

U.S. HEAT PUMP SUMMIT

Air-to-Water Heat Pumps (AWHPs)

Uses, Advantages, and Design Essentials

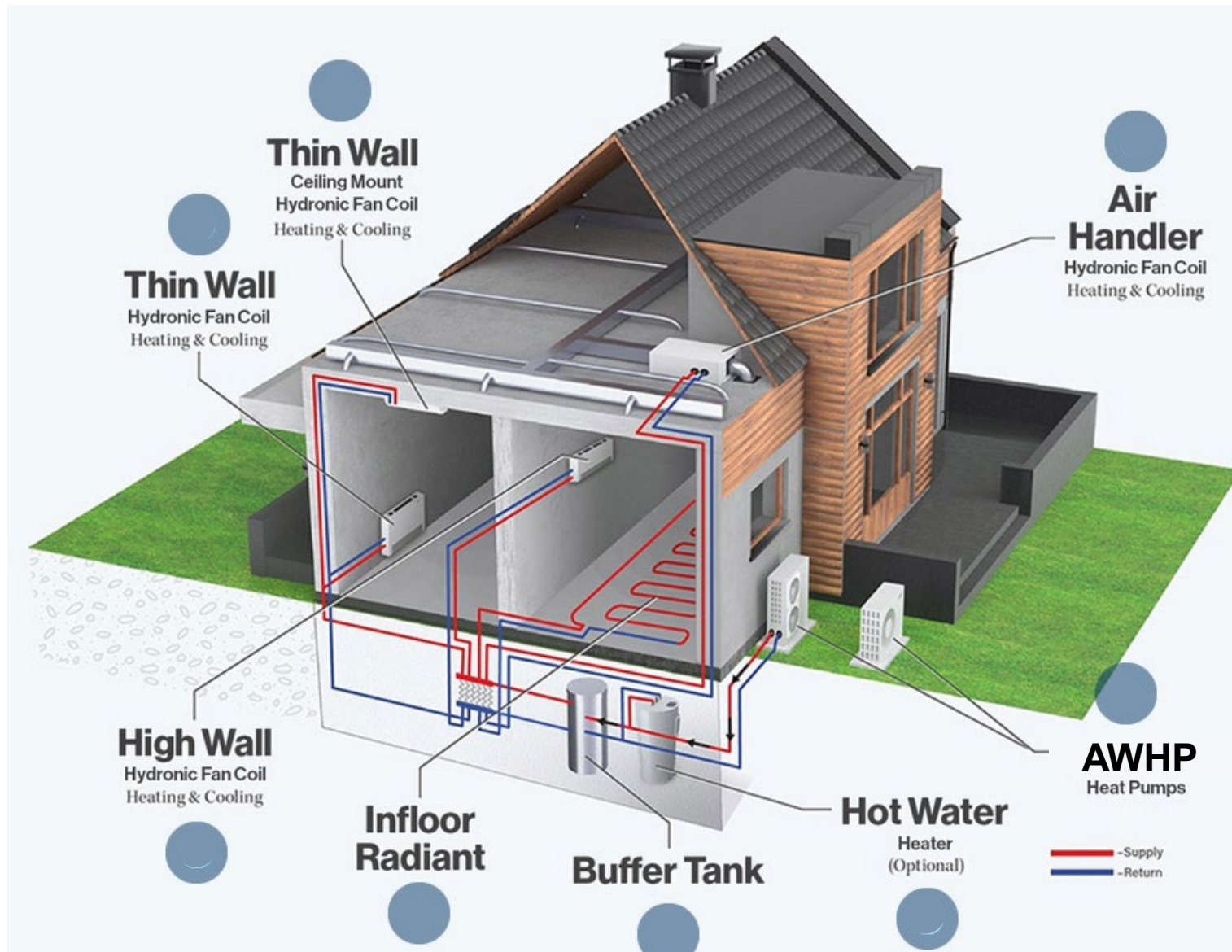
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September 15, 2026 · Worcester, MA



Air-To-Water Heat Pumps (AWHP) – Example System Overview



How Are Air-to-Water Heat Pumps (AWHPs) Used?

Suitable for Any Combination of:

- Cooling
- Heating
- Domestic Hot Water (DHW)



AWHP Monobloc Outdoor Unit

Install With Any Combination of:

- Radiant System (Heating and/or Cooling)
- Ductless Room Fan Coil Units (Up to 16 or more per system)
(High-Wall, Ultra Thin Low Wall, Floor, Ceiling Cassette)
- Ducted Air Handlers (vertical, horizontal, low-static mini-duct, etc.)
- Concealed Ceiling Fan Coil Units
- Indirect Water Heater Tank (DHW)
- Solar Thermal Integration
- PV Solar Integration
- Energy Storage / Load Shifting
- Pool Heating

How Does AWHP Work & What's Different

THE OUTDOOR UNIT

The monobloc outdoor unit has the same basic components as a DX heat pump outdoor unit, with a few important additions. It includes the compressor, outdoor coil/fan, expansion & reversing valves, and all of the other refrigerant components. The main additions are the “indoor side coil” which is a plate heat exchanger, a variable speed pump, a water flow meter, a water pressure sensor, etc. A monobloc uses refrigerant only in the outdoor unit.

HEAT TRANSFER

All heating and cooling done by the compressor unit is transferred by the brazed plate heat exchanger into flexible PEX water lines. No refrigerant enters the building with an AWHP monobloc system.

DISTRIBUTION

The PEX lines (or other hydronic piping) connect to the indoor equipment, usually to a buffer tank.

THE BUFFER TANK

The buffer tank supplies all of the loads. In the summer it's a chilled water system. In the winter it's a compressor-powered boiler (a compressor-driven hydronic thermal source). Connected to the buffer tank may be any or all of AHUs, FCUs, radiant, etc.

Another Big & Important Difference

17.4%

The CAGR (Compound Annual Growth Rate) of the Air-to-Water Heat Pump segment in the USA market is almost double the CAGR of the general USA heat pump segment (9.5%).

AWHP is still a small niche, but it's growing at a much faster rate. Get ready.

Source: Averaged data from Mordor, Global Market Insights, Market Data Forecasts, Grandview, and IMARC.

Who Buys Air-to-Water Heat Pumps, and Why?

- Users concerned with energy efficiency/energy cost.
- Customers who want a system that can efficiently handle radiant heating without needing a second system for cooling.
- People who want to keep all of the refrigerant outside of the building envelope.
- Users who want an ultra-efficient system that can produce *real* high COP for domestic water heating.
- Eco-minded customers looking for lower carbon & electrification.
- Builders & owners of high efficiency buildings.
- Early adopters & tech-savvy customers.
- High-end & green homeowners/builders/remodelers who desire a premium product.
- Customers who drive electric or hybrid vehicles 😊
- Builders, remodelers, and their customers who want to “future-proof” their homes so the next generation of systems can plug right in (anticipating R290 systems). More on this to follow...

