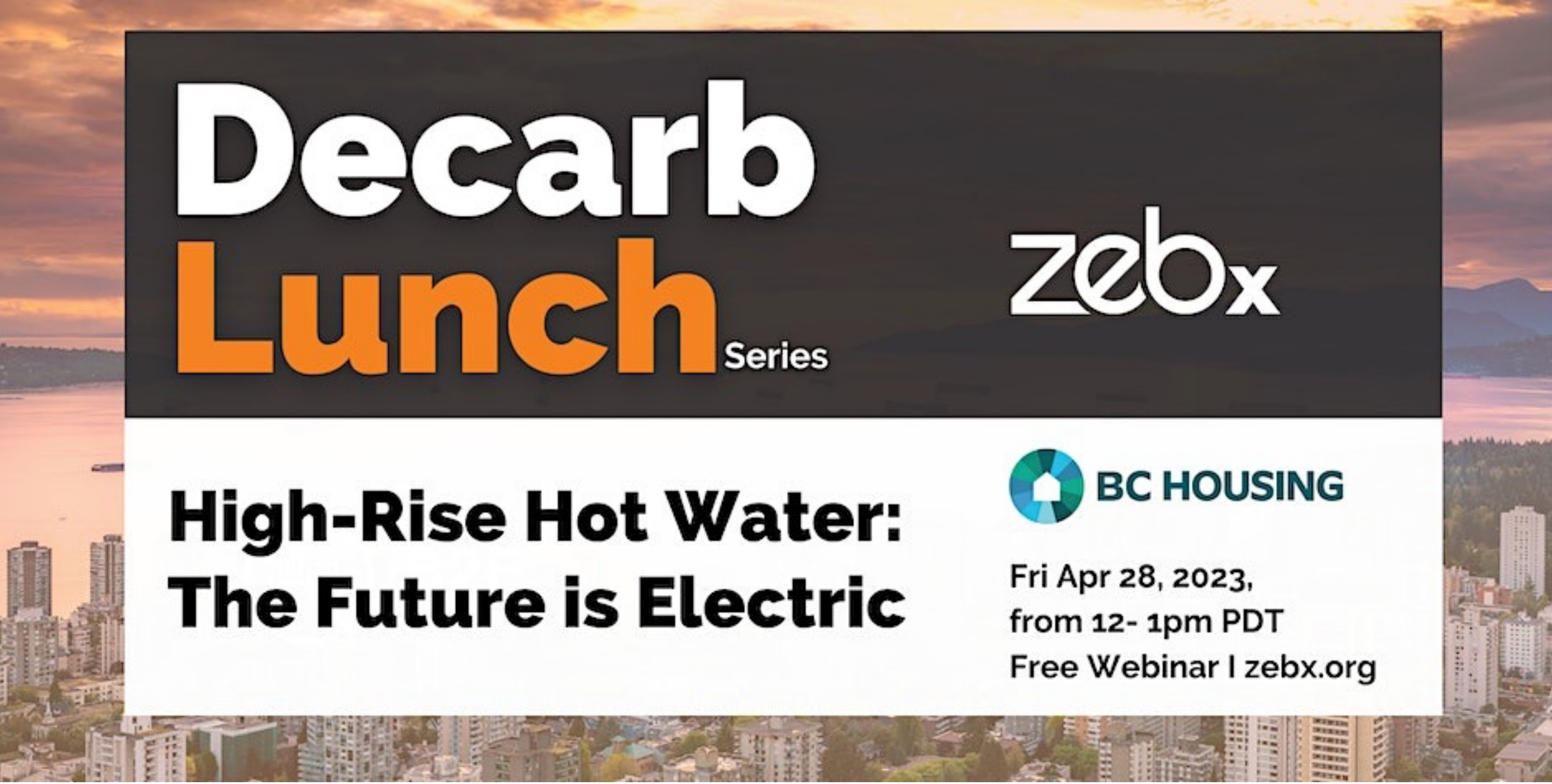
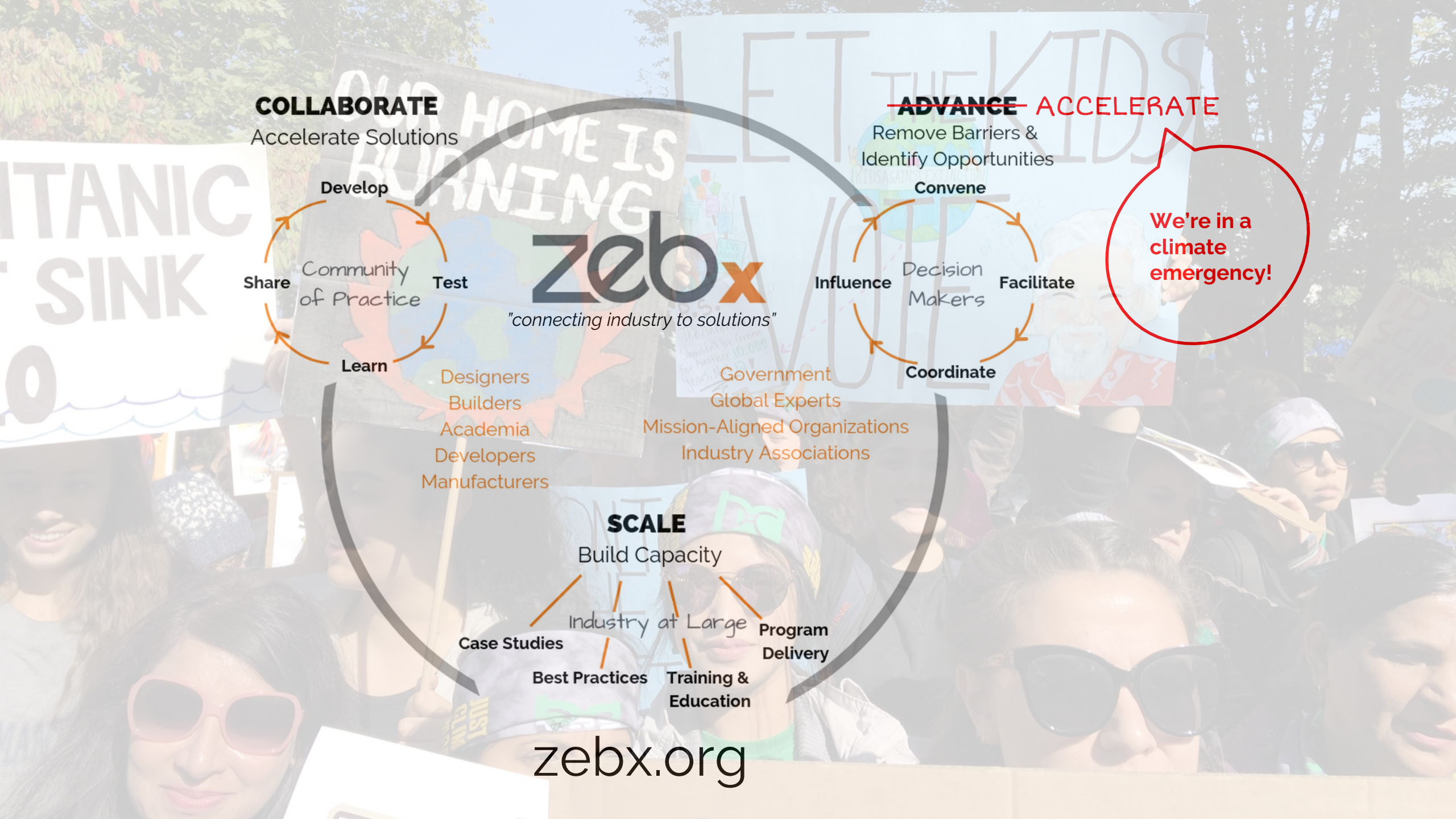


CITY OF VANCOUVER

BC Hydro
Power smart

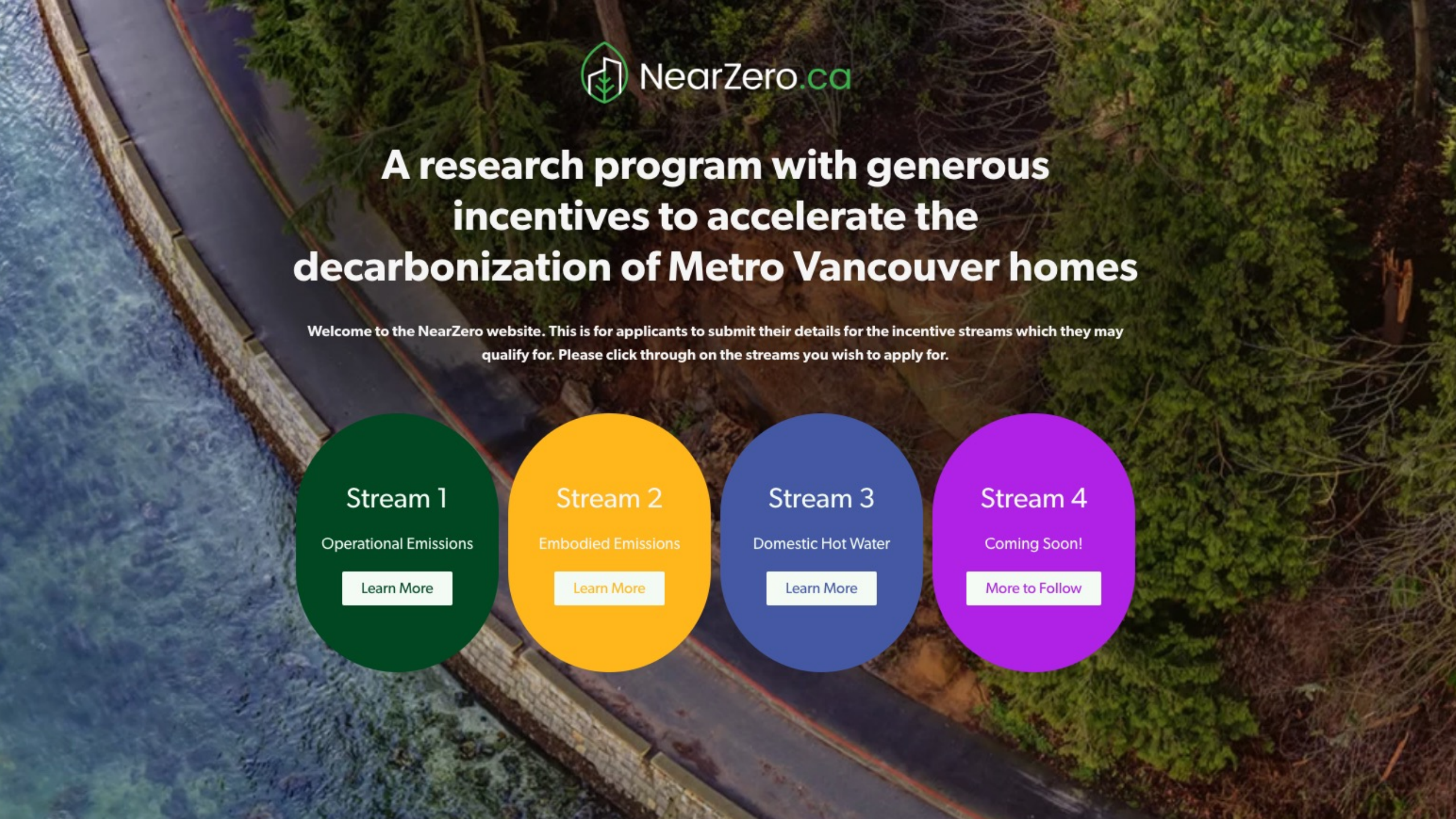

The Zero Emissions
Building Exchange
zebx
Podcast


COLLABORATE
Accelerate Solutions
Develop
Test
Learn
Share
Community of Practice
zebx
"connecting industry to solutions"
~~ADVANCE~~ ACCELERATE
Remove Barriers & Identify Opportunities
Convene
Facilitate
Coordinate
Influence
Decision Makers
We're in a climate emergency!
Designers
Builders
Academia
Developers
Manufacturers
Government
Global Experts
Mission-Aligned Organizations
Industry Associations
SCALE
Build Capacity
Industry at Large
Case Studies
Best Practices
Training & Education
Program Delivery

zebx.org

We are a broad coalition working together to electrify buildings in British Columbia in order to reduce their climate impacts and reliance on fossil fuels.

clfvancouver.com


NearZero.ca
A research program with generous incentives to accelerate the decarbonization of Metro Vancouver homes
Welcome to the NearZero website. This is for applicants to submit their details for the incentive streams which they may qualify for. Please click through on the streams you wish to apply for.
Stream 1
Operational Emissions
Learn More
Stream 2
Embodied Emissions
Learn More
Stream 3
Domestic Hot Water
Learn More
Stream 4
Coming Soon!
More to Follow

POLL 1

Tell us about yourself!

