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CTPH

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or email PassiveHouseTrainingCT@icf.com

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Take energy efficiency to a new level

Residential New Construction Passive House Multi-family buildings with five units or more

PASSIVE HOUSE INCENTIVE STRUCTURE FOR MULTI-FAMILY (5 UNITS OR MORE)				
Incentive Timing	**Activity**	**Incentive Amount**	**Max Incentive (Per Unit)**	**Max Incentive (Per Project)**
Pre-Construction	Feasibility Study[1]	Up to 100% of Feasibility Study Costs	N/A	$5,000.00
	Energy Modeling[2]	75% of Energy Modeling Costs (Before 90% Design Drawings)	$500.00	$30,000.00
		50% of Energy Modeling Costs (90% Design/50% Construction)	$250.00	$15,000.00
Post Construction	Certification[3]	Up to 100% of Certification Costs	$1,500.00	$60,000.00

1. Feasibility Study will require documentation in the form of a Feasibility Study report and invoice from the Passive House Consultant
2. Incentives will only be awarded prior to 50% Construction Drawings for Passive House projects. No incentives will be granted after 50% Construction Drawing set.
3. Certification may be either through PHIUS, PHI, or EnerPHit certification offerings.

Next steps you can take...
Contact your Energy Efficiency Representative or

Go to EnergizeCT.com or call 1-877-WISE USE for more details.

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Heat Pump Water Heating Design and Installation Best Practices

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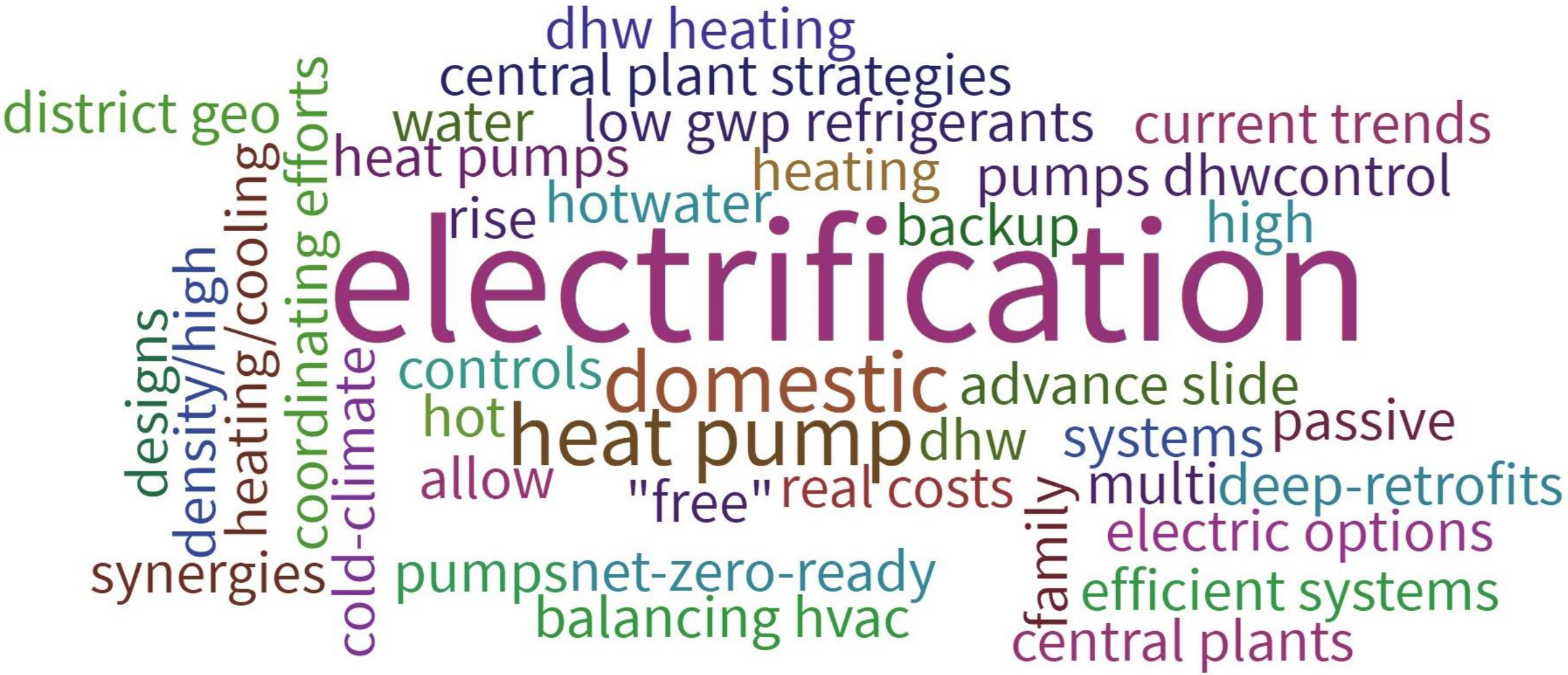
dhw heating
central plant strategies
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current trends
heat pumps
heating
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coordinating efforts
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hotwater
backup
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electrification
heating/cooling
density/high
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controls
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advance slide
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allow
"free"
real costs
multideep-retrofits
cold-climate
family
electric options
synergies
pumpsnet-zero-ready
efficient systems
balancing hvac
central plants

Learning Objectives

System Design: Sizing and Selection

Determine the Requirements

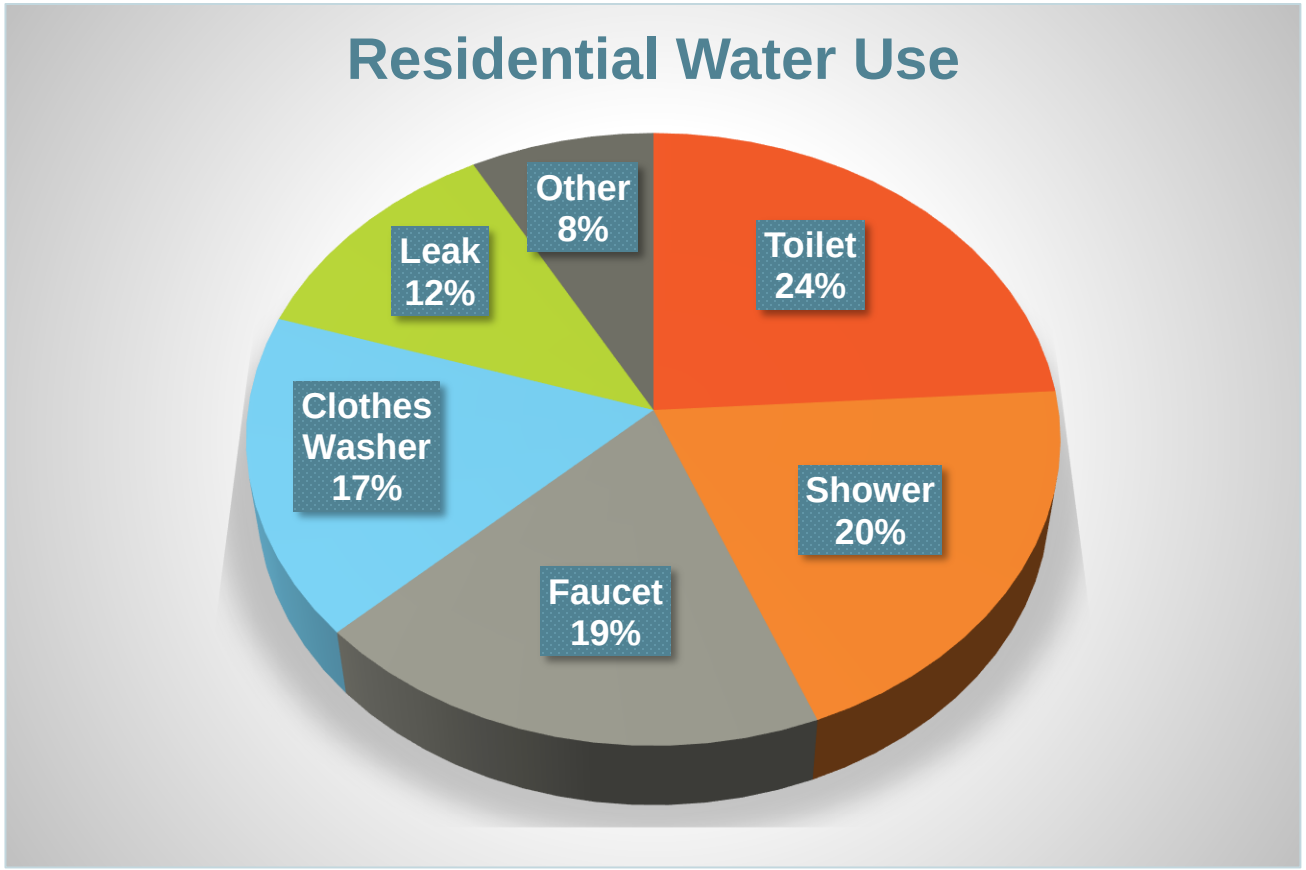
- As a first step, gather the information that is needed to determine what the most appropriate heat pump water heater option is for a particular home.

