

BUILDINGENERGY NYC

Lessons Learned from 5+ Central Heat Pump Water Heaters

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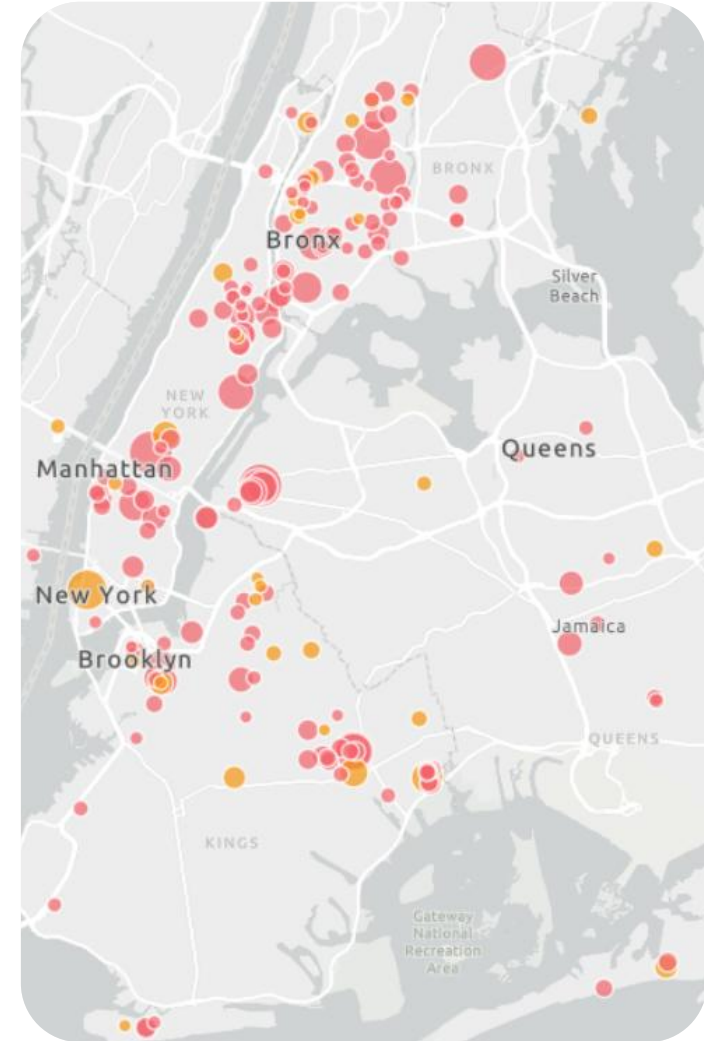
Northeast Sustainable Energy Association (NESEA) | October 15, 2026

M&I Study



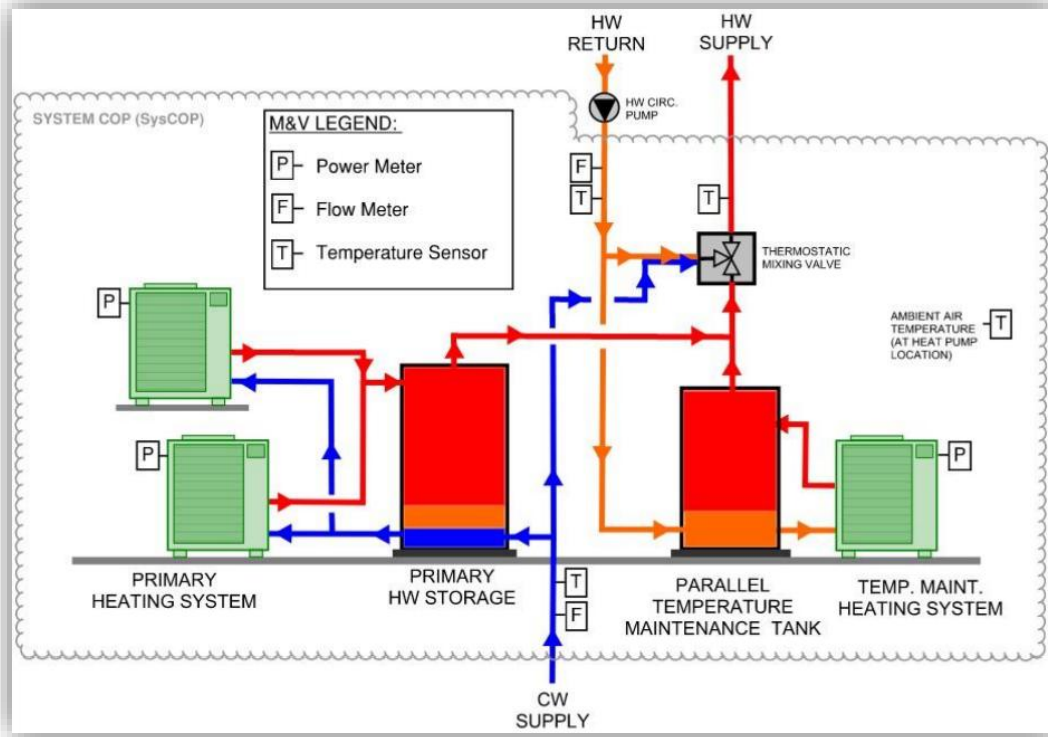
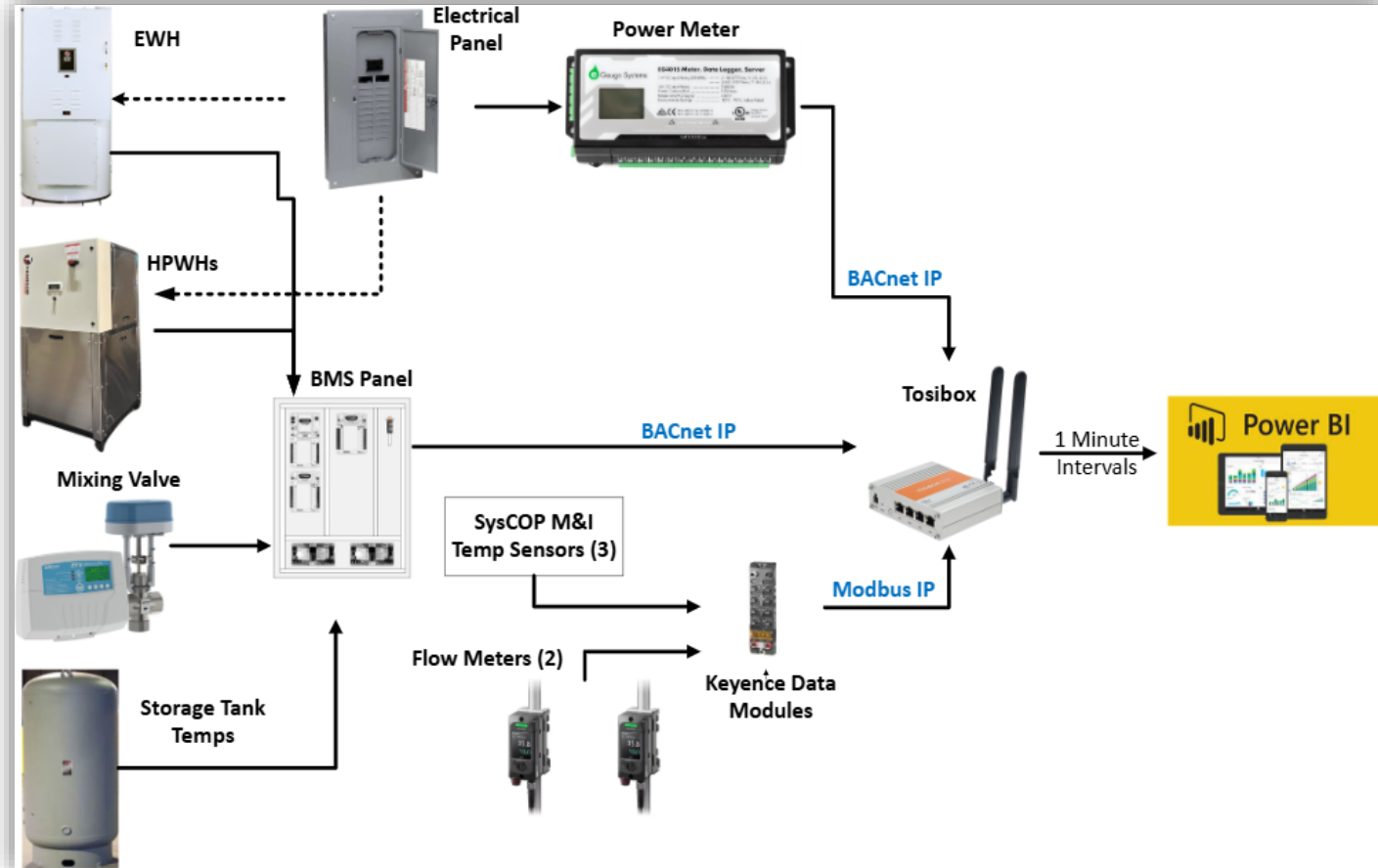
M&I Goals

- Measurement & Improvement (M&I) of **5 early adopters**
- Identify
 - NYC **Load Profiles**
 - Low-cost **improvements**
 - **KPIs** for O&M
- Reliable **seasonal performance**
- Inform NYC market
 - Equipment Reps & Techs
 - Engineers
 - CxAs
- Final reports in 2027, seeking additional funding



SWA NYC Cx Projects

sysCOP & Monitoring System

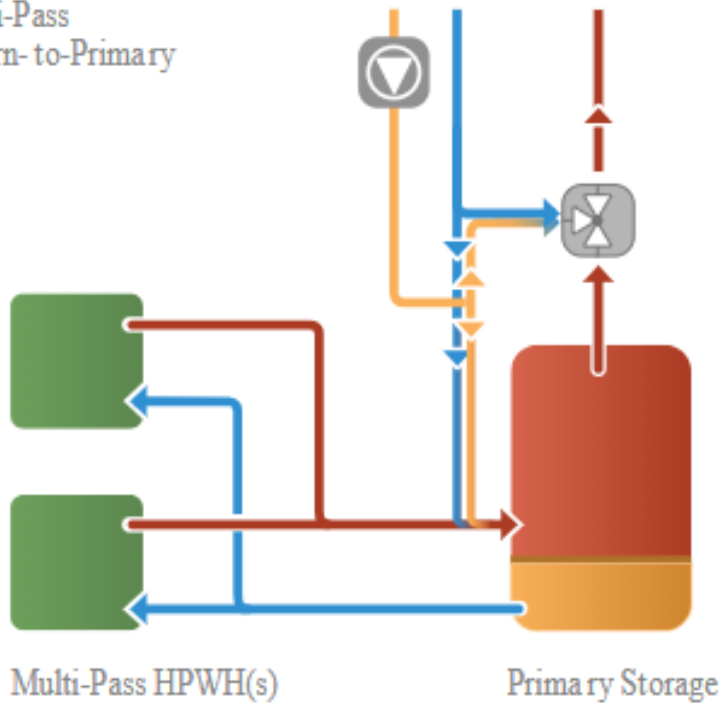


[Advanced-Water-Heating-Spec V8.1](#) Appendix H M&V

Data Collection (Varies by site)

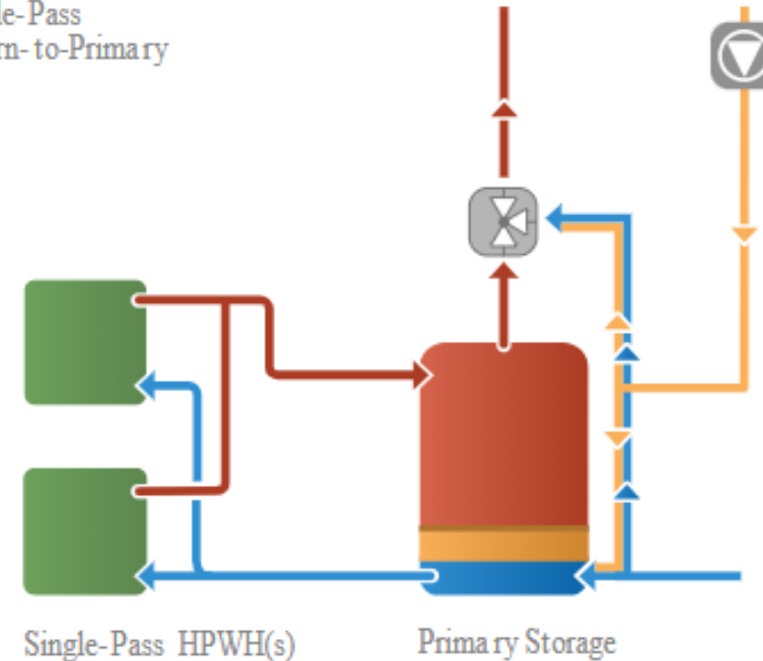
CHPWH Layouts

Multi-Pass
Return-to-Primary



- **Most Monitored Sites**
- 20-30F rise in Heat Pump
- Low Tank stratification, Parallel layout
- R134a, R32, R507, A2Ls, etc.

