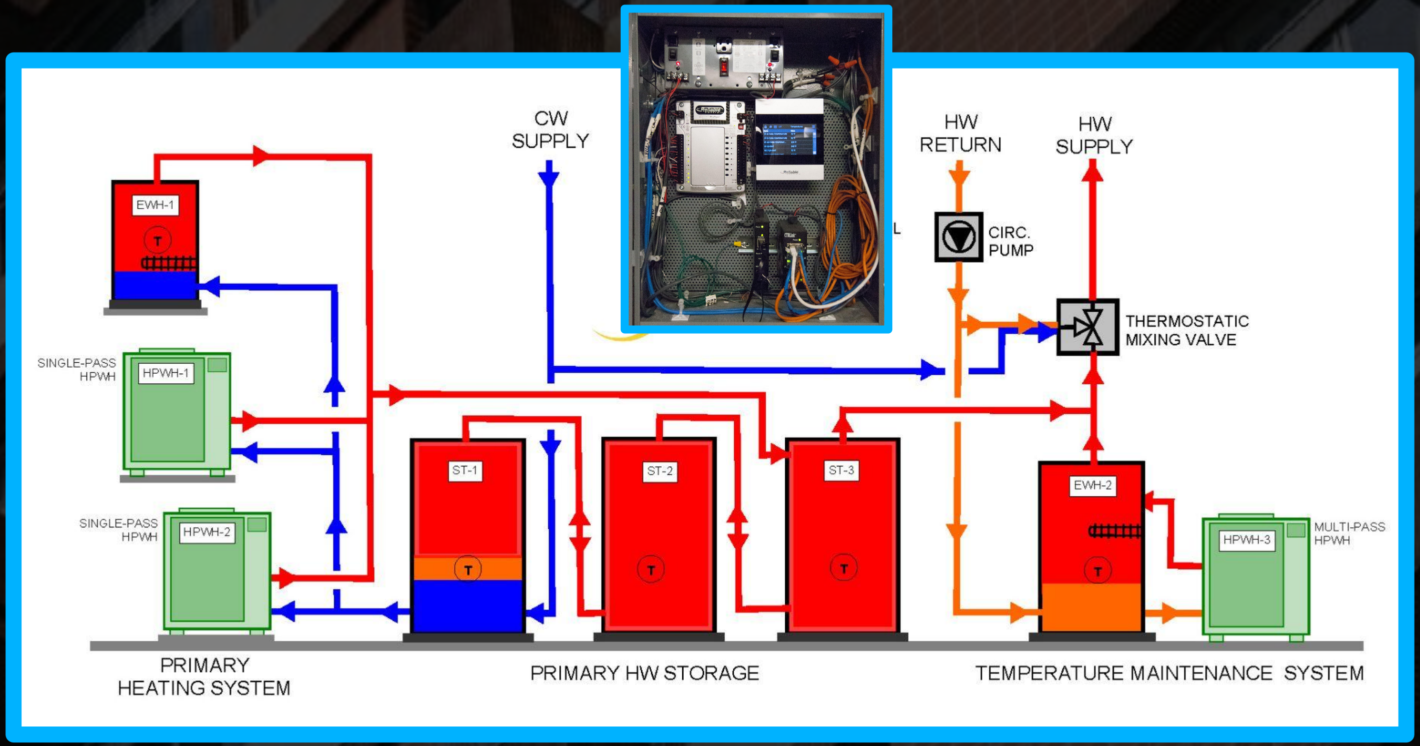
CHPWH CONTROL SYSTEM: **INTERNAL**



INTERNAL

CHPWH CONTROL SYSTEM: **THIRD PARTY**

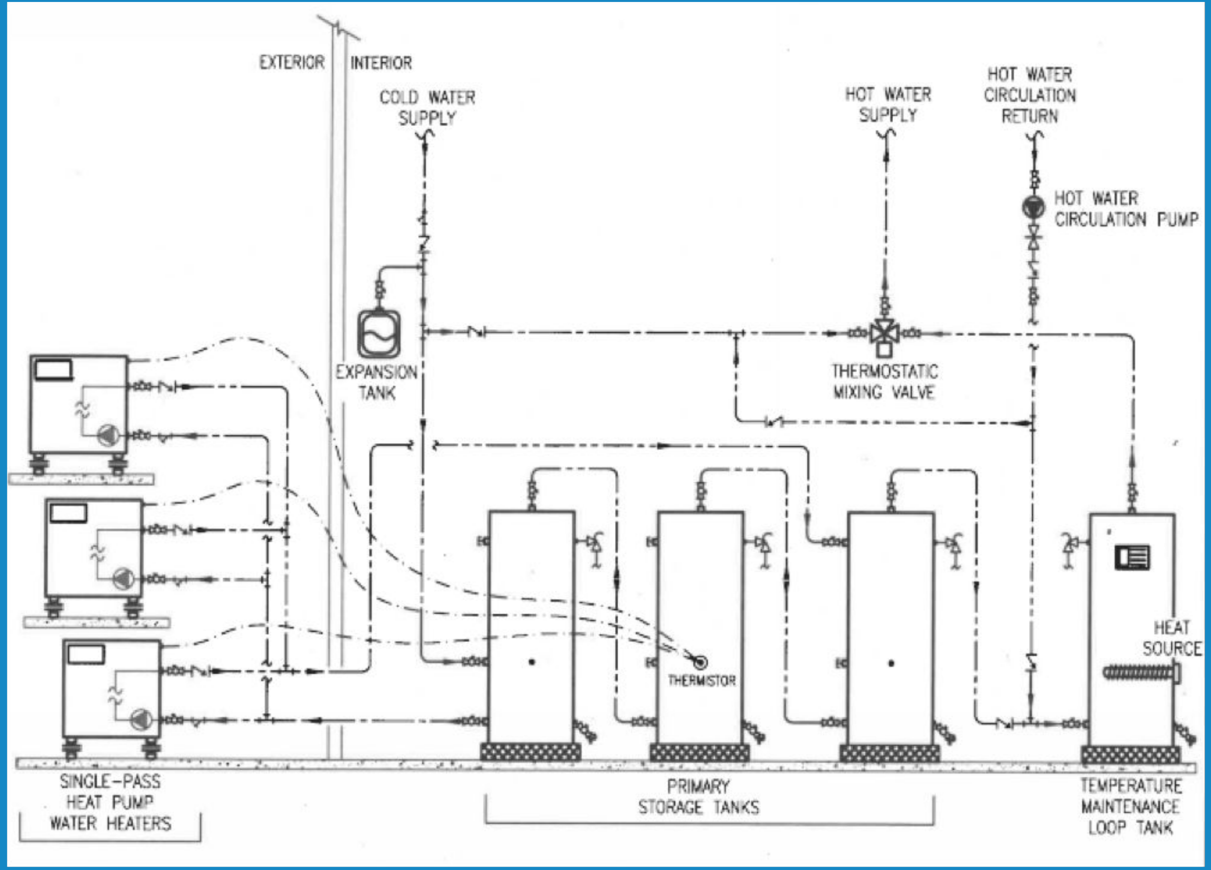




THIRD PARTY

RECAP:

- Language of CHPWHs
- Why?



RECAP:

CHPWH COMPONENTS:

- Heat pump
- Primary storage tank
- Temperature maintenance system
- Controls

NEXT **TIME**

- HW System Designs
- Sizing
- Refrigerant Types & Equipment Selection
- Case Studies

UPCOMING **TRAINING & RESOURCES**

Seattle City Light, in collaboration with the Lighting Design Lab 2021

(https://www.lightingdesignlab.com/education)

CHPWH: Design, Operations, and Maintenance

(8-hour seminar)

Oct 26, Nov. 3, 10, 17

10am-12pm

To host a training session, or for more information, contact:
Lauren Bhaskar at: LBHASKAR@DRINTL.COM

lighting® design lab

Seattle City Light

D+R LEARN

ECOTOPE


THANK YOU
D+R LEARN
ECOTOPE

ADVANCED WATER HEATING INITIATIVE

Emerging Technologies

Bonneville POWER ADMINISTRATION

THANK YOU TO OUR COLLABORATORS