Customer Goals

- Cost Savings
- Environment

Flow Rates

- Lower flow rates to improve efficiency.
- SWA rec flow
  - 1.0 gpm bath sink
  - 1.5 shower and kitchen
- Complaint zone
  - 0.5 gpm in residences



Low Flow Fixtures

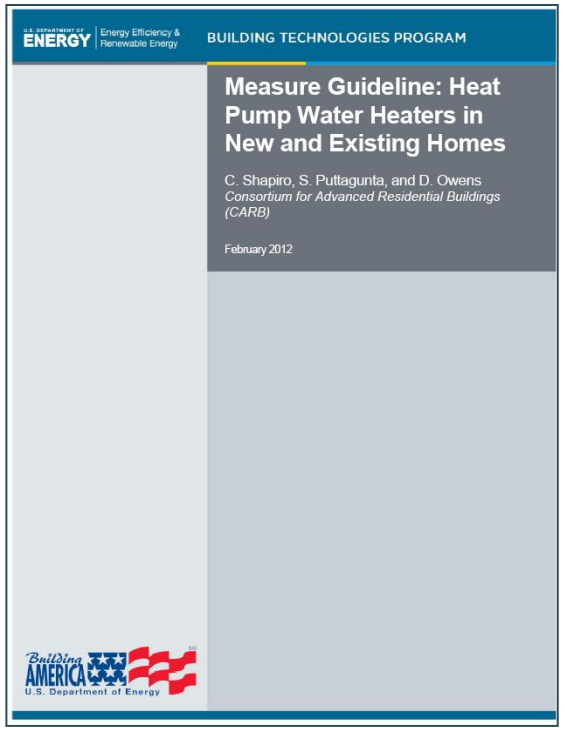
- Low-flow fixtures recommended
- Pressure-compensating options availab
- Tamper-proof options available

Niagara Earth 1.5 GPM showerhead

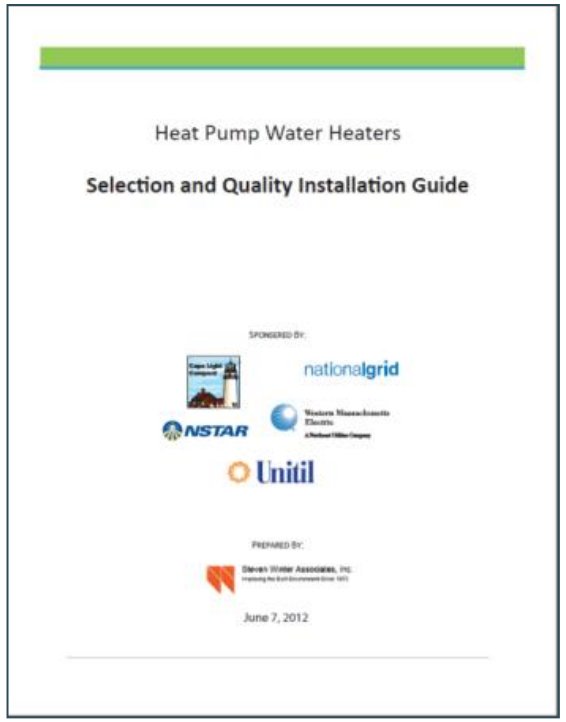
Niagara Stealth dual-flush 0.8 GPF toilet

1.0 GPM aerator

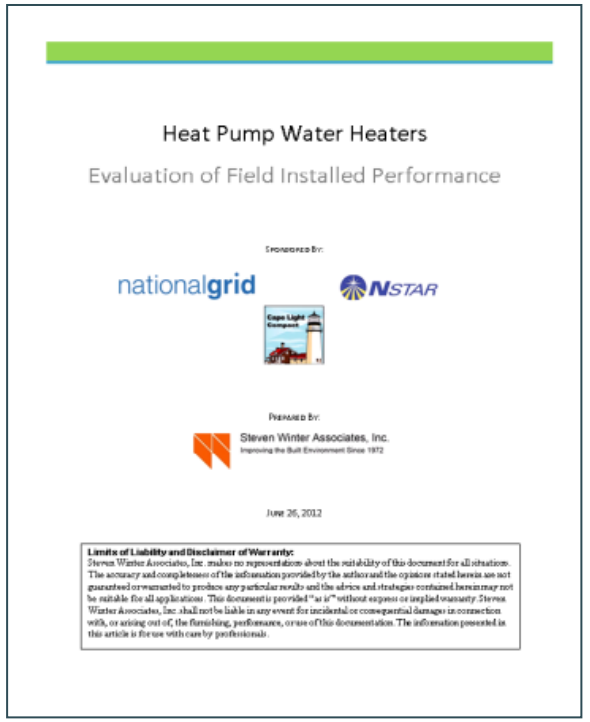
HPWH Resources



http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/measure_guide_hpwh.pdf

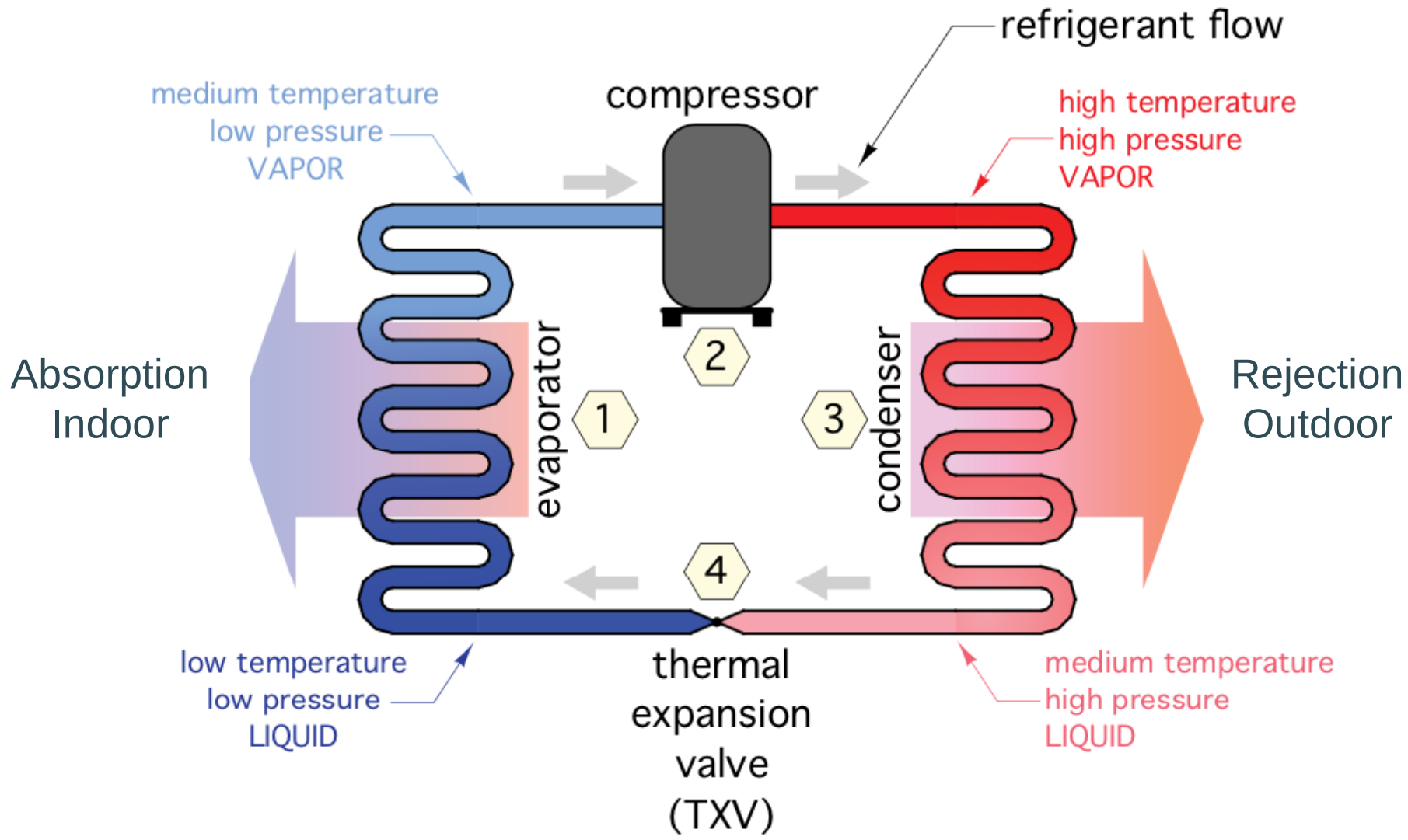


http://www.masssave.com/~/media/Files/Residential/Information-and-Edu-Docs/HPWH_QI_Guide.pdf



http://ma-eeac.org/wordpress/wp-content/uploads/Heat-Pump-Water-heaters-Evaluation-of-Field-INstalled-Performance.pdf