Single-Pass
Return-to-Primary



- Most Efficient
- 50-100F rise in Heat Pump
- Hi Tank Stratification, Series layout
- CO2 typical (SanCO2, Aegis Lync, Mitsubishi QAHV)

<https://ecosizer.ecotope.com>

5 Multifamily CHPWH M&I

Sites:	1 GEO-Large	2 GEO-Med	3 Air-Sr	4 Air-Condo	5 Air-Large
Market	Affordable	Affordable	Affordable Senior	Condos (Retrofit)	Affordable (Retrofit)
Dwellings	146	78	73	38	56
Population est.	300	180	120	150	300
Installed	2025	2022	2023	2025	2025
Monitoring Started	Feb	April	April	August	TBD
Type	Water (Geo) Multipass	Water (Geo) Multipass	Air Multipass	Air (tempered) Multipass	Air Single Pass
Capacity in Winter (Storage)	440 mbh (2,800 gal)	800 mbh (2,000 gal)	1,000 mbh (300 gal)	110 mbh (800 gal)	340 mbh (3,500 gal)
Manufacturer (Qty) & Model	Transom (x4) Severn 080	ArctiChill (x4) Manhattan Chiller	LG (x12) 80 Hydrokit 080 Hi Temp	Lochinvar (x1) VERITUS AHP140	Mitsubishi (x5) QAHV-N136YAU-HPB
sysCOP					
Spring (Apr/May)	2.2	2.2	1.5		
Summer (Jul/Aug)	2.5	2.5	3.0	N/A	
Winter (Feb/Mar)	2.4				

Most visuals are from Site: 1 Geo Large unless noted.

Data Stories



Tracked M&I Data

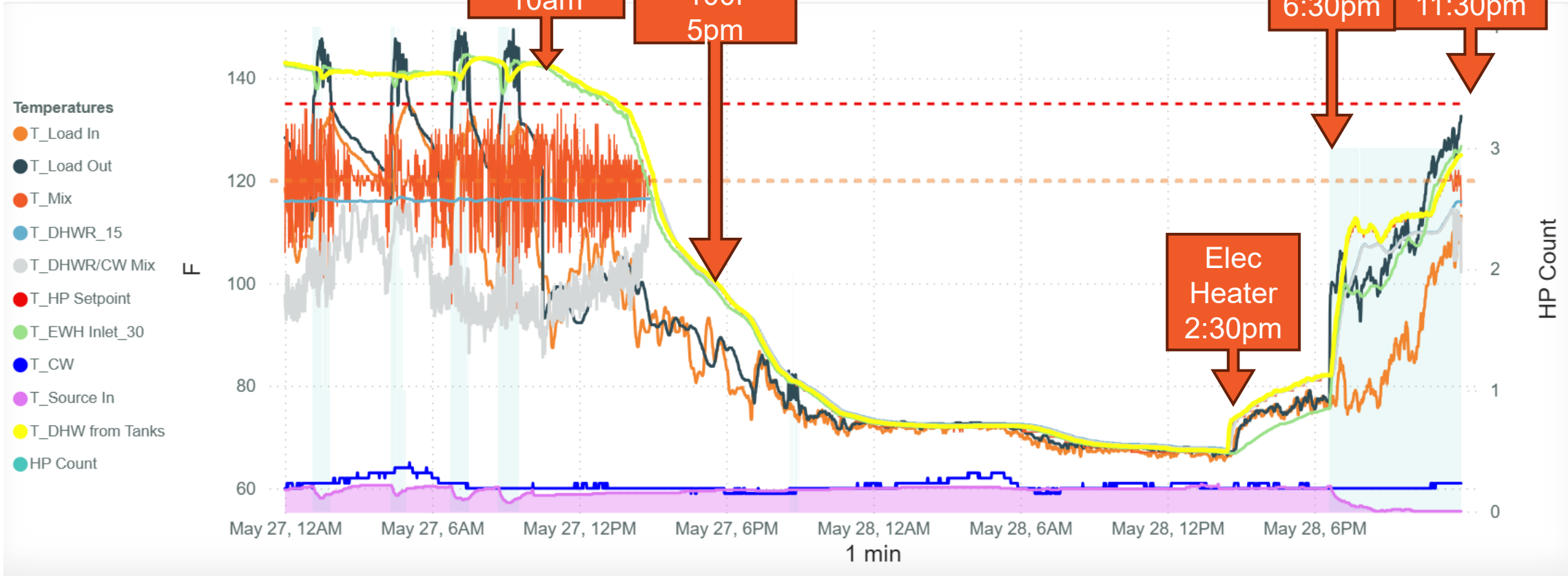
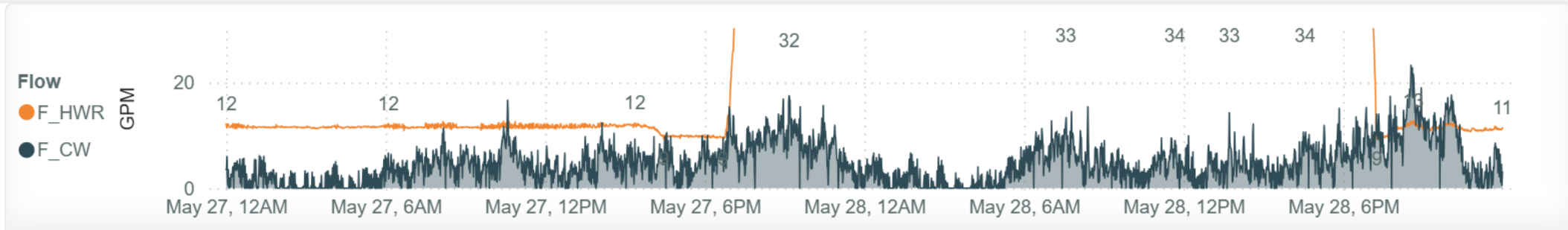
Summary of KPIs by Period and Day (1 Geo Large)

													DHW Load MBH											
Period, Week, Date	# of Days	OAT	Geo Source Temp	Sys COP 3hr	F_CW Avg GPM	Gal/ Pers /Day	T_Mix HWS	Tank Top (F)	T_Load Inlet Avg	Hrs of Major DHW Loss	Hrs of Minor DHW Loss	kW Peak	kW Avg	2Hr Peak	1Hr Peak	1Hr Avg	Recirc %Load	Recirc MBH	Recirc Watts/ Apt	Avg Active Alarms	kwh EWH	CPD_HP	Cycle Length Mins	Avg pump count
_3Summer '26	56	77	67	2.35	4.4	21.2	120	140	126	0	0	57	4	394	490	136	15%	20	41.2	1.0	0	303	4	1.9
30 Jul 20-26	7	75	68	2.47	4.5	21.4	120	141	123	0	0	57	4	232	280	131	16%	21	42.7		0	211	5	1.4
29 Jul 13-19	7	81	71	2.39	4.4	21.0	120	140	128	0	0	55	4	257	290	130	16%	21	41.6	1.0	0	430	3	2.2
28 Jul 6-12	7	75	69	2.21	4.4	21.3	120	139	130	0	0	53	4	323	380	131	15%	20	40.3		0	528	2	2.6
27 Jun 29-5	7	85	71	2.28	4.5	21.9	120	139	130	0	0	47	4	272	320	137	14%	20	39.8		0	569	2	2.7
26 Jun 22-28	7	73	65	2.37	4.3	20.8	120	141	123	0	0	56	4	298	320	135	15%	20	41.1		0	191	6	1.5
25 Jun 15-21	7	74	64	2.34	4.1	19.6	120	141	123	0	0	55	4	296	320	130	16%	20	41.0		0	193	6	1.5
24 Jun 8-14	7	78	64	2.41	4.4	21.1	120	141	122	0	0	57	4	311	350	142	15%	21	41.5		0	172	7	1.5
23 Jun 1-7	7	73	60	2.33	4.6	22.3	120	142	121	0	0	57	5	394	490	152	13%	21	41.2		0	132	11	1.6
2Spring '26	62	59	55	2.24	4.5	21.6	119	141	122	25	32	59	6	408	450	165	13%	21	42.2	3.0	135	121	13	1.8
22 May 25-31	7	68	58	2.34	4.6	22.2	113		117	25	32	58	5	334	360	136	12%	16	32.6	3.0	135	85	14	1.3
21 May 18-24	7	68	58	2.29	4.4	21.2	120	142	121	0	0	58	5	324	370	153	14%	21	42.0		0	117	12	1.6
20 May 11-17	7	63	56	2.02	4.2	20.5	120	141	129	0	0	57	6	336	350	153	14%	22	44.0		0	323	5	2.5
19 May 4-10	7	60	55	2.27	4.4	21.3	120	142	122	0	0	57	5	326	370	160	13%	21	42.8		0	119	14	1.8
18 Apr 27-3	7	55	54	2.15	4.4	21.2	120	142	121	0	0	57	5	349	370	164	14%	22	44.6		0	98	17	1.7
17 Apr 20-26	7	50	54	2.27	4.6	22.4	120	142	121	0	0	58	6	385	410	174	13%	22	43.6		0	94	19	1.8
16 Apr 13-19	6	67	55	2.34	4.6	22.3	120	141	120	0	0	57	6	402	430	178	12%	21	42.2		0	95	18	1.8
15 Apr 6-12	7	47	53	2.24	4.4	21.3	120	141	120	0	0	59	6	408	450	179	12%	22	43.9		0	77	23	1.8
14 Mar 30-5	7	57	53	2.25	4.6	22.0	120	141	120	0	0	58	6	368	410	189	12%	22	44.3		0	77	25	1.9
_1Winter '26	35	43	51	2.37	4.9	23.7	119	136	119	8	32	58	7	568	590	212	11%	22	45.1	1.4	0	82	24	2.6
13 Mar 23-29	7	44	52	2.10	4.8	23.2	120	141	126	0	0	57	7	459	570	203	11%	23	46.1	1.0	0	188	11	2.7
12 Mar 16-22	7	43	51	2.31	5.2	24.9	120	138	119	0	0	58	7	534	590	222	10%	23	45.7	1.5	0	75	31	2.5
11 Mar 9-15	7	50	51	2.51	5.0	24.2	120	135	117	0	2	44	6	568	570	218	10%	23	45.6	1.7	0	52	33	2.7
10 Mar 2-8	7	40	50	2.45	4.9	23.6	120	135	118	0	0	44	7	469	540	217	10%	23	45.6	1.6	0	47	36	2.7
09 Feb 23-1	7	36	50	2.52	4.7	22.7	117	130	114	8	30	44	6	484	570	200	11%	21	42.7	1.4	0	43	48	2.5
Total	153	62	58	2.31	4.6	21.9	119	140	122	33	64	59	5	568	590	165	13%	21	42.5	1.5	135	179	9	2.0