Other AWHP use cases

Off-grid PV users who need to conserve peak power draw and energy consumption · Combining w/ PV or Solar Water Heating · Load Shifting / Energy Storage · Pool Heating · Commercial Cascade Design · Easily expandable systems for potential future additions

Radiant: One Obvious Driver of AWHP Adoption

Radiant heating (and cooling) delivers a unique combination of benefits:

- Direct comfort that works with how the body actually exchanges heat. At least 5 °F difference between sensible temperature and apparent temperature (what it “feels like”).
- More stable temperatures.
- Cleaner air through low velocity.
- Higher efficiency & capacity from the system.
- Effective cooling potential with proper humidity/dew point control.
- Silent operation.
- Greater design flexibility.
- Individual zoning.

Surveys consistently show that people who live with radiant systems are almost never willing to give them up. People who have radiant often say that any future home they consider must have radiant.

Why Radiant Helps Drive Adoption

- Much Higher Efficiency, Lower Energy Costs.
- More Comfortable, Stable Temperature.
- Cleaner Indoor Air.
- Supports Higher ACH Without Comfort Disruption.
- Radiant Cooling Options Consolidate Savings, IF / When Applicable.



Future-Proofing a Home

The residential refrigerant roadmap: R12 to R22, to R410A, to A2Ls (partly flammable refrigerants) such as R32 and R454B. R744 (CO₂) is not viable.

Next up, R290.

WHY R290?

R290 has very low GWP (Global Warming Potential of 3), higher COP, lower refrigerant cost, no PFAS, no fluorinated refrigerant, no bad chemicals, and it's totally natural. It's a refrigerant already widely used in Europe and the rest of the world.

WHEN

In the USA, R290 is in our future - UL for AWHP monoblocs is expected in 2028 with broad U.S. code adoption in the 2030 cycle. People already want it. We are asked about it frequently.

BUT IT CANNOT GO INDOORS

R290 is propane. It's highly flammable. It's heavier than air, can accumulate in a basement, or even inside a wall.

R290 cannot be allowed indoors in a quantity large enough for a whole home heating/cooling system. In a heat pump, R290 is used at design pressure up to 435 psi, not <5 psi like a propane stove or water heater. And, R290 does not have the bad smell of propane that lets you know when there's a problem, as ethyl mercaptan cannot be added to create the odor due to chemical incompatibility with POE/PVE lubricants and expansion valves.

The only way to safely use R290 is with a Monobloc Air-to-Water Heat Pump, where there is only a small amount used, **and where all of the refrigerant stays outside.**

If you are building or remodeling a home, now is the time to convert to monobloc hydronics. You may eventually need to do it, and it will cost a lot less to do it now.

AWHP vs. Geothermal

Both are hydronic. The difference is what has to go in the ground.

	AWHP	Geothermal
Ground work	None	Bore field or trenching — 40–70% of project cost
Installed cost	Baseline	\$3,000–\$8,000 per ton more
Payback on the extra cost vs. AWHP	—	20 Years or Longer

WHAT THE PROJECT INVOLVES

- Depth — 150–300 ft of bore per ton; three tons is 450–900 ft of hole
- Rock — shallow bedrock can double the drilling cost, discovered mid-job
- Land — horizontal loops need 1,000–3,000 sq ft per ton (DOE)
- Access, well permits, and putting the yard back

None of this scope exists on an air-to-water project.

And in 2026 it got worse

Section 25D — the 30% uncapped federal credit for geothermal — was terminated for systems after 31 December 2025 (One Big Beautiful Bill Act, P.L. 119-21).

No grandfather provision. A 2026 geothermal install carries its full cost.

What the extra money buys

Published geothermal paybacks of 8–12 years are measured against a furnace and AC. Against an efficient AWHP system, Zone 5A illustrative modeling puts the annual saving between \$270–\$510 on a 3-ton house — on \$9,000 to \$24,000 of extra installed cost.

Geothermal still wins at design day conditions. At 5 °F outdoor air a ground loop is still delivering 35–40 °F fluid, so it holds its capacity while an air-source machine derates.

Geothermal is great, and highly efficient. But its payback math was built against a furnace. Compared against an efficient AWHP system there is very little left to save - and this year, no 30% credit to help.

AWHP vs. DX: Every Watt Counts

DX is what most people want. It's very popular, and lower cost. That doesn't mean it's the best.

1. LOWER CONDENSING TEMPERATURE

To deliver 100–110°F supply air, a DX coil condenses at 120–140°F — higher with restricted ducts or a dirty coil. An AWHP unit condensing to water typically runs 96–125°F.

2. WATER TRANSPORT IS NEARLY FREE

Three tons of heat is 7.2 - 8 GPM at 10°F ΔT — a 47 W load-side pump. Counting it takes the radiant system from a rated 5.36 down to 5.24. DX fan energy is already inside HSPF and is not claimed here.

3. LOWER BUILDING LOAD

Radiant holds equal comfort at ~5°F lower air temperature (operative temperature, ASHRAE 55). Heat loss tracks ΔT , so the house needs ~14% less heat. That is the gap between the last two columns at right.

4. DYNAMIC OUTDOOR RESET

DX supply air or coil temperature is not a control point. AWHP can dynamically drop its supply water temperature target as it warms outside, so lift falls twice — warmer source and cooler supply. DX gets only half of that.

AWHP Effective Seasonal COP — Fans and Pumps Included

5.24

4.62

Radiant, 95°F water · 5.36 less 47 W Fan coils, 104°F water · 4.88 less 122 W

Factors 1, 2 and 4 are in the first two AWHP columns; factor 3 adds the third.

DX equipment	COP	Fan coils	Radiant	Radiant ALR
HSPF 9.5 mid duct	2.78	40%	47%	54%
HSPF 10.5 ducted	3.08	33%	41%	49%
HSPF 11.8 ductless	3.46	25%	34%	43%
HSPF 13.0 best	3.81	18%	27%	37%

Legacy HSPF used for comparative accuracy. Same machine, two supply temperatures: EN 14825 rates AWHP up to 5.36 at 95°F water and 3.88 at 131°F. Interpolating to 104°F and correcting for curvature gives 4.88. The monobloc's internal circulator is already inside SCOP; only the 47 W load-side pump and the DC fan coil motors (25 W/ton) are added. HSPF already includes the DX indoor fan, so DX adds nothing. Last column ALR (Assumed Load Reduction) applies a 5°F ΔT comfort load reduction.

Calculations: AWHP added our indoor fans and pumps. DX didn't have to add theirs - they're already inside HSPF. Fan coil to fan coil, at the end of the day AWHP uses 18-40% less energy. Radiant at the same thermostat setting, **AWHP 27-47% less energy.** Let radiant do what it does — equal comfort at 5°F lower air temperature — and AWHP reaches **37-54% less energy.**

AWHP Load Side Options

All fan coils & air handlers are available with DC / ECM motors and are connected by PEX water lines.