Vapor Compression Cycle

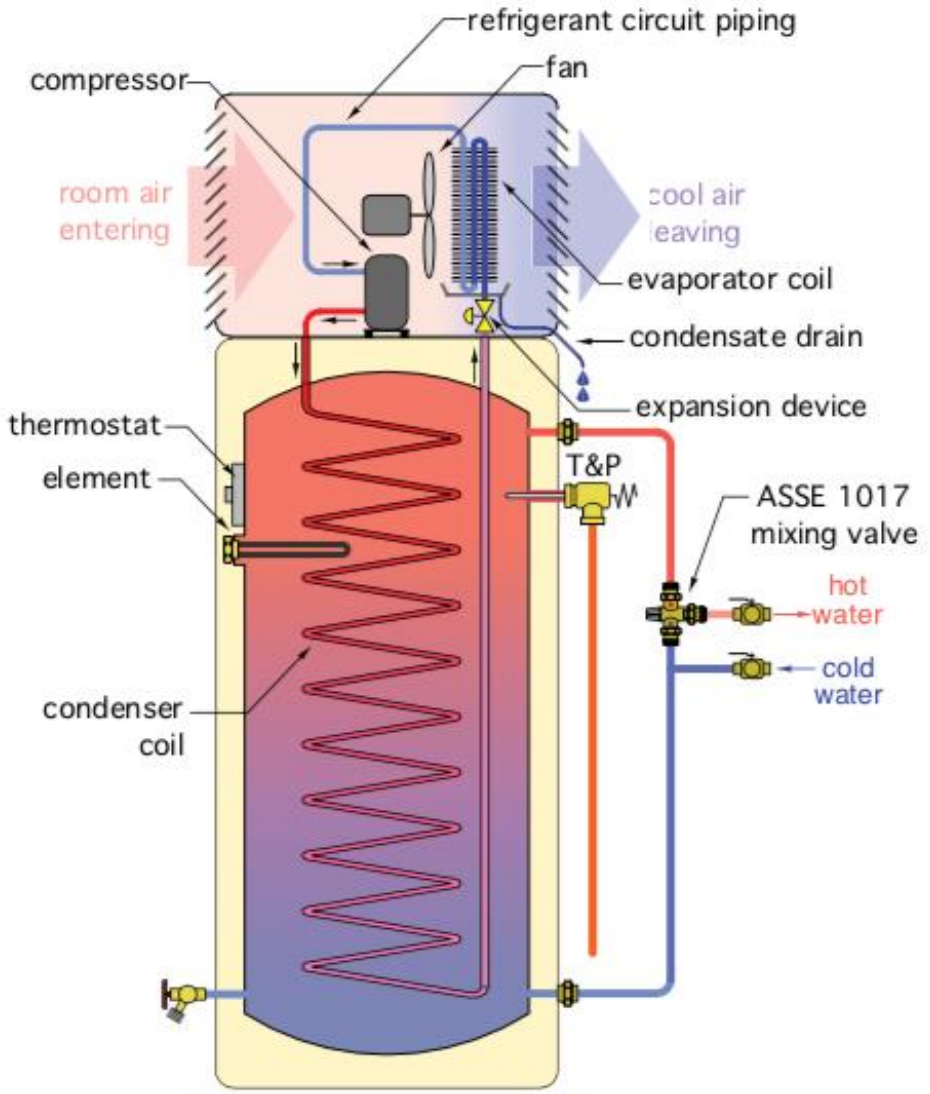


Source: Caleffi idronics

System Types Integrated Heat Pump Water Heater

System Types Integrated Heat Pump Water Heater

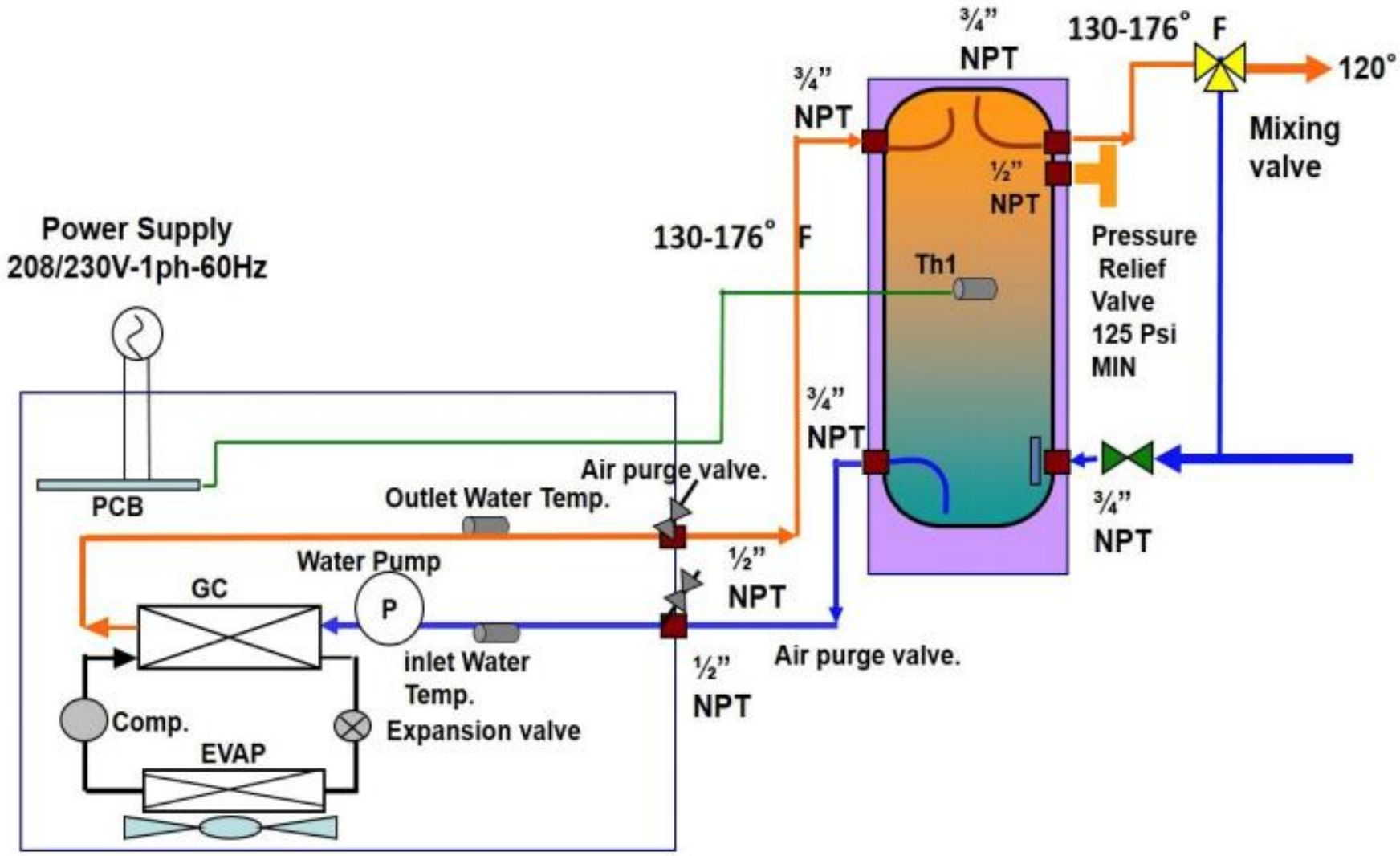
- Located indoors
- Use R-134a, R-410a
- Have electric resistive backup