DHW LOSS: All 4 modules fail

May Weekend

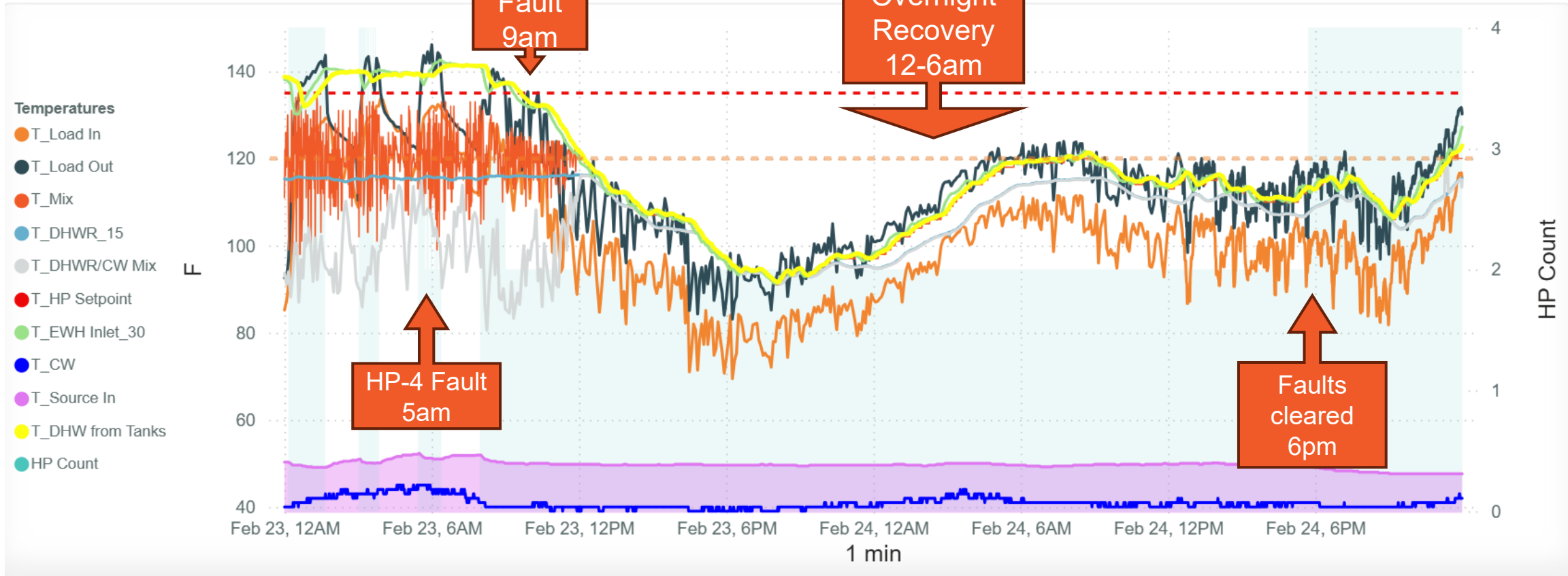
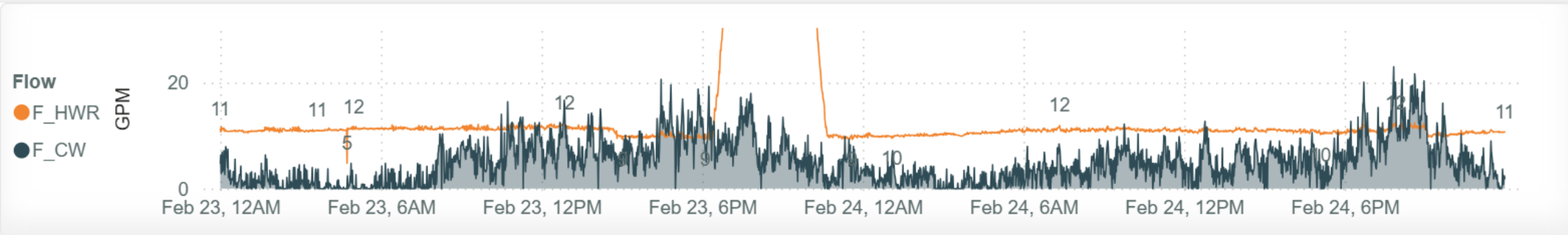
Site: 1 Geo Large



