SANCO2
Hot water, naturally.

Passive House Institute

zehnder
always around you

SMALL PLANET SUPPLY
Building the World of High Performance

Commercial Representatives

- **Co2 Heat Pump Pioneer**
- Established in 2010 to promote a business model anchored in climate crisis. Solutions as “viable market opportunity”.
- Passive House Specialists
- 10 years of “firsts” – Including SanC02.

Multi Partner – Multiyear Application Study

Ken Eklund – Washington State University

2019 HPWH Training

AVAILABLE PRODUCTS

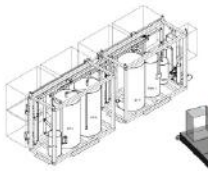
A commercial heat pump water heater (CHPWH) system serves more than four dwelling units or commercial loads needing a total of 120 gallons or more of storage volume and/or more than 6 kW of input power. These systems can be unitary or split systems, built up or fully packaged, and can be configured in several different ways.

Below is a table that displays the range of HPWHs available on the US market and some of their specifications. This is not an exhaustive list but includes those products that have engaged with the Technology Innovation Model (TIM) or the Advanced Water Heater Specification Qualified Products List and have field-verified system COP.









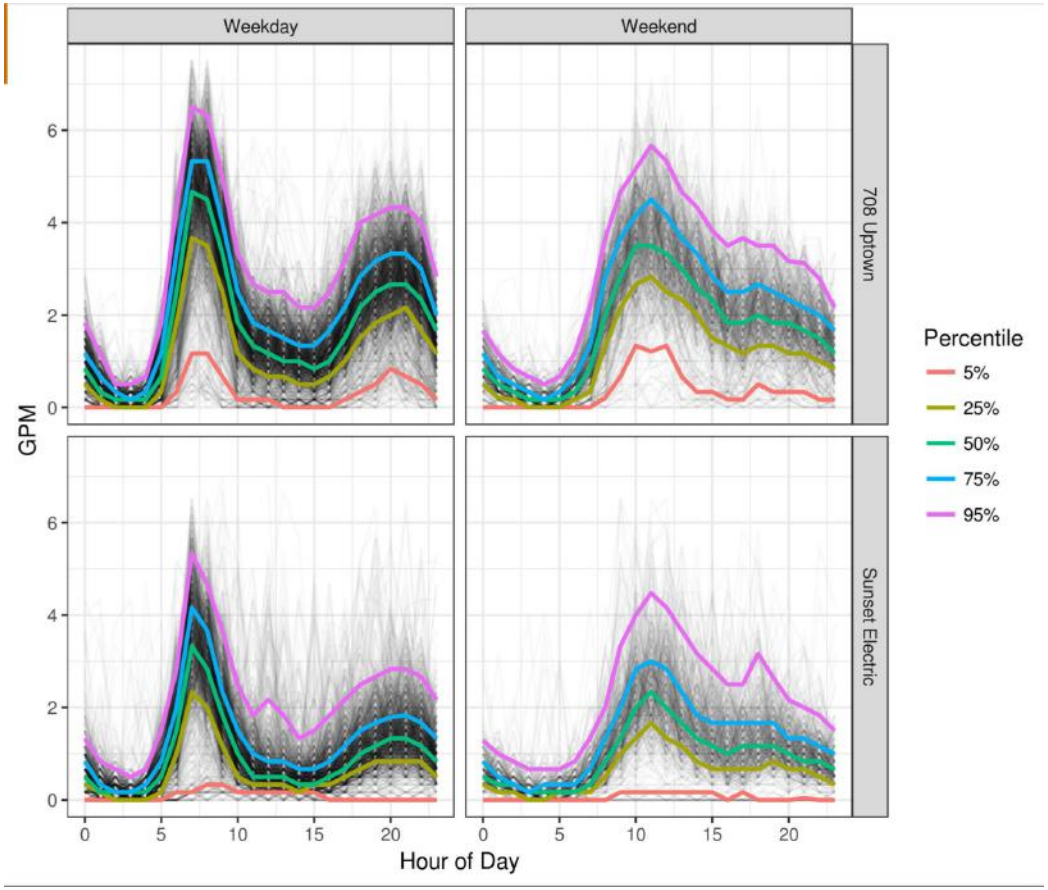

	Various Residential Integrated Units	$SanCO_2$	AO Smith	Mitsubishi	Colmac	Nyle	$SanCO_2$ WaterDrop	Origin by Steffes
Size	>1 ton	1.25 tons	2.5 tons	10 tons	10 - 30 tons	10 - 30 tons	varies	varies
Market delivery	unitary	split	unitary	split	split	split	fully packaged	fully packaged
System design	multi pass	single pass	multi pass	single pass	single or multi pass	single or multi pass	single pass	single pass
COP	3.0 - 4.0 (UEF)	2.8 - 5.5	4.2	3.0 - 4.0	4.0 - 4.4	3.0 - 5.0	2.8 - 5.5	3.0 - 4.0
Refrigerant	R-134a	CO_2 / R-744	R-134a	CO_2 / R-744	R-134a	R-134a	CO_2 / R-744	CO_2 / R-744
Minimum ambient air temperature	~45 °F	-20 °F	45 °F	-15 °F	40 °F	40 °F	-20 °F	-15 °F
Maximum ambient air temperature	~120 °F	104 °F	110 °F	110 °F	110 °F	120 °F	110 °F	110 °F
Maximum outlet water temperature	145 °F	149 °F	150 °F	165 °F	160 °F	160 °F	149 °F	165 °F

The Shift

Moving to heat pump DHW - Is moving from ***Recovery*** to ***Storage***

The Load

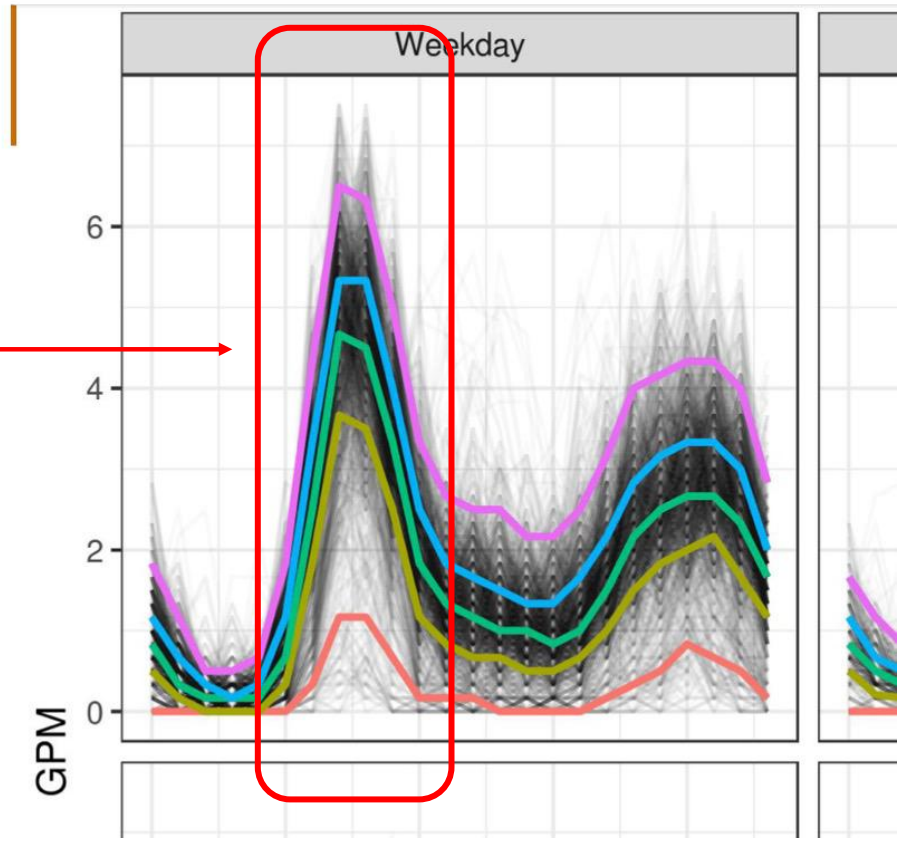
- These are two residential apartment buildings in Seattle WA.
- Normally the gas boiler would be sized to meet the peak flow with very little storage.
- Then there would be the tendency to oversize. Just a little…
- Boilers have high recovery capacity.