Three-part anonymous poll

B2E
Building to Electrification Coalition

BC HOUSING

ZERO CARBON STEPCODE

"**By 2030, all new buildings will be zero carbon**, and all new space and water heating equipment will meet the highest standards for efficiency."– *CleanBC Roadmap to 2030*

Central Heat Pump Water Heating for Large Apartments

Shawn Oram, PE
Ecotope, Inc
Principal
shawn@ecotope.com

4/28/2023

Ecotope CHPWH engagement landscape

- **HPWH Design:** Over 90 projects in various stages of delivery
- Pilot projects and configuration deployment
- Technology Innovation Model
- Manufacturer Engagement: product development and optimization
- **AWHI:** technical support to growing national initiative
- Market Potential Analysis: PNW and National adoption potential
- Code Proposals: SEC, WSEC, IECC
- Load Shift: potential for major daily load shift
- Refrigerant Transition
- Utility program model for APPA
- Numerous reports and resources
- Design Guidance on configuration and performance implications
- Performance Research: lab testing and on-site M&V
- Evaluation of national performance standards
- Temperature maintenance best practice
- Sizing Tool: **EcoSizer**
- Software: **EcoSIM:** development of rule-set for CBECC-Com; additional simulation options needed
- **AWHS:** Prescriptive performance standard for program and policy adoption
- **PADS/QPL:** pre-approved product resource
- Training: 15 hours of training built, plus specific code official training program
- Developing web resource

ECOTOPE

Targeting sectors by energy use

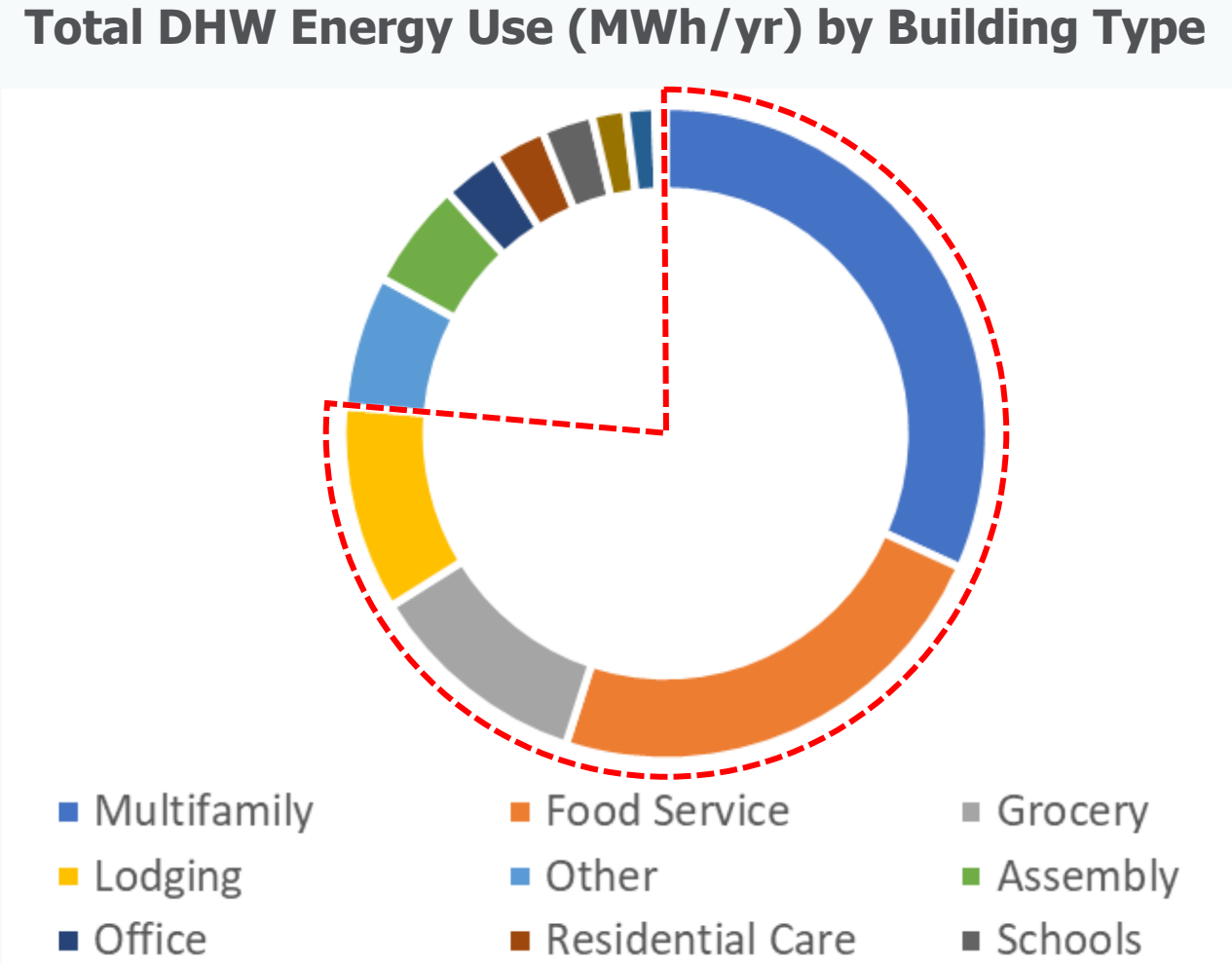
+ 4 building types represent over 75% of total DHW load in commercial and multifamily buildings

Lodging

Grocery

Food Service

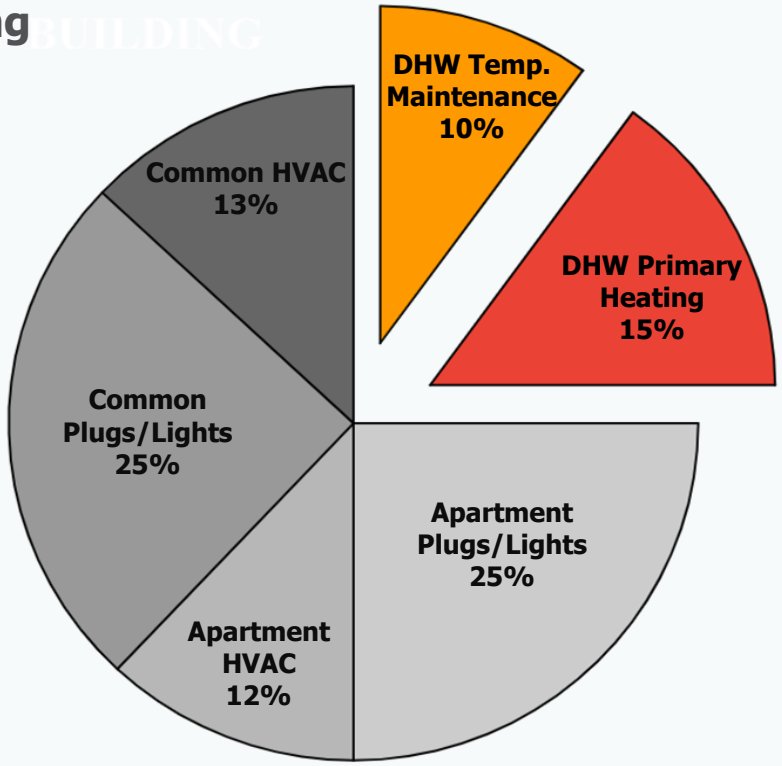
Multifamily



Apartment Energy Savings

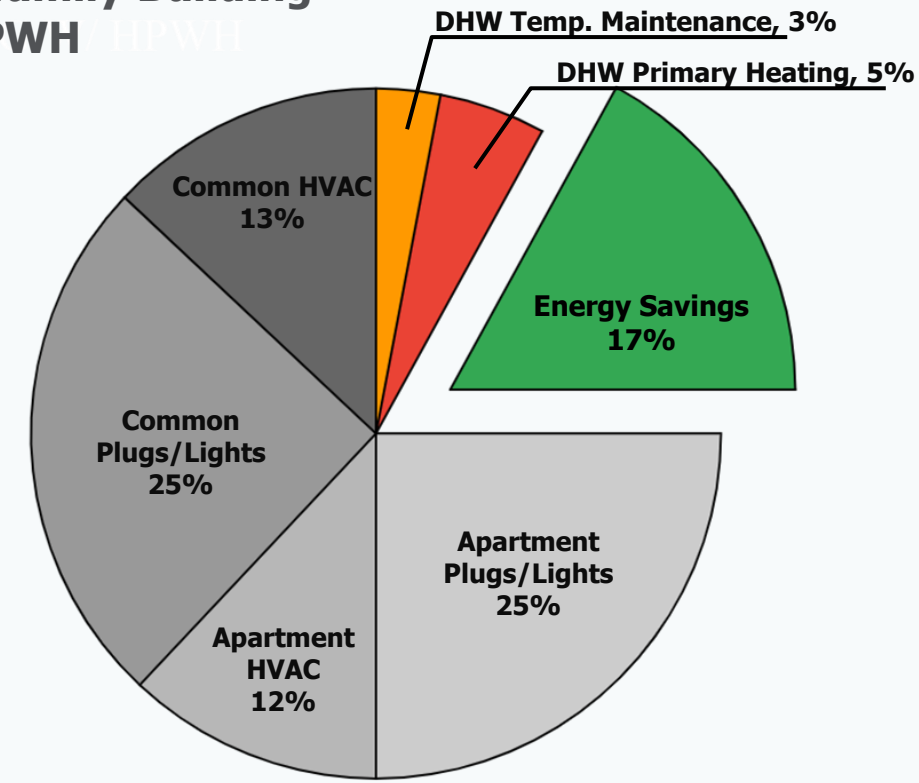
[Ecotope Apartment Design Example ZEBx Case Study (All electric EUI -17 kbtu/sf/yr (56 kwh/m2)]

Baseline Multifamily Building



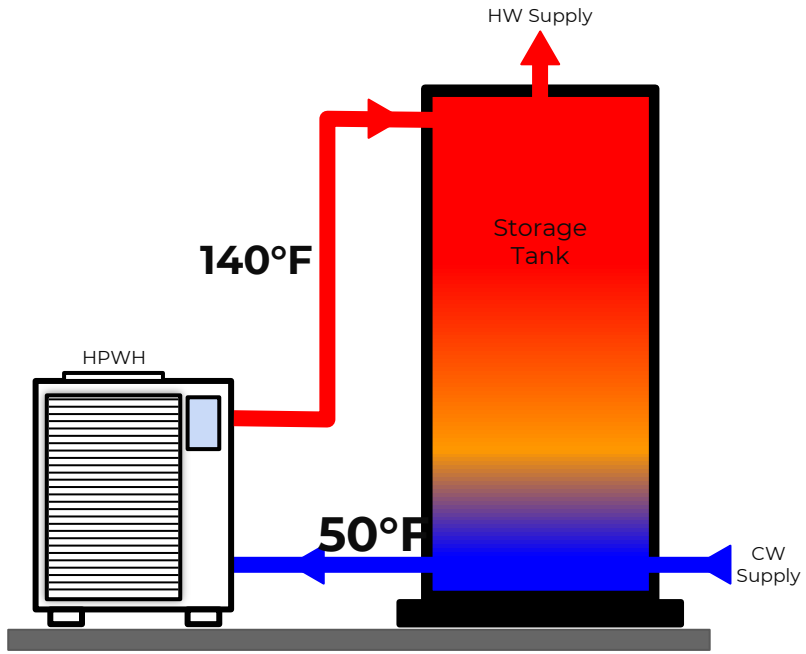
DHW represents 25% of annual building use (Seattle)

Multifamily Building w/HPWH



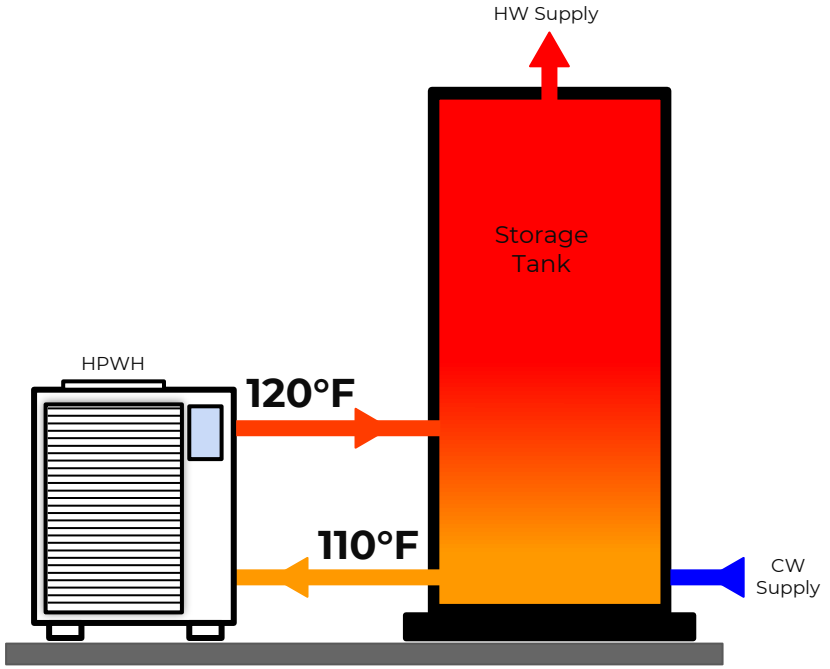
CHPWH systems cut energy usage down by 3x

Single-Pass vs Multi-Pass



SINGLE-PASS

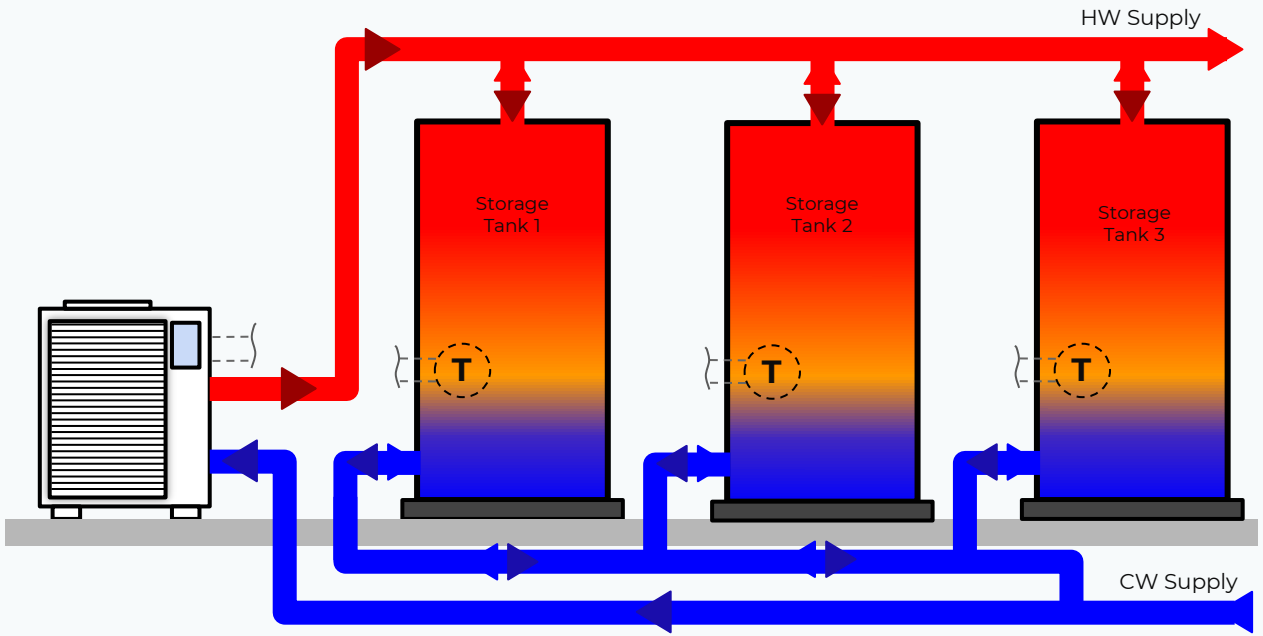
Heats water to working temp. in single pass
(*usually for primary heating load*)