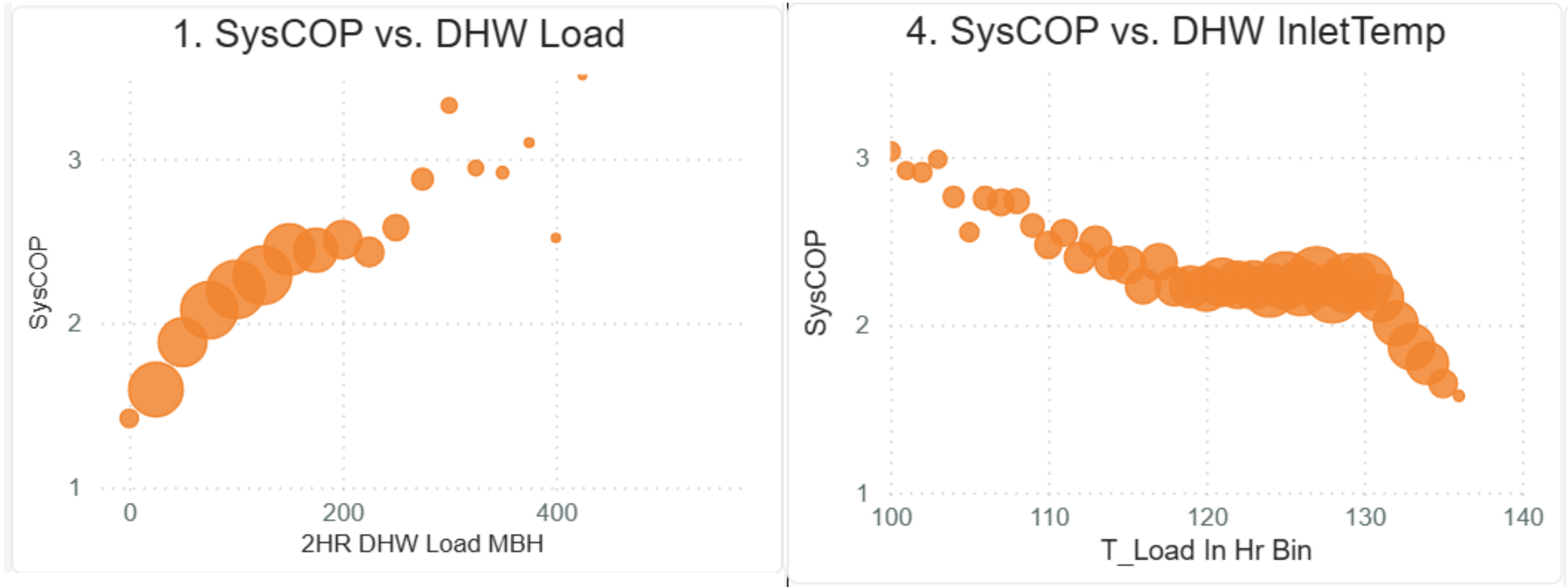
DHW LOSS: Low Capacity

Feb

Site: 1 Geo Large



Characterizing Performance



Site: 1 Geo Large

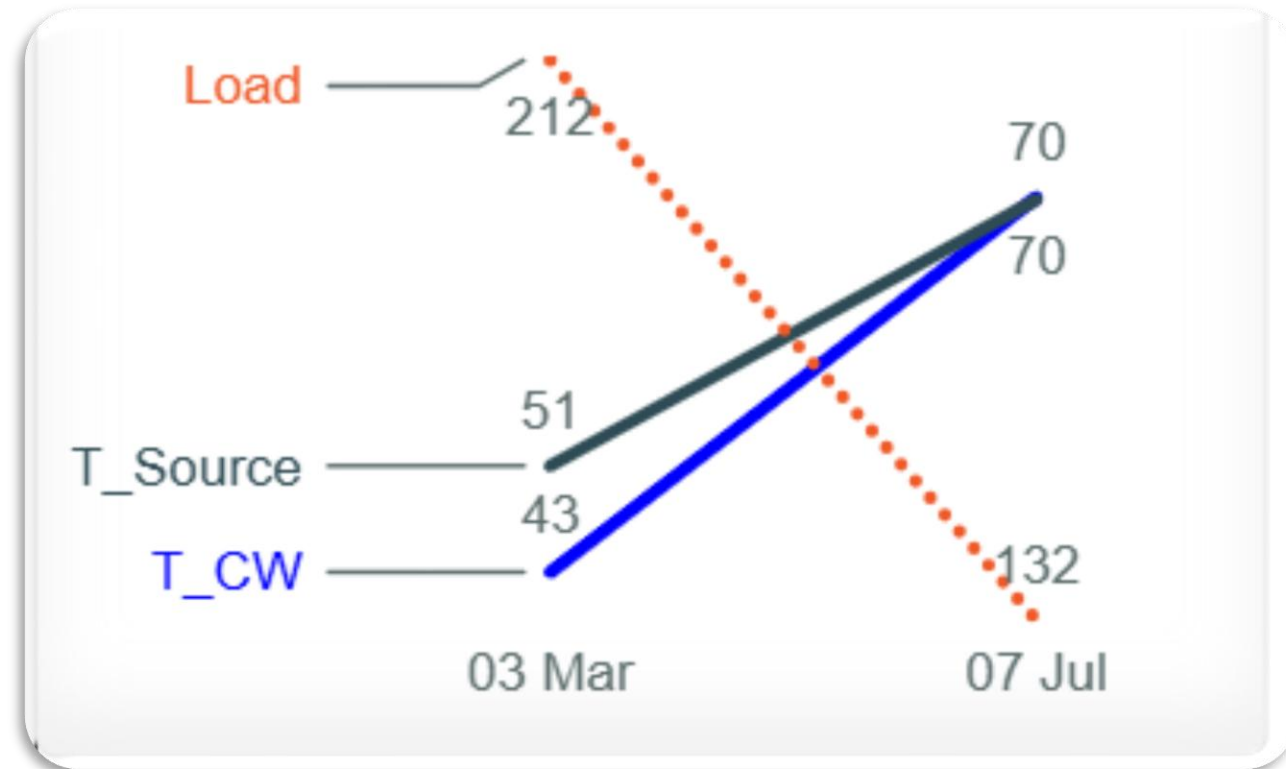
Summer Vs Winter

Summer

↓ 40% Load

↑ 40% Capacity from Heat Pump

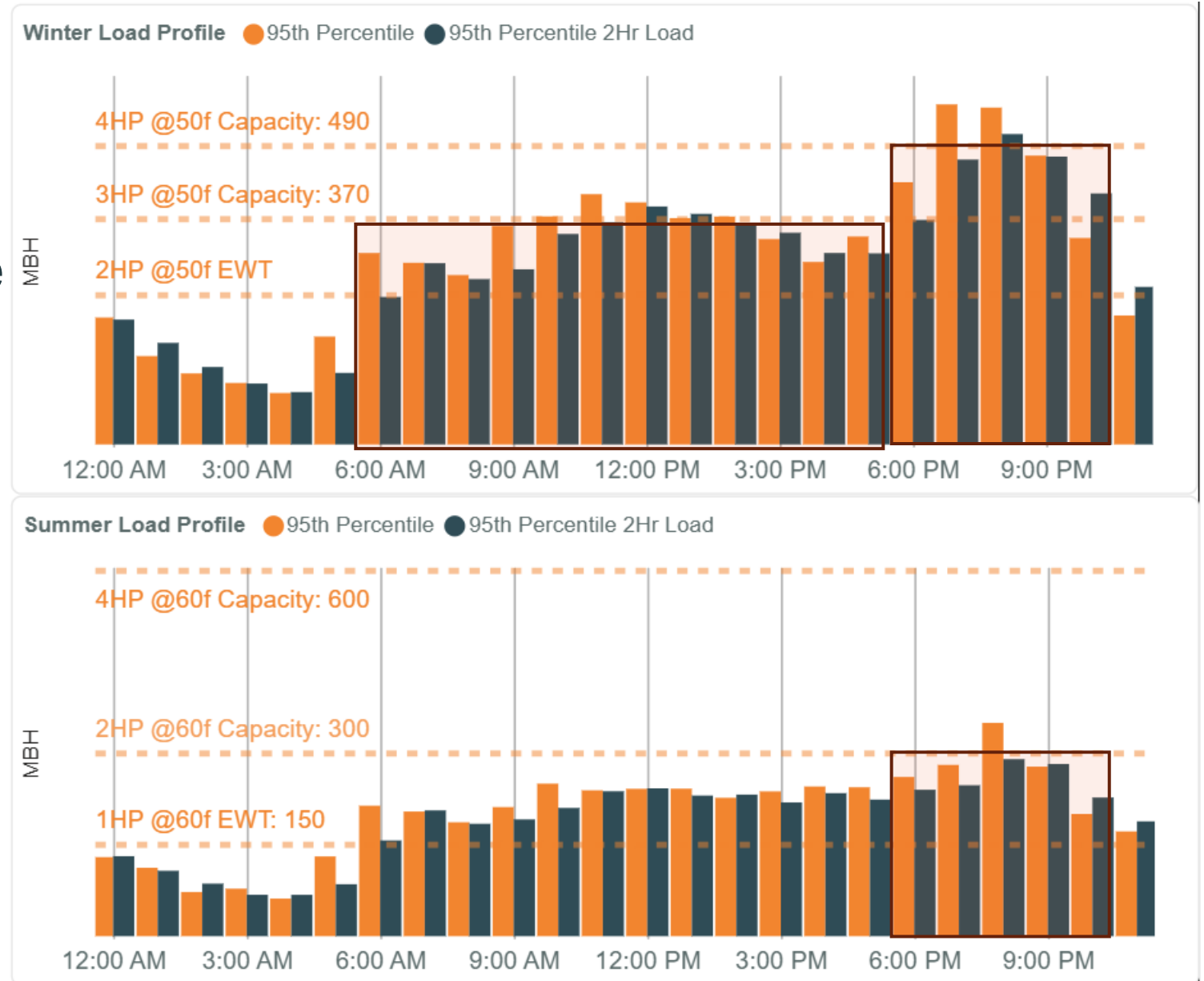
≡ 80% Oversized



Load Profile

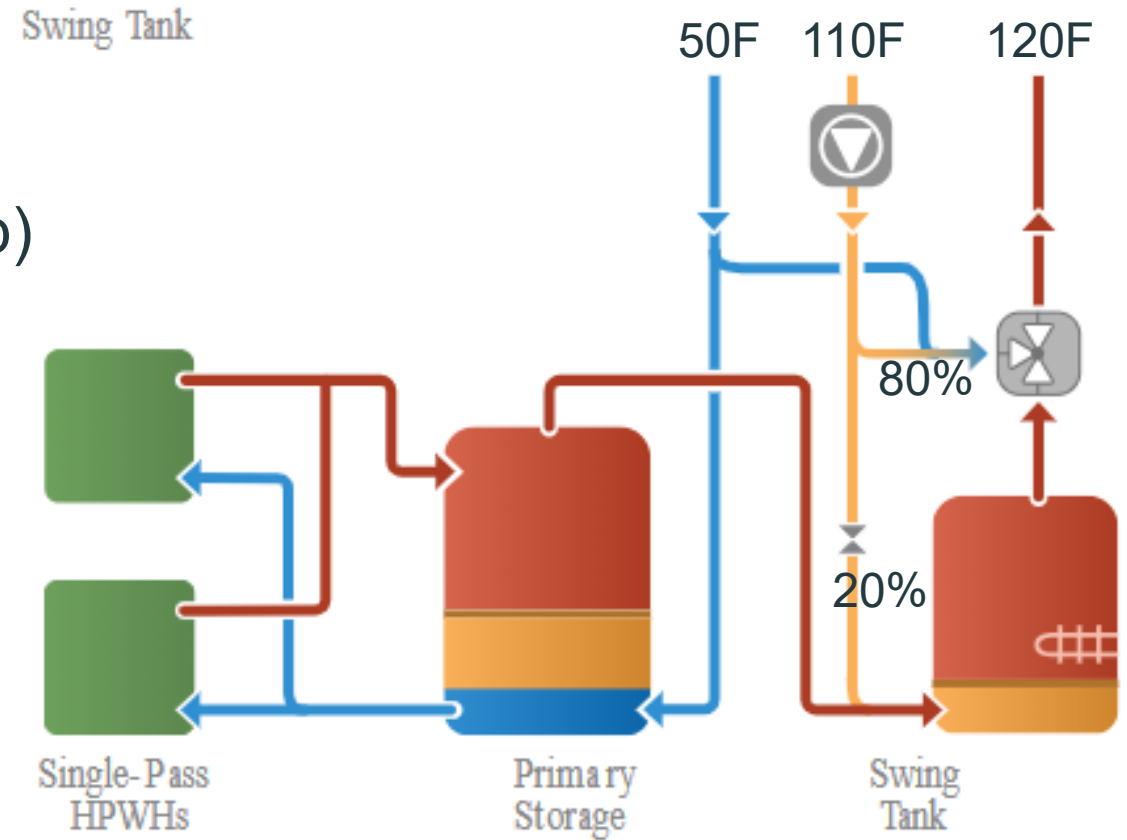
- Affordable Housing Site
 - 6am-6pm flat
 - 6pm-11pm peak
- Limit Active Heatpumps
 - 3 in June
 - 2 in July-Sep
 - \$13,500 in kW savings on TOD Rate

Site: 1 Geo Large



Taming the Recirc

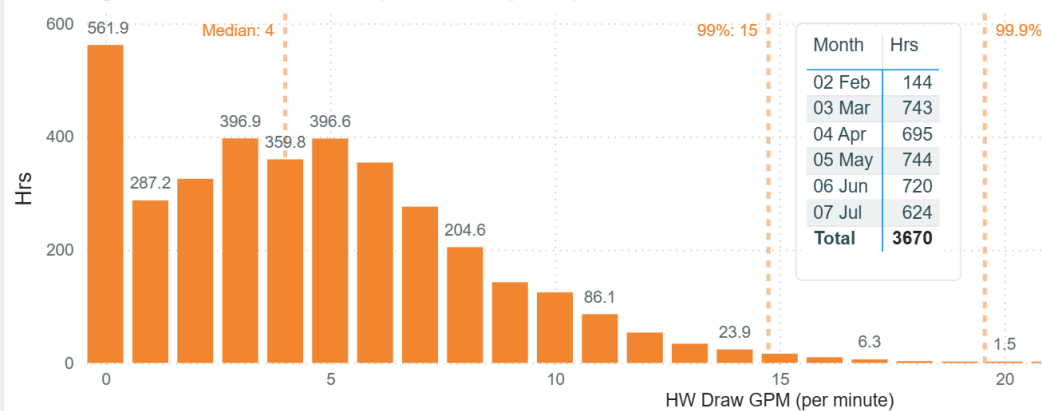
- Problem: Excess Recirc Flow
 - Destratifies Tank (increases inlet Temp)
 - Swing Tank Elec Resistance \$\$\$
 - Recirc pumps often 3-30x oversized
- Solution
 - Thermal valves 0.25-0.4 gpm/riser
 - Balance ~80% Flow to ETV
 - Use small pumps
 - 150 units & 30 risers: 10gpm @10ft ~1/8th HP
 - Plan for air elimination



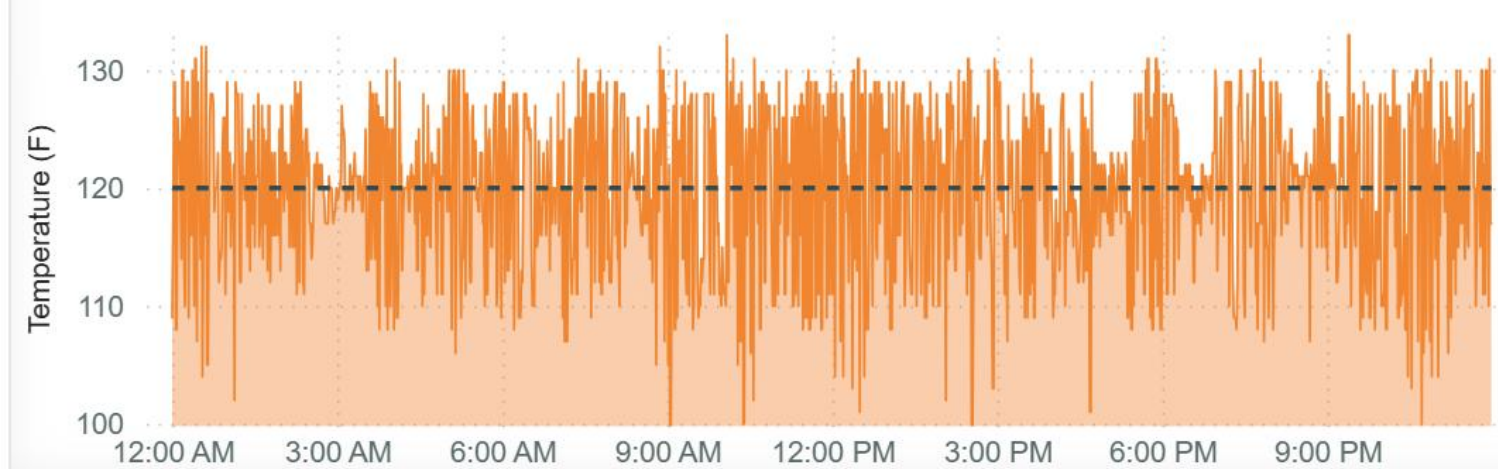
Oversized Mixing Valve Hunts

- Peak Valve Flow
 - Recirc + HW Draw
 - Design 162 gpm (2.5")
 - Actual 33gpm (1.25")