Courtesy of Ecotope

Heat Pump Strategy

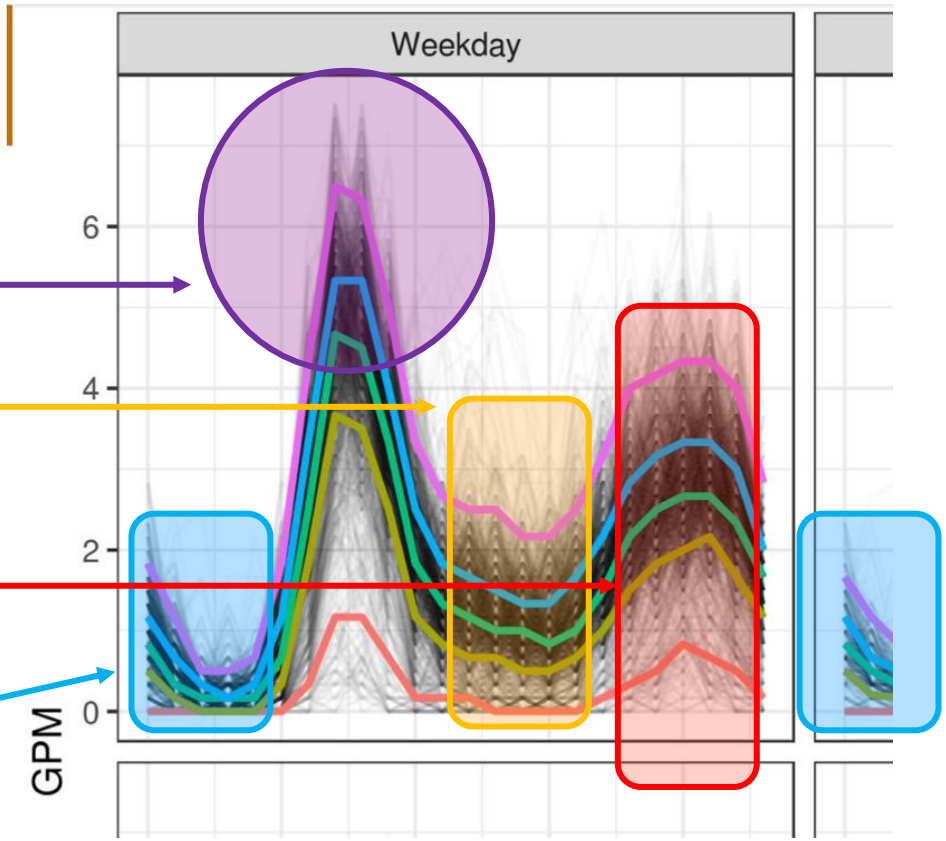
- Build storage ahead of draw.
- Size storage to meet the peak loads. In residential buildings this is the morning peak.
- Heat pump capacity is sized to recover the peak in 4 to 8 hours. The recovery rate is developed by load patterns, renewable energy strategy, and equipment utilizations.



Courtesy of Ecotope

Load Shape

- Morning draw served by storage
- Daytime recovery rebuilds storage.
- Evening Draw takes some storage
- Overnight recovers storage.



Courtesy of Ecotope

The nature of CO2

Super Critical – Super Good

Why We Like CO2

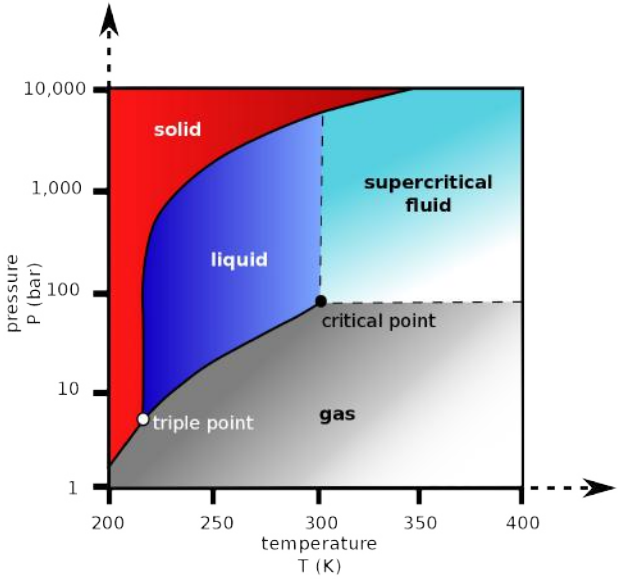
- Minimal Global Warming, approx. 1/1500th compared to “normal” refrigerants
- Non ozone depleting, Safe & secure
- It’s gets hot and crazy under pressure

	Refrigerant	ODP	GWP	Toxicity	Flammability	Notes
Fluorocarbon refrigerant	R134a	0	1,430	No	No	Refrigeration & HPWH
	R410A	0	2,086	No	No	HP, AC & HPWH
	R407C	0	1,800	No	No	HP & AC
Natural refrigerants	CO_2	0	1	No	No	
	Propane Gas	0	20	No	Yes	Flammable
	NH3 Ammonia	0	<1	Yes	Yes	Plume Study required

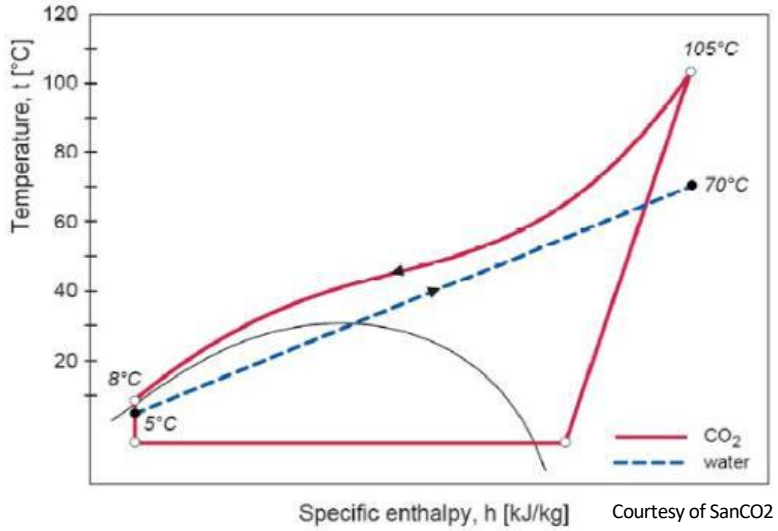
Courtesy of SanCO2

No Phase Change Means More COP

Super Critical Fluid will drop the heat quickly as pressure is released.