System Types Split Heat Pump Water Heater

System Types Split Heat Pump Water Heater

- Located outdoors
- Use R-744 (CO2)
- No backup



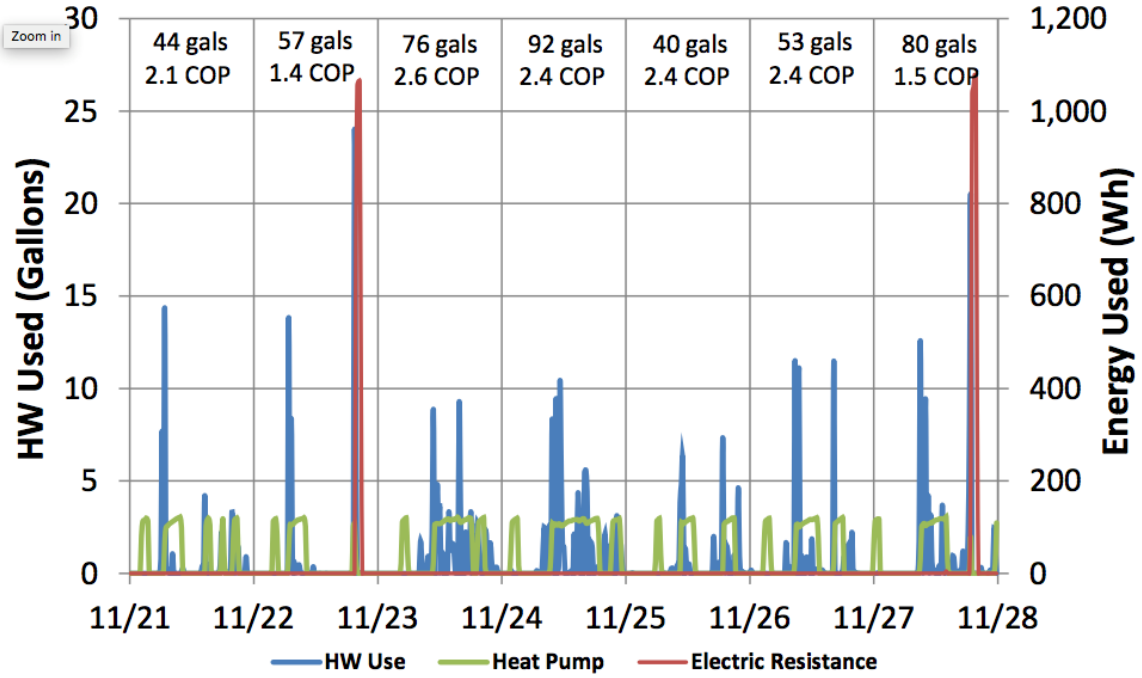
What Affects Performance? (Integrated)

- COP depends on:
  - Ambient Temperature
  - Ambient Relative Humidity
  - Mains Temperature
  - Water Draw Profile
    - Total Volume
    - Draw Pattern

Site	HPWH Model	Adults + Children	Water Heater Set Point Temp (°F)	Days Monitored	Avg. Daily Hot Water Use (gal)	Avg. Cold Water Temp. (°F)	Avg. Hot Water Temp. (°F)	% of Electricity Consumption from Electric Resistance[b]	Avg. Air Temp. (°F)[a]	Avg. Relative Humidity (%)[a]	Avg. Wet Bulb (°F)[a]	Total COP
1	A.O. Smith-80	2 + 1	120	454	44	54	119	0%	59	47%	49	2.1
2	Stiebel Eltron	5 + 0	140	438	73	57	136	8%	71	45%	58	2.6
3	GE	2 + 1	125	469	60	53	121	48%	64	38%	51	1.8
4	A.O. Smith-60	3 + 0	120	445	45	53	119	11%	63	56%	54	2.1
5	GE	2 + 0	129	460	64	52	127	78%	53	62%	46	1
6	GE	2 + 0	122	475	35	53	118	5%	62	55%	53	2.1
7	GE	2 + 0	125	450	23	58	123	11%	66	49%	55	1.8
8	GE	2 + 1	125	430	33	55	122	15%	66	44%	54	2.1
9	GE	2 + 2	120	468	41	55	122	22%	62	48%	52	2
10	Stiebel Eltron	2 + 0	140	424	41	57	138	2%	68	55%	58	2
11	GE	2 + 3	140	459	72	58	136	58%	76	34%	58	1.5
12	GE	2 + 1	130	492	42	56	128	29%	71	46%	58	1.9
13	GE	2 + 0	130	388	32	59	126	15%	70	57%	60	1.4
14	GE	2 + 0	120	433	32	53	119	15%	62	52%	52	1.9