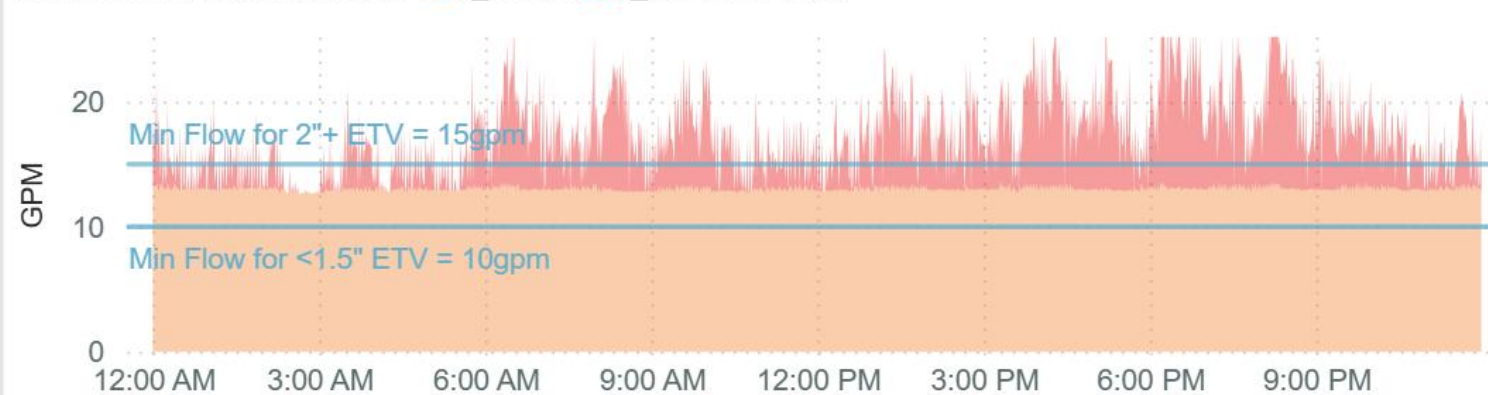
2. Histogram of HW Draw GPM (~300 Occupants)



ETV Temperature (F) ● T_Mix supply ● SetPoint

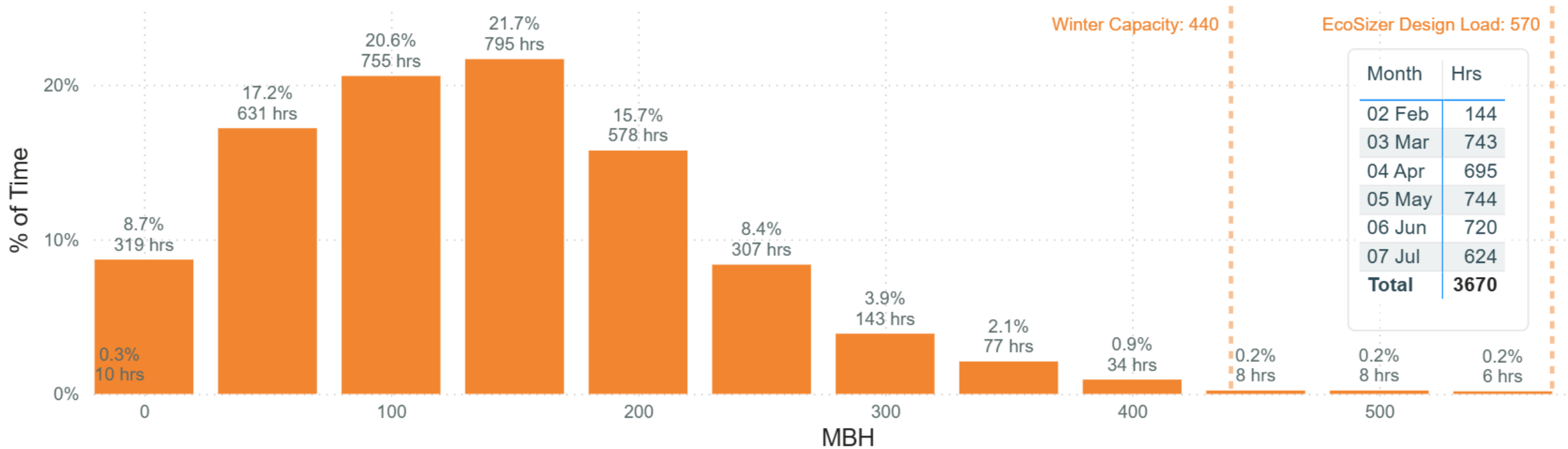


Flow Vs ETV Minimum GPM ● F_Recirc ● F_HW Draw (CW)



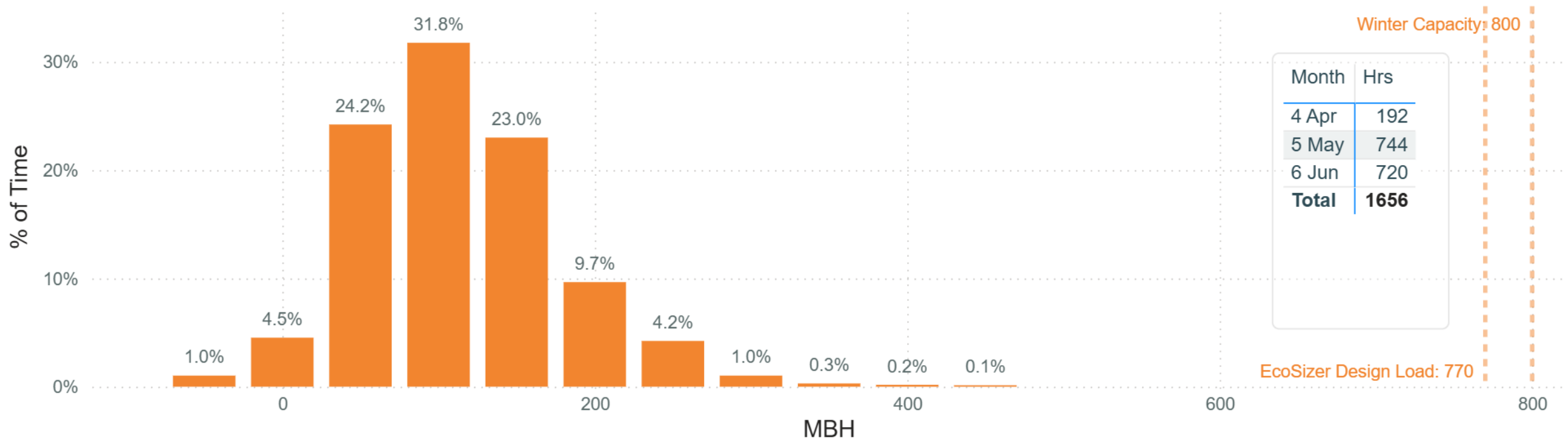
Peak Load vs Capacity

1. Histogram of HourlyDHW Load Site: 1 Geo Large



Peak Load vs Capacity

1. Histogram of HourlyDHW Load Site: 2 Geo Medium



Tracked M&I Data (Other Sites, Analysis in Progress)

Summary of KPIs by Period and Day Site: 3 Airsource Senior

Period	# of Days	HDD Avg	OAT	Sys COP	F_CW Avg GPM	Gal/ Pers /Day	Hrs of Major DHW Loss	Hrs of Minor DHW Loss	kW Peak	kW HP Avg	E KWH	DHW Load (MBH)			Recirc % Load	Recirc Watts/ Apt	Avg Active Alarms _IDU	Avg T_Mix	Avg ACCU Count	Avg HK Count	Max HK Count
												Peak 1Hr	Peak 2Hr	Avg 1Hr							
☐ _Baseline1	92	0	77	2.2	2.1	25	4	47	40	7	14,805	160	147	53	4%	9.1	7.3	118	1.6	1.8	7
☐ 23 Jun 1-7	7	0	73	1.5	1.8	22	0	3	35	10	1,665	150	147	51	5%	9.6	6.0	118	1.2	1.4	6
☐ 24 Jun 8-14	7	0	78	1.5	1.6	20	0	25	26	8	1,357	140	122	44	5%	9.4	7.1	117	1.3	1.5	5
☐ 25 Jun 15-21	7	0	74	1.3	1.4	17	0	11	25	8	1,427	110	91	39	6%	9.8	7.0	117	1.4	1.4	5
☐ 26 Jun 22-28	7	0	73	1.4	1.4	17	0	0	40	8	1,303	110	99	39	6%	9.5	8.0	118	1.9	2.0	7
☐ 27 Jun 29-5	7	0	85	1.9	1.8	22	0	3	33	7	1,153	140	113	47	4%	8.2	8.0	118	1.9	2.0	4
☐ 28 Jul 6-12	7	0	75	2.4	2.1	25	0	0	26	6	1,035	130	116	53	4%	9.2	7.4	118	1.8	2.1	4
☐ 29 Jul 13-19	7	0	81	2.7	2.1	26	0	0	22	5	919	130	113	53	4%	8.9	6.7	118	1.7	2.2	4
☐ 30 Jul 20-26	7	0	75	2.6	2.3	28	0	0	22	6	1,001	160	145	57	4%	9.2	7.7	118	1.3	1.9	4
☐ 31 Jul 27-2	7	0	77	2.9	2.5	30	4	5	22	6	973	150	119	62	4%	9.2	7.0	116	1.7	2.2	4
☐ 32 Aug 3-9	7	0	81	3.1	2.7	33	0	0	24	6	982	130	123	65	3%	8.7	7.6	118	2.2	2.6	5
☐ 33 Aug 10-16	7	0	79	3.0	2.5	31	0	0	23	6	928	130	122	61	4%	8.7	6.9	118	2.1	2.4	4
☐ 34 Aug 17-23	7	0	76	2.8	2.5	30	0	0	22	6	974	130	112	59	4%	8.9	7.7	118	1.6	1.5	4
☐ 35 Aug 24-30	7	0	75	2.7	2.4	29	0	0	21	6	956	120	110	56	4%	9.2	7.7	118	1.8	1.7	3
☐ 36 Aug 31-6	1	0	74	2.7	2.3	28	0	0	19	6	133	120	114	55	4%	9.0	8.0	118	1.8	1.7	2
Total	92	0	77	2.2	2.1	25	4	47	40	7	14,805	160	147	53	4%	9.1	7.3	118	1.6	1.8	7