MULTI-PASS

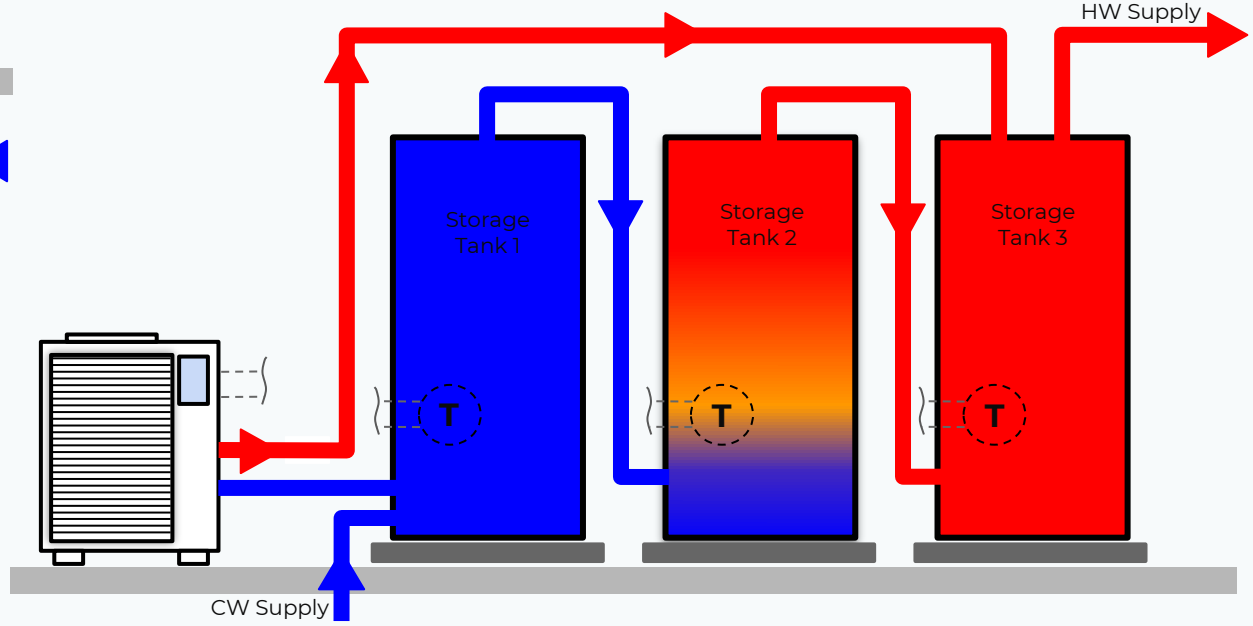
Heats water to working temp. in multiple passes
(*typical temperature maintenance systems*)

Hot Water Storage Piping



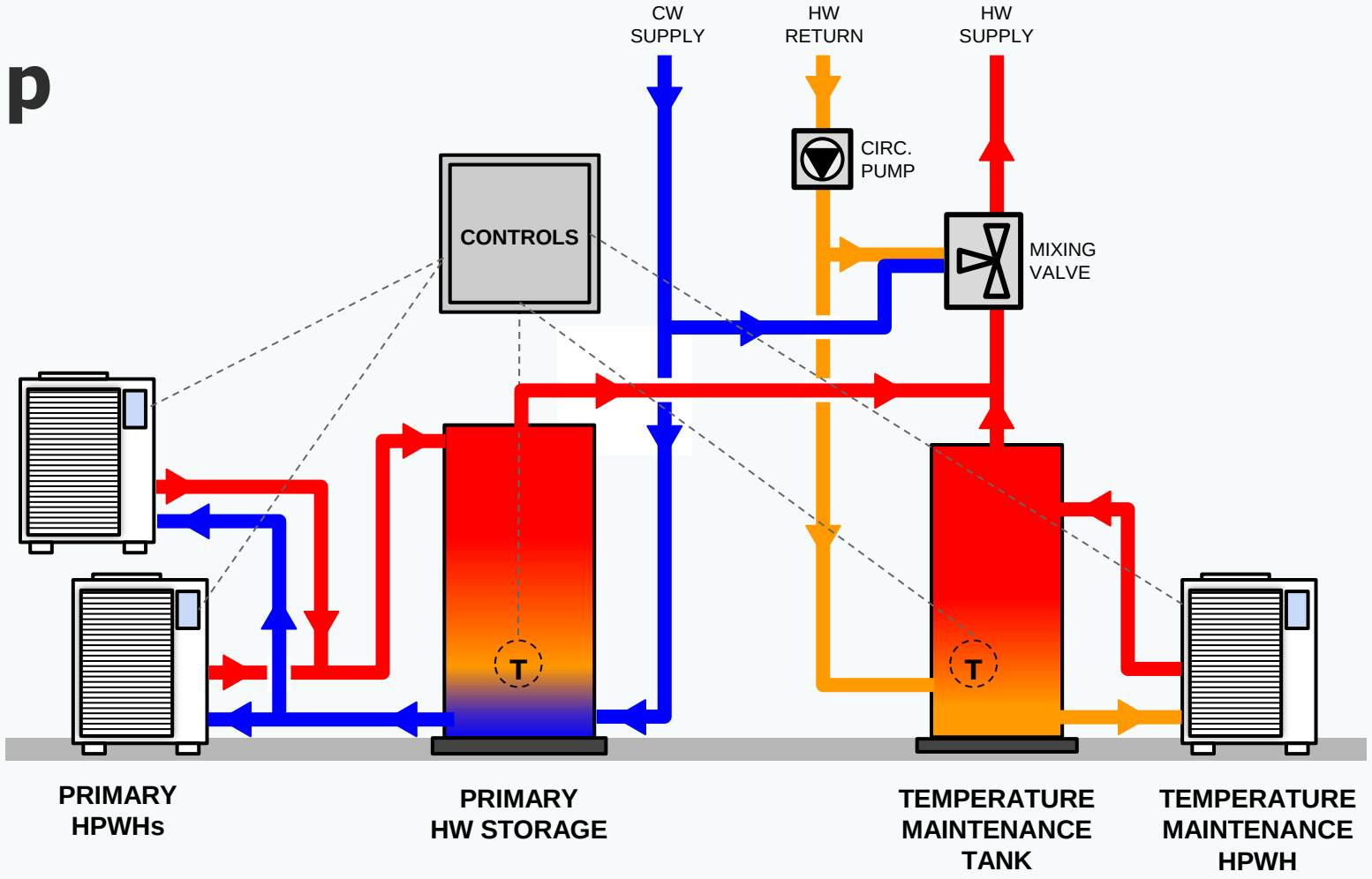
IN PARALLEL

IN SERIES



Components of CHPWH sytem

+ Primary heat pump water heater
+ Primary HW storage tank
+ Temperature maintenance system
+ Control system



Single Pass + Swing Tank

Single Pass + Parallel Multi-Pass

Figure 4. Single-Pass Primary HPWH with Series Temperature Maintenance Tank System (Swing Tank)

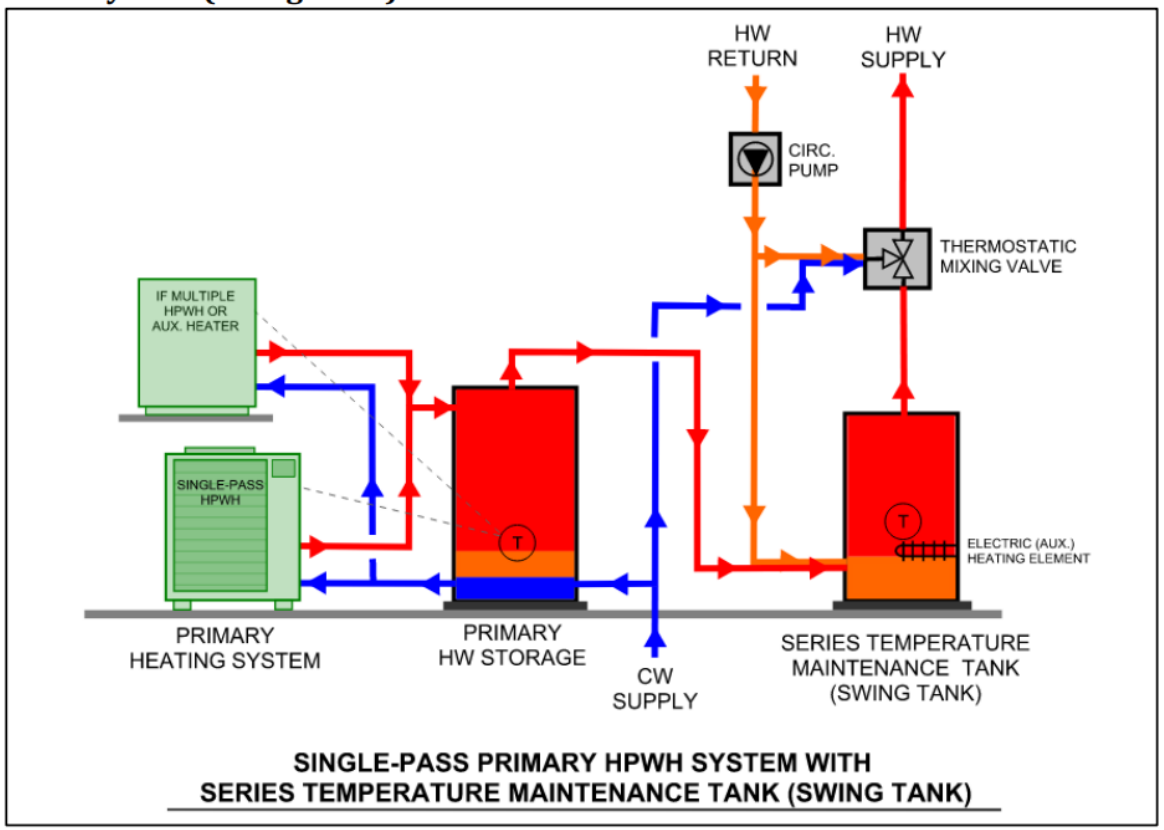
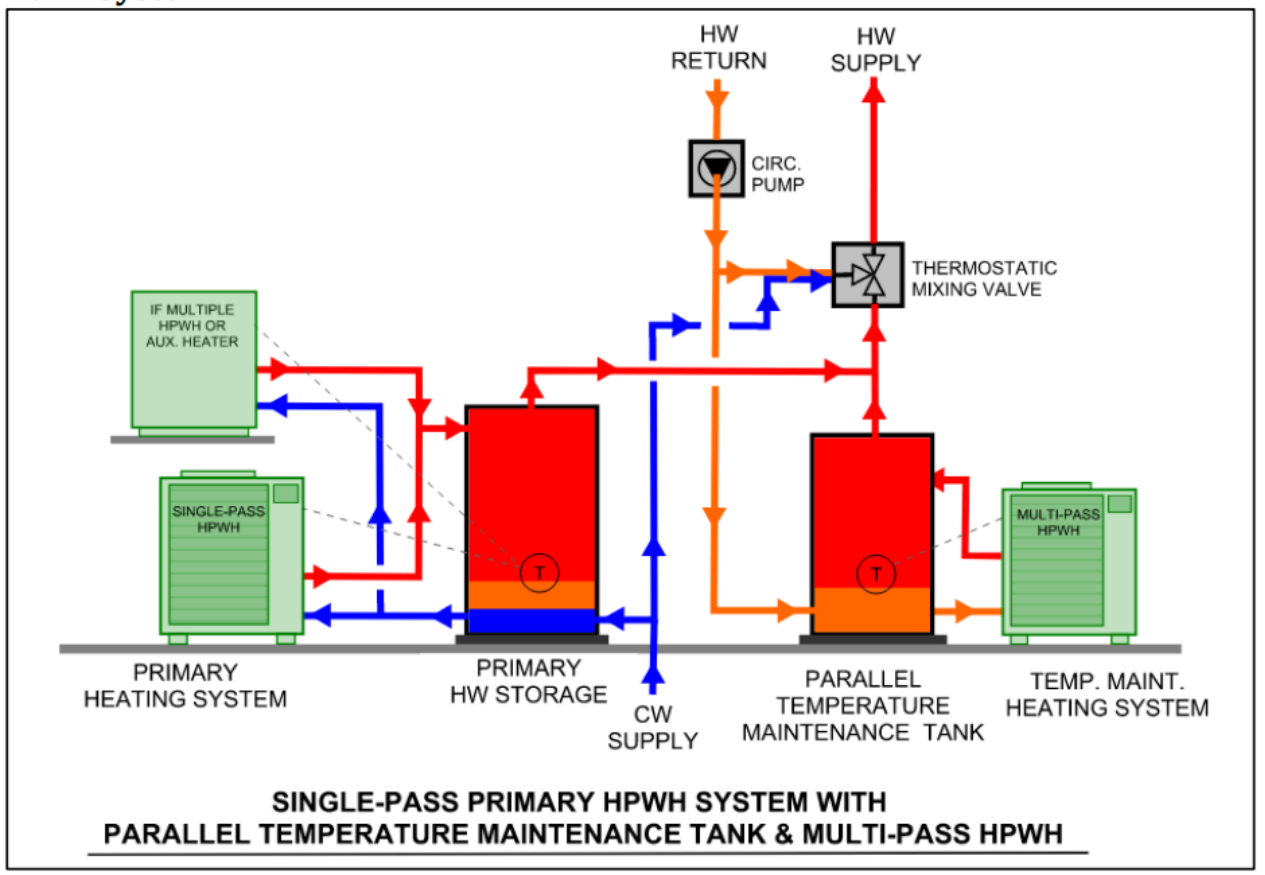


