Heat Pump Water Heater Guide & Technical Reference

Version 1.1, July 21, 2022

Audience: The body of this document provides an overview for homeowners. The appendices contain more technical information for interested homeowners and for Alliance Coaches..

Table of Contents

1. Introduction

Heat-pump water heaters (HPWHs) are also known as “hybrid” water heaters because they have both a heat pump and conventional electric resistance elements for backup. The most common type of HPWH transfers heat from the surrounding indoor air into a hot water tank, which is typically located in an open, unfinished basement or garage. Other types of HPWHs are described in **Appendix B**. Because heat is transferred instead of generated by burning fossil fuels or electric resistance, heat-pump water heaters can be about three times more efficient than conventional water heaters. HPWHs reduce your electric usage as well as greenhouse gas emissions. And they may help with dehumidification.

Homeowners are well-advised to consider water heater replacement well in advance of failure of their existing water heater. It takes time to identify suitable installers, obtain estimates, and make a well informed decision.

Information from various brands of HPWH is used throughout this document and its appendices, but the Alliance does not endorse any specific brand or installer. Manufacturer’s installation instructions, usually available free on-line, supersede information included here.

We suggest that you begin with the Massachusetts Clean Energy Center (Mass CEC) HPWH Guide.

2. Technical Considerations

2.1 Life Expectancy

From the HPWH Guide:

“Heat pump water heaters are robust, and can last much longer than conventional water heaters, with standard warranties for many HPWHs lasting 10 years or more.”

From: https://waterheaters.com/heat-pump-water-heater-benefits/:
“The average lifespan of a conventional electric water heater is somewhere between 8 and 12 years. So, every ten years or so, it will have to be replaced. On the other hand, a heat pump water heater can last anywhere between 13 and 15 years.”

This lifespan difference is reflected in warranties of 10 years for HPWHs vs. 6 years for most conventional electric tanks. **Appendix C3** includes thoughts on why the lifespan of heat-pump tanks is longer, even though most models have the same type of glass-lined steel tanks. Both types of water heaters usually have replaceable sacrificial anode rod(s) made of aluminum or other metals that reduce corrosion (See **Appendix A4**).

2.2 Efficiency and First Hour Rating

Uniform Energy Factor: The HPWH GUIDE explains: “One of the primary metrics of a water heater’s performance is its Uniform Energy Factor (or UEF). The UEF is a measure of how much water a system

of a certain size can heat in a given time period relative to how much energy it uses. The higher the UEF, the more efficient the water heater." UEF is typically in the range 3-4 for HPWHs compared to 0.8-0.95 for conventional water heaters. When comparing candidate models, UEF is an important criterion. Technology is advancing and there are now models with UEF of 4. Beware of any models with UEF below 3.2, which no longer qualify for MassSave incentives.

First Hour Rating: Starting with a full tank at 125°F, how much hot water can it supply during the first hour? The best 50-gallon tanks are rated around 65-67 gallons per hour, while 80 gallon units supply about 84-86 gallons per hour.

2.3 Space Requirement

A new HPWH will usually be located in the same place as the water heater it's replacing. In most homes in the Northeast U.S., an unfinished basement provides plenty of air for the HPWH to draw from, with a volume much greater than the minimum of 750 to 1000 ***cubic*** feet typically required by the manufacturer. The space may be unconditioned, but, as for any water heater, the temperature must remain above a minimum temperature specified by the manufacturer (for example, Rheem specifies a minimum temperature of 37°F). If the room containing the HPWH is smaller than the minimum, see **Appendix B, Type 2**, which discusses optional ducts, louvers and related topics. In most cases, installation can proceed without ducting.

Dimensions are available for comparison once you have narrowed down to specific brands and models. Another important consideration is clearance required, which is covered here: https://www.youtube.com/watch?v=smfyPdr8SnE
As shown in this video, Rheem allows for tighter packing into small spaces because their total-replacement scheme results in zero maintenance clearances (sides and back), but there may be other local plumbing requirements known to installers, for example a minimum distance to electrical panels. Most HPWHs require more vertical height than conventional water heaters, plus ~6" to allow for air filter cleaning (see **Section 2.7**) and even more for ducting. This is rarely a concern for the typical basement installation, but can be a limitation for unusual installations (such as under a stairwell, where height is limited), and for larger-capacity (taller) tanks.