Summary of KPIs by Period and Day

Site: 2 Geo Medium

Period	# of Days	HDD Avg	OAT	Geo Source Temp	Sys COP	F_CW Avg GPM	GPD	Tank Top (F)	Tank Bot (F)	T_Mix	DHW Loss (Hrs)		kW Peak	kW Avg	kwh EWH	DHW Load (MBH)			Recirc %Load	Recirc MBH	Recirc Watts/Apt	Avg Active Alarms	CPD_C1	CPD_C2	CPD_HP	CL_HP	MP Count	HP Count
											Major	Minor				Peak 2Hr	Peak 1HR	Avg 1HR										
[-] _Baseline1	158	1	73	50	1.8	3	24.7	137	134	129	5	10	94	19	18,140	441	480	121	29%	35	130	1.1	14	18	7	1071	2.4	0.6
[-] 4 Apr	8	6	54	49	2.0	4	30.8	139	137	130	0	0	81	25	141	441	480	174	25%	43	160	1.5	10	17	4	1095	2.7	1.2
[-] 17 Apr 20-26	4	7	53	49	2.0	4	30.8	138	136	130	0	0	81	26	141	441	480	171	24%	42	156	2.0	10	14	5	820	2.5	1.4
[-] 18 Apr 27-3	4	5	55	49	2.1	4	30.7	140	138	130	0	0	70	24	0	373	400	177	25%	44	164	1.0	10	20	2	3164	3.0	1.0
[-] 5 May	31	2	64	50	2.1	3	27.6	141	138	130	0	0	94	21	0	393	400	153	26%	40	149	1.0	16	16	2	5796	2.9	0.9
[-] 18 Apr 27-3	3	5	55	49	2.2	3	25.2	140	138	130	0	0	69	20	0	237	270	156	28%	44	164	1.0	12	20	1	7764	3.0	0.9
[-] 19 May 4-10	7	2	60	51	2.0	3	28.3	141	138	130	0	0	82	23	0	323	350	162	26%	42	156	1.0	19	14	1	4784	3.0	1.3
[-] 20 May 11-	7	2	63		2.0	4	29.7	141	138	130	0	0	94	24	0	393	400	163	24%	39	145	1.0	21	21	2	9217	2.9	1.2
[-] 21 May 18-	7	3	68		2.2	3	27.2	140	138	130	0	0	66	20	0	266	280	148	26%	39	146	1.0	13	13	2	5770	2.9	0.7
[-] 22 May 25-	7	0	68		2.2	3	26.1	141	138	130	0	0	65	18	0	249	250	139	27%	38	144		12	13	2	3300	2.8	0.7
[-] 6 Jun	30	0	75		2.1	3	23.5	141	138	130	0	0	77	15	0	215	230	111	30%	34	127	1.1	15	18	4	1351	2.3	0.7
[-] 23 Jun 1-7	7	0	73		2.1	3	23.9	141	138	130	0	0	66	16	0	215	230	118	30%	35	133		10	17	3	2016	2.1	0.7
[-] 24 Jun 8-14	7	0	78		2.1	3	25.0	141	138	130	0	0	68	16	0	214	230	120	29%	35	130	1.0	22	15	5	1053	2.4	0.7
[-] 25 Jun 15-21	7	0	74		2.1	3	21.7	141	138	130	0	0	77	14	0	166	170	100	32%	32	121		20	13	2	1898	2.4	0.7
[-] 26 Jun 22-28	7	0	73		2.1	3	23.8	141	138	130	0	0	68	15	0	204	220	106	30%	32	120	1.0	11	28	5	842	2.2	0.7
[-] 27 Jun 29-5	2	0	81		2.3	3	22.3	140	138	130	0	0	68	14	0	161	190	108	33%	35	133	1.5	10	20	3	3632	2.6	0.7
[-] 7 Jul	31	0	78		1.0	3	24.4	122	120	128	1	6	68	28	17,995	185	200	101	29%	29	109	1.3	15	17	4	6877	1.7	0.2
[-] 27 Jun 29-5	5	0	86		1.3	3	22.8	127	126	129	0	1	52	23	2,074	165	190	104	30%	31	117	2.0	12	11			2.9	0.3
[-] 28 Jul 6-12	7	0	75		0.8	3	23.8	114	112	127	0	0	43	34	5,735	164	180	93	29%	27	100						1.2	0.0
[-] 29 Jul 13-19	7	0	81		0.9	3	27.5	112	110	125	1	4	43	38	6,347	174	190	111	25%	28	107						1.0	0.0
[-] 30 Jul 20-26	7	0	75		1.1	3	23.8	123	121	128	0	1	66	27	3,838	179	180	99	30%	30	112	1.0	10	18	4	2317	1.5	0.3
[-] 31 Jul 27-2	5	0	76		2.1	3	23.4	141	138	130	0	0	68	14	0	185	200	97	30%	29	110	1.0	20	20	4	1863	2.3	0.7
[-] 8 Aug	31	0	78		2.4	3	22.4	141	139	130	3	3	78	13	0	244	270	108	32%	35	130	1.0	12	19	12	495	2.8	0.6
[-] 31 Jul 27-2	2	0	80		2.2	3	20.3	140	138	130	0	0	69	12	0	141	180	93	30%	28	105	1.0	18	22			3.0	0.6
[-] 32 Aug 3-9	7	0	81		2.4	3	20.6	140	138	130	1	1	70	12	0	239	260	99	32%	32	119	1.0	13	16	3	4767	3.2	0.6
[-] 33 Aug 10-	7	0	79		2.5	3	23.9	141	139	130	1	1	68	14	0	244	270	117	31%	36	136	1.0	8	25	12	455	2.7	0.7
[-] 34 Aug 17-	7	0	76		2.4	3	23.4	141	139	130	0	0	70	14	0	216	270	114	33%	37	139	1.0	12	22	15	295	2.7	0.6
[-] 35 Aug 24-	7	0	75		2.3	3	22.2	141	139	130	1	1	78	13	0	230	240	107	33%	35	132	1.0	15	14	12	387	2.6	0.6
[-] 36 Aug 31-6	1	0	74		2.2	3	23.1	141	139	130	0	0	68	13	0	183	230	105	31%	33	123	1.0	19	11	17	116	1.4	0.5
[-] 9 Sep	27	0	74		2.3	3	23.4	141	139	130	1	1	69	14	5	227	290	108	31%	34	127	1.0	9	17	10	404	2.5	0.6
[-] 36 Aug 31-6	6	0	75		2.2	3	23.4	141	139	130	1	1	69	14	5	211	240	103	31%	32	118	1.0	9	12	10	381	2.5	0.6
[-] 37 Sep 7-13	7	0	75		2.4	3	23.4	140	138	130	0	0	69	14	0	227	290	112	32%	36	135	1.0	9	22	10	438	2.4	0.5
[-] 38 Sep 14-	7	0	72														0											
[-] 39 Sep 21-	7																0											
Total	158	1	73	50	1.8	3	24.7	137	134	129	5	10	94	19	18,140	441	480	121	29%	35	130	1.1	14	18	7	1071	2.4	0.6

CHPWH Resources

- [CHPWHs- Resources — AWHI](#)
 - [NEEA: Advanced Water Heating Specification V 8.1](#)
 - [NEEA CHPWH Qualified Products List](#) (rolling updates Monthly+)
 - Includes links to design templates for each configuration
 - HPD now requires listing w/ SysCOP>2.0 in Mild Climate (Sales Reps to contact NEEA for 1-2 month listing process)
 - On [hpd-sustainability-technical-requirements](#) see [Tech Regs- HPWH](#)

Commercial/Multifamily HPWH Systems Qualified Products List												
for												
Advanced Water Heating Specification Version 8.1												
A Specification for Residential, Commercial/Multifamily, and Industrial Water Heaters and Heating Systems												
Updated: 09/22/2026												
Company	Identifier	Configuration	Market Delivery Method	Hot Climate Zone		Mild Climate Zone		Cold Climate Zone		Very Cold Climate Zone		ASHRAE/ANSI 118.1 Performance Map
				Tier	SysCOP	Tier	SysCOP	Tier	SysCOP	Tier	SysCOP	
A. O. Smith	AHPA060¹	Multi Pass Return to Primary	Custom Engineered System	2	2.5	2	2.1	2	1.8	2	1.6	No





Operator Takeaways

- 1 System is not stressed until Winter
- 2 Address Alarms/Faults early
- 3 Limit active Heat Pumps in Summer
- 4 Log compressor Starts, Hours & datetime
KPIs: cycles per day, avg cycle length



Designer Takeaways

- 1 ½" Thermal Valves on Risers
(Circuit Solver 115f)
- 2 Small Recirc Pump & Mixing Valve
- 3 ¾" Circuit Setter for ~20% Recirc to
Heat Pump
- 4 Plan for modulation/Staging in
Summer & Winter



Owner Takeaways

- 1 Consider Time of Day ConEd Rate
- 2 Extend Warranty phase to include a 90% occupied Winter
- 3 Consider signing first service contract after construction with installer
- 4 O&M readiness – train operators early & often
- 5 Commissioning- once at start up, once more under winter load

Partial Electrification

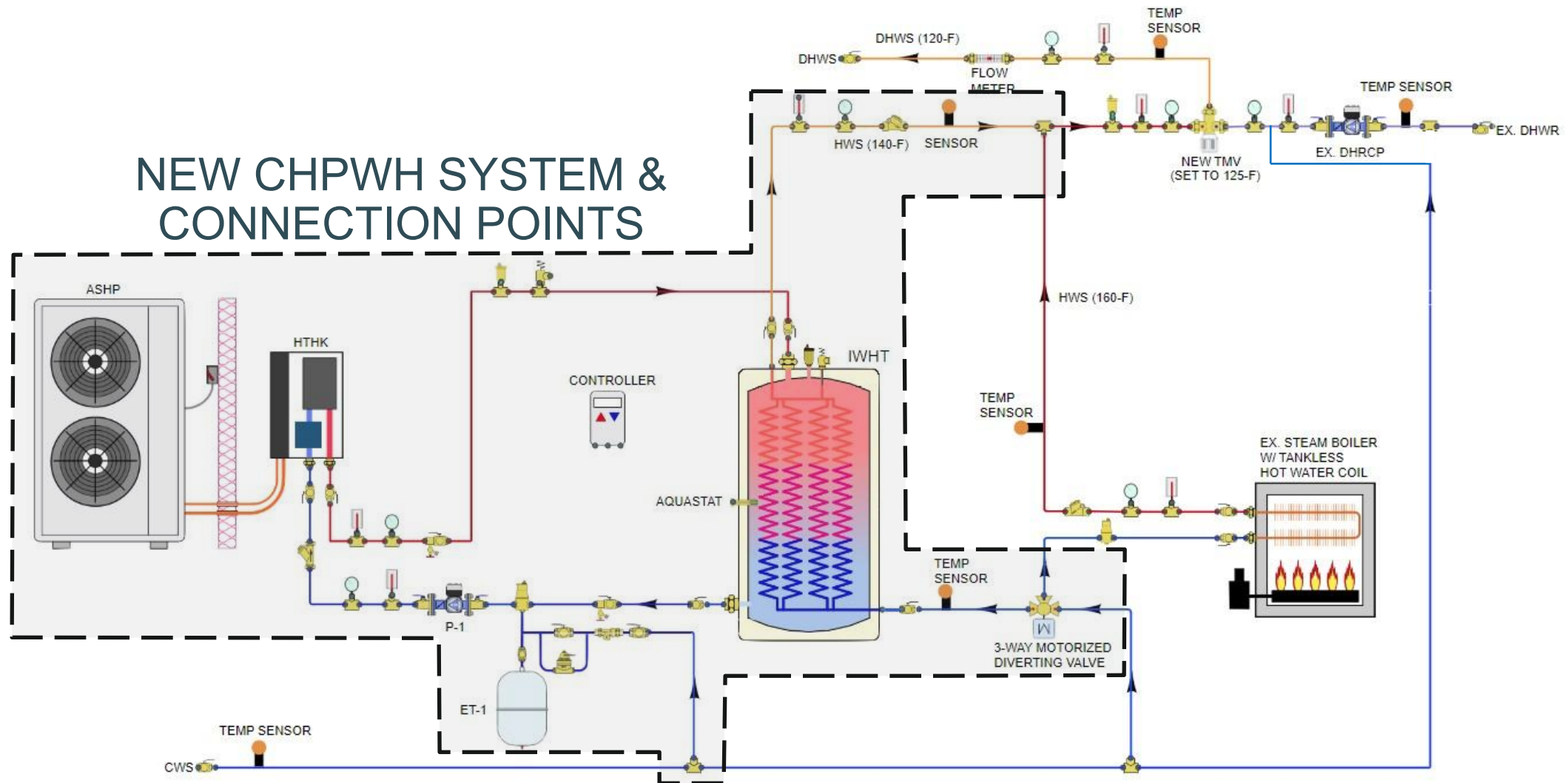


Esperanza

- 6 Stories
- 25 Units (80BR)
- Affordable Housing
- Existing Scotch Marine Boiler w/
Tankless Coil
- No BMS