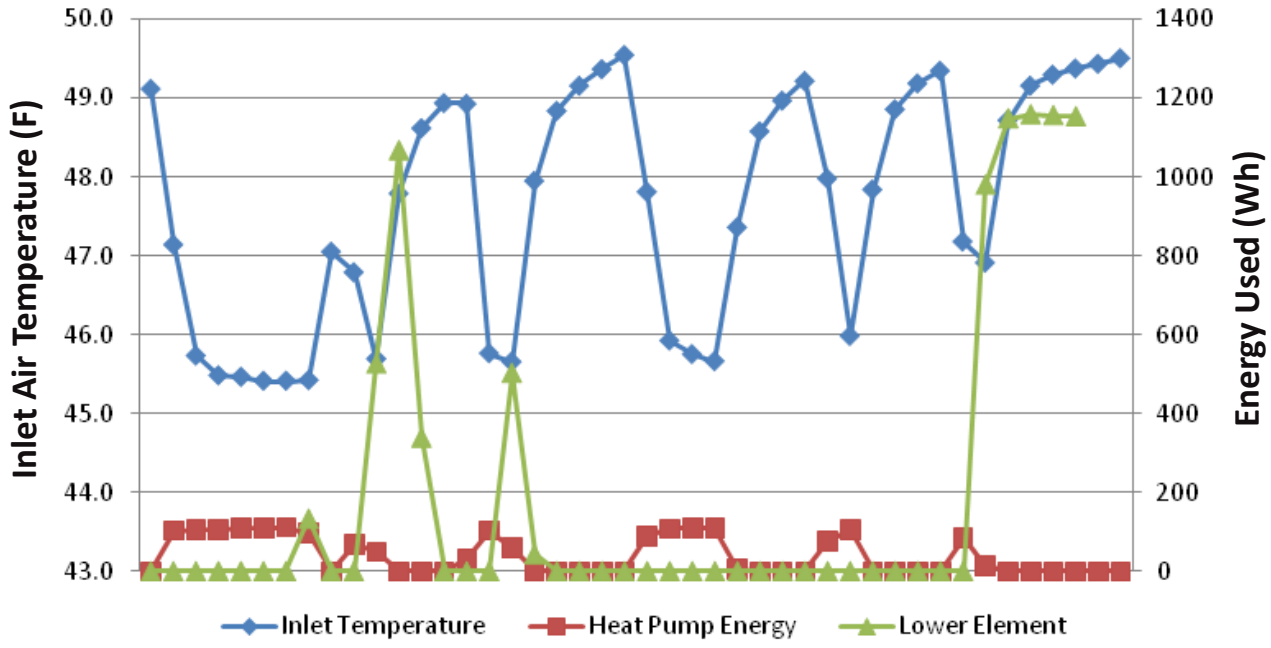
HPWH Monitoring

Hot Water Use



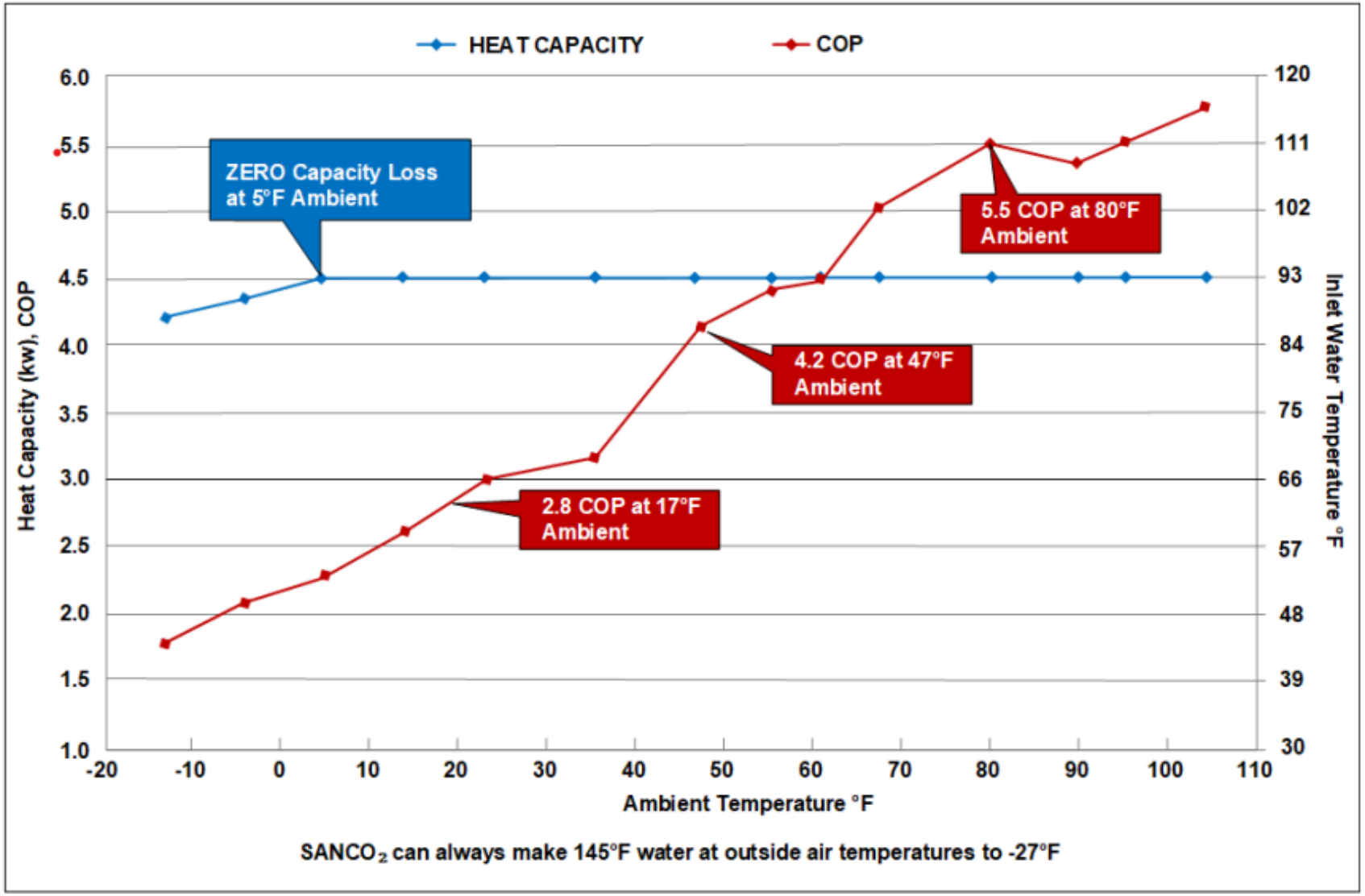
Site 3: COP = 1.8; Concentrated Draws

Ambient Temperature



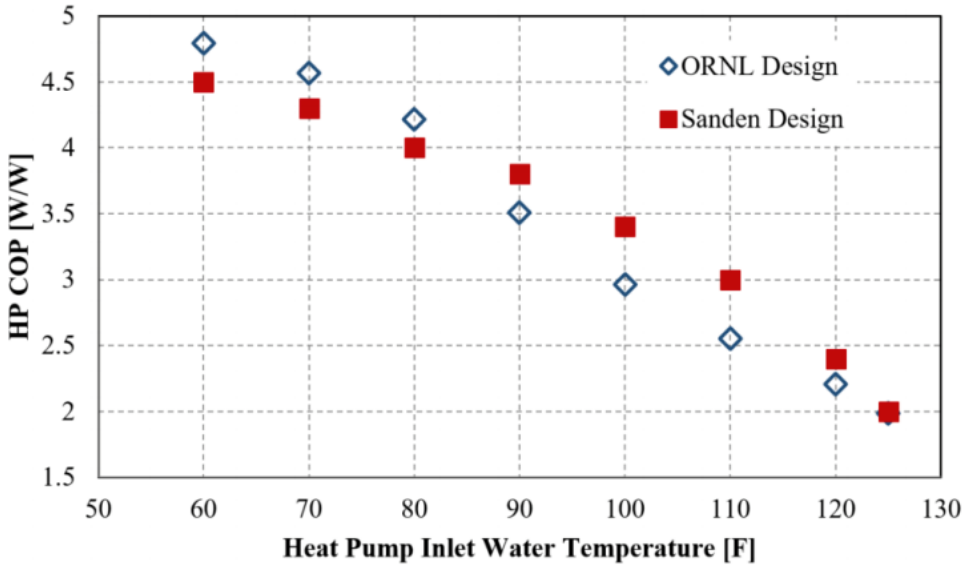
Site 5: COP = 0.77; Average Ambient Temperature = 48°F

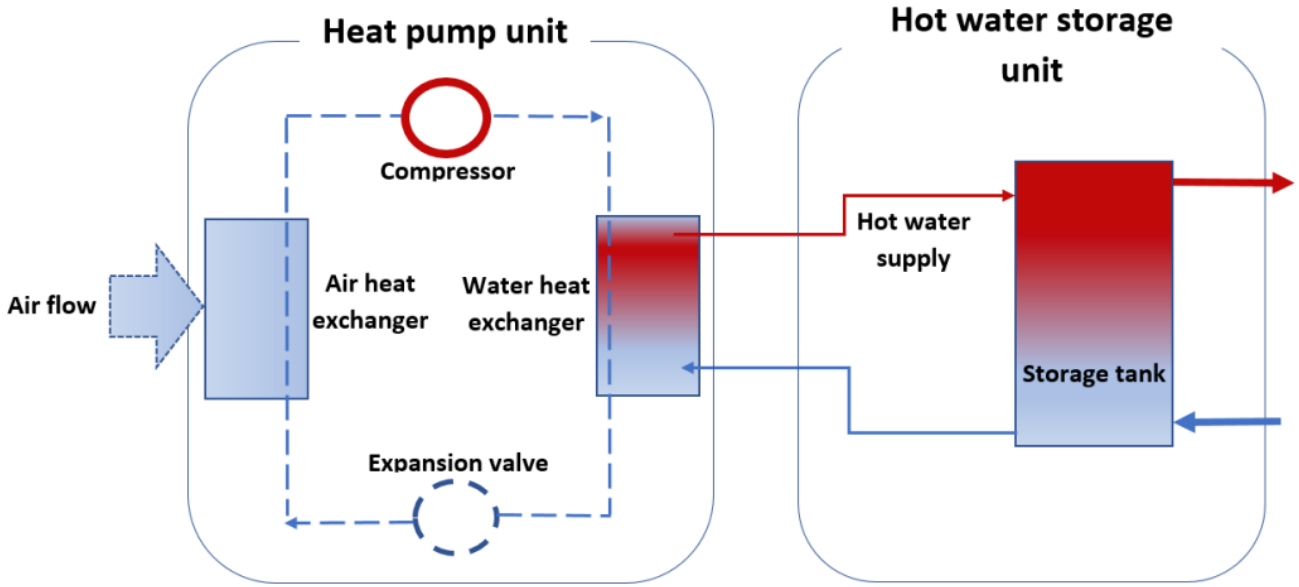
Split Heat Pump Water Heaters



Split Heat Pump Water Heaters

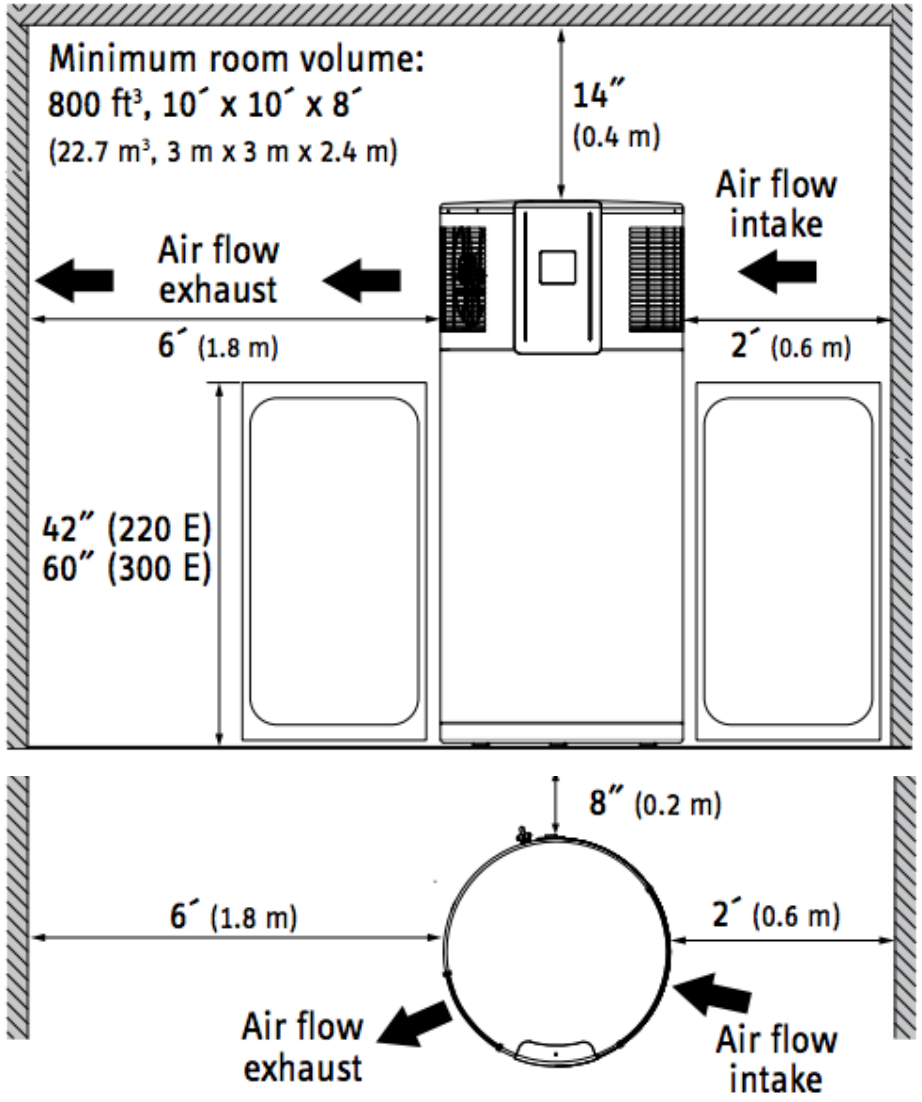
- Considerations
  - CO2 refrigerant cycles operate at far higher pressure than standard vapor compression cycle equipment.
  - Inlet water temperature has an impact on efficiency.