High-Wall Fan Coil



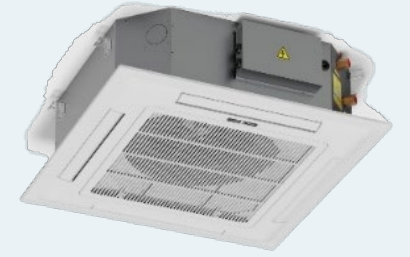
Thin Ceiling Suspended



Thin Low-Wall Fan Coil



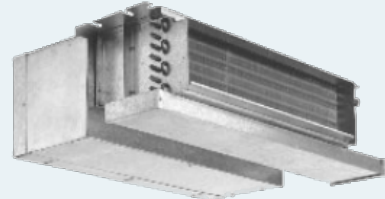
Thin Floor Console



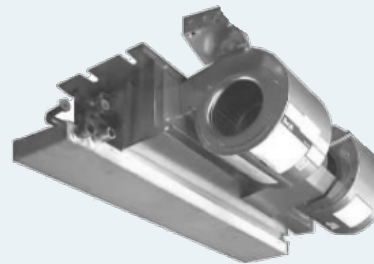
Ceiling Cassette



Ceiling Recessed



Ceiling Concealed with Plenum



Ceiling Concealed (Uncased)



Vertical or Horizontal Air Handler

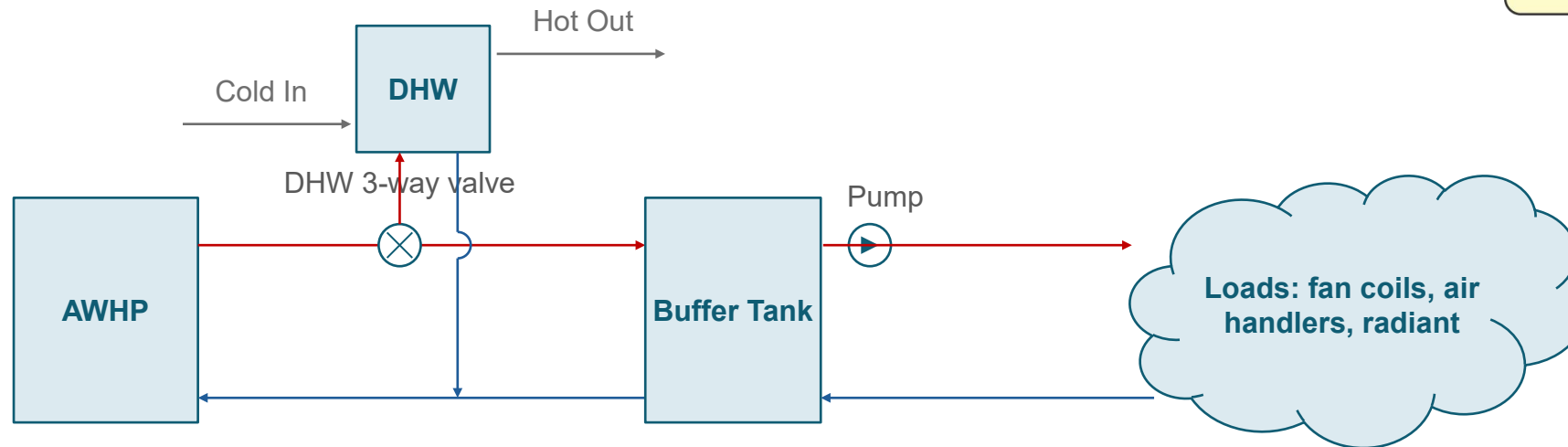
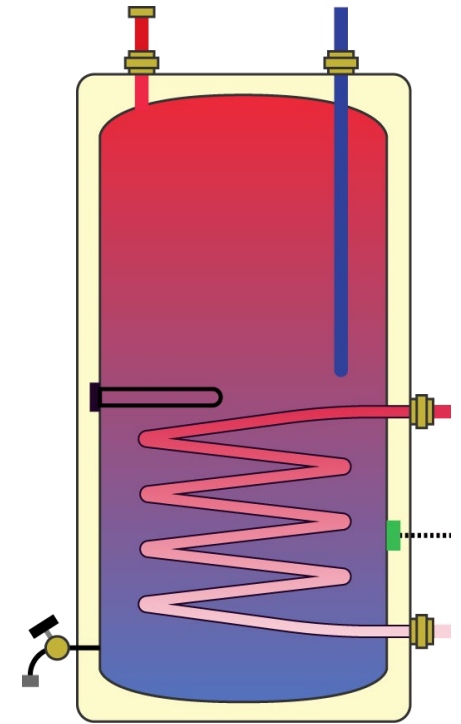


Radiant Floor / Ceiling

A broad range of hydronic terminals can address nearly all residential and light-commercial applications.

AWHP Domestic Water Heating

- DHW function requires a heat exchanger tank (indirect water heater with a heat-exchanger coil).
- Uses a 3-way valve, controlled by heat pump.
- **DHW gets priority.** When the DHW tank needs heat, the heat pump switches to DHW mode (Full speed heating) and switches a 3-way valve to the tank. Space heating/cooling heat pump operation is paused temporarily, space conditioning is served by the buffer tank.
- Always Use a Manufacturer-Approved Tank (& Coil Size).
- **Off-The-Charts Efficiency.** Properly configured, this setup beats every certified heat pump water heater system in the market.



When We Say “Off the Charts,” We Mean It. Literally.

See the EnergyGuide label at right, where a leading Air-to-Water heat pump with DHW exceeded the current version of the U.S. FTC energy label format and set a world record.