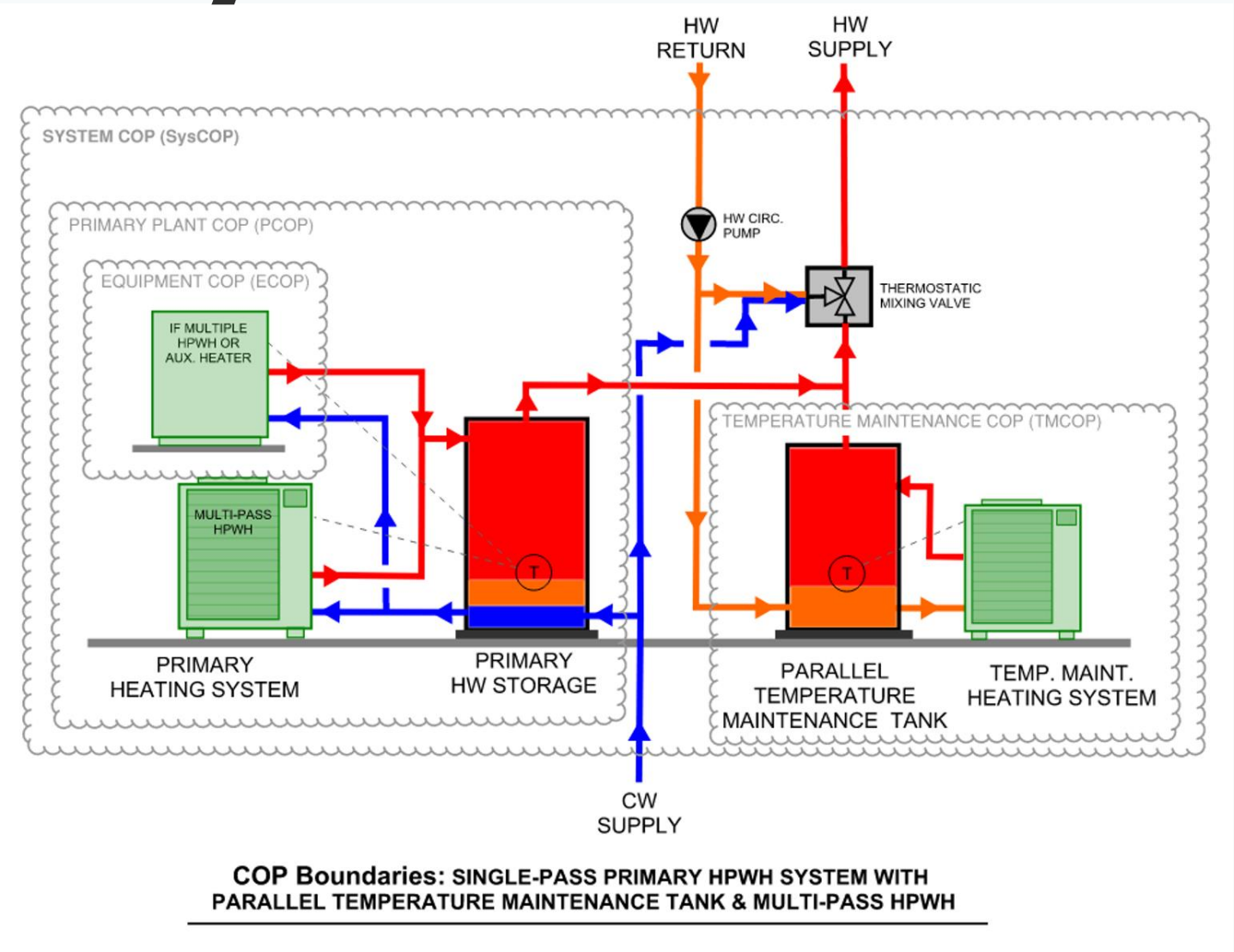
Figure 5. Single-Pass Primary HPWH with Parallel Temperature Maintenance Tank System



ECOTOPE

System efficiency

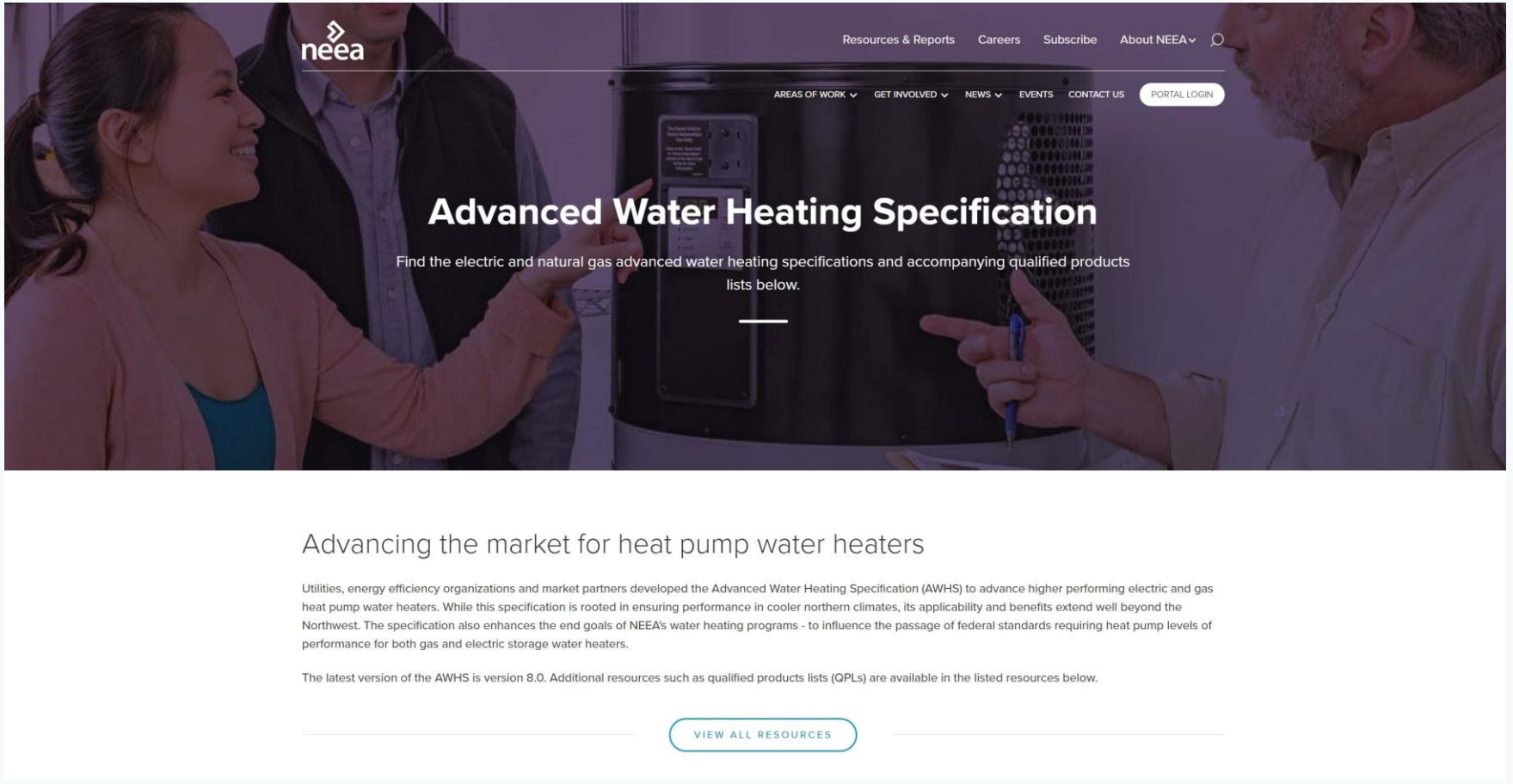
+ Heat pump
+ Heat pump plus storage tank
+ Temperature maintenance system
+ Total system COP



COP Boundaries: SINGLE-PASS PRIMARY HPWH SYSTEM WITH PARALLEL TEMPERATURE MAINTENANCE TANK & MULTI-PASS HPWH

Advanced Water Heating Specification (AWHS)

https://neea.org/resources/advanced-water-heating-specification



Qualified Products List

https://neea.org/resources/commercial-hpwh-qualified-products-list

Tools build on each other to deliver consistent and predictable results with manufacturer collaboration

ECOTOPE

Product Availability

Available in select U.S. markets

1. Origin by Steffes Skid
2. SanCO2 (CO2)
3. Waterdrop Skid (CO2)
4. Colmac (134a/513a)
5. Nyle (134a/513a)
6. Mitsubishi Heat2O (CO2)
7. AOSmith Commercial (134a)
8. Rheem Commercial (134a)
9. Lochinvar (134a/513a)
10. Lync Aesis (Large CO2)
11. Mayekawa (Medium CO2)

Coming to U.S. market soon

1. US Manufacturer (Large CO2)
2. US Manufacturer (Small/Large CO2)
3. US Manufacturer (Large CO2)
4. US Manufacturer (Medium CO2)
5. European Manufacturer (Medium CO2)

*Products on the QPL

ECOTOPE

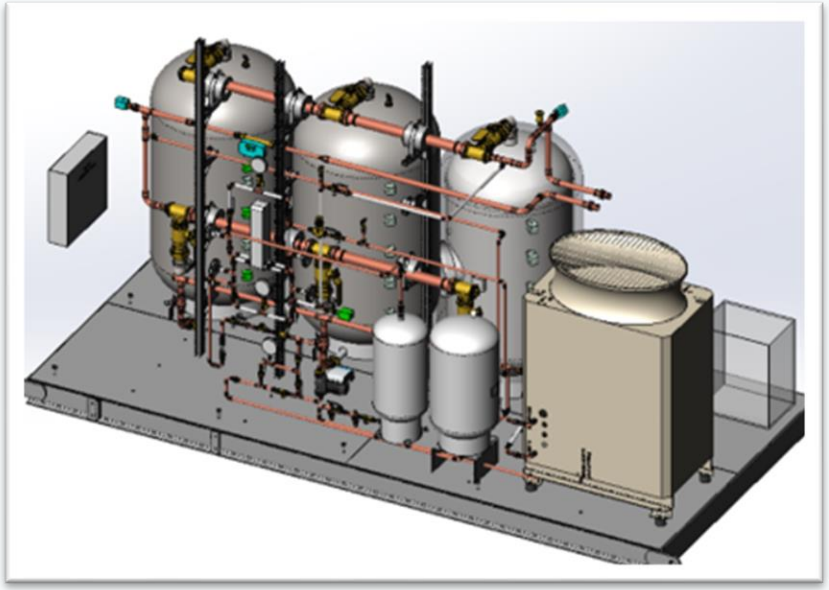
Market delivery models

Custom Engineered System

All the pieces are separate and come from multiple distributors and/or manufacturers.

Specified Built-Up System

All the pieces are separate but come from a single distributor or manufacturer.



Packaged / Skid

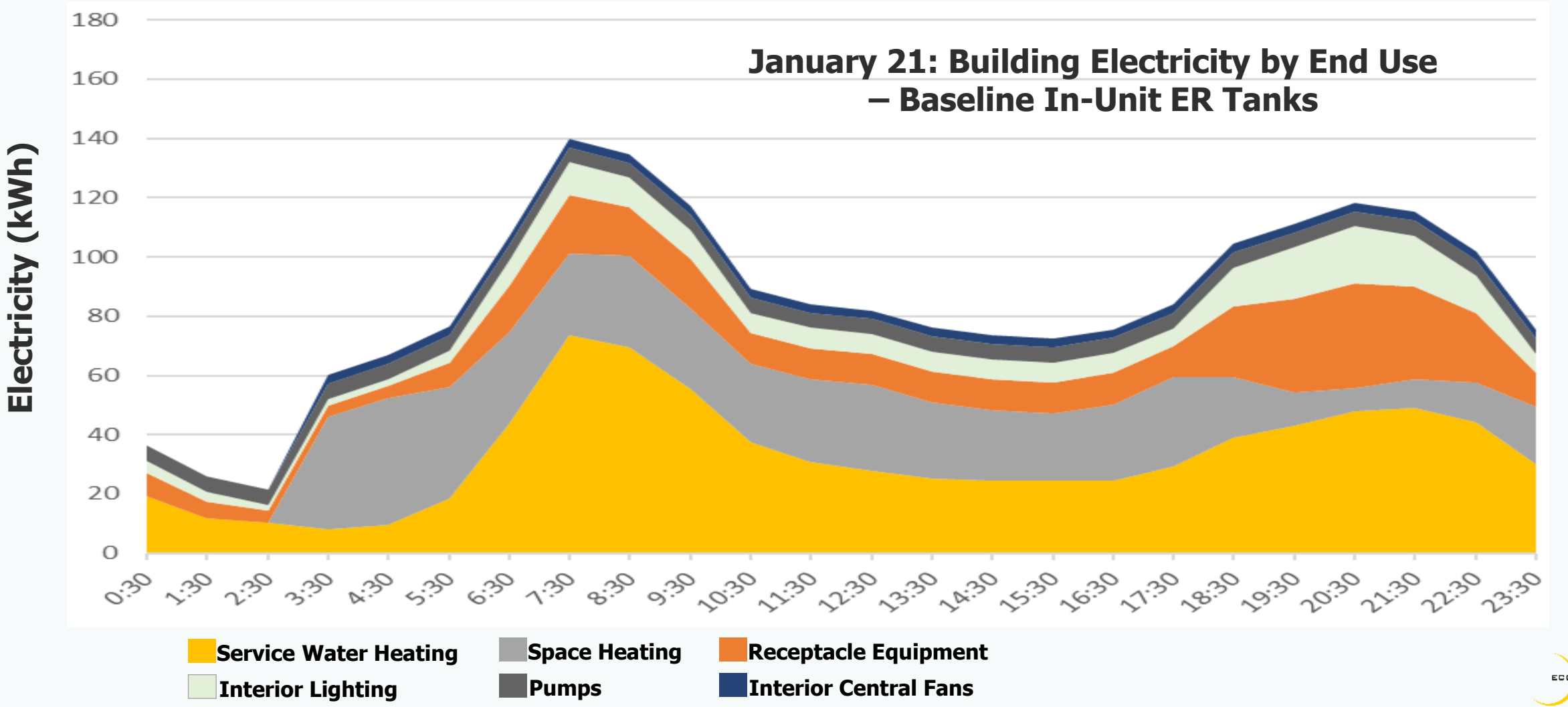
Everything is assembled and delivered in a single package.