2.4 Electrical Supply Requirement

Most HPHWs require a dedicated 240V supply circuit which can be re-used if the HPWH is replacing an existing conventional electric water heater. If replacing a gas, propane, or oil-fired water heater, a panel upgrade may be required to add a 240V circuit. From the HPWH GUIDE: "Homes that have less than 200-amp electrical service or lack sufficient panel space will likely incur additional costs for upgrading the electrical service or panel to accommodate a heat pump water heater." Some newer 120V HPWHs have less powerful back-up elements, thus only need a 120V circuit, which can simplify installation when replacing a fossil-fuel water heater. See: https://www.greenbuildingadvisor.com/article/a-new-generation-of-heat-pump-water-heaters-is-on-the-way If the HPWH is installed in conjunction with a heat pump for space heating/cooling, the electrical needs of both systems can be accommodated and covered in a Mass Save HEAT Loan (see https://heatsmartalliance.org/rebates/

2.5 Condensate Drain

The HPWH needs to be connected to a drain or condensate pump, just like a dehumidifier or air conditioner. The condensate is distilled water. Fortunately, the heat pump is located high atop the tank, so a drain well above floor level, like one for a clothes washer, can usually suffice via a sloped PVC pipe. If no drain at a suitable height is available, a condensate pump is necessary. Condensate pumps have a reservoir and a float that turns on the pump above a certain water level, quickly emptying the reservoir, which then slowly fills again. They are inexpensive, and typically plug into a 120 Volt outlet.

2.6 Remote Monitoring and Leak Detection

Some models offer web-based remote monitoring and control using a proprietary app on a mobile device, allowing remote monitoring and setting of delivery temperature, modes, schedules, etc. A common safety feature is leak detection, which can let you know, locally and remotely, if there is a problem. Some models even offer an option that, upon detection of a leak,automatically shuts off the cold water supply to the tank, potentially saving you from extensive damage elsewhere in the house.

2.7 Maintenance

As outlined in the HOMEOWNER MAINTENANCE section of the HPWH GUIDE, compared with a conventional water heater, the only additional periodic maintenance tasks required for HPWH are cleaning the intake air filter and checking the condensate drain.

Most models have a flexible, thin plastic air filter element that slides out atop the unit once the cover has been removed. At the recommended interval (typically 2-6 months), or when a clean filter alert appears on the display, clean this filter by brushing dust off or using a mild detergent solution, then rinse and dry. Most HPWHs also have a protective screen in the inlet or outlet ports that can accumulate dust over many years, gradually restricting flow. If you notice reduced air flow, clean these screens.

3. Advantages and Disadvantages

Table 1 lists pros and cons of Hybrid HPWH (later referred to as Type 1 or Type 2), compared to a conventional electric water heater. A more extensive comparison that may help you select the most appropriate HPWH Type for a home is in **Appendix C1**.

Table 1: Pros and Cons of Hybrid HPWH Relative to a Standard Electric-Resistance Water Heater

Advantages of HPWH	Disadvantages of HPWH
Lower operating cost typically provides an advantageous payback period*	Higher first cost
Substantial energy and carbon emissions savings*	
Incentives available (See https://heatsmartalliance.org/rebates/)	
Longer standard warranty (typically 10 years vs. 6 years))	
	Noise may be a concern if the water heater is near a bedroom or office.
Partial dehumidification of basements may reduce load on dehumidifier	
Possible beneficial cooling in summer	Possible comfort issue with cold blows if HPWH is in or near an occupied room

*These advantages apply even after considering the slight increase in space heating load due to the HPWH.

4. Selecting an Installer

HPWHs can be installed by full-service HVAC firms or licensed plumbers. Licensed plumbers may be less expensive than full-service firms, but some installations may require an HVAC specialist. Installation of a HPWH is most often separate from the space heating system. HPWH installers can be identified from the following lists, which overlap somewhat. These lists were available as of May 2022.