Installation Considerations

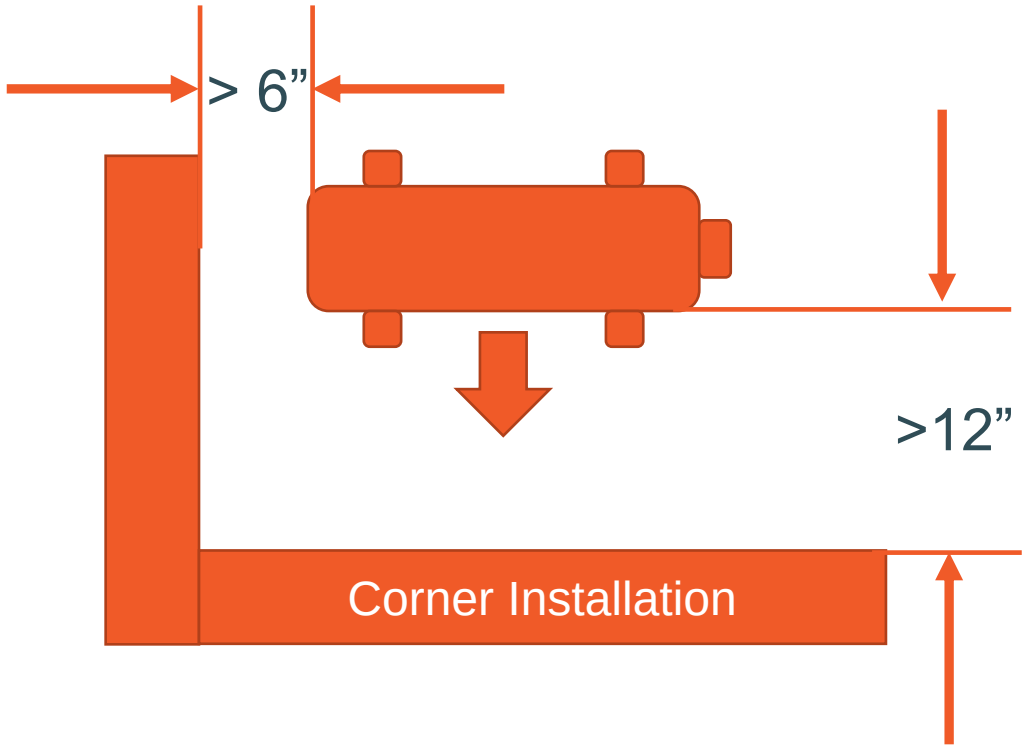
Space Requirements

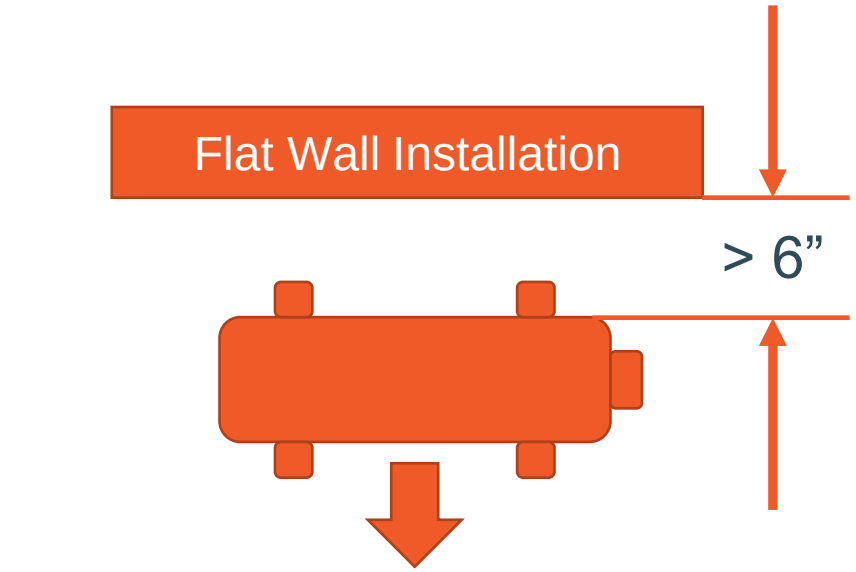


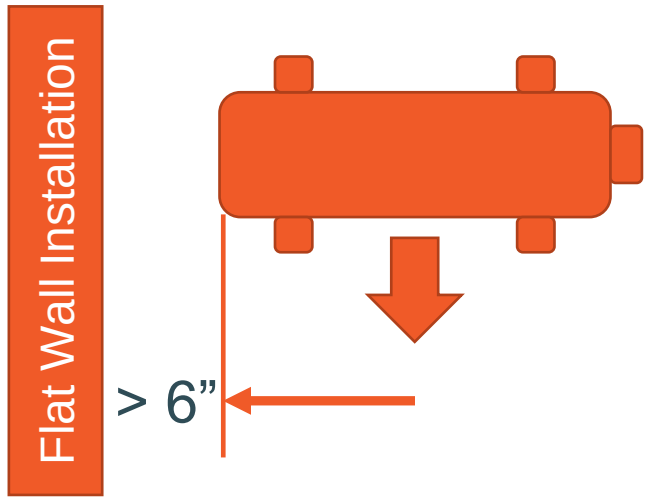
Space Requirements

- Properly site outdoor unit
  - Be aware of max horizontal and vertical distance to indoor tank
- Raise the Heat Pump unit 4”-6” from the ground – this will allow defrost condensate to drain
  - In areas with high snowfall, the unit must be installed above the anticipated snowline.