Heat drops from the gas/fluid onto the water with no phase change energy



Courtesy of SanCO2

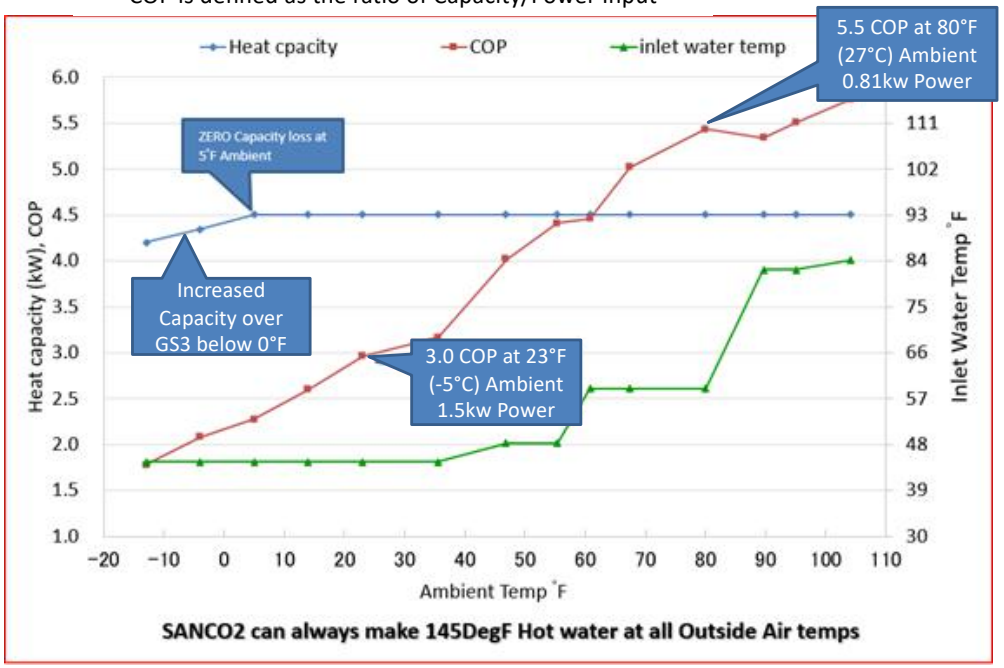
CO2 Works in the Cold

- 5.5 COP at 26C
- 4.5 COP at 15C
- 3.1 COP at freezing!
- 1.75 COP at -25C

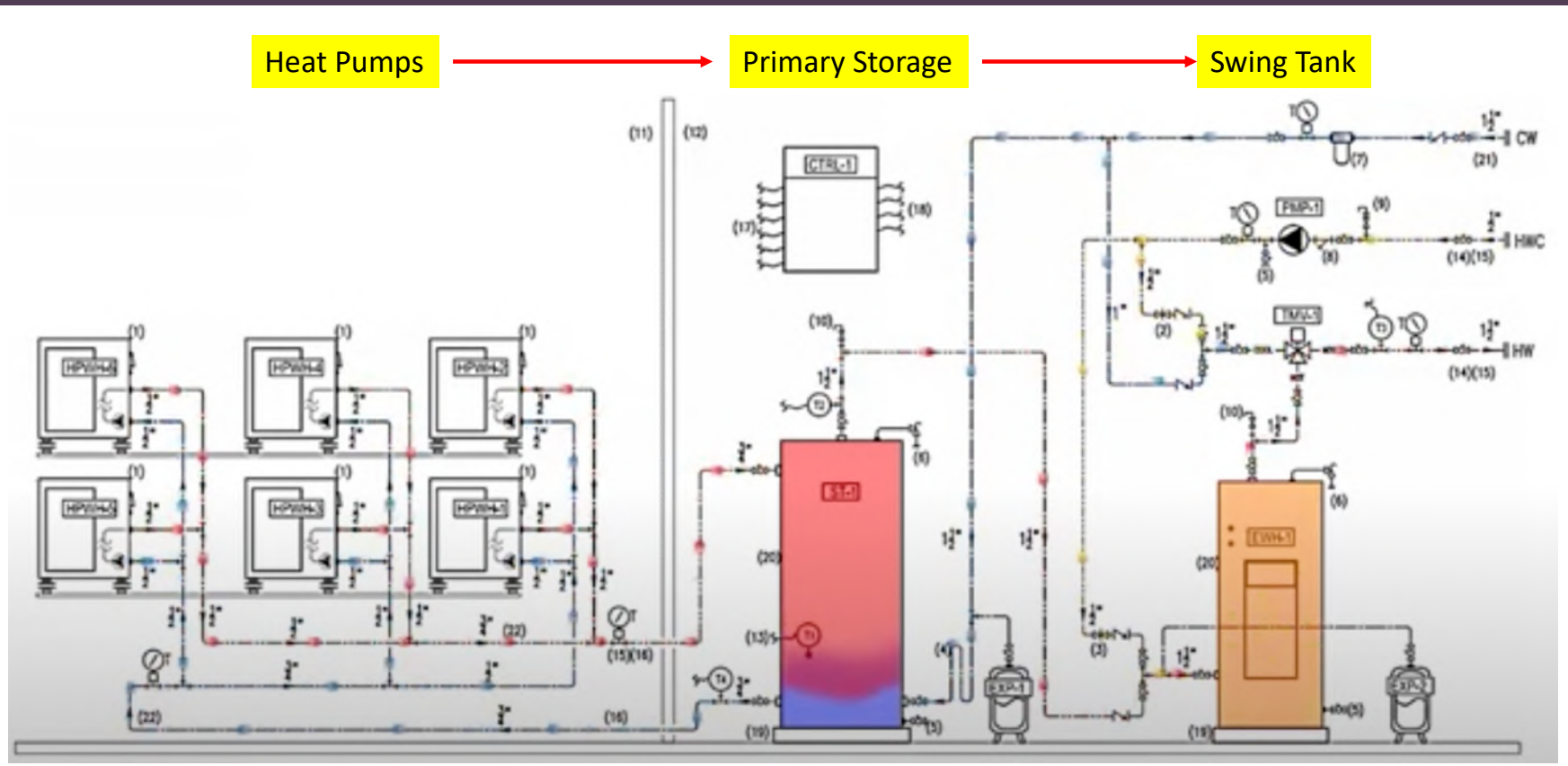
Based on inverter driven compressor, fan, & water pump and a double wall heat exchanger.

GS4-45HPC COP

COP is defined as the ratio of Capacity/Power Input

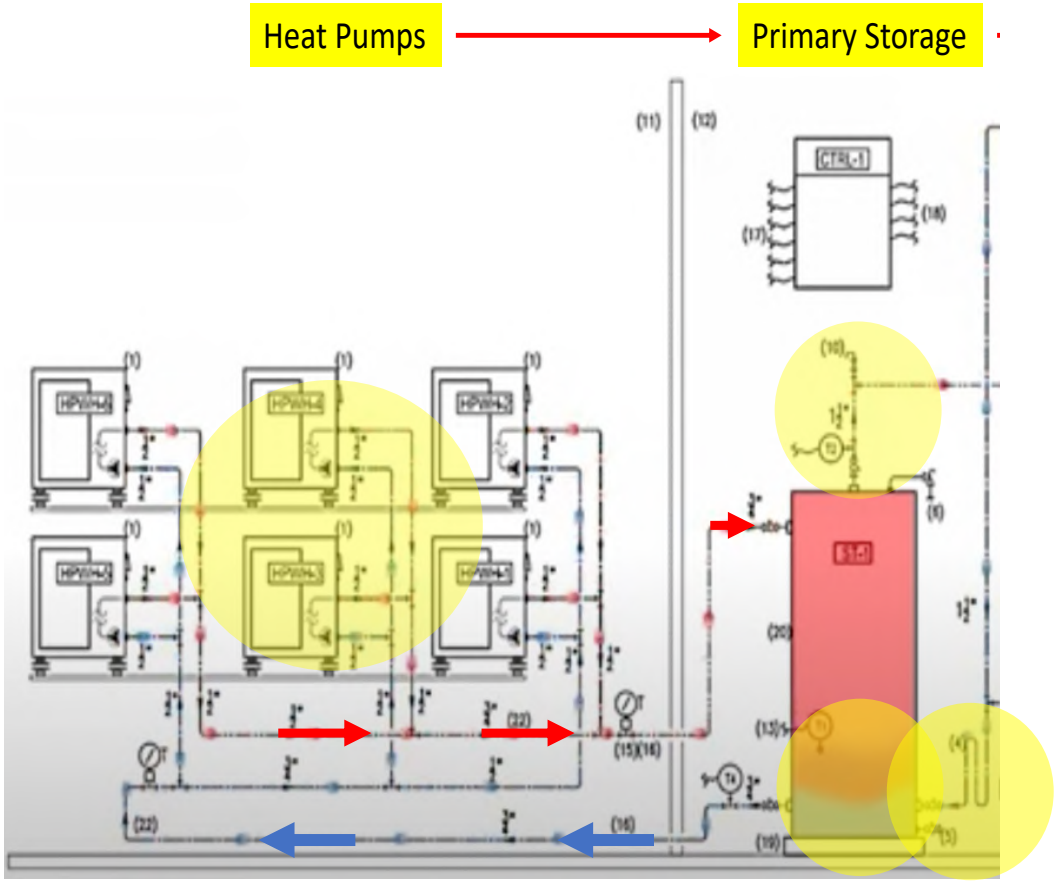


SANCO2 can always make 145DegF Hot water at all Outside Air temps


Heat Pumps
Primary Storage
Swing Tank
CW
HW
HWC
CTRL-1
PMP-1
TMV-1
ST-1
EWH-1
HPWH-1
HPWH-2
HPWH-3
HPWH-4
HPWH-5
HPWH-6

Breaking into Functions

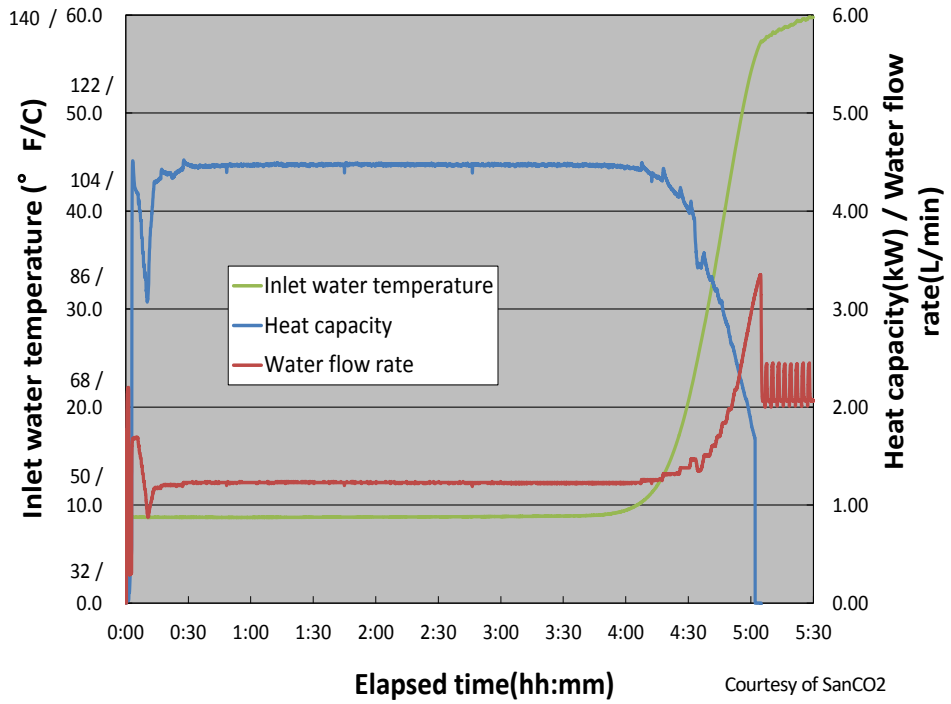
- The primary storage tank(s) are stratified
- The cold municipal water is piped into the bottom of the primary storage tanks(s)
- Heat pump(s) take cold water from the bottom of primary storage tank(s) and provide the 100F lift in a single pass.
- The high temperature (150F-170F) is piped to the top of the primary storage tank(s)
- The hot DHW is piped from the top of the primary storage tank to the load.



CO2 Needs Cold Water

- CO2 Heat pumps loose both capacity and COP when return temperatures increase.
- As the inlet temperature increases, the delta T decreases.
- The water pump try's to compensate by speeding up the flow.
- The overall capacity is reduced as the entering water temperature increases.