- MassCEC HPWH Installer List: https://goclean.masscec.com/installers/
- EnergyStar list: https://www.energystar.gov/productfinder/product/certified-water-heaters/results

An available HeatSmart Alliance coach may be able to assist you with identifying installers who service homes in your area. You may also research installers through on-line reviews, obtaining references from friends and neighbors, the BBB, etc. The goal is to make a well-informed selection of installer and equipment before a water-heater replacement becomes an emergency.

It is desirable to evaluate quotes from multiple installers, who may offer different equipment at different price points. If you are a technically-inclined homeowner, you may want to write a Request for Proposal (RFP) listing your requirements (examples are provided in **Appendix D**). An available Alliance coach may be able tohelp with evaluating proposals.

Mass Save incentives for HPWHs are described in the HPWH GUIDE are current for May 2022, but may fall out of date with information on the Mass Save website.. If you are in a Municipal Light Plant (MLP) community, check with the MLP for possible incentives.

Appendix A. Considerations for All Water Heaters

A1. Storage Volume

The HPWH GUIDE suggests:
You can probably replace your existing water heater with a heat pump water heater of the same size, but you should ask your candidate installers if your current water heater is over- or undersized for your home's hot water load. If you are in between sizes, choose the larger tank size.

A2. Plumbing Details

Water pipes should be insulated to reduce losses, condensation, and noise. In accessible areas, adding split tubular pipe insulation is an easy DIY project. In most water-heater replacements, copper pipe can be reused. Because copper is very expensive, your plumber may use PEX (cross-linked polyethylene) pipe, which comes in red and blue to identify hot and cold lines. Because of its flexibility, PEX may also reduce noise. If you have municipal water with a check valve, an expansion tank is required in the cold water supply. You can re-use the old one if it is in good shape. With wells, there is usually no check valve and already an expansion tank. Well water treatment systems should be left in place. The purified water usually benefits tank life. If not there already, we recommend adding a supply shut-off valve so that the house can still have cold water if the tank needs to be serviced. You may also need a drain pan, especially if installed on a wooden floor. Many of these topics are covered in a Rheem training video:
https://www.youtube.com/watch?v=g1RZ6PMTBaY

If your current system has any "water hammer" issues, such as when a clothes washer's water valve closes suddenly launching a noisy pressure shockwave through the pipes, you should engage a plumber. Water hammers may contribute to premature failure of plumbing, including glass lined tanks.

A3. Tempering (*aka* Mixing) Valves

Tempering or mixing valves allow you to limit the temperature of hot water flowing to the house. These valves mix cold water with the hot to reduce the delivered water to a safe temperature, usually ~120°F. The supply temperature is adjustable over a typical range of ~70-145°F (Honeywell AM-1 series or equivalent).

According to the Bolton, MA plumbing inspector, tempering valves are recommended but not required in MA. They are required in NH. While one can use the water-heater controls to limit delivered hot-water temperature, tempering valves have advantages:

1. Certain bacteria can survive at 120°F, but not at 140°F, see: legionellosis fact sheets
2. More energy is stored in the tank if it is hotter, lowering the chance of running out of hot water
3. The delivered water temperature varies less as the hot water from the tank is consumed
4. Built-in-tank temperature regulation may be poor, as described below, and
5. Greater compatibility with demand-response using CTA-2045 (see **Appendix C4**)

A disadvantage is that higher tank temperatures lead to higher stand-by losses and, for HPWHs, to less efficient heat-pump operation.

Details on hot-water-temperature safety are presented here:
https://www.phcppros.com/articles/1898-what-are-safe-hot-water-temperatures

A4. Powered Anode Rods

Conventional “sacrificial” anode rods are included in most glass-lined steel tanks to reduce tank corrosion by letting the anode itself erode instead of the steel tank, where cracks in the glass allow the water to contact it. Stainless steel tanks don’t need anode rods. Even though replacement anode rods are readily available, required periodic anode rod replacement is often overlooked, leading to premature tank failure, especially where the water supply has high mineral content, *aka “hard”* water. One solution to that problem is Powered Anode Rods. During our research on this subject, we found that some Steibel-Eltron water heaters (which happen to also be HPWH), which are also glass lined like most other HPWHs, come with "Impressed current anode corrosion protection”. The Accelera® 220 E and 300 E are equipped with an electronic anode for maintenance-free protection instead of an anode rod. This system also provides protection with the minimum current necessary as opposed to a steady-on system.