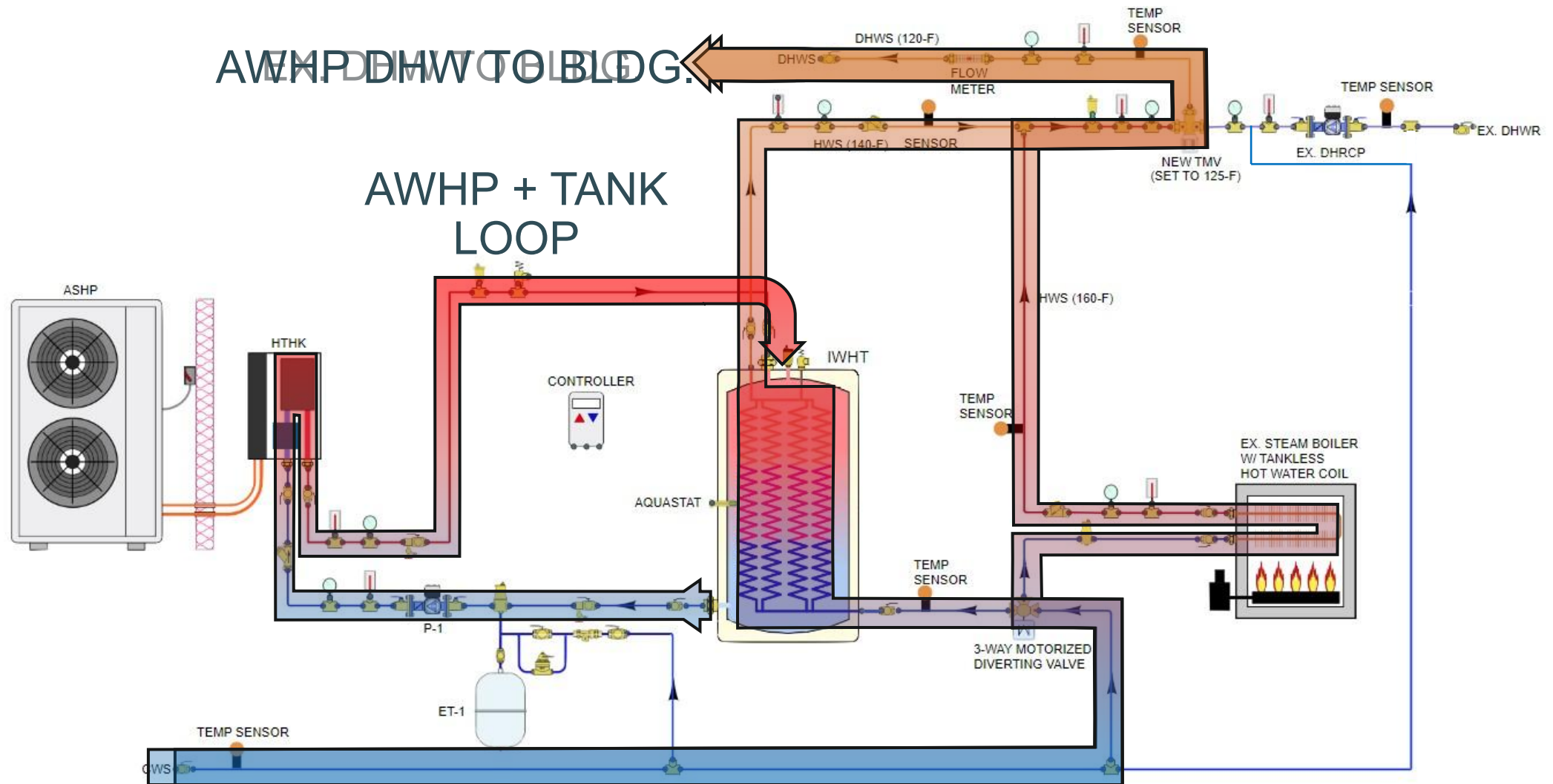


Ex. Offsetting Steam Boiler w Tankless Coil



AWHP DHW TO BLDG.

AWHP + TANK LOOP



Installation

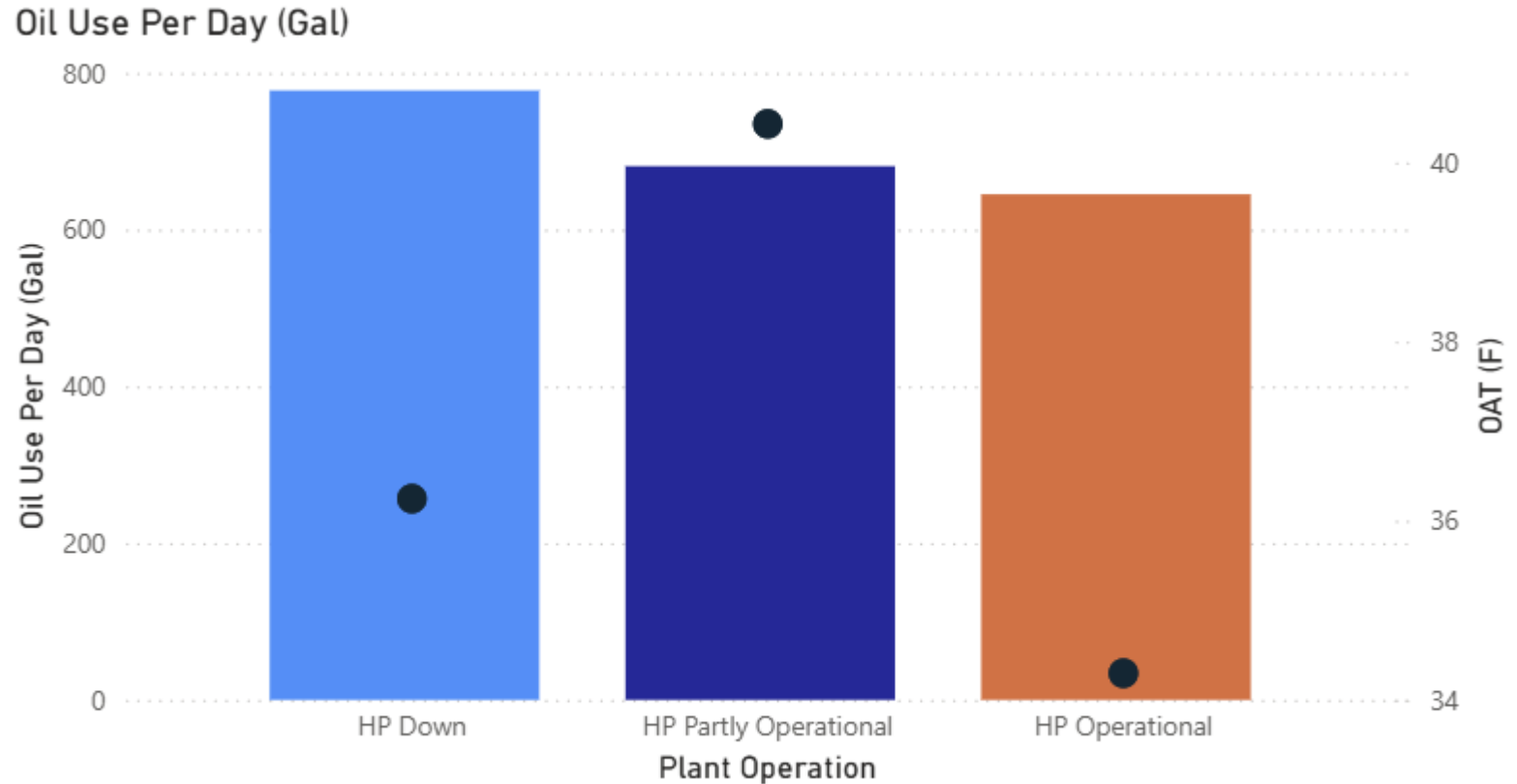


Another Installation (not monitored)