DHW Plant Costs (2022)

	Plant Cost	Cost/Unit
HPWH System	$204,820	$2,410
Gas Boilers	$129,790	$1,527
Electric Boilers	$119,130	$1,402

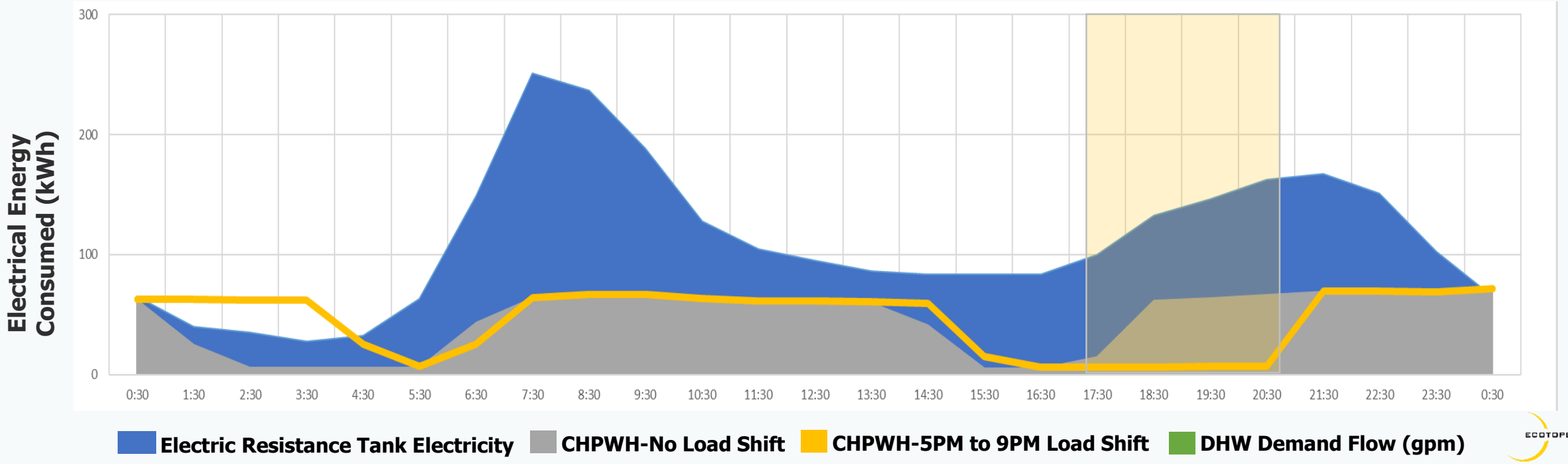
- **Actual bid for 85 Unit Apartment in PNW**
- **US Dollars**

Multifamily end use load shape



DHW load shape w/CHPWH and Time of Use

+ **Baseline electric resistance load shape directly aligned with DHW demand, while CHPWH has typical daily cycle that leverages storage to meet demand**
+ **Load Shift strategy modifies typical cycle to meet load shift criteria, achieving ~40% peak demand reduction**
+ **Technology deployment achieves ~$20,000 annual energy savings, TOU rates with load shift adds ~$1000 annual utility bill savings.**



Load Shift Results - Bayview

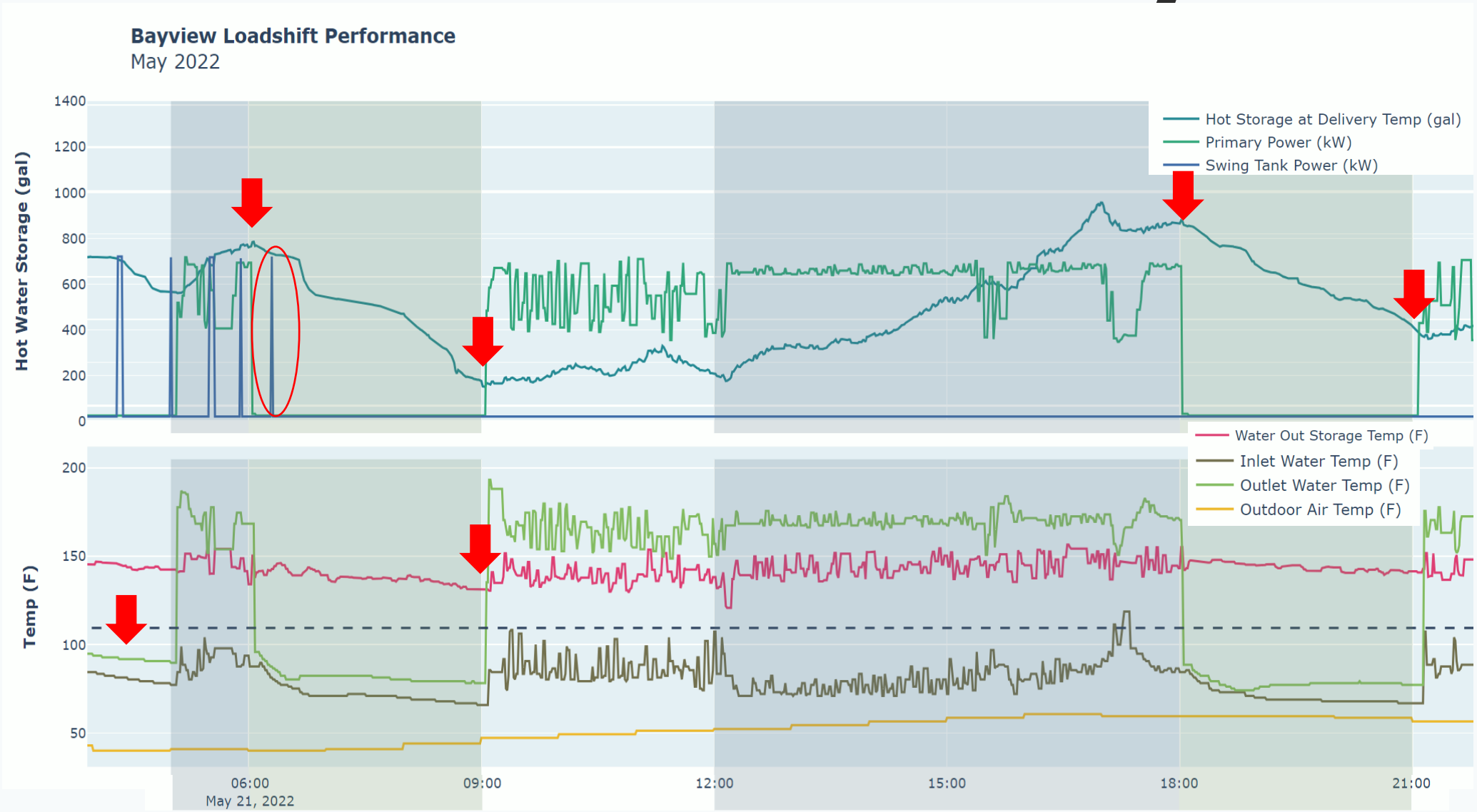
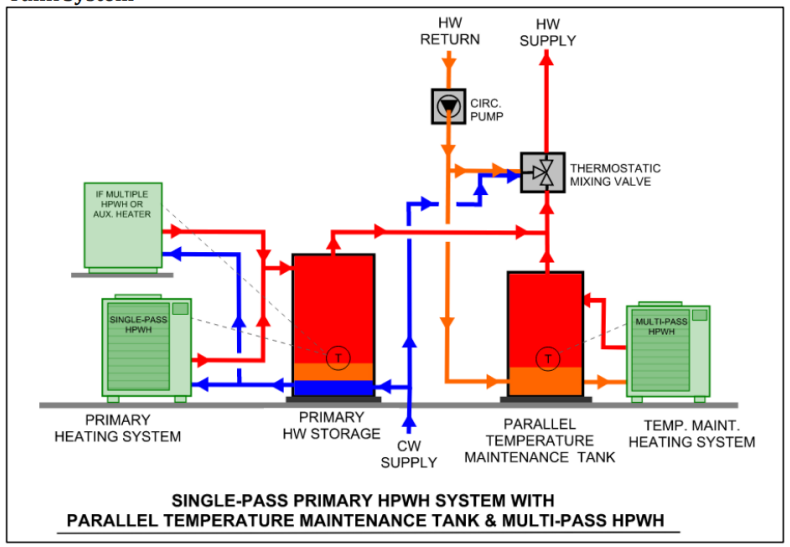


Figure 5. Single-Pass Primary HPWH with Parallel Temperature Maintenance Tank System



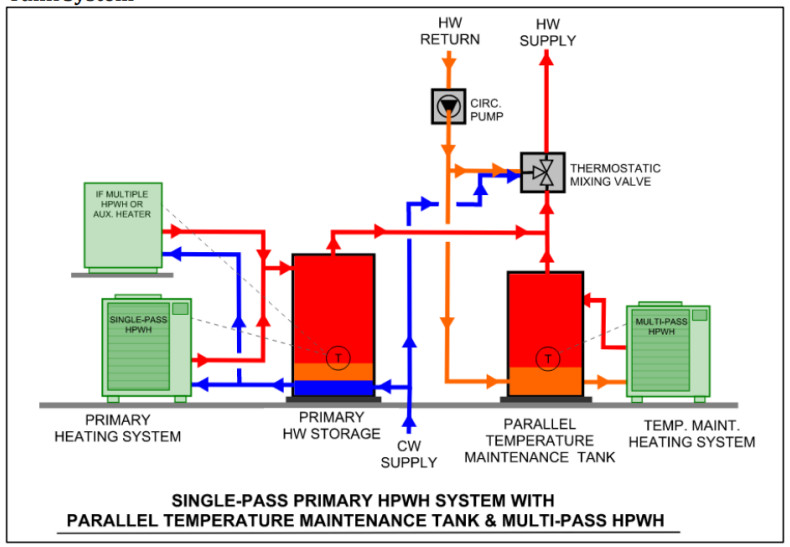
Pasadena, CA
2022 Completion
77 Unit Senior Housing

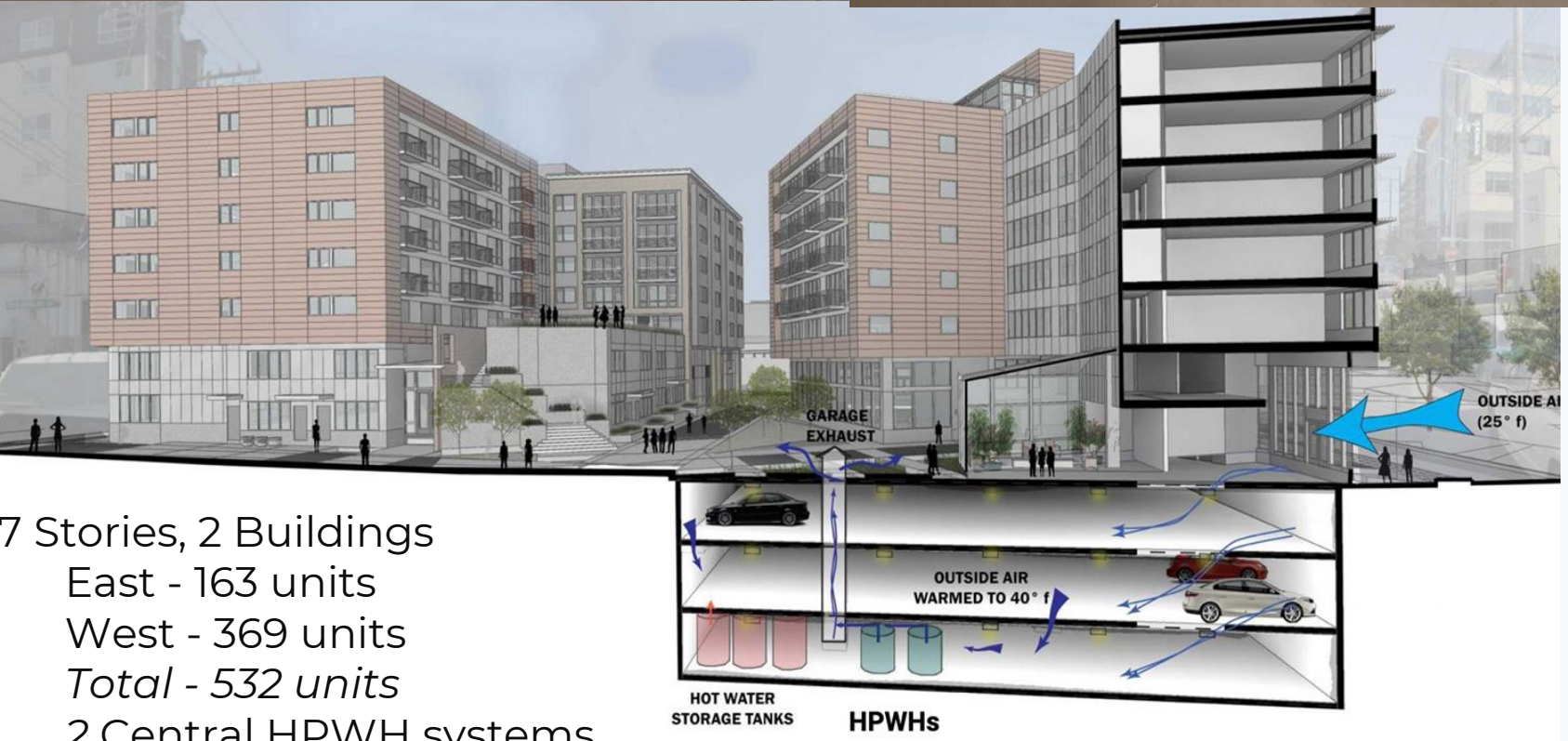
Single Pass +
Parallel Multi-Pass

Retrofit of an earlier problematic HPWH design

ECOTOPE

Figure 5. Single-Pass Primary HPWH with Parallel Temperature Maintenance Tank System