Impressed current is a well-known technique for corrosion prevention:
https://en.wikipedia.org/wiki/Cathodic_protection?wprov=sfla1
It has been applied to many areas including water heaters, but we don't know of any currently-available HPWH other than Steibel-Eltron that comes with it. We are seeking understanding of why powered anodes are not being included by most major HPWH manufacturers anymore.

But past HPWH models did have powered anodes. We have seen a schematic of a State HPWH that had a powered anode. This AO Smith manual has a section on Operation of Powered Anode. It is even integrated with the electronic controller.
https://www.hotwater.com/lit/training/321547-000.pdf
There are good reviews from 2012 -2014 for these tanks. The 60-gallon model was discontinued in 2014.

We also found this AO Smith add-on part that has good, recent reviews:
https://www.amazon.com/100305721-Product-Preservers-Powered-System/product-reviews/B[…]/ref=cm_cr_dp_d_show_all_btm?ie=UTF8&reviewerType=all_reviews
And Corro-Protec also makes a titanium "Unrivaled Powered Anode Rod For Water Heater Durability", costing about $160, that can be fitted to any tank that has a hole for an anode rod: https://www.corroprotec.com/ It has thousands of reviews averaging nearly 5 stars, but mostly for sulfur odor reduction. It is made in Canada and has a 20-year warranty, though has only been available for 12 years. We have found nothing but positive views of powered anodes, e.g.
https://forum.heatinghelp.com/discussion/184227/new-hybrid-hot-water-system-problem

Regarding power consumption of powered anodes, the "Vampire" power transformer they use is of a size that is typically only 10-15 Watts, which also helps with water heating.

Appendix B. Other HPWH Types

Table 2 lists key characteristics of five types of HPWH, most-popular first. The most common, self-contained HPWHs, *aka* hybrid water heaters (shaded green) are referred to as Type 1 and are the

focus of the main body of this document. Details of the four other types are covered here in **Appendix B**, with Pros and Cons in **Appendix C1.**

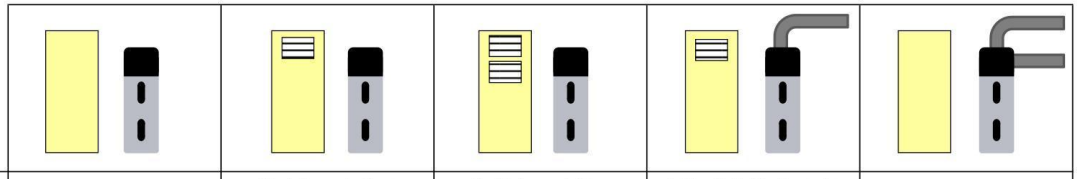
	Table 2: Heat Smart Alliance Heat Pump Water Heater Summary						2022 Mar 30
					Outside to Inside		
Type*	Heat Source	Common Name	Refrig. Loop	Outside Unit	Heat Xfer Medium	Conduit	Inside Unit(s)
1	Inside air	Hybrid	Packaged	NONE	NA		Tank w. 1-sp HP on top
2	Inside, opt. seasonal Outside Air	Hybrid with ducting, louvers	Packaged	NONE			Tank w. 1-sp HP on top
3	Outside Air + solar radiation	Solar Assisted HP (NESolar)	Split	Thermo-dynamic Panel(s)	Refrigerant	Cu line set	Stainless Tank with 1-sp HP on top
4	Outside Air	SanCO2 Gen4 (ECO2)	Packaged	Single speed HP	Potable Water	Cu pipe + Htr.	Stainless Tank
5	Inside Air	Geyser (Nyle)	Packaged	NONE	NA		Tank + 1-sp HP
* Type Numbers are not standard; are intended for use only in this document							
Key:	NA (Not Applicable)		Most Common Suggestion		Do Not Suggest Yet		

Type 2: Hybrid HPWH with Louver Venting and/or Ducting

Type 2 is just a variant of Type 1, differing only in venting or ducting of the air flowing through the HPWH to an adjacent indoor space. In some homes, the space available for the HPWH is too small to provide sufficient air for proper operation. HPWH manufacturers suggest several ways of circumventing this limitation. One example is the table below from manufacturer AO Smith that shows various combinations of louvers and/or short ducts to work around space limitations. The HeatSmart Alliance recommends ducting or venting only to indoor spaces for New England installations. While some videos referenced below discuss ducting to the outdoors, we are unaware of any significant benefit in New England's cold climate that would justify the additional cost and complexity.