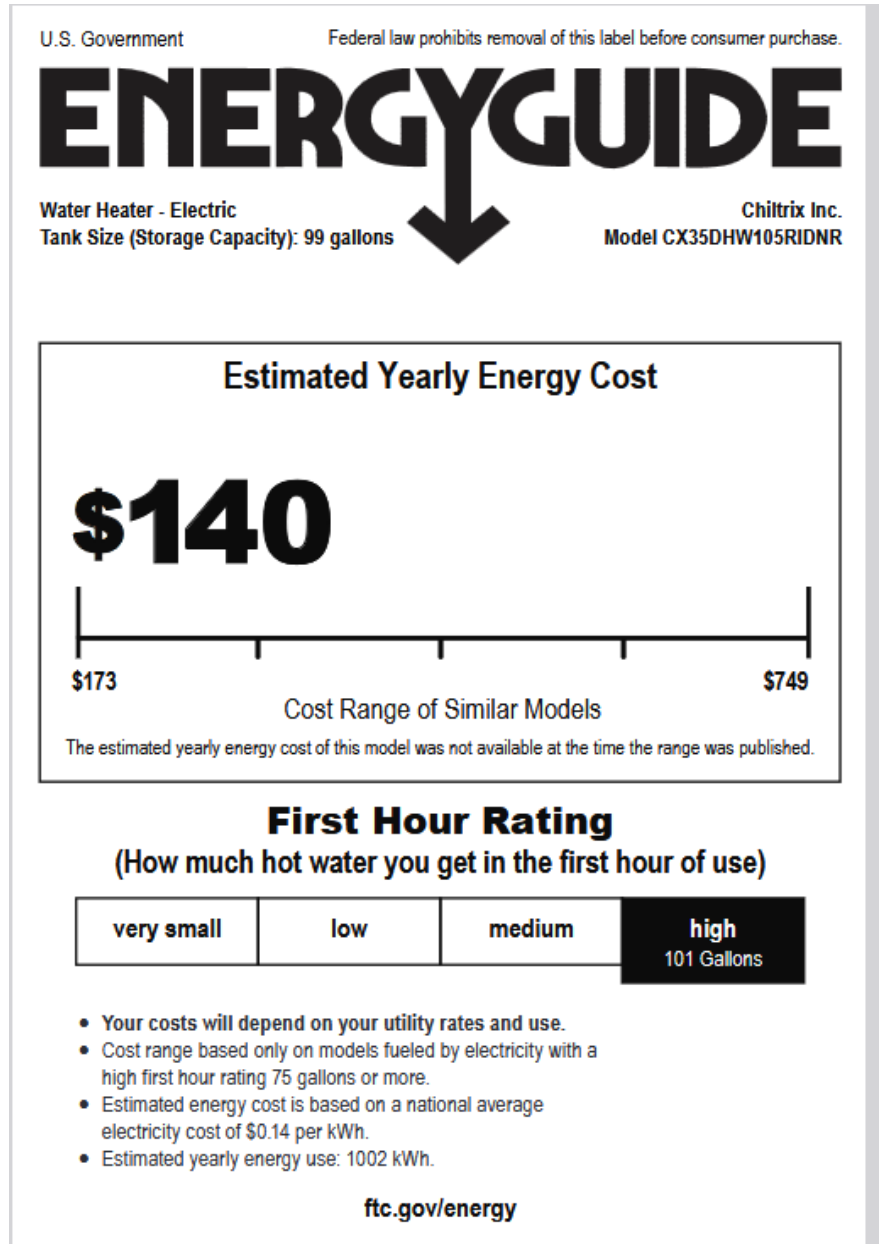


The printed FTC scale starts at \$173. At \$140, this unit lands well below the bottom of the range — the label has no position to mark it.

UEF up to 4.95

Did You Know?

The highest UEF rating of any water heater ever certified by the U.S. Department of Energy is part of an Air-to-Water Heat Pump System.



Rating Information For AWHP Heating & Cooling

DX Heat Pumps

are rated and certified under AHRI 210/240

The current DX ratings are SEER2 and HSPF2. The new “2” mainly means that the ratings include estimated 0.5” duct static pressure/fan losses.

SEER/SEER2 is the seasonal average energy efficiency for cooling measured in Btu/Wh

HSPF/HSPF2 is the seasonal average energy efficiency for heating measured in Btu/Wh.

Air-to-Water Heat Pumps

are rated and certified under AHRI 550/590 and EN 14825

The current AWHP ratings are IPLV and SCOP.

IPLV is the seasonal average energy efficiency for cooling measured as Btu/Wh

SCOP is the seasonal average energy efficiency for heating measured at W/W. (A seasonal average COP value)

Definition of SCOP

The total heating output of a heat pump during its normal annual usage period divided by the total electric energy input during the same period, in consistent units (e.g., W/W).

Definition of HSPF

The total heating output of a heat pump during its normal annual usage period divided by the total electric energy input during the same period, in non-consistent units (e.g., Btu/Wh)

1W = 3.412 BTU/h. Therefore, 1 W/W = 3.412 Btu/Wh. Assuming US DOE Climate Zone 5A BIN data, a SCOP of 4.8 = HSPF 16.38 unit-equivalent rating. An HSPF of 10 = SCOP 2.93 unit-equivalent rating. Some AWHP units have SCOP as high as 5.36 (~ HSPF 18.29)

Like most heat pumps, AWHP units are typically rated at 47 °F outdoor temperature. Most AWHP manufacturers also publish their detailed **heating performance map** so you can see the capacity and COP under a wide range of outdoor and supply temperature conditions.

About Buffer Tanks, Heat Exchangers, and Glycol

Not to be confused with an expansion tank, buffer tanks are small tanks used to provide certain important advantages in a hydronic system.

- Hydraulic Separation Between Pumps
- Thermal Buffering
- Mitigation of Cycling

Some space-constrained users may wish to avoid a buffer tank in which case a hydraulic separator can be used, but it does not provide any buffering.

Other users may wish to use a heat exchanger between the heat pump(s) and the buffer tank, to avoid the need for propylene glycol in the buffer tank & inside piping. This is not ideal but can be OK if sized correctly.

Another freeze protection option is the use of drain valves that open if the system is close to freezing. Not generally recommended as a freeze protection solution.

Some users believe that glycol lowers the COP or capacity of a hydronic system. This is only partly true, as the difference in capacity is compensated for by a slightly faster flow rate. The COP difference is around 0.007 in a typical system of 35% propylene glycol, essentially a rounding error. It's a result of a small increase pump energy.

Note that using a heat exchanger with a design approach of 4-5 °F has a much worse impact on COP than 35% propylene glycol, and when used for cooling, can impact latent heat removal. Suggested for cooling is an oversized heat exchanger.

Using a buffer tank, and glycol, without a heat exchanger, is usually the preferred design.



Some AWHP brands say they can run without a buffer tank. And that's true, in fact ALL variable speed AWHPs can run without a buffer tank.

It's also true that ALL AWHPs will run much better, with a buffer tank.

The AWHP Design Process

MODULAR BY DESIGN

AWHP heat pumps are modular — single, double, triple or more outdoor units may be used as needed in a single system. A supplier may offer two or more module sizes. Examples:

Module	Cooling	Heating
A (Small)	2 to 2.5 tons	up to 3.5 to 4 tons
B (Large)	3.5 to 5 tons	up to 5.5 to 6.5 tons

TYPICAL MAXIMUM RATED SUPPLY SIDE PER SYSTEM

10-12 tons

Cooling

15-19 tons

Heating

Actual heat pump capacities at design temperatures may be substantially lower than rated capacity. Build from multiple modules if required.

DESIGN PROCESS

A SIMPLER WAY: Just submit the load report and customer preferences and let the AWHP manufacturer provide the design.