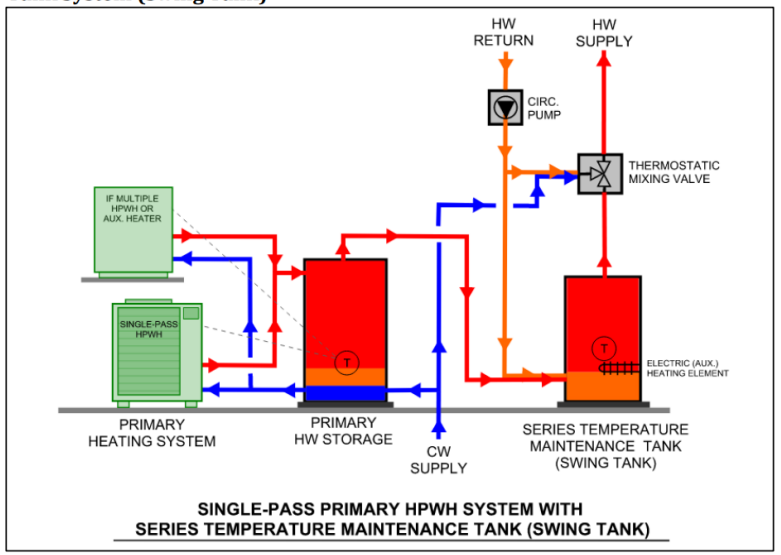
7 Stories, 2 Buildings
East - 163 units
West - 369 units
Total - 532 units
2 Central HPWH systems

Jackson Apartments
Seattle, WA
2019 Completion
525 Units

Single Pass +
Parallel Multi-Pass
Located in BG Parking Garage. Discharge air is ducted out of the room

ECOTOPE

Figure 4. Single-Pass Primary HPWH with Series Temperature Maintenance Tank System (Swing Tank)



Lassen Apartments
San Francisco, CA
2022 Completion
81 Unit Senior Housing

Primary Mitsubishi CO2Heat Pump and Swing Tank

Gas Retrofit

ECOTOPE

McClellan Apartments
Seattle, WA
2017 Completion
130 Unit Market Rate

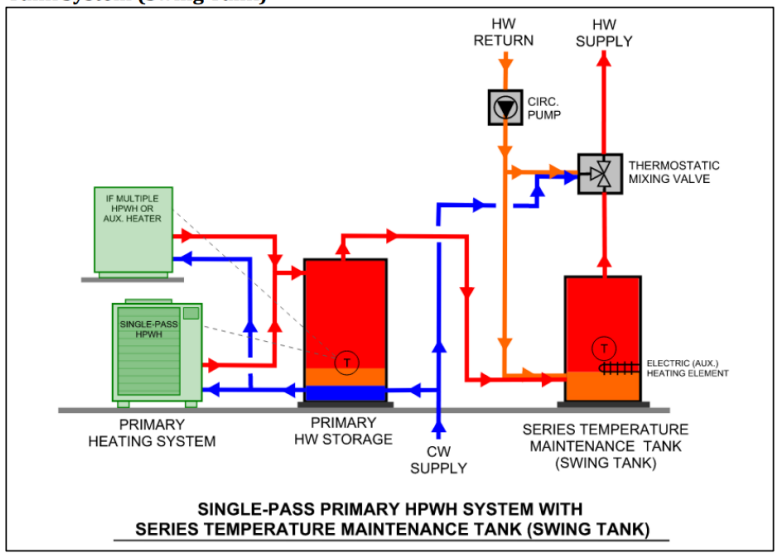
HPWH/Gas Plant in Greenhouse.

COP is high when sunny

Poor mans solar thermal

ECOTOPE

Figure 4. Single-Pass Primary HPWH with Series Temperature Maintenance Tank System (Swing Tank)

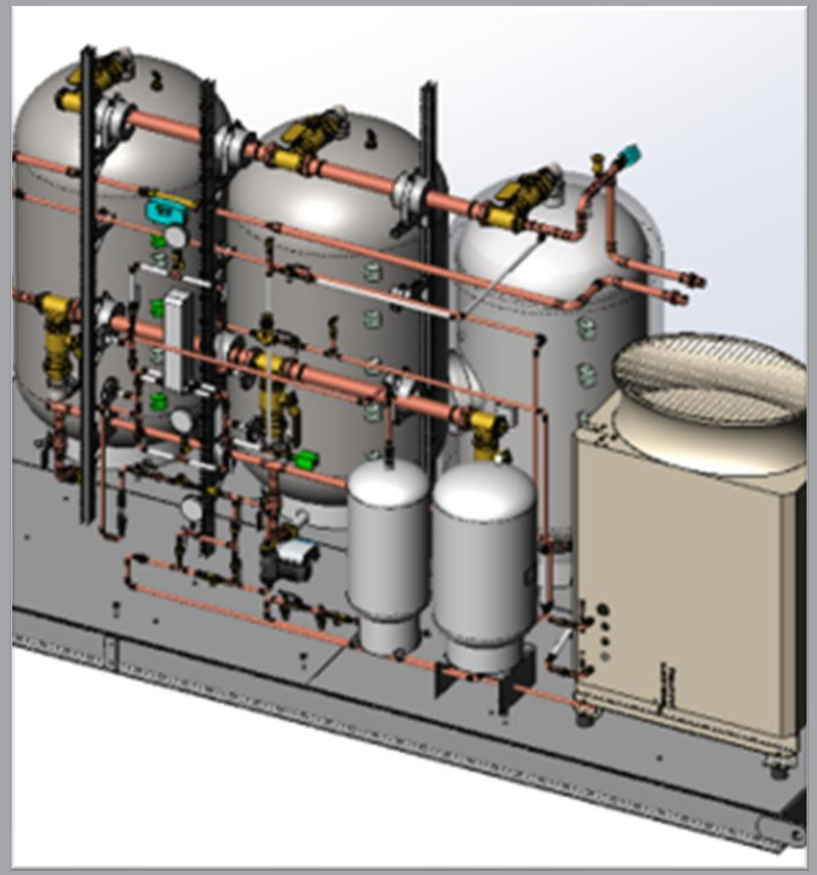


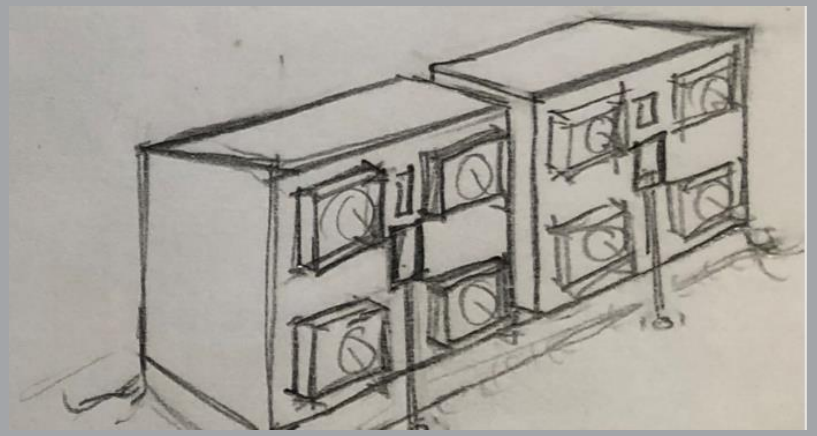
Bayview Apartments
Seattle, WA
2022 Completion
100 Unit Senior Housing

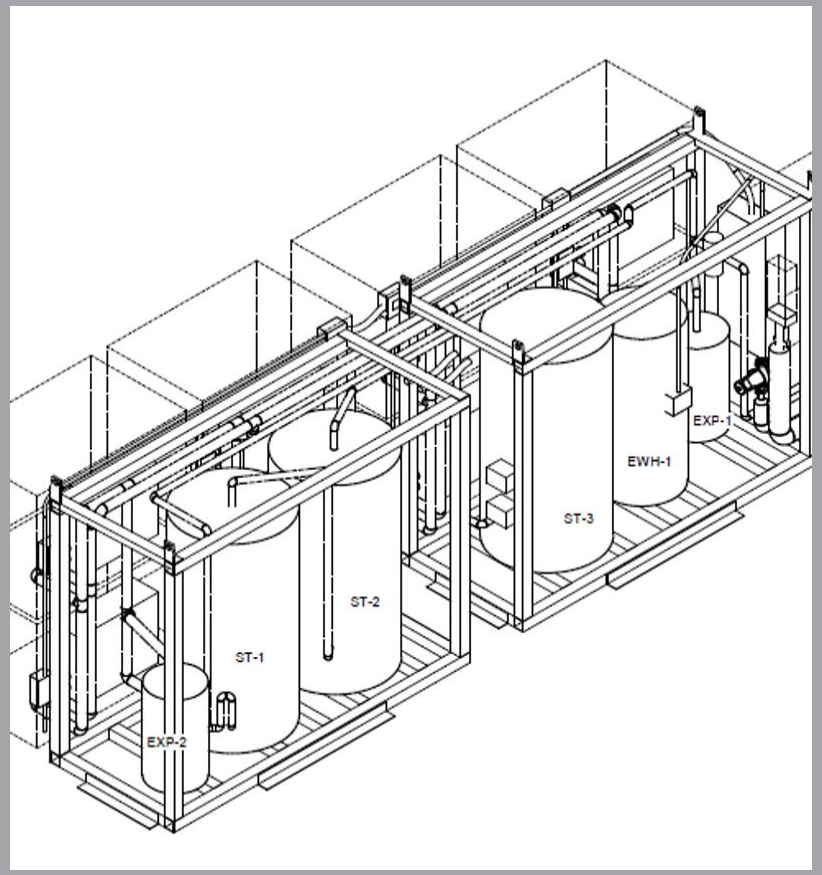
Primary Heat Pump and Swing Tank

Electric Retrofit, 11 Story Apartment withLoad Shift

ECOTOPE





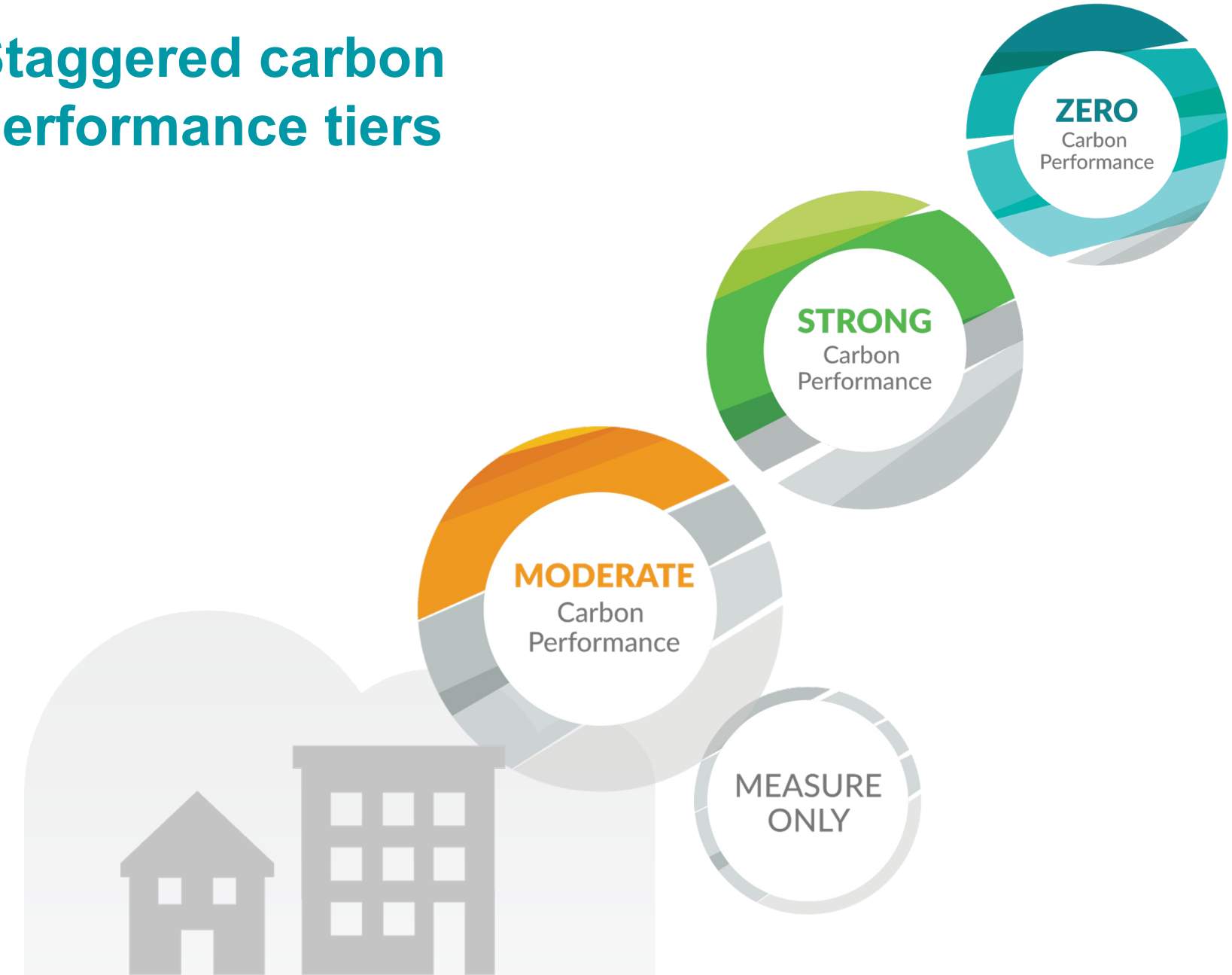


HPWH PLUG AND PLAY DEVELOPMENT

Ecotope

Putting the market package together

Staggered carbon performance tiers



BC HOUSING

What's Happening at BC Housing?