Heat Pump Space Requirements

HPTU



Configuration (see Note 1)	Enclosed Room	Single Louver in Door (Note 2)	Double Louver in Door (Note 3)	Inlet or Outlet Ducting and a Single Louver in Door (Note 4)	Inlet and Outlet Ducting
Minimum Space (FT^3)	700	300	120	No minimum space requirement	No minimum space requirement
Space Example H x L x W (FT)	8 x 8-3/4 x 10	5 x 6 x 10	3 x 4 x 10		

Note 1: Minimum louver size is 24" x 14" or 336 in^2
Note 2: When one louver is installed, please install the louver at the location where is close to the top of the heater.
Note 3: When two louvers are installed, install one louver just over the top of the heater and the other one where is close to the center of the heater's top shroud.
Note 4: When one duct adapter is used, locate the louver close to the non-ducted grill. (eg if outlet is ducted, place louver near inlet grill)

Another example is a Rheem training video (https://www.youtube.com/watch?v=9gRuVqaFUF8), part of a series, that shows similar approaches and clarifies that the 750 ft^3 volume requirement is open space; *i.e*. the volume of anything big inside the room must be subtracted from the room volume.

Another YouTube video (https://www.youtube.com/watch?v=saz8ci4WUsc) discusses ducting that allows switching the output port from inside in summer, to capture the cool, dry air, to outside in winter. In most New England installations, seasonal duct switching provides little or no benefit.

Finally, another YouTube video (https://www.youtube.com/watch?v=ukv1cMp3vFI) discusses how a bathroom vent could be connected to the HPWH intake port to benefit from the warm, humid air while directing cool, dry air elsewhere in the building. We believe this has negligible if any benefit.

Type 3: Solar-Assisted HP (SAHP)

A novel HPWH introduced several years ago by SAHP (Solar Assisted Heat Pumps) of UK uses an outdoor evaporator, which they call a *thermodynamic panel* because it can gain additional energy from solar radiation. The only moving part is the compressor, offering quieter operation (41dBA) than Type 1, 2, and 5 HPWHs. It has a stainless-steel tank with a 25-year warranty. It neither uses nor contributes to internal air cooling, heating or dehumidification. It is popular in other countries and has been recently introduced in the U.S. Distributors in NY and MA have installed about 200 SAHPs as of early 2022.

Under the European Union ErP rating methodology which is more stringent than UEF testing, the SAHP achieves a COP of 2.6. Energy Star certification and UEF ratings are to be completed in 2022. The manufacturer claims that solar radiation improves performance by 5-7% when the panel is in direct sunlight. COP varies depending on exterior conditions and solar exposure (the manufacturer estimates annual average COP of 2.5-3.0 for installations in New England.) The manufacturer claims an optional double-stacked panel improves performance by an additional 10%. Multiple single panels (not stacked) may also be used to capture additional solar energy, further improving performance.

Type 4: SanCO2 Split HPWH

Several years ago, Sanden introduced a novel HPWH to the U.S. market that uses CO_2 as the refrigerant. The SanCO2 uses a packaged heat pump installed outdoors, with water lines connecting to an indoor stainless-steel storage tank. While this eliminates the space-heating penalty associated with Type 1 HPWHs, it introduces a challenge in northern climates, namely the water lines require trace heating outside the home and can potentially freeze during a power outage. At the time of U.S. market

introduction, the SanCO2 was expected to be about twice as efficient as a typical HPWH, but also about twice as expensive (including equipment and installation). The SanCO2 is distributed in the U.S. by High Performance Building Supply (https://foursevenfive.com/sanco2/) and ECO2 Systems LLC (https://www.smallplanetsupply.com/small-planet-blog/sanco2-heat-pumps-for-electrification). Through these websites, we found two installers in Massachusetts. Both installers expressed concerns about financial return, running water lines outdoors, and the lack of service infrastructure.