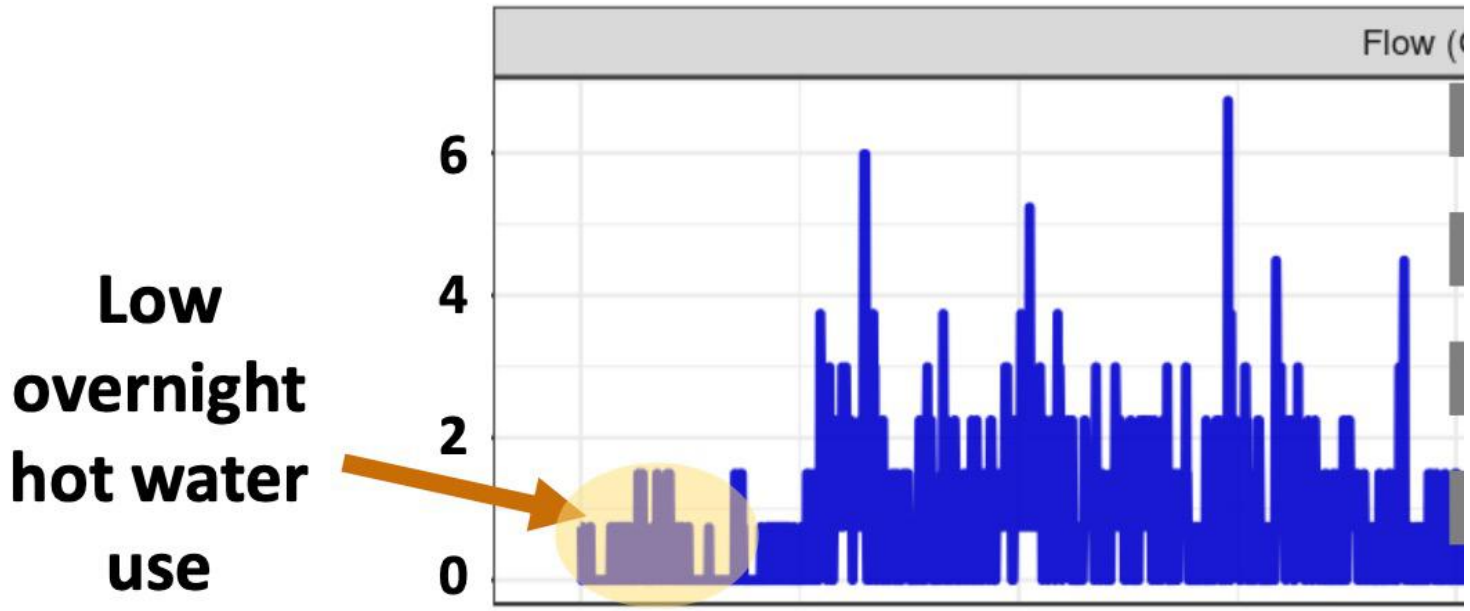
Heating 83 Gallon tank from Cold



Courtesy of SanCO2

Recirculation loss

Happens overnight as the recirc loop pulls heat from the tank and looses it to the building

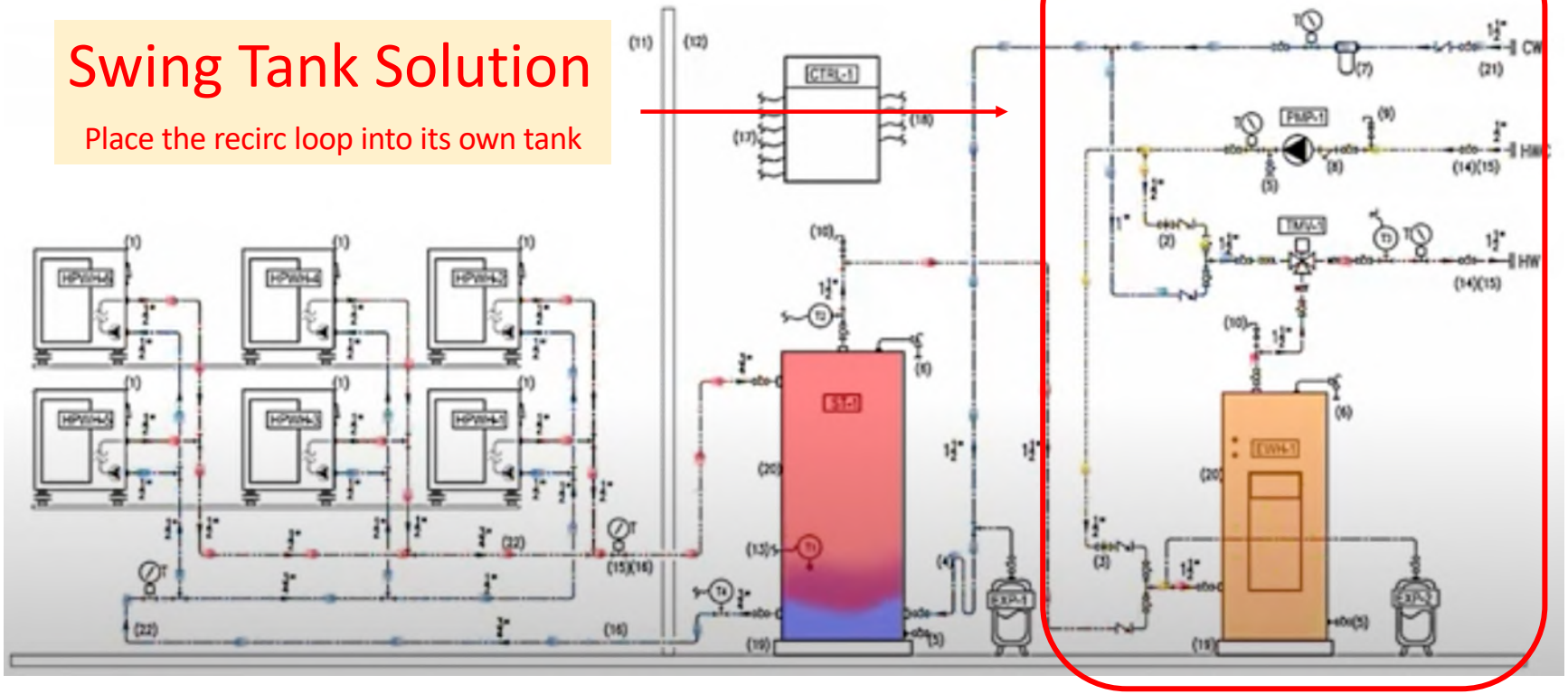


Courtesy of Ecotope

Heat Pumps → Primary Storage → Swing Tank

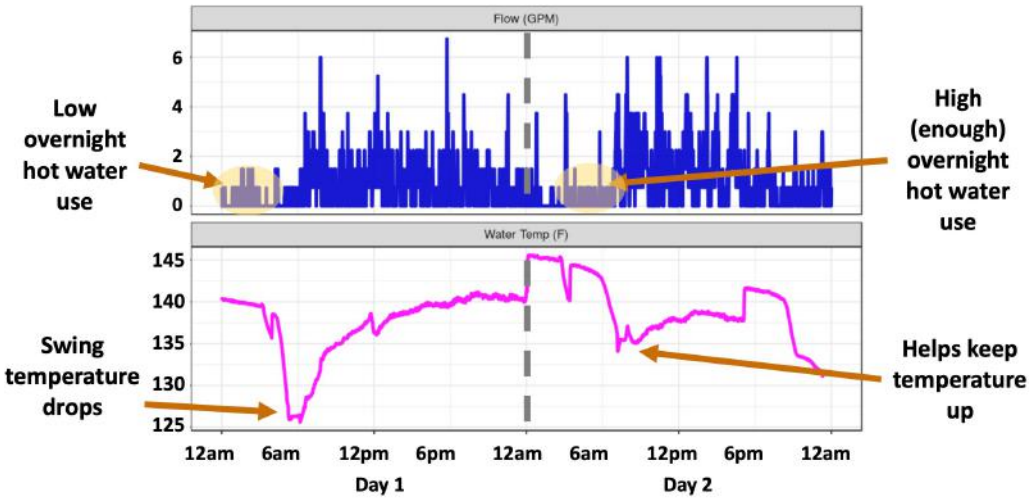
Swing Tank Solution

Place the recirc loop into its own tank



How it works

- Recirculation losses are isolated from primary storage
- Overnight tank temperature can often cool below set point (120F)
- Add electric resistance to provide a short lift back to set point.
- Can also use a multi-pass heat pump.