Ju Chan Kim, Project Technologist – Energy & Sustainability

April 28, 2023

WHO WE ARE

Subsidized Housing

Address Housing Gaps

License Residential Builders / Home Warranty Insurance

Research and Education

Provincial Targets

- Required to be Carbon Neutral – Climate Change Accountability Act
- 59 - 64% reduction in GHG emissions by 2030 for the building sector

Corporate Targets

- 50% GHG Emissions Reduction by 2030
- 80% GHG Emissions Reduction by 2050

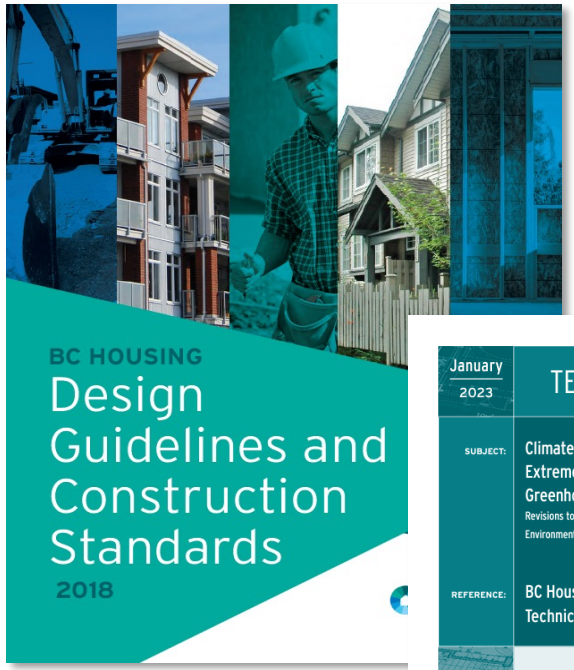
Project Targets

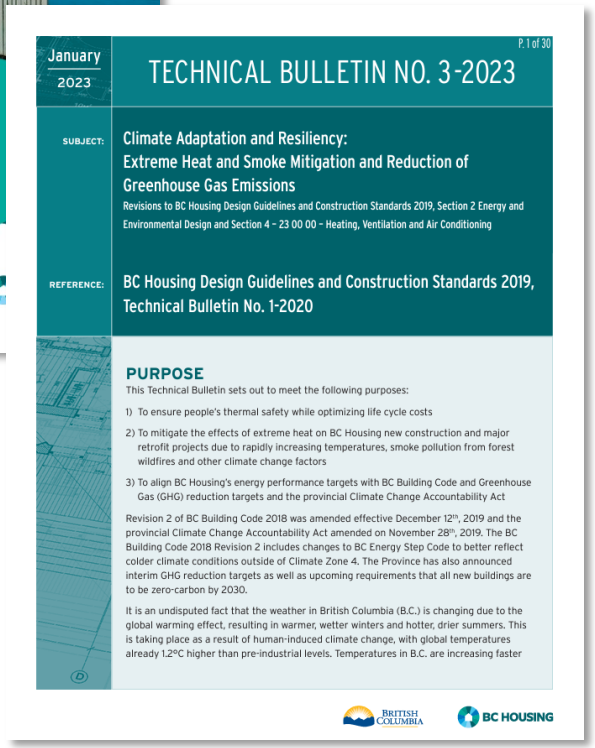
- Project specific energy/GHG emissions targets

BC HOUSING

Design Guidelines and Construction Standards for BCH Projects

- [BC Housing Design Guidelines & Construction Standards]
- [DG+CS Technical Bulletin No.1-2020: Energy & Environmental Design]
- [DG+CS Technical Bulletin No.2-2022: Sections 1, 4 & 5]
- [DG+CS Technical Bulletin No.3-2022: Sections 2 & 4]





BC HOUSING

Building and Energy Performance – Part 3 Projects

Part 3 Projects —Less than 7 Storeys:

Climate Zone[1]	Step Code Level	GHGI ($kgCO_2e/m^2/year$)	Whole building: $EALR_{N75}$ ($L/s*m^2@75\ Pa$)	Suite airtightness: $IPALR_{N50}$ ($l/s/m^2@50\ Pa$)
4[2]	Step 4	~~5.5~~ 3.0	2.0	1.2
5[3]	Step 3	~~5.5~~ 5.0		
6[4], 7[5], 8[5]	Step 3	6.0		

Part 3 Projects —7 Storeys and Higher:

Climate Zone[1]	Step Code Level	GHGI ($kgCO_2e/m^2/year$)	$EALR_{N75}$ ($L/s*m^2@75\ Pa$)	$IPALR_{N50}$ ($l/s/m^2@50\ Pa$)
4[2] ~~5[3],6[4],7[5],8[5]~~	Step 3	~~6.0~~ 3.0	2.0	1.2
5[3]	Step 3	~~6.0~~ 5.0		
6[4], 7[5], 8[5]	Step 3	6.0		

BC HOUSING

Building and Energy Performance – Part 9 Projects

Part 9 Projects:

Climate Zone[1]	Step Code Level	GHGI ($kgCO_2e/m^2/year$)	Airtightness Testing (ACH@50pa)
4[2]	Step 4	3.0	Refer to BC Energy Step Code
5[3]			
6[4], 7[5], 8[5]			

1 Climate Zone is based on Heating Degree Days (HDD) below 18°C for 25-year period ending in 2006 as per BC Building Code Appendix C - Division B Climatic And Seismic Information for Building Design in Canada
2 Less than 3000 HDD
3 3000 to 3999 Heating Degree Days (HDD)
4 4000 to 4999 Heating Degree Days (HDD)
5 Greater than 4999 Heating Degree Days (HDD)

+

Thermal Comfort Evaluation
(passively/partially cooled buildings)

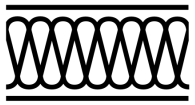
Passive Design Strategies

Site and orientation

(Solar orientation, thermal layout)

Exterior Shading

Minimize Thermal Bridges



Optimize Insulation

Utilize Additional Passive Design Measures

Maximize passive cooling potential through window design

Low Carbon Mechanical Systems

All major systems should be fully electric wherever possible. Any gas systems must be reviewed and approved by BC Housing

Section 2.4.1 Energy Efficient Systems

ALT Hastings

11 storeys / 112 residential units

132,000 sqft

Commercial rental space + underground parking + gathering space + healing space

Step 3

GHGI – 1.1 kgCO2e/m2/yr

Society: Aboriginal Land Trust Society

Architect: Urban Arts Architecture

Development Consultant: Lu'ma Development Management

Contractor: ITC Construction Group

Mechanical: AME Consulting Group

Source: Urban Arts Architecture Inc (https://www.urban-arts.ca/aboriginal-land-trust-housing/)

POLL 1

What did you tell us about yourself?

B2E
Building to Electrification Coalition

BC HOUSING

ALT HOUSING HASTINGS

HEAT PUMP DHW

AMEGroup

INTRODUCTION

Patrick Stewart *P.Eng., CPHD, LEED Green Associate*

Patrick has been working in the mechanical building system design industry since 2011. He has worked on many sustainable projects all around British Columbia that include institutional, Commercial, and multi-family residential. Patrick is a certified Passive House Designer and has completed multiple mechanical designs utilizing heat pump technology for domestic hot water systems

BUILDING LEGACY

AME Group

AME OVERVIEW

Mechanical Engineering firm with 5 office locations.

VICTORIA

VANCOUVER

CALGARY

EDMONTON

GRANDE PRAIRIE

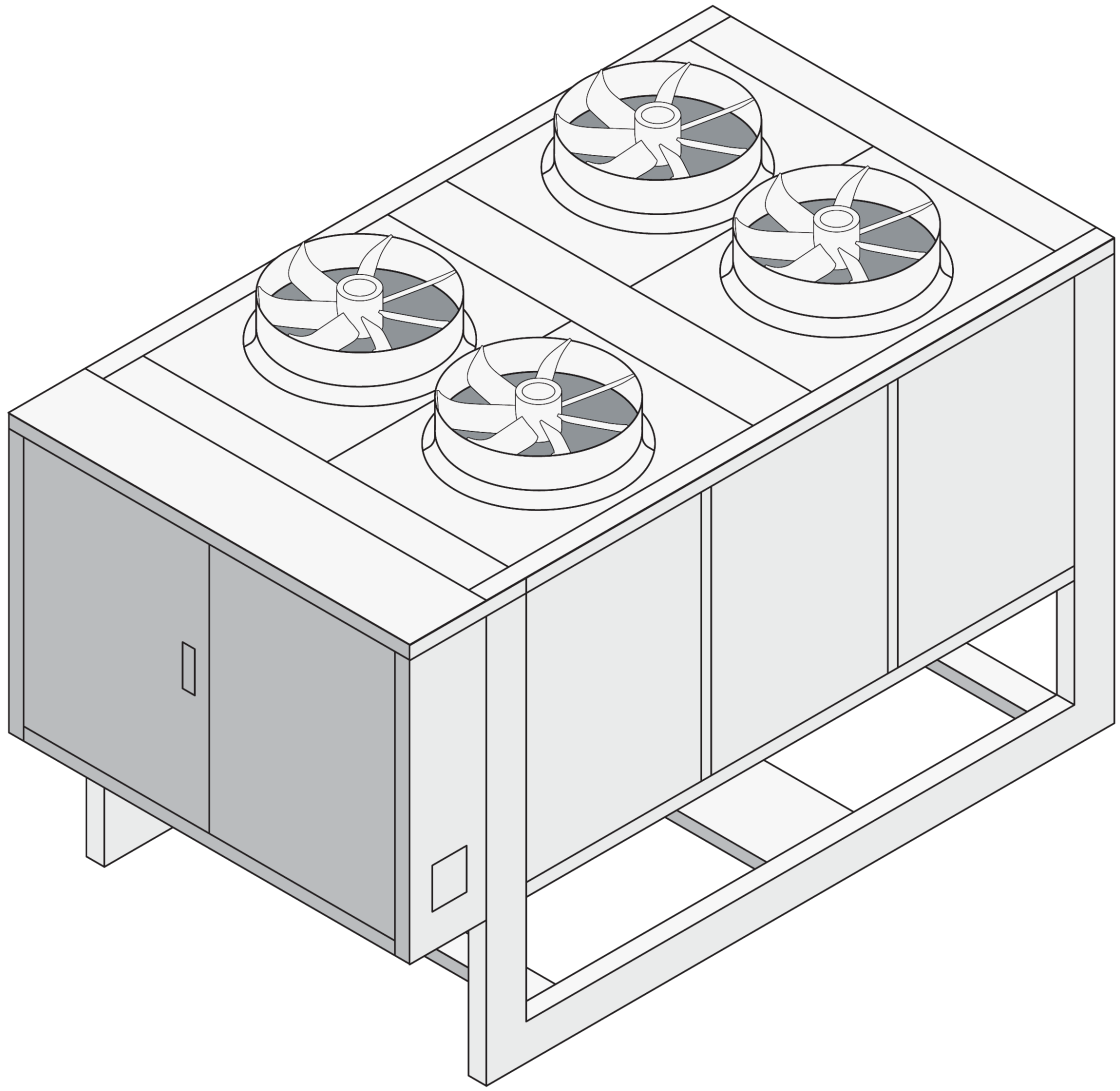
- **Single Discipline** Mechanical Engineering firm
- **170+** people
- **100% employee** owned
- **Over 45%** of employees are shareholders
- **Small** teams
- **Building Performance** team in-house
- **Commissioning** team in-house
- **Building Energy Services** team in-house
- **Experience** in countless sectors
- **Sustainability** focused

AME Group

BUILDING LEGACY

WHY HEAT PUMP?

- BC Housing reducing GHG emissions and providing offsets to zero emission levels
- CleanBC incentives
- CoV – Zero Emissions Building Plan GHGi Limit of 11.8 for whole building
  - This project hit a GHGi limit of 1.1



AMEGroup

BUILDING LEGACY

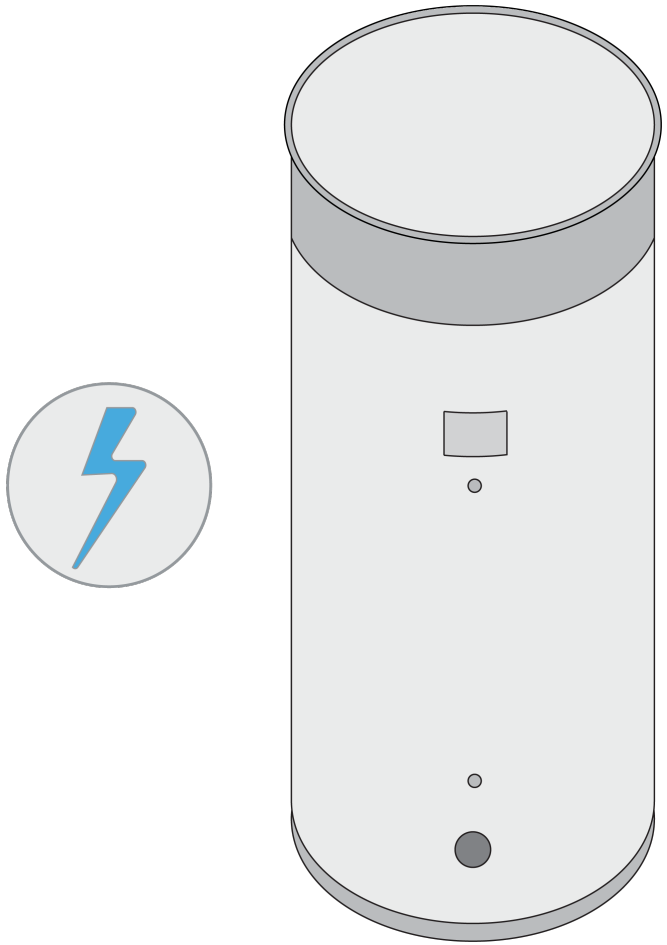
ELECTRICAL

CHALLENGES

- Capacity issues?
- Service size issues?

SOLUTIONS

- Substation slightly increased
- No service issues



BUILDING LEGACY

AMEGroup

FINANCIAL CHALLENGES

CHALLENGES

- Capital costs
- Lifecycle costs

SOLUTIONS

- CleanBC incentives
- Funding through CMHC

BUILDING LEGACY

SIZING STRATEGY

WHAT DID WE DO/SOFTWARE USED?