Type 5: Geyser

This HPWH, manufactured in Maine, has two separate components: a 6,000 BTU/h Heat Pump that runs on 120 Volts and a conventional 40-120 gallon electric hot water tank. They are connected via a special coaxial tube inserted into the tank's drain, as described in two 2016 videos:
https://www.youtube.com/watch?v=u4hQVr5qYZo&t=15s
https://www.youtube.com/watch?v=RzJB7ID3jos

Appendix C. Special HPWH Considerations

C1. Comparing HPWHs

The tables in this appendix are intended to help you decide which HPWH type is best for your home. Pros and Cons of the most common HPWHs (Types 1 and 2) are covered in the body of this document, in Section 3, Table 1. The tables below cover Types 3, 4 and 5.

Table 3: Pros and Cons of SAHP (Type 3) relative to a standard electric-resistance water heater

Advantages of SAHP	Disadvantages of SAHP
Lower operating cost	Higher first cost
Substantial energy and carbon emissions savings	
Stainless-steel tank with 25-year warranty requires less tank maintenance and less frequent replacement	
Can support an optional small-capacity hydronic space-heating loop	Limited field data
Does not remove heat from indoor space which may be detrimental in winter	Does not contribute cool, dry air, which may be beneficial in summer
Built in timer, once a week, heats the water above 140°F to provide pasteurization, but tempering valve is included	Maximum water temp only 131°F
	Slow recovery, with one resistive element mounted low. Can be mitigated by using a larger tank.
	No remote monitoring & control
Qualifies for 26% federal tax credit (through 2022)	Does not qualify for MassSave HPWH incentive (as of 2022)

	Recently introduced to New England market
The heat pump/compressor unit can be replaced without replacing the tank or evaporator panel assembly	

Table 4: Pros and Cons of San CO2 (Type 4) relative to a standard electric-resistance water heater

Advantages of San CO2	Disadvantages of San CO2
Lower operating cost (about half of Type 1 and 2)	Much higher first cost (about double Type 1 and 2)
Substantial energy and carbon emissions savings	
Stainless-steel tank with 15-year warranty requires less tank maintenance and less frequent replacement	
Can support an optional small-capacity hydronic space-heating loop	Limited field data
Does not remove heat from indoor space which may be detrimental in winter	Does not contribute cool, dry air, which may be beneficial in summer
Uses R744 CO2 refrigerant that produces higher-temperature 160°F water	High-pressure refrigerant loop limits field maintenance options
	Potable water lines require trace heating outside the home, and could freeze during a power outage

Table 5: Pros and Cons of Geyser (Type 5) relative to a standard electric-resistance water heater

Advantages of Geyser	Disadvantages of Geyser
Lower operating cost*	Higher first cost
Substantial energy and carbon emissions savings*	
Longer standard warranty (typically 10 years vs. 6 years)	
	Noise may be concern if water heater is near a bedroom or office
Partial dehumidification of basements may reduce load on dehumidifier	
Possible beneficial cooling in summer	Possible comfort issue with cold blows if HPWH is in or near an occupied room
Can use a separate conventional tank, less costly to replace than the entire system. Also, could use a long-lasting stainless-steel or fiberglass tank.	Requires more floor space for separate heat pump and tank.
	Requires more open volume (1,500 ft^3) than other HPWH types

Runs on 120 Volts.	Requires an additional water pump (also a disadvantage vs. all other HPWH types) with a coaxial connection to tank drain that is reportedly subject to blockage
	Uncertain availability in MA

*These advantages apply even after considering the slight increase in space heating load due to the HPWH.

A recent video by Matt Risinger (https://youtu.be/wt95SE2ogNI) that compares HPWHs with conventional electric resistance, gas, and gas tankless water heaters may be helpful. Note that the comparison is based on energy costs in Texas and results may differ substantially for Massachusetts and as prices fluctuate. Past versions of this annual video are also interesting.