1. Perform or obtain a Manual J or other load report.
2. Consider the customer's requirements for indoor equipment type, placement, and required capacity.
3. Consider the supply temperatures needed by the load side equipment and consult the manufacturer's certified full speed heating performance map.
4. Specify the load side equipment based on customer preferences. Add DHW if applicable.
5. Consider the use of backup heat. Often the use of a backup heat source is part of a proper design.
6. Specify the supply side heat pumps to meet the load side requirements and load report. Specify the buffer tank.
7. Draw out the rough system piping diagram showing all equipment and piping lengths and perform a preliminary head calculation.
8. Provide the load report and proposed system design to the AWHP manufacturer for review, approval, or further assistance.

2-pipe systems will account for 99% of residential. For very large homes with lots of glazing or internal gains, you may be required to have simultaneous heating & cooling — if so, use multiple heat pump modules and a virtual 4-pipe design, with both a hot buffer tank and a cold buffer tank. Consult the Air-to-Water heat pump manufacturer for design and automated hot-tank-cold-tank controls options.

AWHP Heating Performance Map

Capacity and COP of an AWHP heat pump vary as a function of both outdoor ambient temperature and leaving water temperature. Below is an example Full-Speed Performance Map. It shows full speed operation, and does not show the higher COPs of part-load operation.

LWT °F	Outdoor Ambient °F	-22	-15	-9	-4	0	5	10	17	23	32	39	45	47	50	60
86	Heating Capacity(KBTU/H)	41.524	45.789	48.962	52.169	54.285	57.424	59.778	61.825	62.815	64.248	65.408	66.773	68.308	70.560	78.169
86	INPUT POWER(KW/H)	5.94	6.07	6.13	6.24	6.24	6.24	6.38	5.96	5.2	4.37	3.9	3.69	3.69	3.7	3.73
86	COP (KW/KW)	2.05	2.21	2.34	2.45	2.55	2.7	2.75	3.04	3.54	4.31	4.92	5.3	5.43	5.59	6.14
95	Heating Capacity(KBTU/H)	38.556	42.650	45.721	48.792	50.805	53.841	56.742	59.301	60.495	62.303	63.770	65.135	66.363	68.206	74.416
95	INPUT POWER(KW/H)	6.04	6.1	6.15	6.24	6.2	6.241	6.38	6.08	5.44	4.72	4.3	4.04	4.02	3.99	3.92
95	COP (KW/KW)	1.87	2.05	2.18	2.31	2.4	2.53	2.61	2.86	3.26	3.87	4.35	4.73	4.84	5.01	5.57
105	Heating Capacity(KBTU/H)	35.280	39.170	42.138	45.038	46.983	49.883	53.398	56.503	57.970	60.154	61.928	63.293	64.214	65.613	70.253
105	INPUT POWER(KW/H)	6.08	6.14	6.17	6.24	6.23	6.24	6.38	6.16	5.66	5.08	4.71	4.43	4.39	4.31	4.13
105	COP (KW/KW)	1.7	1.87	2	2.12	2.21	2.34	2.45	2.69	3	3.47	3.85	4.19	4.29	4.46	4.99
120	Heating Capacity(KBTU/H)	30.299	33.915	36.645	39.374	41.149	43.844	48.314	52.238	54.080	56.912	59.164	60.529	60.972	61.655	63.907
120	INPUT POWER(KW/H)	6.12	6.17	6.21	6.23	6.25	6.24	6.38	6.3	5.98	5.6	5.35	5.03	4.94	4.81	4.45
120	COP (KW/KW)	1.45	1.61	1.73	1.85	1.93	2.06	2.22	2.43	2.65	2.98	3.24	3.53	3.62	3.76	4.21
131	Heating Capacity(KBTU/H)			32.755	35.314	37.020	39.579	44.697	49.133	51.180	54.217	56.673	58.550	58.652	58.823	59.403
131	INPUT POWER(KW/H)			6.23	6.23	6.24	6.24	6.38	6.34	6.1	5.8	5.61	5.45	5.34	5.16	4.67
131	COP (KW/KW)			1.54	1.66	1.74	1.86	2.05	2.27	2.46	2.74	2.96	3.15	3.22	3.34	3.73
140	Heating Capacity(KBTU/H)						26.307	30.572	35.826	40.569	47.700	53.398	57.663	57.663	57.697	57.765
140	INPUT POWER(KW/H)						6.27	6.22	6.18	6.16	6.13	6.11	6.08	5.93	5.71	5.11
140	COP (KW/KW)						1.23	1.44	1.7	1.93	2.28	2.56	2.78	2.85	2.96	3.31
149	Heating Capacity(KBTU/H)									22.519	29.957	41.183	50.122	56.776	56.673	56.571
149	INPUT POWER(KW/H)									6.02	6.22	6.46	6.61	6.71	6.52	5.55
149	COP (KW/KW)									1.1	1.41	1.87	2.22	2.48	2.55	2.96

Full Speed Performance Map courtesy of Chiltrix Inc.

Most Important Design Tip: Design for the Lowest Lift

Where:

- T_{hot} = absolute temperature of the hot side (water supply temperature)
 - T_{cold} = absolute temperature of the cold side (outdoor air)
- Carnot temperatures are in absolute scale (Kelvin or Rankine), not Celsius or Fahrenheit.

$$COP_{Carnot} = \frac{T_{hot}}{T_{hot} - T_{cold}}$$

WHAT THE FORMULA TELLS US

The Carnot formula tells us the **best possible efficiency any heat pump could ever achieve** under given temperatures. No real machine can equal or beat it. **All real heat pumps track it as a fraction of Carnot** with the best achieving up to 46%.

The bigger the temperature difference between the outdoor air and the water you’re trying to heat, the lower the efficiency and capacity becomes.

This is why it is always important to design for a lower “lift” with an Air-to-Water heat pump. Keep the required heating supply temperature as low as you can. An efficient load side design helps more than just better COP, it can also reduce the size & number of heat pumps needed, and the need for backup heat.

RADIANT

Install PEX closer together than you would for a boiler (6-8” is best) & minimize the R-value of any materials that separate the PEX/heat spreaders from the room-facing surface. In a concrete slab, “chair” or tie the PEX up so it does not lie at the bottom of the pour. Insulate under the slab.

FAN COILS

Size equipment for lower temp supply water, e.g. 105 °F or 110 °F. All FCU/AHU manufacturers can give you extended capacity ratings for the lower supply temperatures. Just ask them.

Outdoor Air (°F)	Supply Water (°F)	“Lift” °F	Carnot Max. COP	Real World AWHP COP
47	95	48	11.56	4.9
47	120	73	7.94	3.62
32	95	63	8.80	3.87
32	120	88	6.59	2.98
17	95	78	7.11	2.86
17	120	103	5.63	2.43
5	95	90	6.16	2.53
5	120	115	5.04	2.06

*Above is full speed data. Lower compressor speeds have higher real world COP.

You don’t need to fully understand this, but you do need to use it in your system design process.

Air-to-Water Heat Pumps Are Not Boilers.

Crucial AWHP Installation Tips

RTM

Read the manual(s) before you get started. Yes, it needs to be said. Many AWHP manufacturers have multiple manuals for heat pumps, tanks, fan coils, backup heat, etc. Read all that apply to your application.