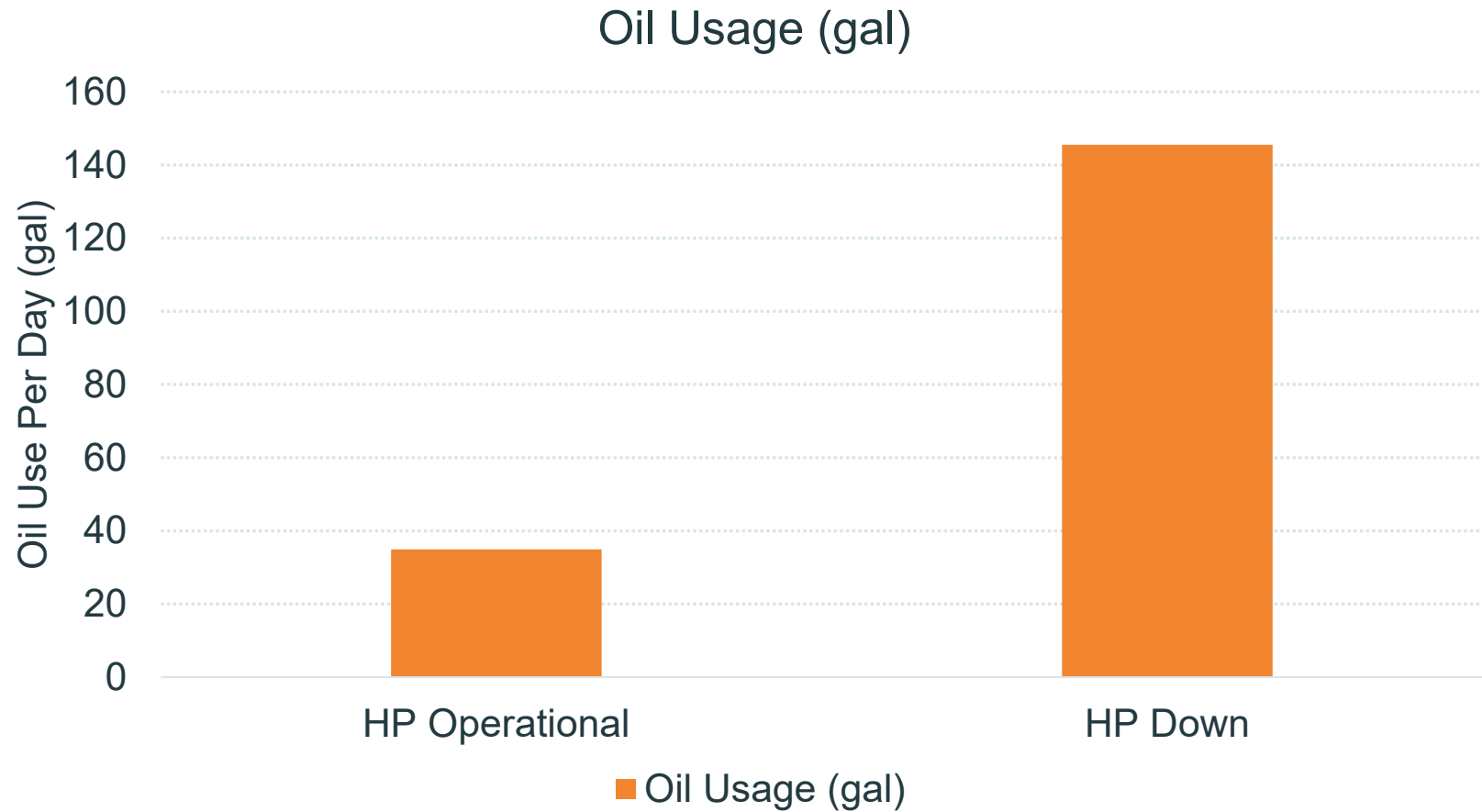


Heating Season Oil Use

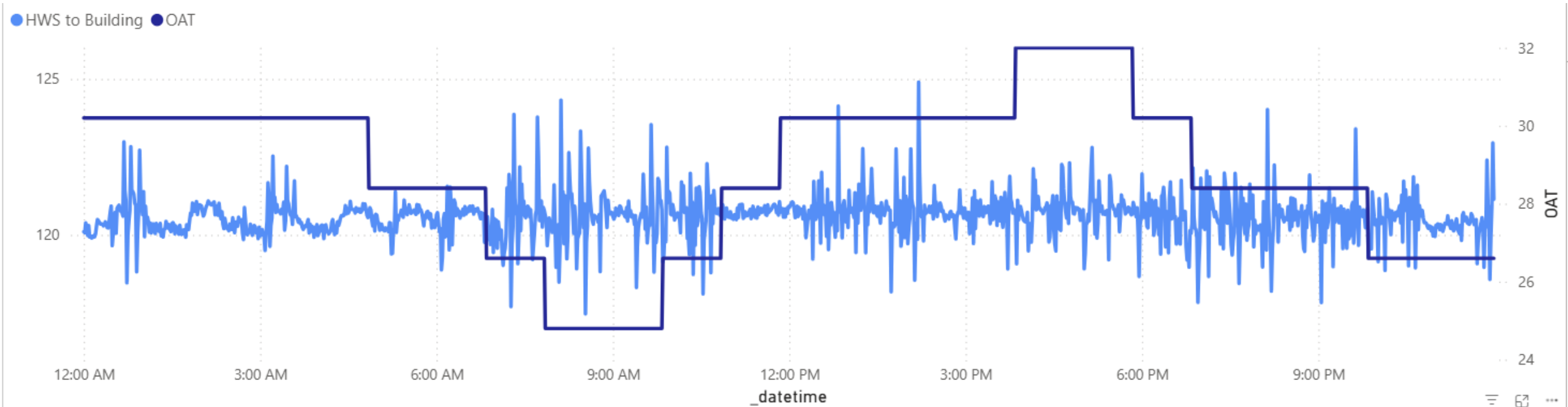
- **ORANGE:** HP operational = lower oil usage even with colder OATs
- **LIGHT BLUE:** Boiler only = higher oil usage even with milder weather
- ● OAT (right axis)



Cooling Season Oil Use



DHW Delivery Consistency





CX/Design Takeaways

- 1 RCX on existing system
- 2 Air elimination is critical
- 3 Dialing in flow rate for most effective heat transfer
- 4 Include monitoring for failures

Integrated

Heat Pump Water Heaters



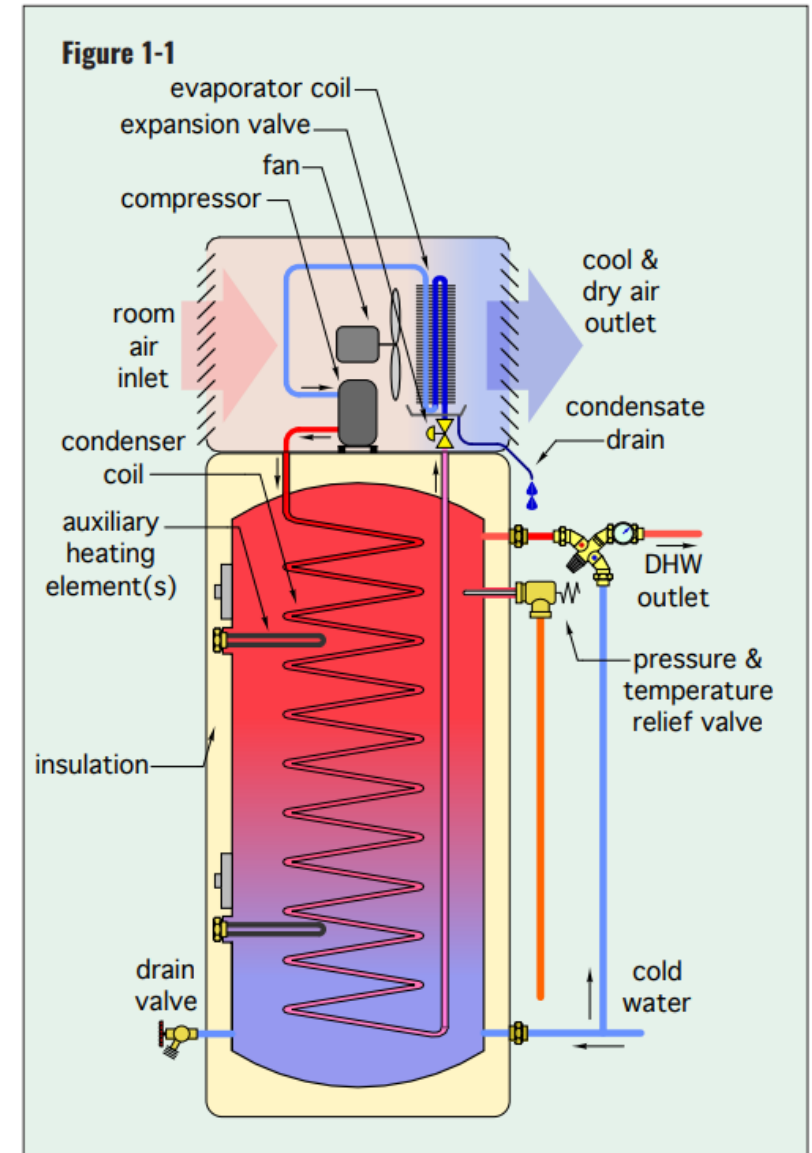
Kendal Crosslands, PA

- Senior housing community
- iHPWH within each dwelling unit
 - 1,200 to 1,600 ft²
- Intake and discharge air from iHPWH ducted to locations within dwelling unit
 - Designed to minimize discomfort and noise
- “Hybrid” iHPWHs



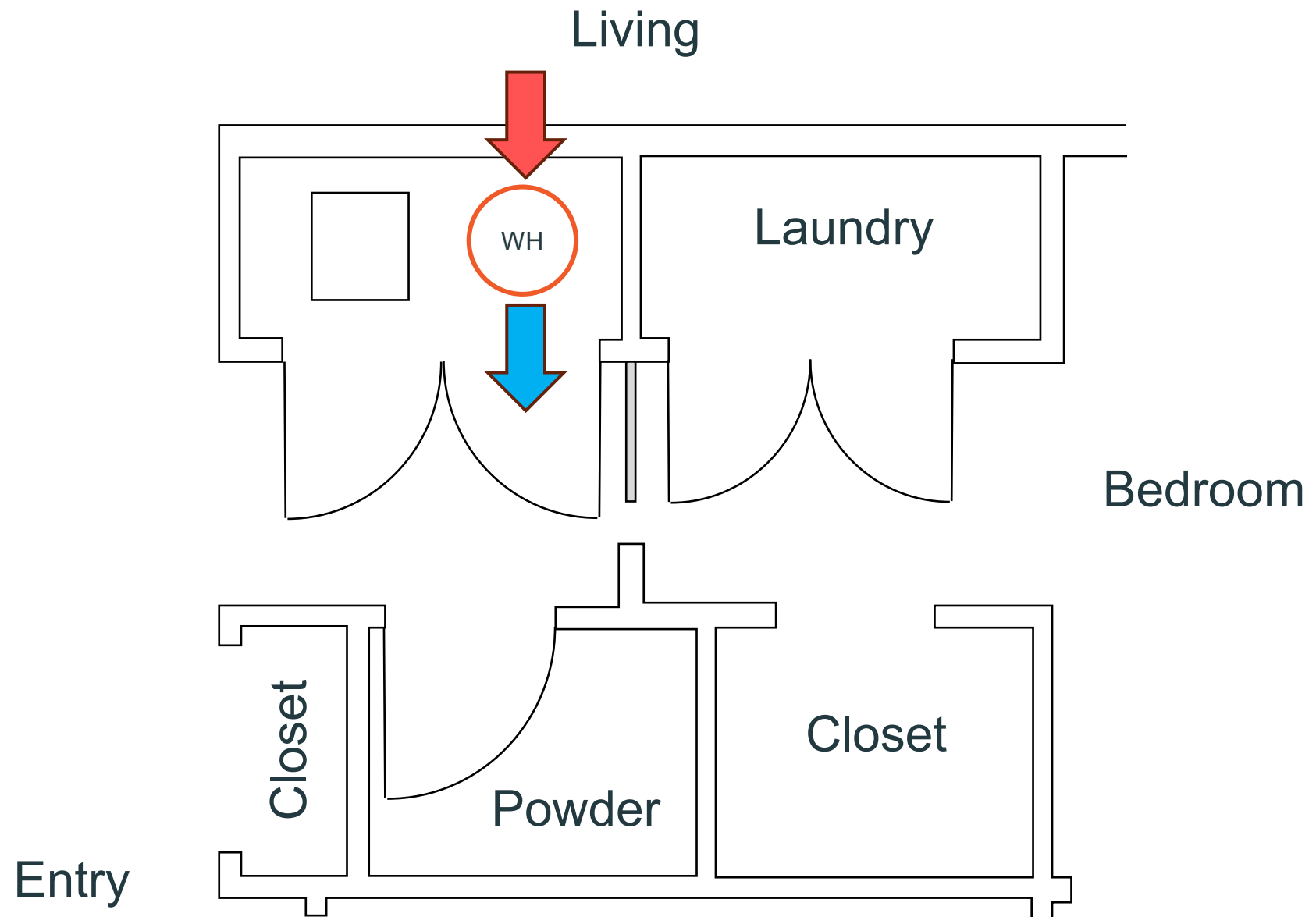
iHPWH Challenges

- Unitized WHs in closets
 - Limited airflow, reduced capacity & efficiency
- Noise
- Discharges cold air
 - Savings during cooling season
 - Costs during heating season



Average iHPWH Electricity







“Stealing” Heat

Free Cooling
(43 kWh)

Heating Penalty
116 kWh

Net HVAC Increase
73 kWh

HPWH Savings
vs. Resistance:

~500 kWh



Success!
but...

- 1 Not necessarily practical everywhere
- 2 Still room for improvement
- 3 Think about applications

What Else?



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