Once the options have been narrowed to a few specific brands and models, an Energy Star website (https://www.energystar.gov/productfinder/product/certified-water-heaters/results) is very useful for comparing specifications, including UEF and First Hour Rating and other characteristics for up to 4 alternatives at a time.

Installers should provide model numbers in their proposals. You can then download installation and use manuals for a few final candidates. Available Alliance Coaches may be able to assist with making comparisons to help you choose a model.

C2. Noise Concerns

While running, the fan and compressor of a HPWH generate some noise that does not occur for a conventional electric resistance water heater. This noise is not a concern for most installations, but may be a concern if the HPWH is located adjacent to a bedroom or other frequently occupied living space. Homeowners who have HPWHs installed in their basements generally report that the noise is unobjectionable. Following are some techniques for reducing noise, in rare situations where there is reason for concern:

During planning and installer selection:

- Include a maximum noise level of 50 dBA as a requirement.
- Speak with others who have HPWHs, such as references that installers provide.
- If louver venting is needed because the room is too small, note that some noise may be transferred through them.
- From passive home consultant Mike Duclos: “Resonance is also a consideration. Rheem has an under-unit sound isolation pad to acoustically de-couple the unit when installed on framed floors.”

During Installation:

- Insulate water supply lines to reduce noise, especially near the tank.
- Use PEX (Cross-linked polyethylene) water lines which may reduce noise conducted to the water supply lines throughout the house. Flex joints for this purpose are also available.
- Ensure that any transport hold downs of the compressor are removed and that it can freely move on its flexible mounts.
- Spin the fan to verify that it is not hitting or scraping against anything and balance weights are in place.

After installation:

- In accessible areas, add split tubular pipe insulation around the water supply pipes. This is an easy DIY project.
- Most HPWHs have a clock and a way to set up intervals each day during which the heat pump will not run. This feature, included mainly to capture lower electric rates during off hours, can also be used to mitigate noise during certain time periods. If noise is objectionable, depending on your usage pattern, you could program it to disable the heat pump during sensitive hours, for example by letting it run only overnight, when it can prepare for the next day while residents sleep elsewhere. Depending on one's water-use patterns, this may reduce the overall efficiency of the HPWH with a consequent increase in electricity use and GHG emissions.

C3. Thoughts on Lifespan of HPWH vs. Conventional Electric WH

In Section 2.1, we showed that HPWH are robust, and can last longer than conventional electric water heaters. Here, we present thoughts on why the lifespan of Hybrid HPWHs is longer, even though most models of both types use the same glass-lined steel tank technology.

Temperature changes inside a HPWH tank are much slower and less spatially-concentrated than in a conventional tank. Relative to typical 4 kW resistive heating elements, an HPHW's condenser coil, wrapped around the outside of the steel tank,

- Runs at a much lower temperature
- Experiences slower-changing temperature, and
- Distributes heat over a much bigger area.

Because the condenser coil is the main heating mechanism, with the resistive heating elements used only for occasional back-up if at all, thermal stress on the vulnerable steel tank is far less than in a conventional electric water heater in which the electric elements switch on and off during every heating cycle. Especially vulnerable are the tank penetrations for electric elements. We therefore believe that, given periodic replacement of anode rods or incorporation of powered anode rods, reduced dynamic thermal expansion stress extends the lifespan of glass-lined steel HPWH tanks. And wear and tear on the resistive heating elements is greatly reduced because they seldom turn on.

C4. CTA-2045 Port For Future Low-Cost Grid Interaction

ANSI/CTA-2045 is a standard, open communications protocol and physical port for electricity-using appliances. The port is analogous to a computer USB port, which accepts universal communication modules (UCMs) that can network with other devices, a building network, or the electric grid. Some HPWHs have a CTA-2045 socket for future compatibility with utility demand response automation.