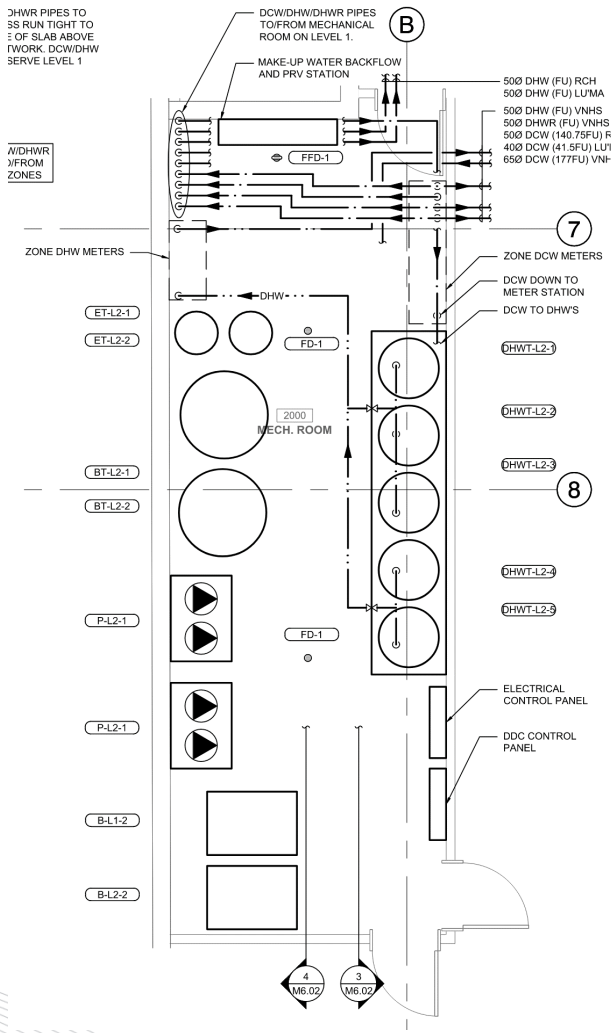
- VBBL + Nyle water heating design workbook

BUILDING LEGACY

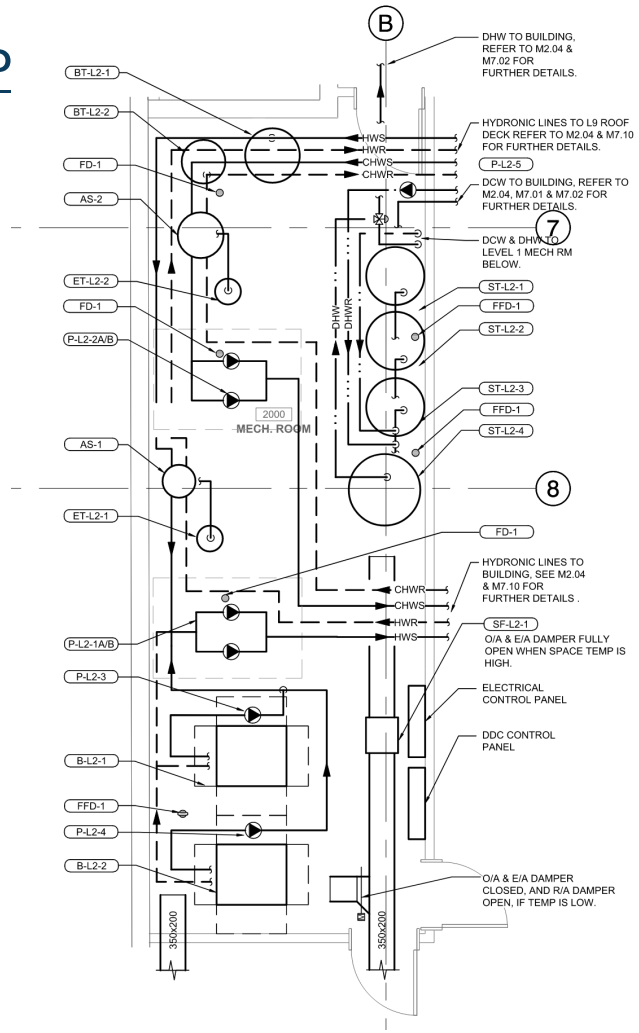
AMEGroup

SPATIAL CHALLENGES

Gas



HP



BUILDING LEGACY

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CLIMATE CHALLENGES

CHALLENGES

- OA ambient temperatures
- Derating of equipment due to low OA temps/defrost

SOLUTIONS

- Pre-heat thru electrical room

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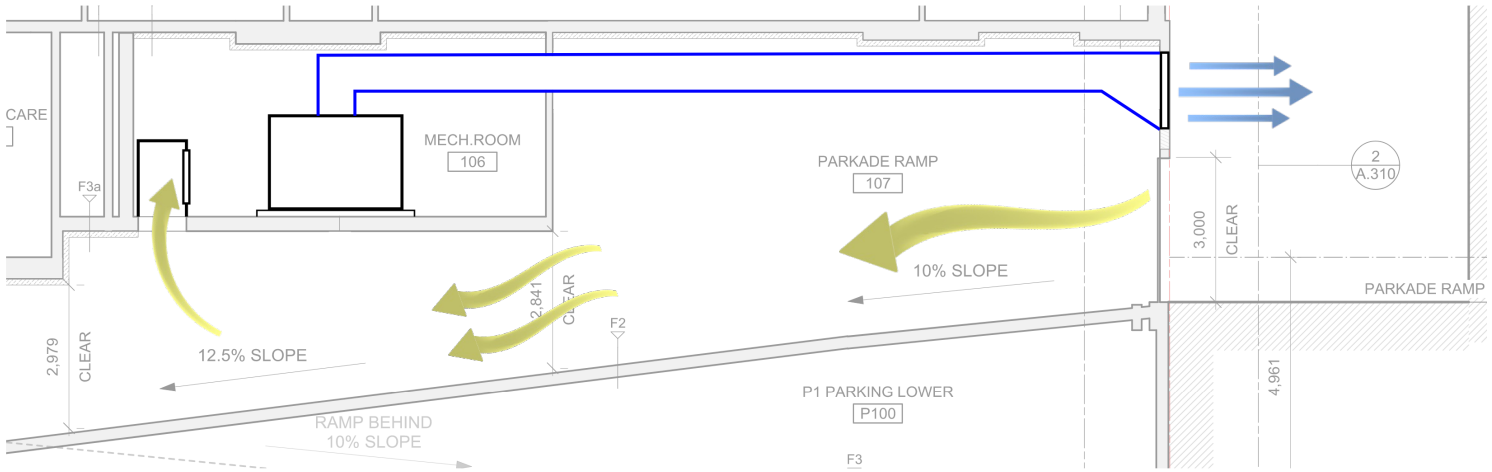
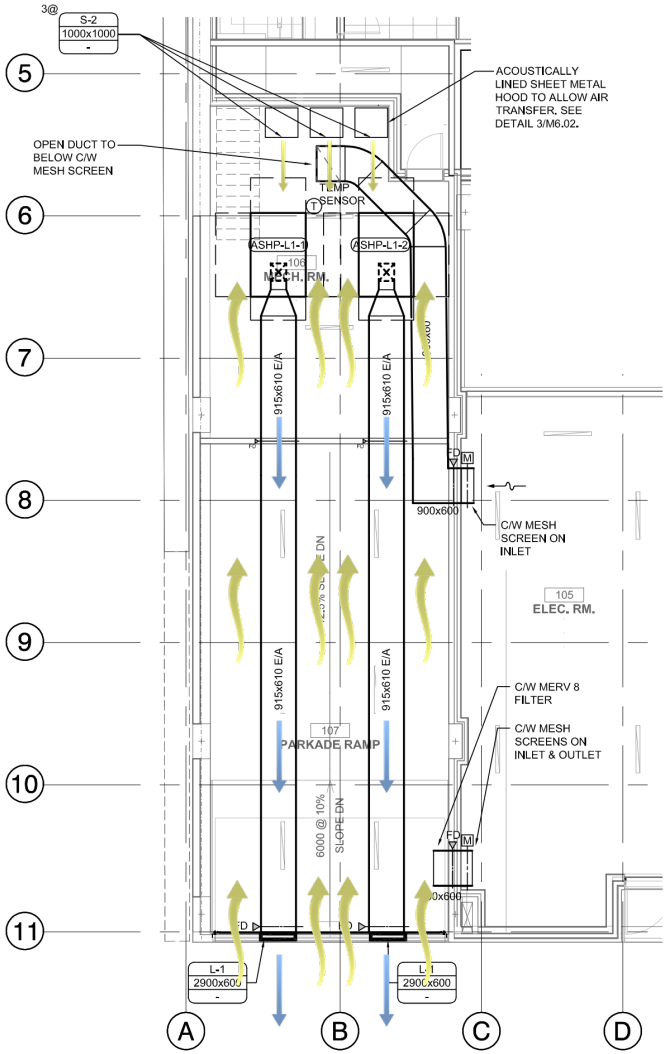
BUILDING LEGACY

SOLUTIONS

Regular Operation

- OA is pulled through parkade door and through dampers at floor of mechanical room
- Dampers to main electrical room closed





1 M1 LEVEL 1 MECHANICAL ROOM LAYOUT
SCALE: 1:100

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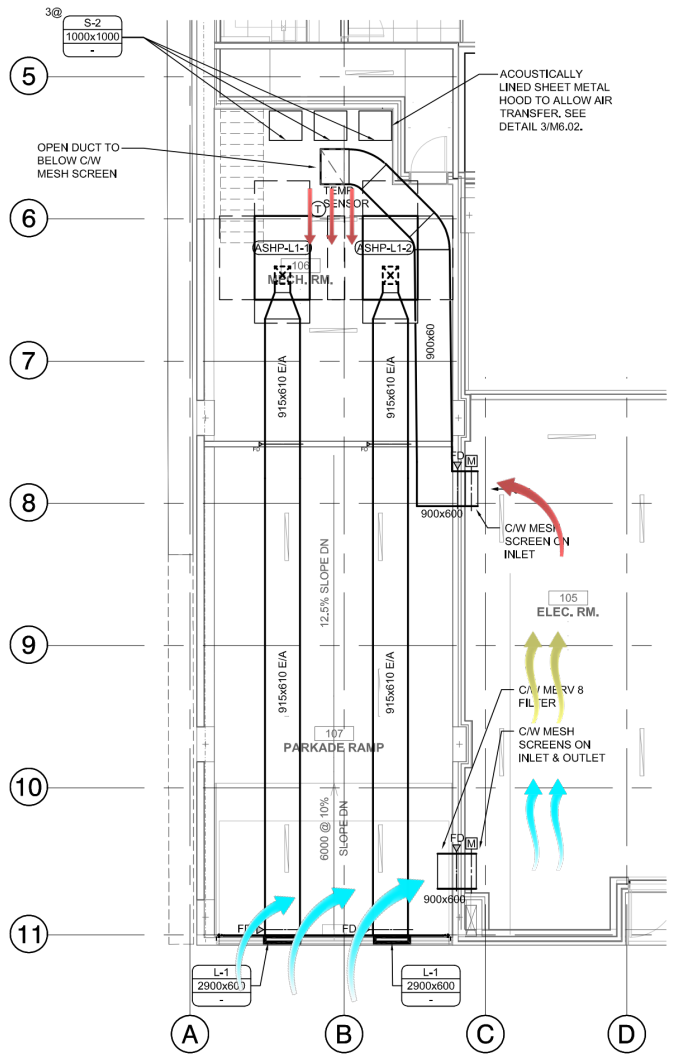
SOLUTIONS

Heat Recovery Mode

- When OA temps are suitable, or if temperature in mechanical room is too low
- Dampers at floor of mechanical room are closed
- Dampers in/out of main electrical room are opened



1 / M1 LEVEL 1 MECHANICAL ROOM LAYOUT

SCALE: 1:100

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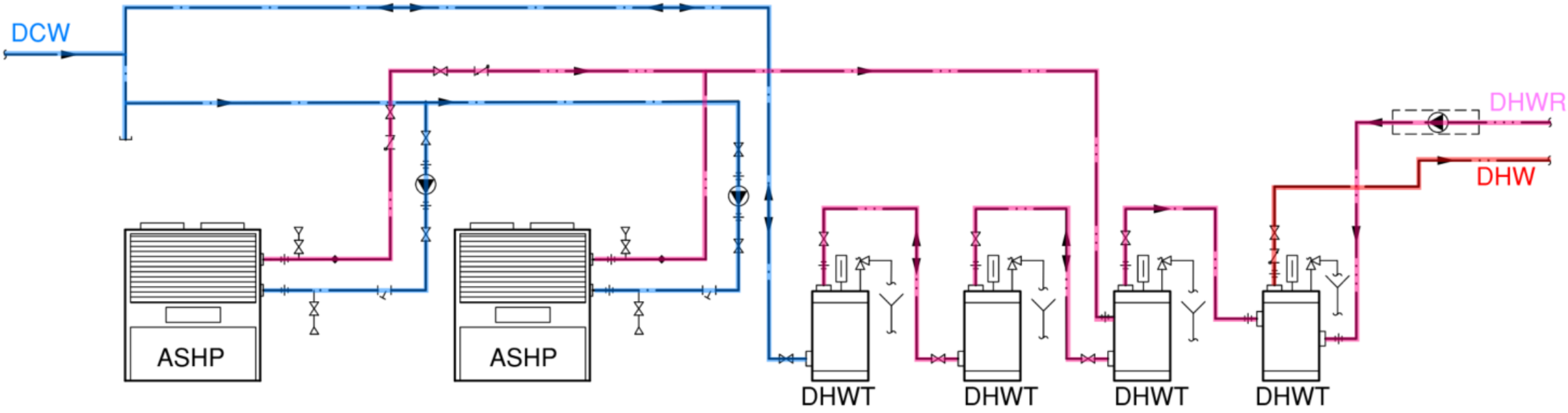
SOLUTIONS



1
M7.02

DOMESTIC WATER SCHEMATIC CONTINUATION

SCALE: NOT TO SCALE

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THANK YOU

QUESTIONS?

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