Space Requirements







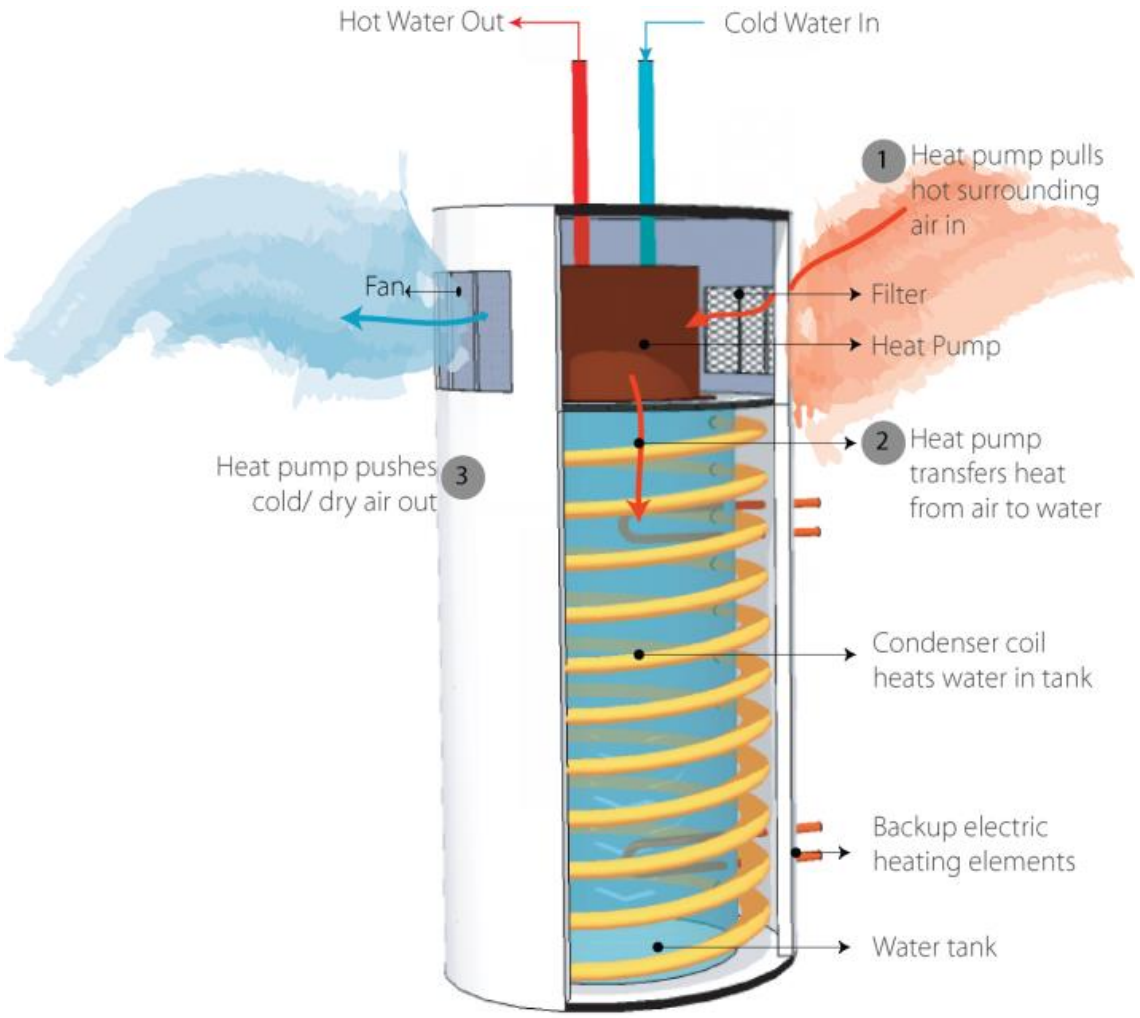
Noise Considerations

~ 45 dBa

~ 55 dBa

~ 70 dBa

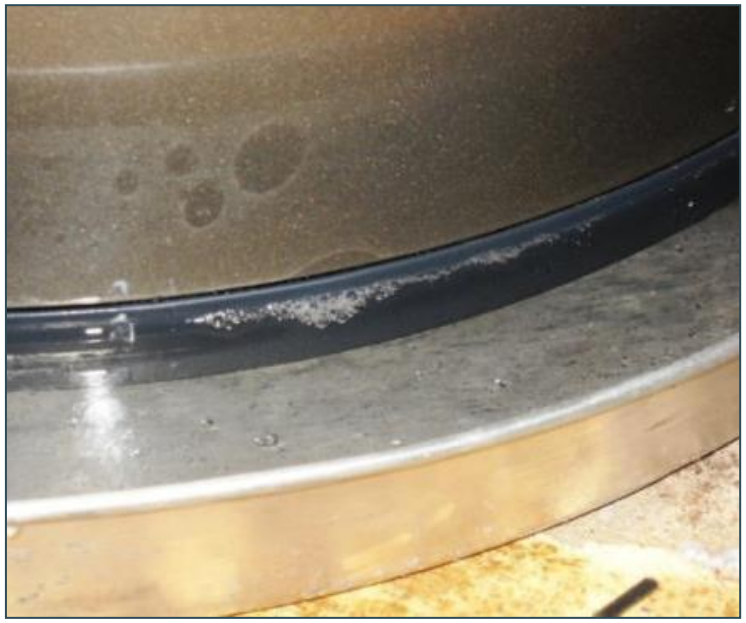
Comfort Considerations



Managing Condensate

- Install condensate pump, if needed
- Place on blocks
- Install drain pan

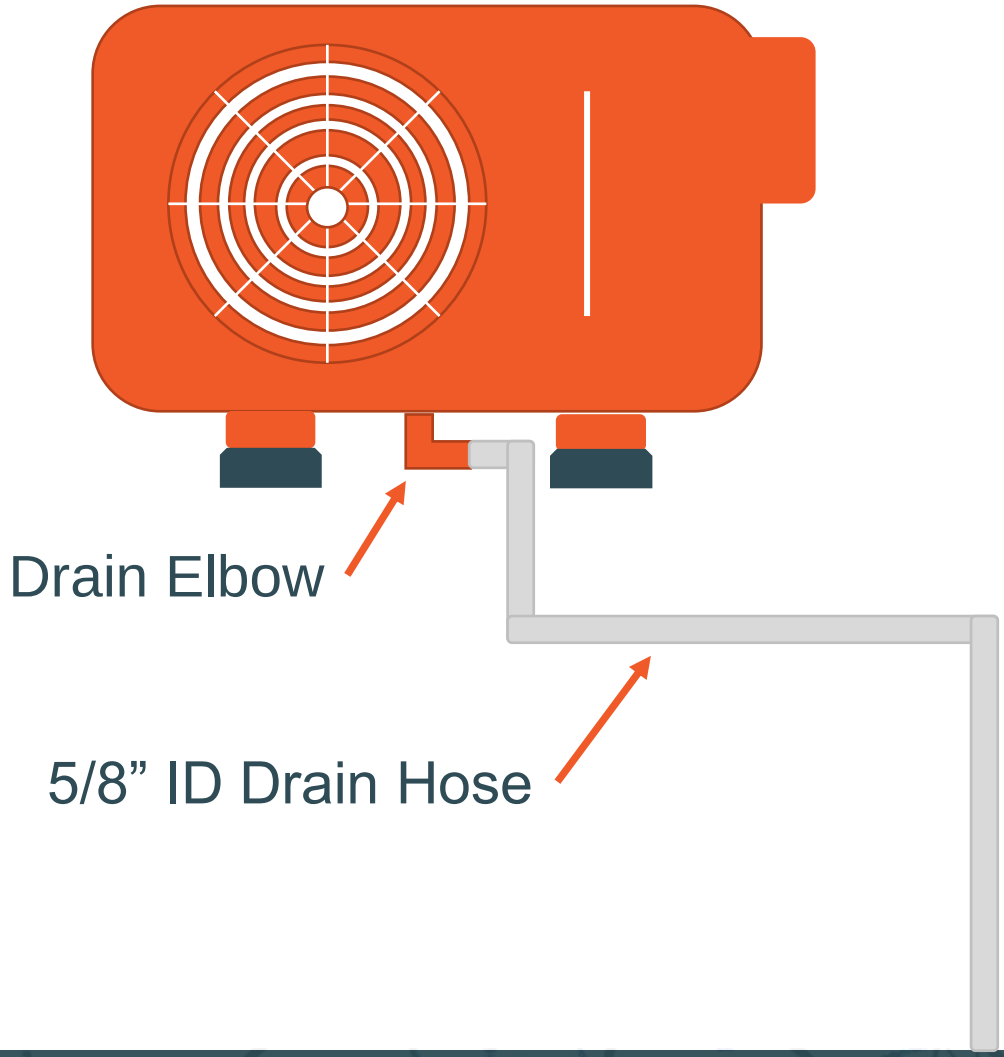
Proper Installation



HPWH Sitting in Water

Managing Condensate

- Outdoor unit will create condensate during normal operation
- Its recommended not to pipe condensate in areas with temperatures below 23F
- Need to pipe condensate away from the unit and ensure that is does not spill on walkways or other areas where it can freeze.
- Drain pan heaters are not necessary in most environments unless temperatures are below 10F



Installation Guidance

- Piping located outdoor shall be minimized as much as possible
- Piping insulation exposed to weather shall be protected from damage
- A continuous metal jacket shielding shall also be installed to protect the insulation from exposure to solar radiation, which can cause degradation of the material.

Installation Guidance

- Heat trace should be installed on all exterior piping below the insulation and in direct contact with the pipe wall.
- The heat trace shall be self regulating

Installation Guidance

- Once the plumbing connections are made, seal the openings with an approved sealant to prevent air movement and pest intrusion.
- A cover can be installed to protect the piping and help improve aesthetics