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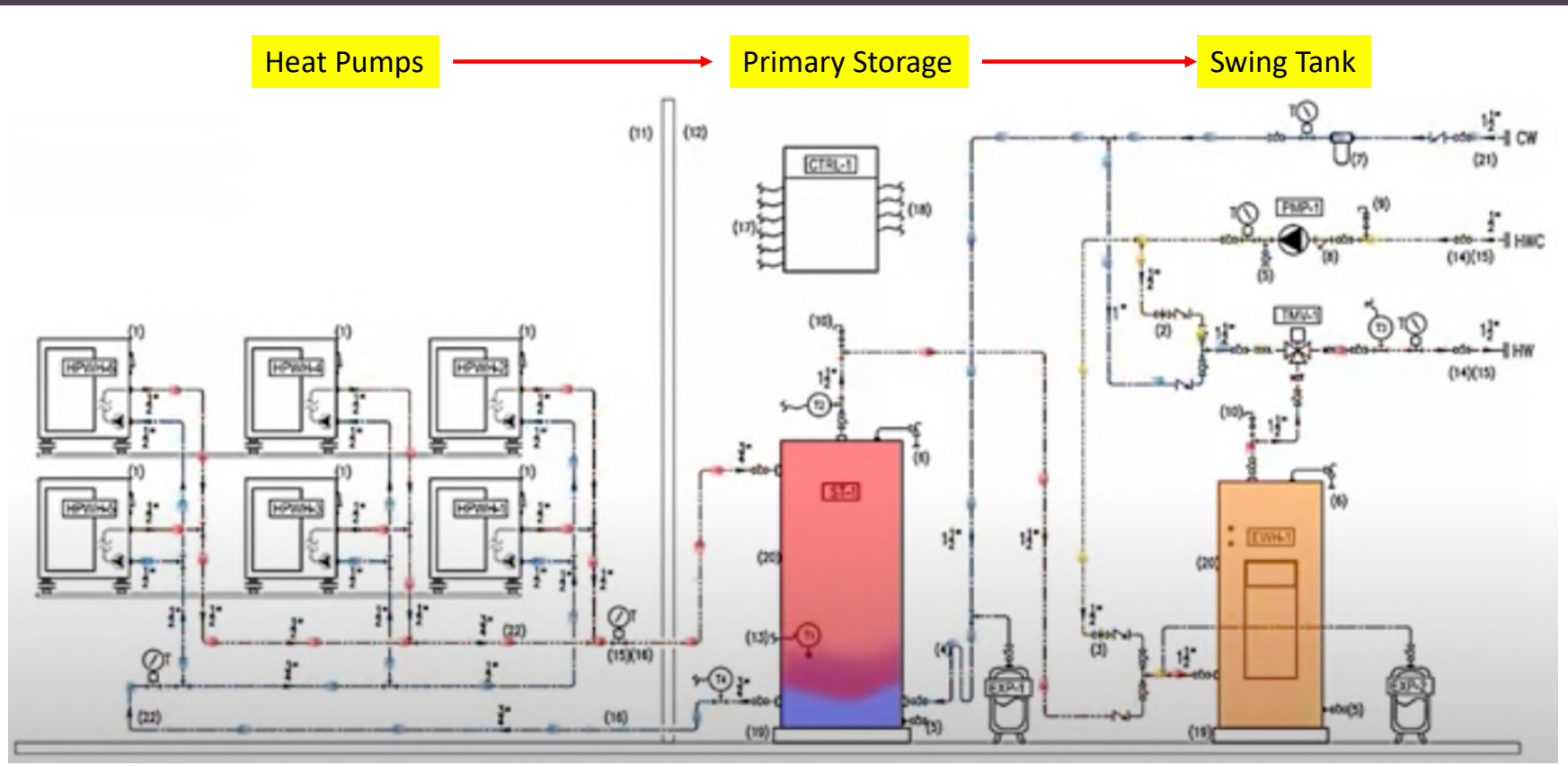
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HPWH-4
HPWH-5
HPWH-6

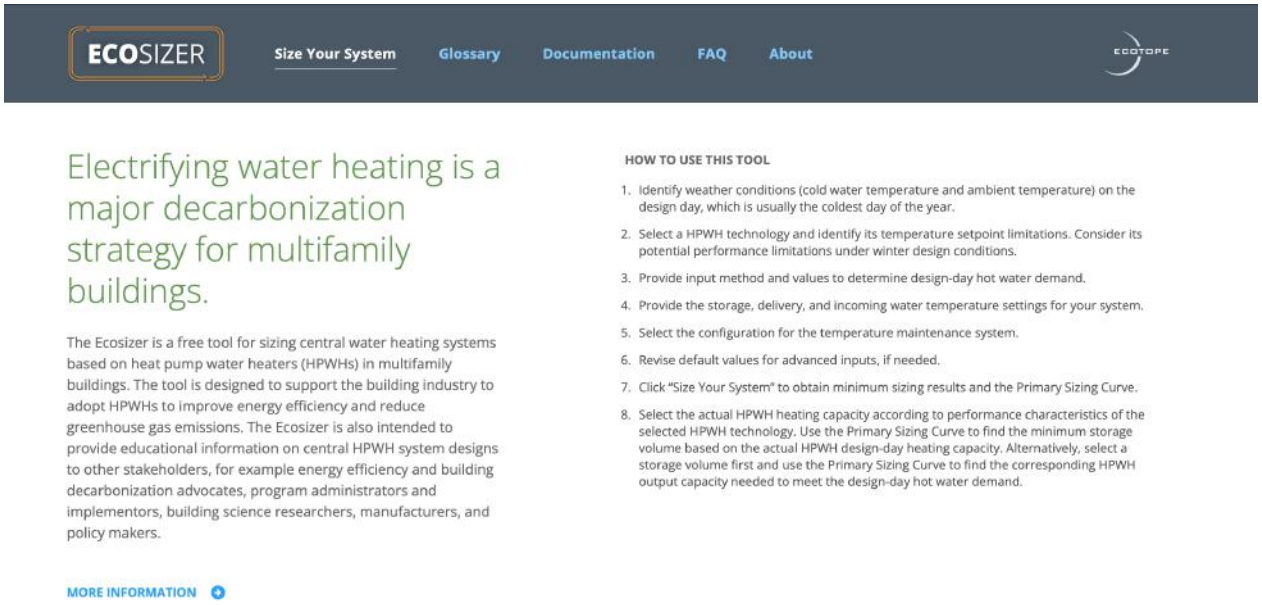
Control & Visibility

The WaterDrop Controller Functions: Basic, Communication Package, BMS, Full M&V.


Sizing a Building
New tools!

The Ecosizer

https://ecosizer.ecotope.com/sizer/



Occupancy Inputs

ECOSIZER

TOTAL PEOPLE & APARTMENTS | APARTMENT SIZE & OCCUPANCY RATES

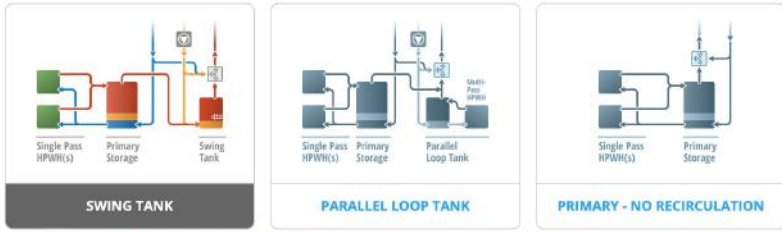
	Number of Apartments	Occupancy Rate: ASHRAE Market Rate	Peak Gallons per Day per Person: Ecotope Market Rate with Low Flow Fixtures	1	25	49
Studio	50	1.49		1	25	49
1 Bedroom	0	1.93		1	25	49
2 Bedroom	0	2.39		1	25	49
3 Bedroom	0	2.84		1	25	49
4 Bedroom	0	3.29		1	25	49
5 Bedroom	0	3.74		1	25	49

Water Temperatures

Water Temperature

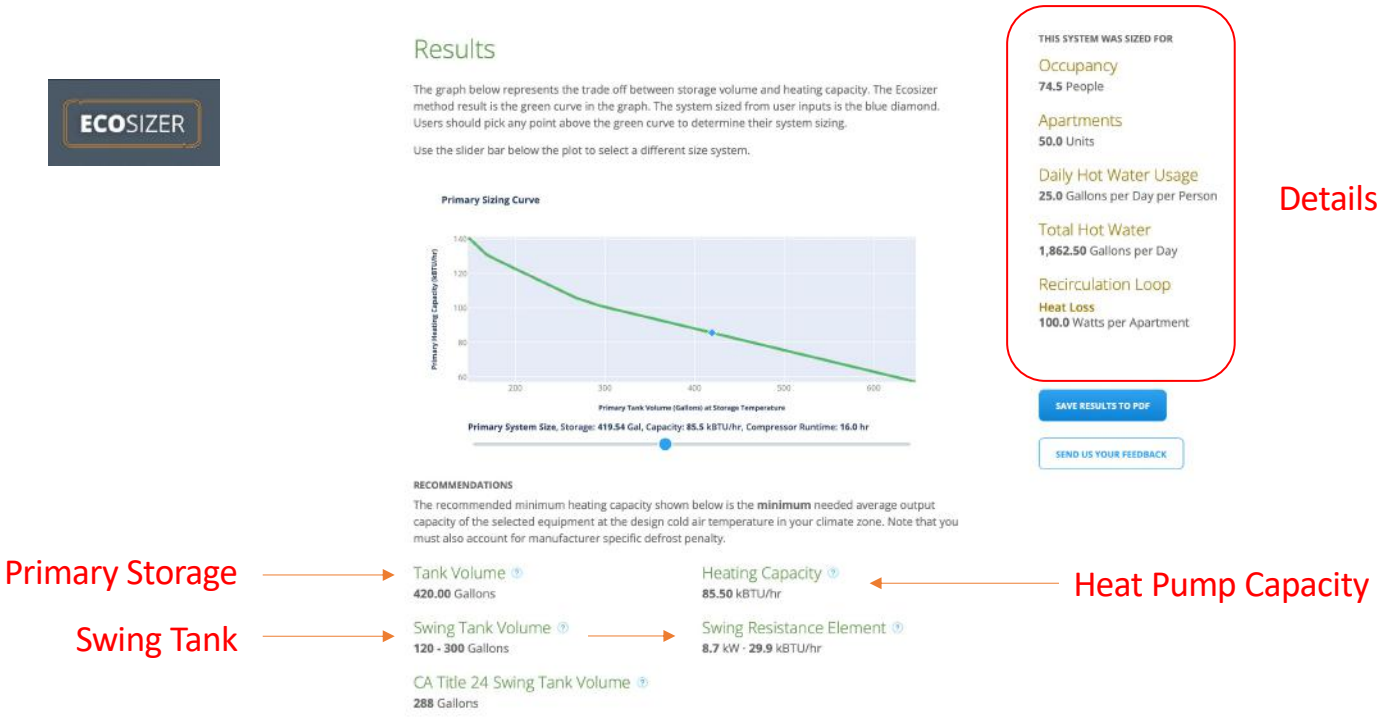
Design Cold	Supply	Hot Storage
50 °F	120 °F	150 °F