VAPOR-TIGHT INSULATION

All hydronic piping should be insulated with closed-cell insulation. Critical for any system that will be used for cooling (dew point condensation issues) is to make it vapor-tight. Outdoor PEX needs UV/mechanical protection.

PURGE PROPERLY

The most common problem with AWHP occurs during or just after commissioning and is related to flow errors caused by air in the system. Do not assume air vents will be sufficient for initial purging. Proper brute-force purging with a strong transfer pump is required, follow the manufacturer's instructions/manual.

AUTOMATIC AIR VENTS

Air can accumulate over time and affect water flow, which causes an AWHP to produce errors. Place one or more Automatic Air Vents at the highest physical points of the system, and at a bare minimum, one on the top port of the buffer tank. If unsure, ask the AWHP manufacturer for assistance.

USE PEX

Not a hard requirement but it is better than copper for avoiding elbows, it can be easier to work with, and costs less. Oxygen-barrier PEX is needed for most but not all systems.

HEAD LOSS CALCULATION & PUMP SIZING

Avoid elbows in your piping whenever possible. Your piping distances, complexity, and elbows will impact pressure drop and drive the required pipe diameter and pump sizing. Don't guess. Once the final design is known, perform a head calculation. The head loss numbers will allow you to select a proper load-side pump. If you are not familiar with these calculations or pump curves, get the AWHP manufacturer to assist.

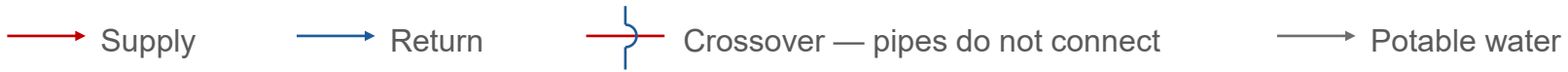
SYSTEM VOLUME CALCULATION

Once the final design is known, calculate the system volume so you can provide the correct percentage of glycol and properly size the expansion tank. Don't guess. If unsure, have the AWHP manufacturer assist.

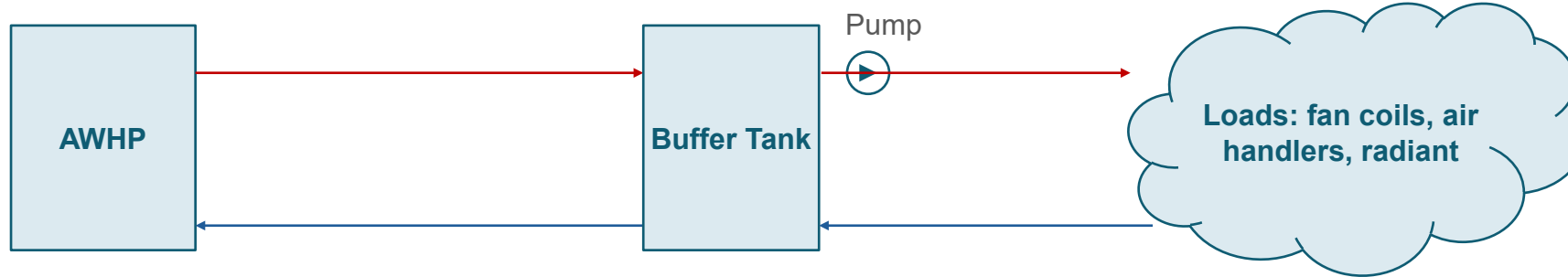
COMMISSIONING CALL

The manufacturer should be willing to (or even insist) on a "commissioning call" at time of startup to finalize all settings and verify proper system operation. Be ready to provide your "as-built" piping diagram.