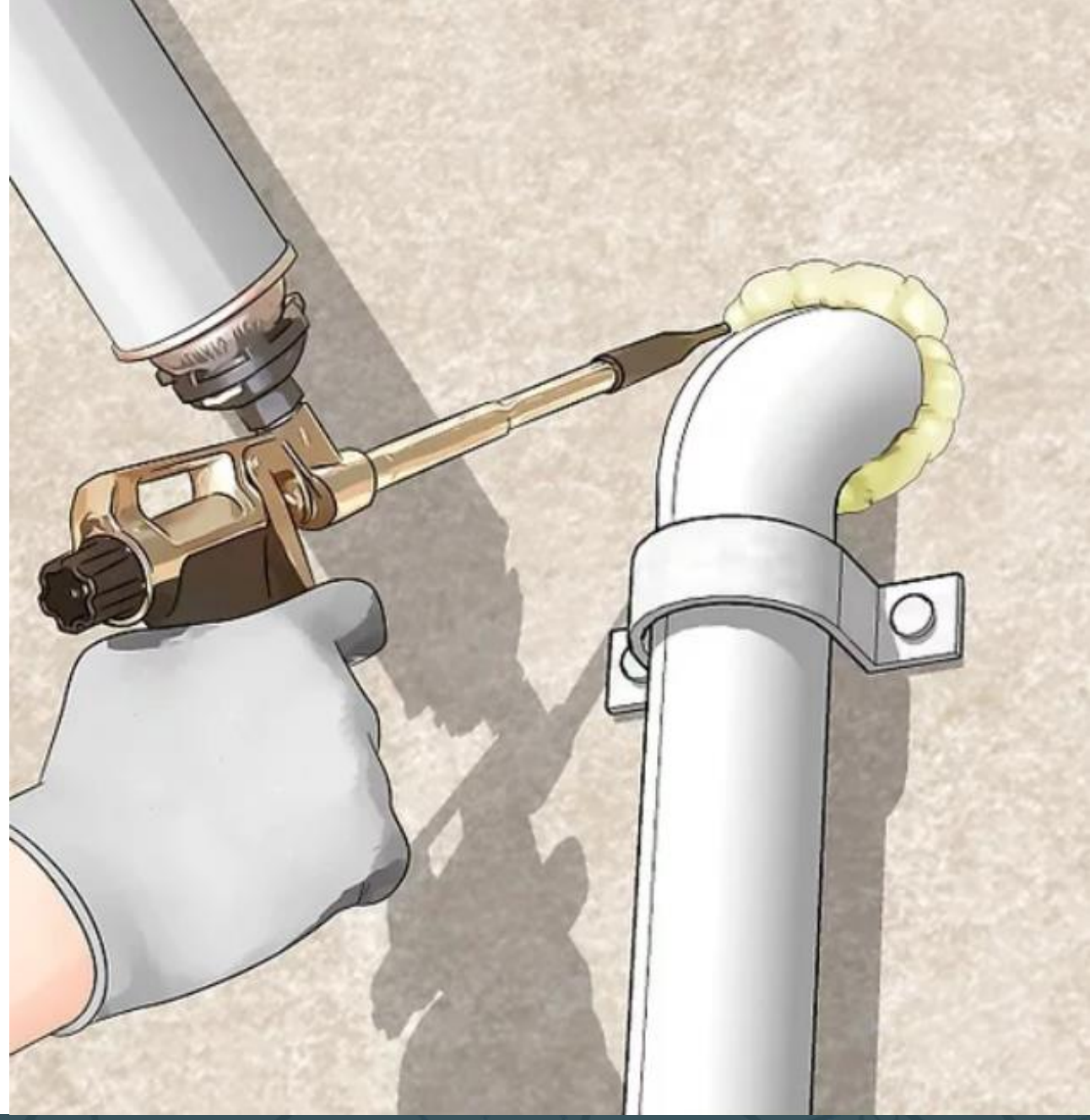


Image Credit: wikiHow

Installation Guidance

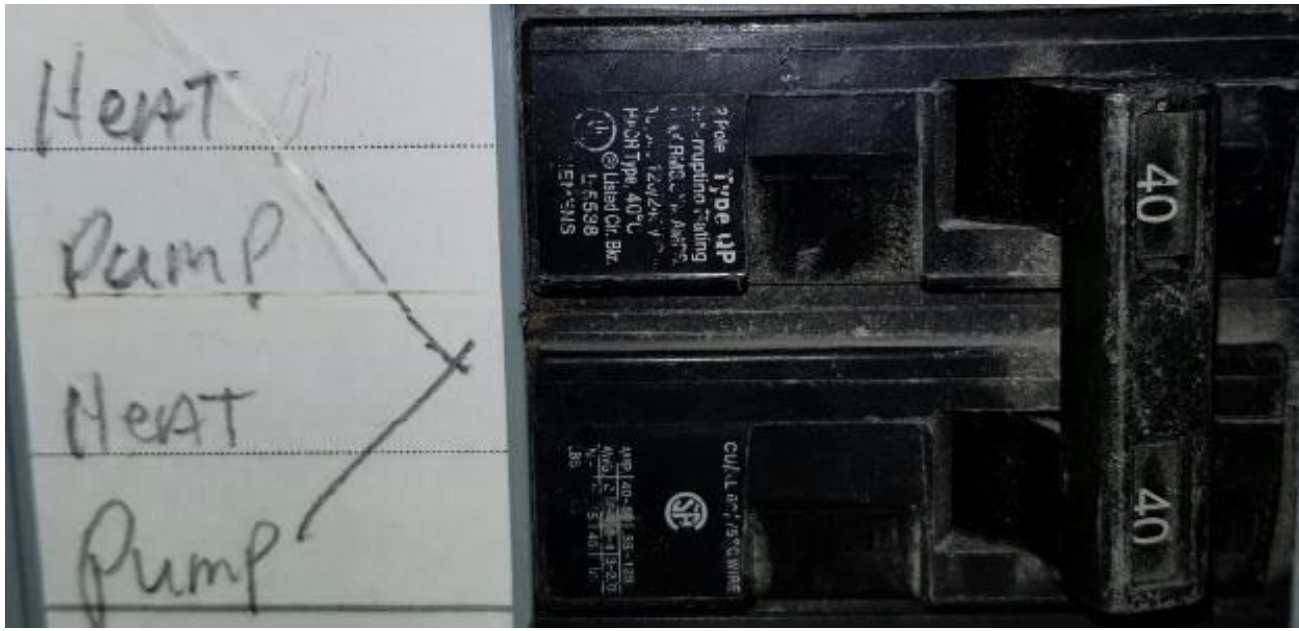
- Insulate hot water piping to the requirements in accordance with local code.

Installation Guidance

- Heat traps installed on the cold water inlet and hot water outlet, help prevent unwanted convection causing heated water to flow out of the tank.

Wiring

- Ensure that the overcurrent protection device is labeled, and the correct size based on the manufacture's requirements
- Ensure the conductors are the correct size and compatible with the terminals.



Wiring

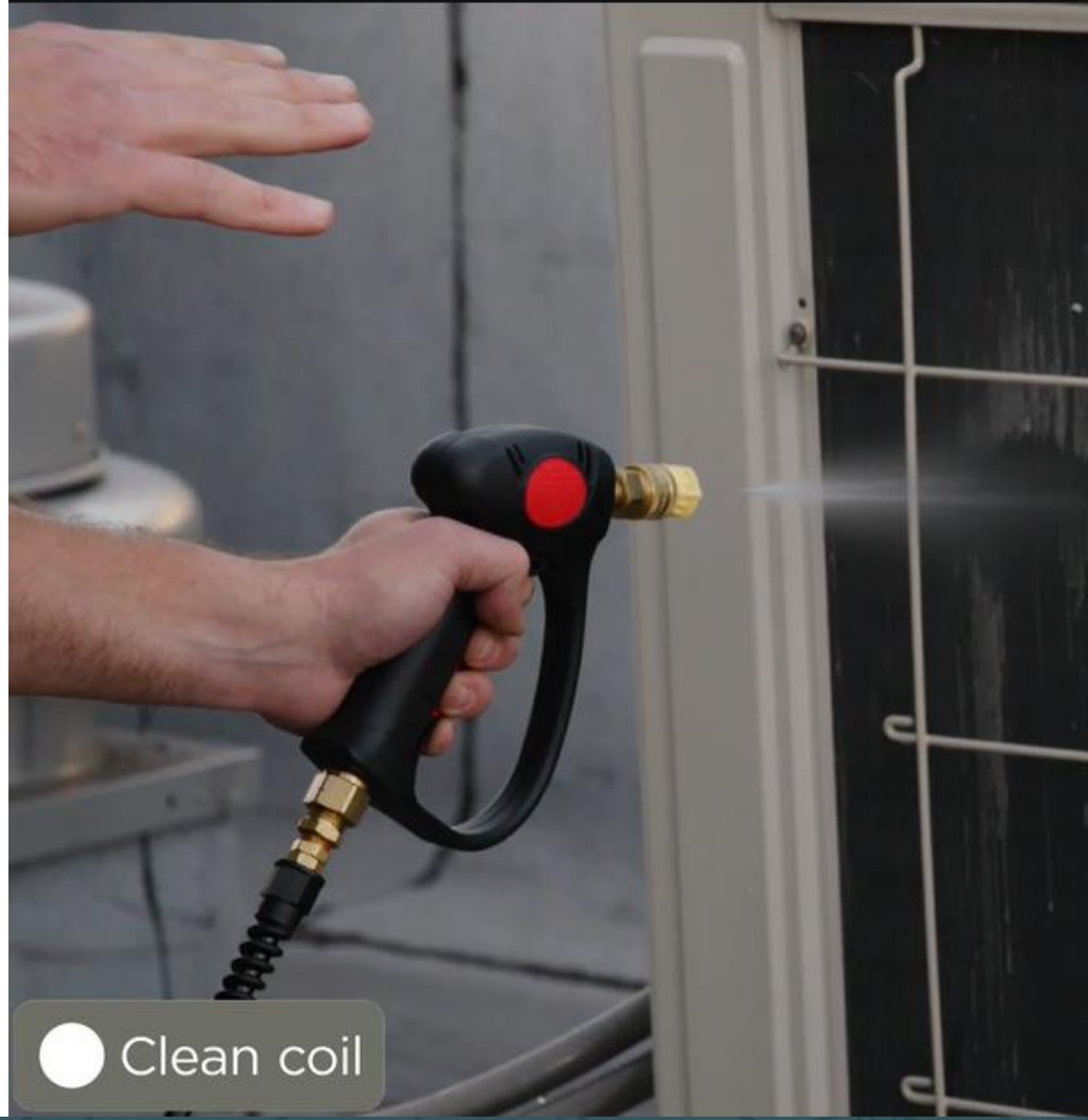
- A disconnect switch needs to be installed at the outdoor unit to allow for service, and the ability to deenergize the unit in the event of an issue.
- The disconnect switch should be located within arms reach of the service panel of the unit.

Maintenance

- Some filters in HPWHs should be regularly cleaned.
- Educate homeowners.

Maintenance

- Outdoor coils require cleaning on an annual basis
- Use a garden hose or coil cleaning machine and avoid high pressure , since you can run the risk of bending the fins.



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