Temperature Maintenance System



SWING TANK	PARALLEL LOOP TANK	PRIMARY - NO RECIRCULATION
Primary plant with a temperature maintenance plant in series	Primary plant with a temperature maintenance plant in parallel	Just the primary plant without a temperature maintenance load

Results



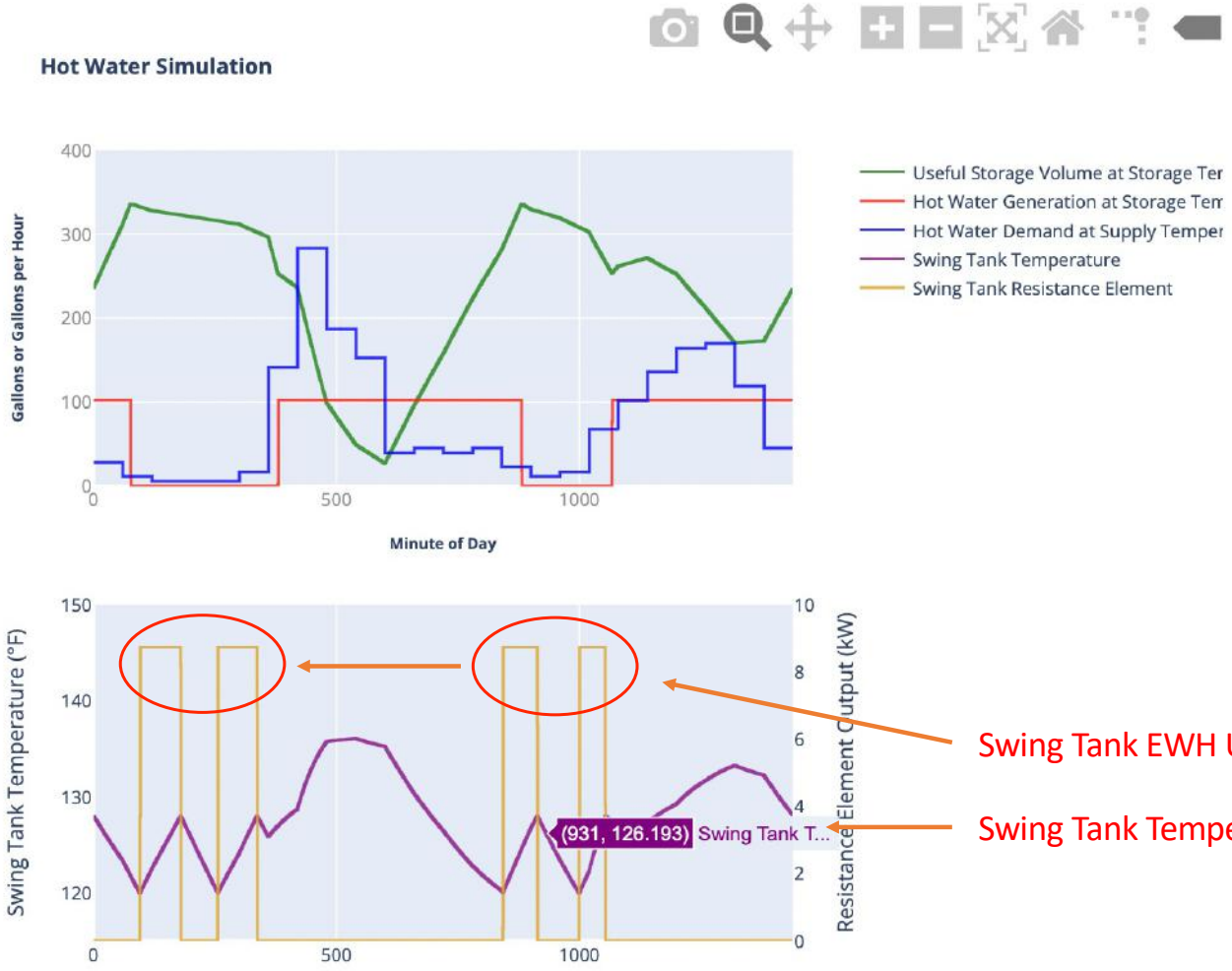
Details

Primary Storage

Swing Tank

Heat Pump Capacity

ECOSIZER



Swing Tank EWH Used

Swing Tank Temperature

Deliveries

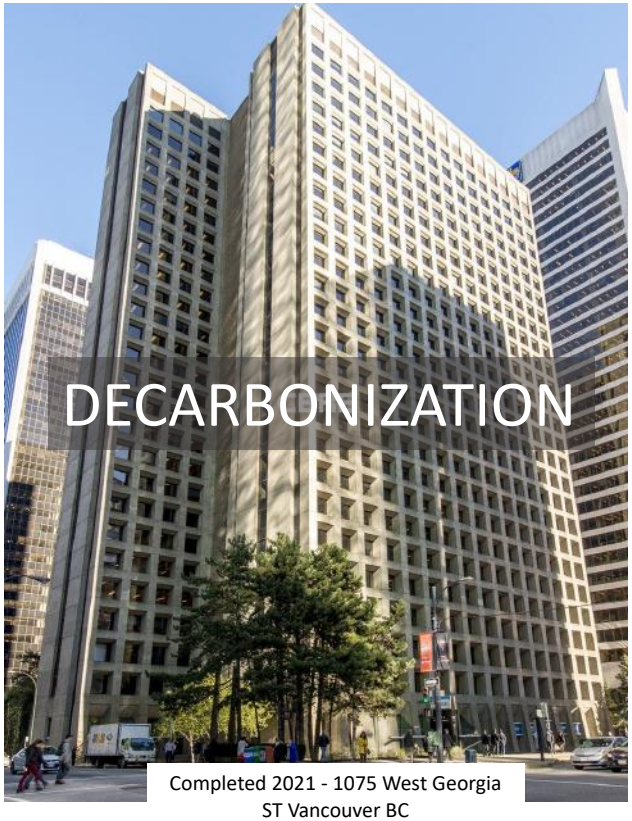
Parts, Pumps and Skids

10 Heat Pumps

1 BMS Controller

WATER DROP
Powered By SANCO2

DECARBONIZATION



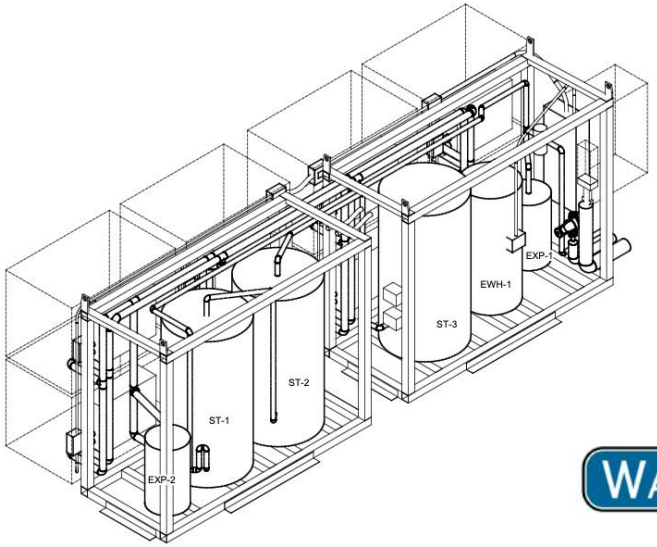
Completed 2021 - 1075 West Georgia ST Vancouver BC

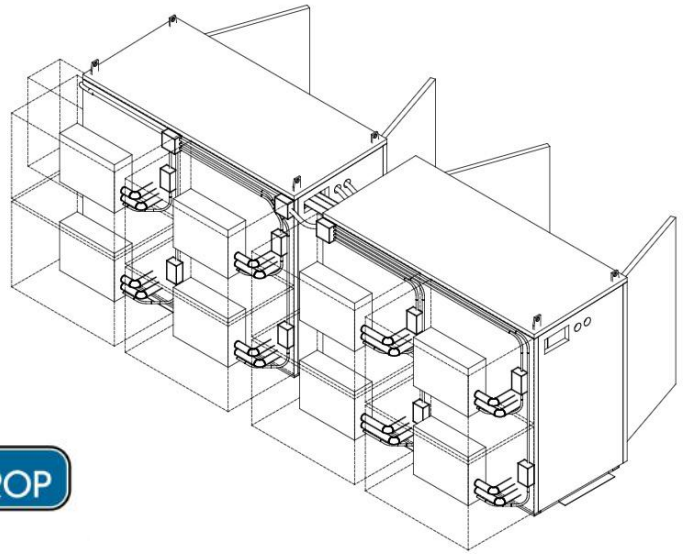
Existing Buildings

- Custom sizing to fit building
- Site assembled using a wide range of tank sizes – 119 to 505 Gallon.
- Drop in ready heat pump piping design.
- Drop in ready primary & swing tank piping design.
- Standard or custom controller package is plug and play ready.
- Bidder & installer training
- Full start-up service