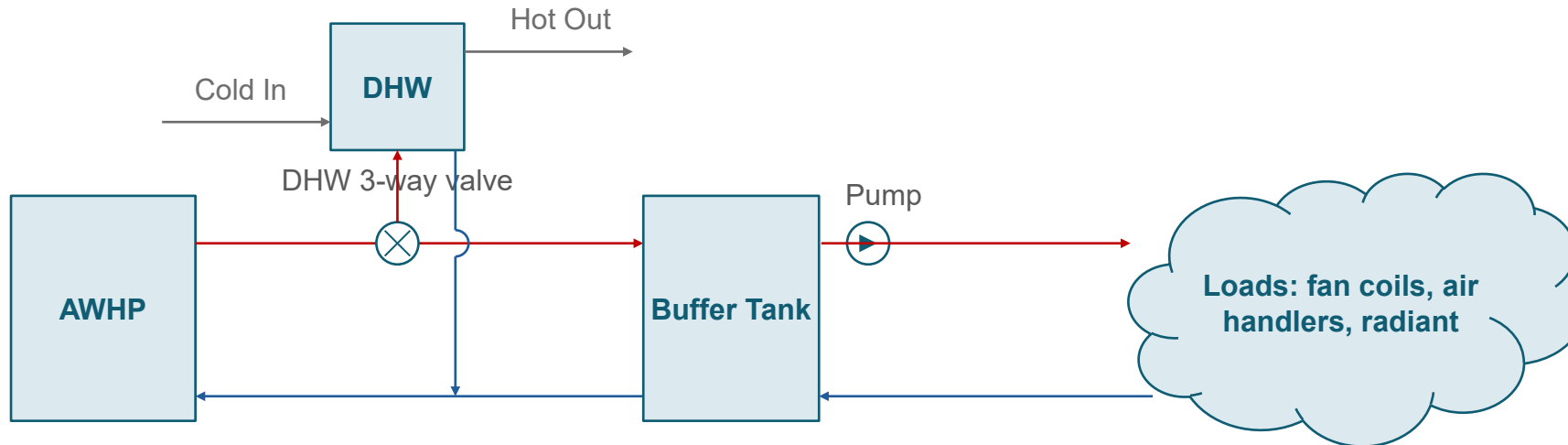
AWHP System Design



1 · The Most Basic Design

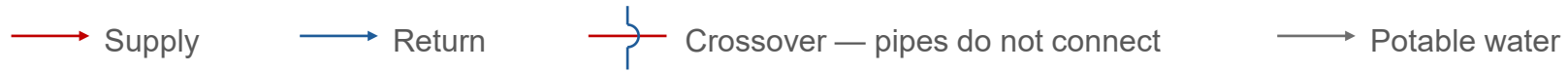


2 · Basic Design with Optional DHW

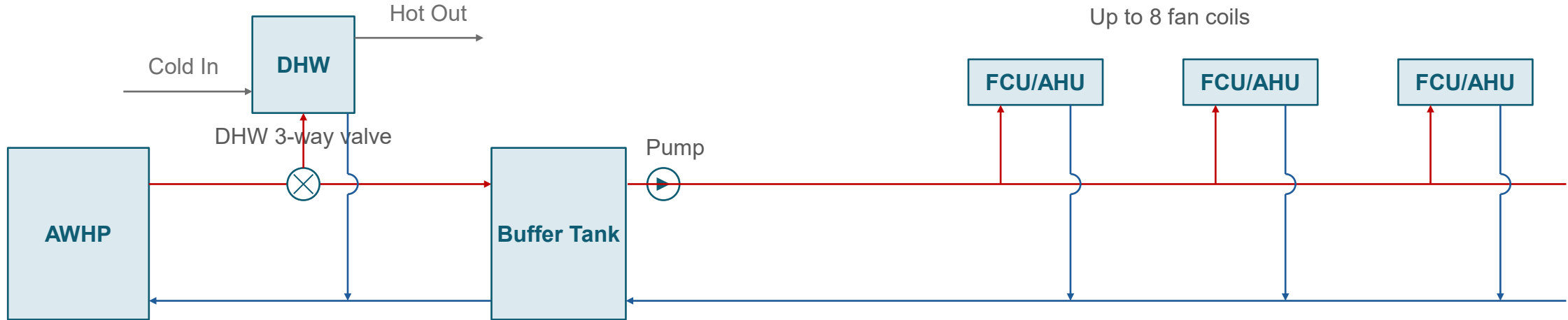


Concept only. Not all components are shown. There are 1,000s of possible designs.

AWHP System Design

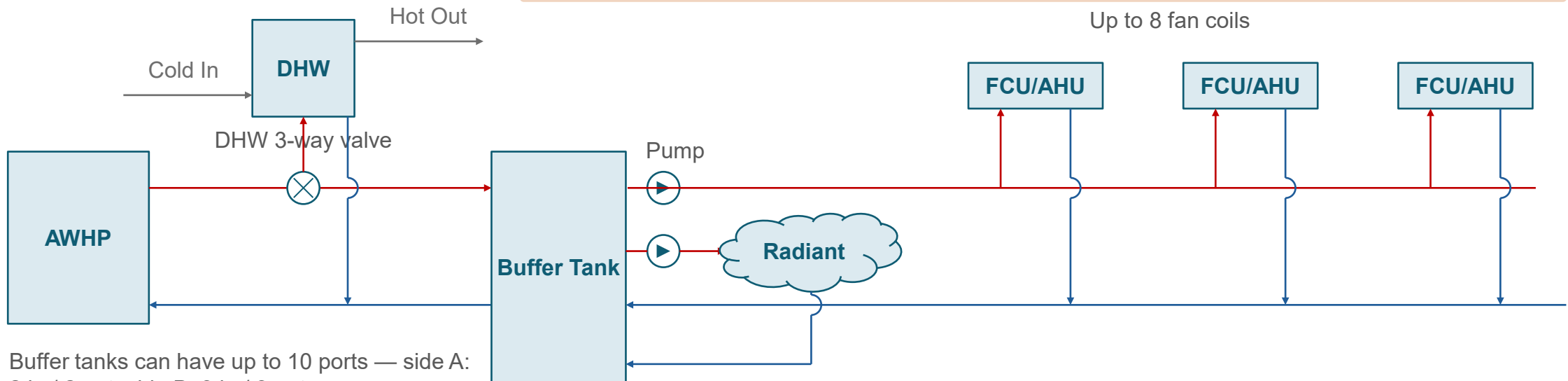


3 · Shown with Fan Coils & DHW



4 · Shown with Fan Coils, DHW, & Radiant

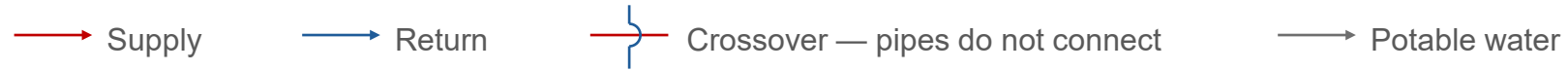
Concept only. Not all components are shown. There are 1,000s of possible designs.



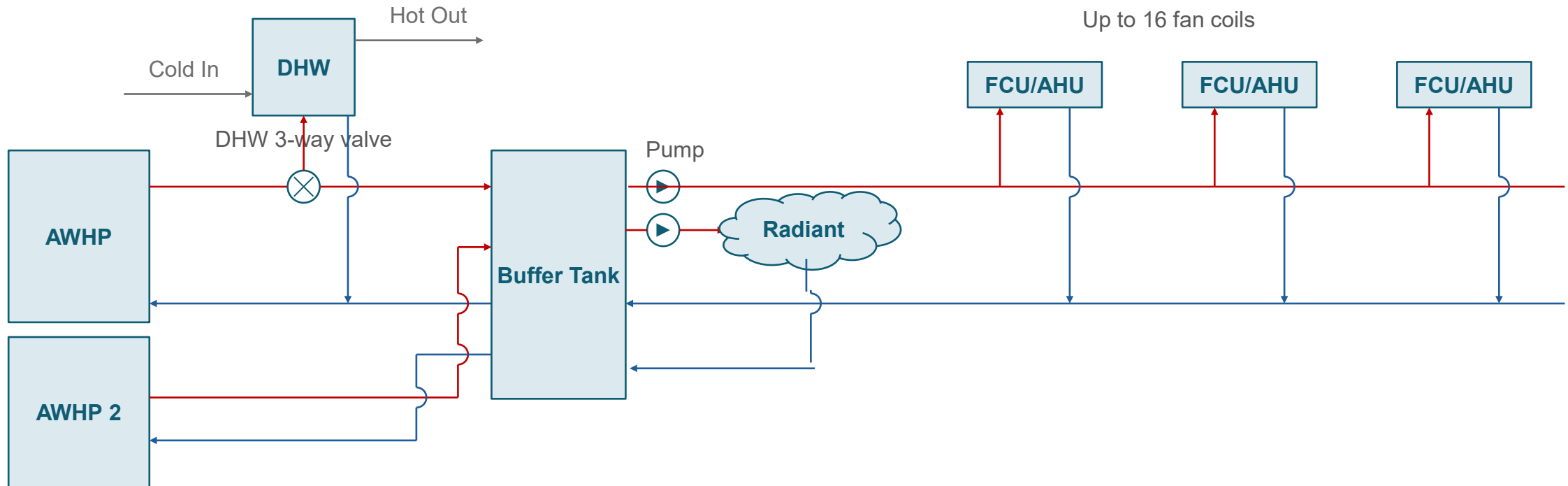
Buffer tanks can have up to 10 ports — side A: 2 in / 2 out, side B: 3 in / 3 out.

Dual AWHP System

In this example, each heat pump home-runs its own supply and return pair to the buffer tank — they are not manifolded together. Up to 3 AWHPs per system.



Dual AWHPs shown with Fan Coils, Radiant, & Optional DHW



2nd or 3rd heat pump does not need to be the same size as the first heat pump.
Buffer tanks can have up to 10 ports — side A: 2 in / 2 out, side B: 3 in / 3 out.