Appendix D. Request-for-Proposal Examples

Before contacting the installers, it may be helpful to write a brief Request for Proposal (RFP) listing your requirements. Even if this document is not provided to installers, it should be useful to guide your discussion with each installer during home visits. Following are two examples of RFPs that you can tailor to meet your needs. Providing the RFP to all candidate installers may result in proposals that are more consistent, complete, and easier to compare. The Basic RFP is sufficient for many homeowners, while the Detailed RFP includes everything we could think of or find recommended in references. Included are suggestions from "Questions to Ask Your Installer" in the HPWH GUIDE.

Basic RFP

Company Name _____ Representative Name _____
Phone_____ Email_____ Date_____

Please submit a proposal to install a Hybrid Heat Pump Water Heater in compliance with the following:

Requirements

1. Include brochure or model number of each proposed alternative Hybrid HPWH tank
2. UEF of at least 3.2
3. All necessary electrical & plumbing permits
4. Workman's Comp & General Liability Insurance
5. Per most HPWH instructions, keep the tank upright during transport and installation
6. Include disposal of old equipment

Questions that we expect to be answered in your proposal:

1. Where will the condensate drain go?
2. What is the installation price and what incentives may be available? Is your HPWH distributor participating in the MassSave instant savings?
3. Will I need an electrical upgrade?
4. Do you provide a warranty for the systems you install? What are the different warranty options?
5. Have you participated in manufacturer training for the systems you would install, and can you provide references from previous customers? Please list a few local references where the same equipment was installed

Proposal valid until _____

Detailed RFP

Company Name _____ Representative Name _____
Phone_____ Email_____ Date_____

Please submit a proposal to install a Heat Pump Water Heater in compliance with the following

Requirements

1. Brand and model, if you have a preference
2. Include brochure or model number of each proposed alternative Hybrid HPWH tank
3. Energy Star Rated (Please include a copy of each EnergyGuide label)
4. UEF of at least 3.2
5. Noise level not greater than 50 dBA while compressor is running
6. Keep intake and exhaust duct connections accessible for possible future use
7. Flexible cold/hot piping to tank for noise isolation – flexible piping / PEX ?
8. All piping to be well insulated, homeowner can do / assist with this
9. Keep piping short and direct, avoiding elbows where reasonable.
10. All necessary electrical & plumbing permits
11. Workman's Comp & General Liability Insurance
12. Per most HPWH instructions, keep the tank upright during transport and installation.
13. Unless included or re-used from old tank, please price the following as independent options:
    a. Disposal of old equipment
    b. Mixing valve ASSE 1017 to limit hot water temperature
    c. Install leak pan under tank
    d. Install cold water feed shut off valve near WH
    e. Louvers and/or Ducting if needed to overcome small room volume
    f. Powered Anode Rod

Site characteristics

1. Number of steps from outdoor level _____
2. Tank location _____e.g. Walk in basement location, flat access from garage
3. Approximate volume of room where tank will be installed _____Cubic Feet
4. Electrical circuit for existing water heater _____Amps (on breaker) Volts _____(120 if single pole, 240 if double)
5. Ceiling height _____Feet _____Inches
6. Existing drain distance _____Feet _____Inches and height _____Feet _____Inches

Questions that we expect to be answered in your proposal

1. What size water heater tank do I need? Is my current water heater over- or undersized for my hot water load?
2. Do I have enough space for a heat pump water heater?
3. Where will the condensate drain go?
4. How will the controls be set up? Will it have Wi-Fi integration? Will it have leak protection?
5. What is the installation price and what incentives may be available? Is your HVAC distributor participating in the MassSave instant $750 savings so you can pass that on to us?
6. Aside from annual electricity costs, what other annual costs can I expect (such as regular maintenance or parts)?
7. How far in advance can we plan the installation, and how long does the installation take?
8. What should I do to prepare for the installation?
9. Will I need an electrical upgrade?
10. Do you provide a warranty for the systems you install? What are the different warranty options?
11. Have you participated in manufacturer training for the systems you would install, and can you provide references from previous customers? Please list a few local references where the same equipment was installed.
12. Will you hire subcontractors to complete portions of the project? If so, what will they do? What are the names of these companies and how long have you worked with them?
13. Will you provide training on how to properly operate and maintain the system (i.e., thermostat settings, cleaning air filters, etc.)?

Available Alliance volunteer coaches may review proposals you receive and discuss follow-up questions and requests.