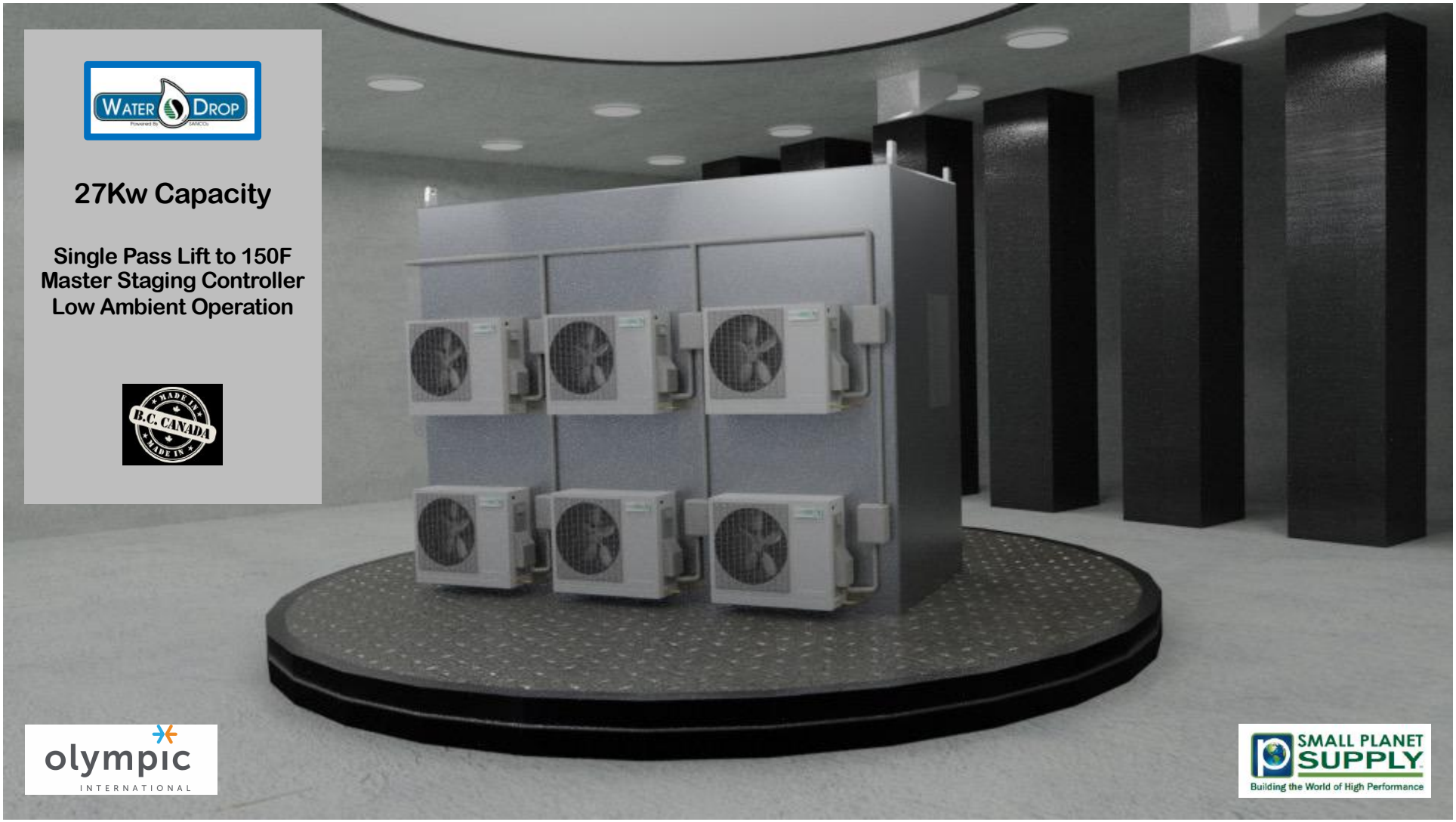
Factory Assembled

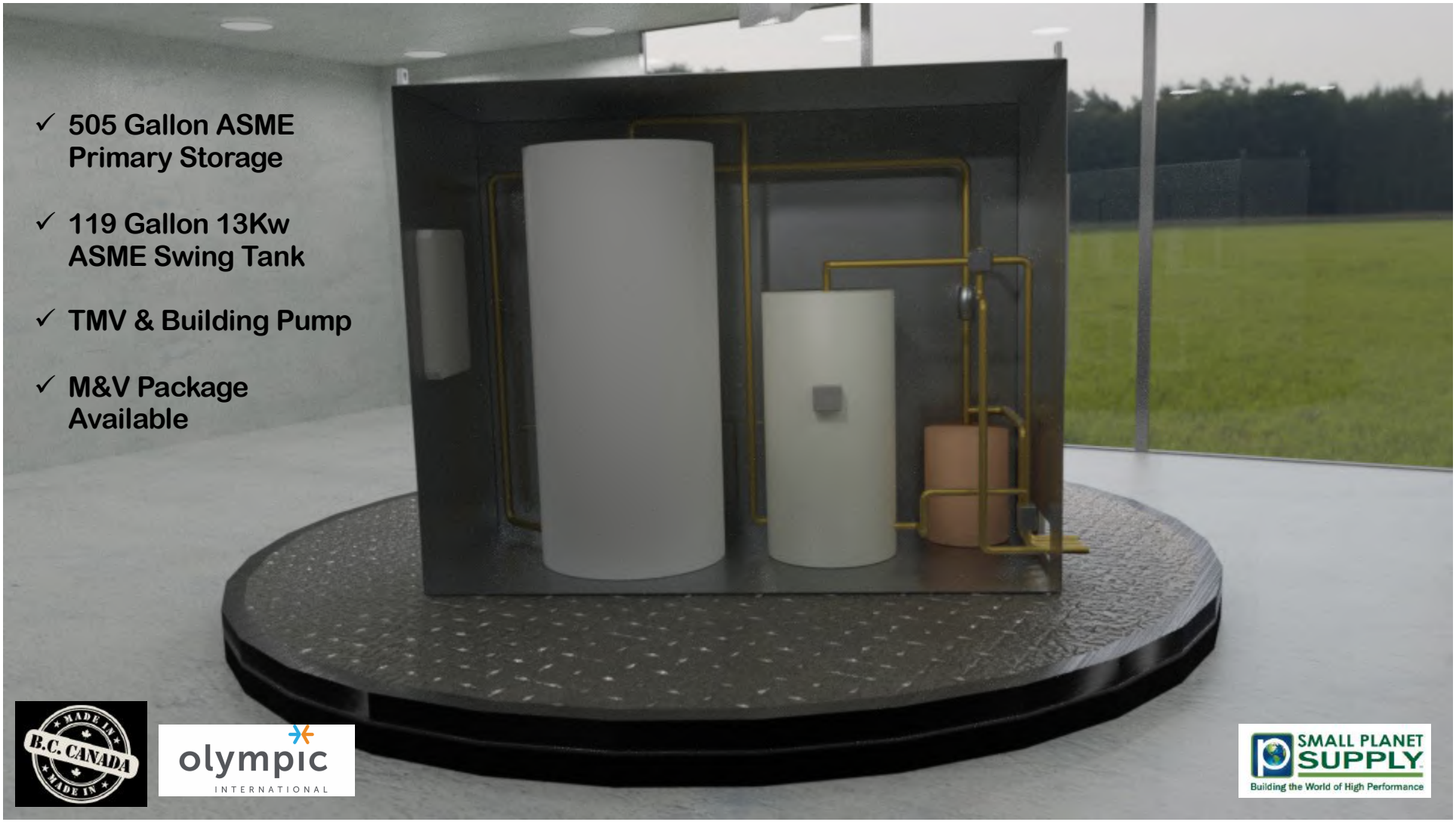
WaterDrop Fully Functioning Plant. - Just add water.