Concept only. Not all components are shown. There are 1,000s of possible designs.

How to Select/Compare AWHP products

What brands and models have the highest performance ratings for heating, cooling and domestic hot water? Since manufacturers chase the highest ratings, achieving higher ratings signifies superior engineering expertise.

AHRI Certified? This is a big one.



Published data. Is their data official third-party accredited lab data, or is it company provided data? Check online AHRI, DOE, and EN 14825 certification body databases to verify official certification.

Best-of-breed components vs. vertically integrated? Careful brand-agnostic component engineering allows superior results over selecting components only from internal sources.

Build quality? Warranty? Spare parts availability? Features (ability to customize?) Cost?

USA support & engineering: Are the heat pump engineers located in the USA and are they available? Can you get a real engineer on the phone if you need to?

Open interface – Modbus, BACnet, relays – support for a wide range of 3rd party controls?

If they offer DHW, do they have official ratings in the DOE's Compliance Certification Management System (CCMS) database?





Thank You!

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or at our headquarters in Chesapeake, VA.



Serving the USA Market
With Air-to-Water Heat Pumps
Since 2015



About: John Williams is the CEO and personally leads the Chiltrix engineering team: Among all officially certified A2L Air-to-Water Heat Pumps, Chiltrix holds the record for the Highest Seasonal Average Heating COP (SCOP), the Highest Seasonal Average Cooling EER (IPLV), and the highest-ever US DOE UEF for water heating. In 2020 Chiltrix was presented the Energy Star Emerging Technology Award.

Reference: How the AWHP vs. DX Numbers Were Derived

Supporting calculations for slide 9. Every step from certified ratings to the percentages shown.

STEP 1 · CERTIFIED INPUTS

AWHP — EN 14825, Chiltrix CX65: SCOP 5.36 at W35 (95 °F supply), SCOP 3.88 at W55 (131 °F).

DX — AHRI 210/240 certified HSPF, compared across a range: 9.5, 10.5, 11.8 and 13.0.

STEP 2 · SCOP AT 104 °F (FAN COIL SUPPLY)

$f = (40 - 35) \div (55 - 35) = 0.25$
linear = $5.36 - 0.25 \times (5.36 - 3.88) = 4.99$
curve : map @47 °F predicts 4.39 at 105 °F; map reads 4.29
factor = $4.29 \div 4.39 = 0.977 \rightarrow 4.99 \times 0.977 = 4.88$ used

STEP 3 · ADD LOAD-SIDE PARASITICS

The monobloc's internal circulator is already inside SCOP — not added again.

Radiant: 47 W load-side pump 5.36 → 5.24

Fan coils: 25 W/ton motors (75 W) + 47 W pump 4.88 → 4.62

HSPF already includes the DX indoor fan, so nothing is added to the DX side.

STEP 4 · PUT DX ON THE SAME BASIS

$COP = HSPF \div 3.412$

HSPF 9.5 → 2.784 HSPF 11.8 → 3.458

HSPF 10.5 → 3.077 HSPF 13.0 → 3.810

$HSPF2 \approx 0.85 \times HSPF$, so HSPF2 10 ≈ HSPF 11.8

STEP 5 · THE PERCENTAGES

$saved = 1 - (COP_{DX} \div COP_{AWHP})$

e.g. $1 - (2.784 \div 4.62) = 39.7\% \rightarrow$ shown as 40%

STEP 6 · THE ALR COMFORT CREDIT (LAST COLUMN ONLY)

Operative temperature $t_o \approx (t_{air} + MRT) \div 2$, valid below ~80 fpm air velocity and $MRT - t_{air}$ under ~7 °F (ASHRAE 55).

A heated floor raises MRT, so air temperature can fall ~5 °F at equal comfort.

Heat loss tracks ΔT . Bin-weighted over a Zone 5A season that is 14% less delivered heat.

Applied at unchanged SCOP — no COP gain is claimed from the lower reset temperature.

KNOWN LIMITATION

SCOP (EN 14825) and HSPF (AHRI 210/240) are separate test procedures. They differ on defrost, cyclic degradation and backup-heat accounting. Both figures used here are evaluated on Zone 5A-comparable bin hours, which removes the largest source of non-comparability.

DELIBERATELY NOT CLAIMED

- No stratification benefit from radiant
- No infiltration benefit from the lower indoor air temperature
- Fan power modeled linear with load; affinity laws are cubic, so real draw is lower
- The 104 °F SCOP was corrected downward for curvature, not upward

ALR: ASHRAE 55 recognizes operative temperature as a function of both air temperature and mean radiant temperature, particularly in a low velocity air flow environment. When radiant heating raises MRT, equal comfort is possible at a lower air temperature. In the illustrative Zone 5A model used here, an assumed 5°F reduction in air temperature reduced seasonal delivered heat by approximately 14%.

Reference: Geothermal Comparison — Inputs and Sources

Supporting calculations for slide 8. What is published, what is ours, and the arithmetic in between.

PUBLISHED FIGURES

- Vertical bore: 150–220 ft per ton in northern climates, 250–300 in southern — DOE guidance.
- Horizontal loop land: roughly 1,000–3,000 sq ft per ton — DOE guidance.
- Loop field share of project cost: 40–70%, the largest single line item. Sources vary; the low end is the more conservative reading.
- Drilling: \$15–\$25 per foot in normal ground, \$30–\$50 in hard rock.
- Installed premium over AWHP: \$3,000–\$8,000 per ton, from contractor pricing surveys.
- Published geothermal payback: 8–12 years — measured against a furnace and AC, with the 30% credit.

THE 2026 CREDIT CHANGE

Section 25D terminated for systems after 31 December 2025. One Big Beautiful Bill Act, P.L. 119-21, signed 4 July 2025; details in IRS Fact Sheet 2025-05 (21 August 2025). No grandfather provision.

WHAT IS OURS, NOT PUBLISHED

- The \$65–\$270 per year saving figure — our Zone 5A modelling, not a measured result.
- The resulting payback in decades — arithmetic from that saving and the installed premium.

ROI ARITHMETIC · 3 TON, ZONE 5A

extra cost = \$3,000–\$8,000/ton × 3 = \$9,000–\$24,000
saving = 400–1,700 kWh/yr (geo vs efficient AWHP)
at \$0.16/kWh = \$64–\$272 per year
at \$0.30/kWh = \$120–\$510 per year
payback = extra ÷ saving → decades in some cases

WHY PUBLISHED PAYBACKS LOOK SHORTER

The 8–12 year figures compare geothermal against a furnace and AC — not against an already efficient AWHP system — and they assumed the 30% credit that no longer exists.

WHERE GEOTHERMAL GENUINELY WINS

At design conditions a ground loop still delivers 35–40 °F fluid at 5 °F outdoor air, so it holds capacity while any air-source machine derates. That advantage is real and concentrated in the coldest hours.