WATER DROP
Powered By SANCO2


WATER DROP
27Kw Capacity
Single Pass Lift to 150F
Master Staging Controller
Low Ambient Operation
MADE IN B.C. CANADA MADE IN
olympic
INTERNATIONAL
SMALL PLANET SUPPLY
Building the World of High Performance


✓ 505 Gallon ASME Primary Storage
✓ 119 Gallon 13Kw ASME Swing Tank
✓ TMV & Building Pump
✓ M&V Package Available
MADE IN B.C. CANADA
olympic INTERNATIONAL
SMALL PLANET SUPPLY
Building the World of High Performance

54Kw Capacity

Single Pass Lift to 150F
Master Staging Controller
Low Ambient Operation

MADE IN B.C. CANADA

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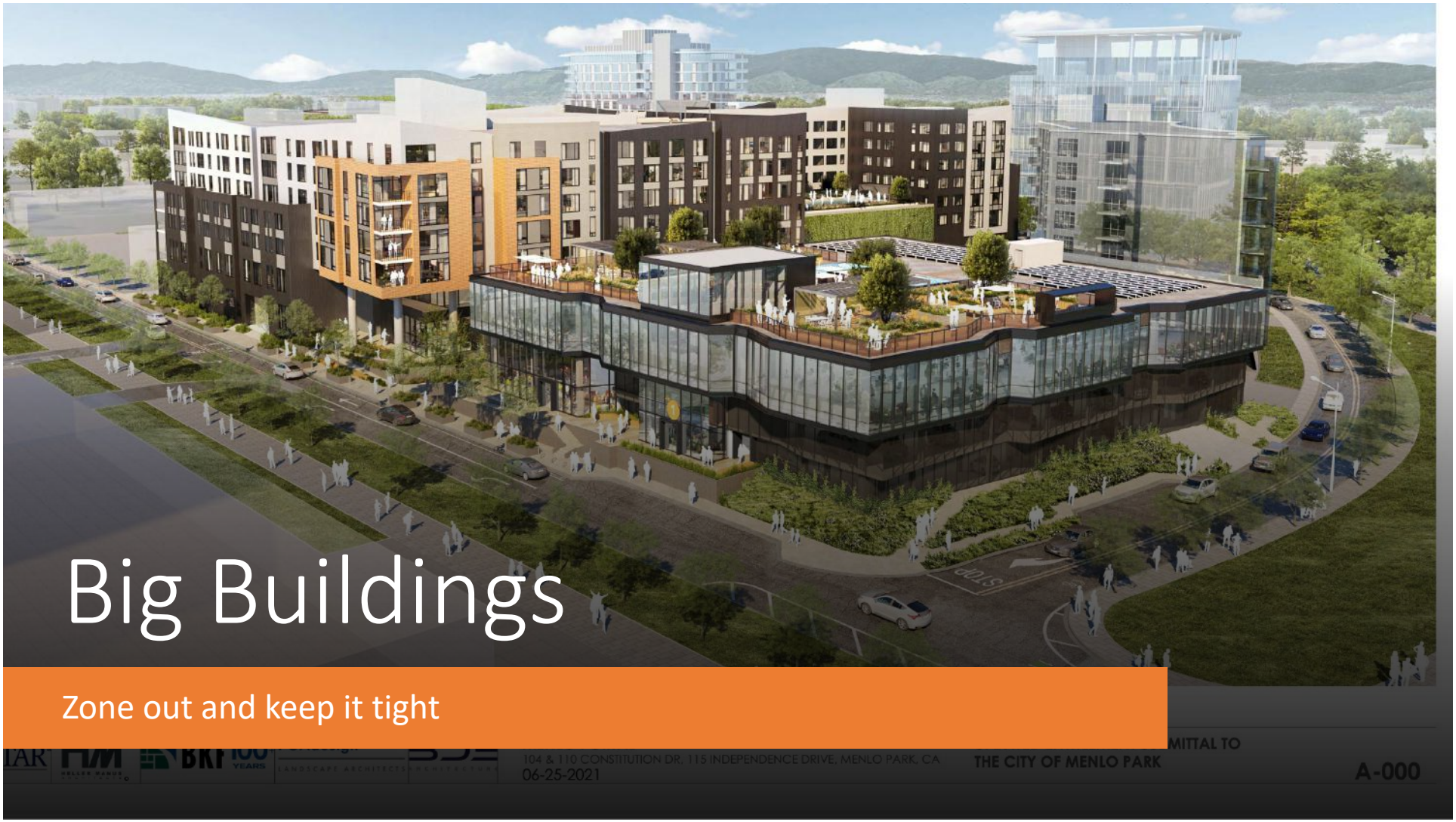
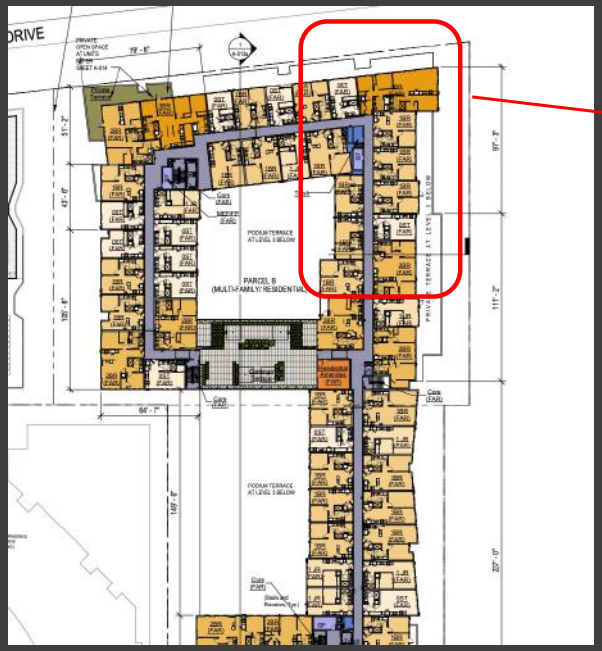
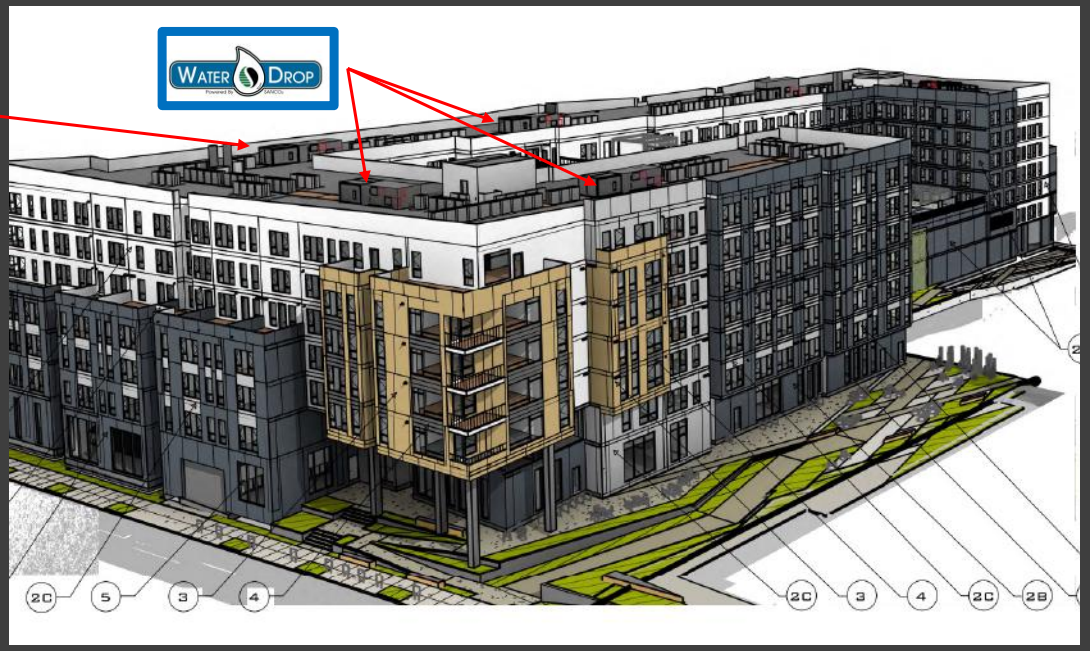


Big Buildings

Zone out and keep it tight





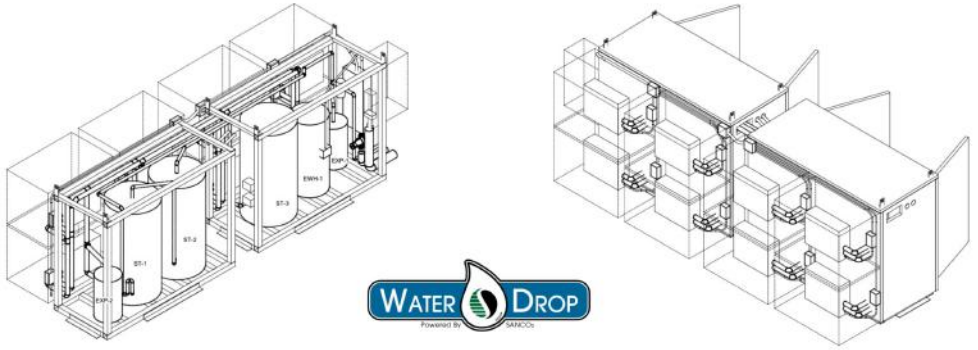
Break it into zones

- Compact distribution systems use less pump energy
- Shorter runs have less loss with a smaller swing tank lifts
- Multiple plants offer better security and lower power drops.

- Supported System
- Ecosizer System Sizing
- “Drop In” Design
- Factory Assembled
- All Major Components
- System Pricing
- Bidder & Installer Training
- Factory Startup Service
- Warranty on Factory Skids

Locally supported by…

olympic INTERNATIONAL



Questions about WaterDrop?
Contact Albert Rooks

albert@smallplanetsupply.com

Want more information about Small Planet Supply?

www.smallplanetsupply.com

or visit our warehouse

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