**Building Science Education Solution Center – Decision Guidance for HPWH**

Proficiency Level 1: Remember

**Learning Objectives 1.1:**

* Identify the key installation challenges that must be considered when installing a HPWH, including:
	+ Space considerations, such as room temperature and clearance space
	+ Installation requirements for electrical, plumbing connections, and condensate drainage

**Lecture Notes 1.1:**

References:

Hot Water Solutions. *Heat Pump Water Heater Installation Best Practices*. Accessed 2023.
 < https://hotwatersolutionsnw.org/assets/img/documents/hws-installation-best-practices- guide.pdf>

ENERGY STAR. *Is a Heat Pump Water Heater right for your home?*. Accessed 2023.
 < https://www.energystar.gov/products/ask-the-experts/is-a-heat-pump-water-heater-right-for- your-home>

When installing a heat pump water heater (HPWH), there are several key challenges that should be considered before installation begins. Some of these challenges include the space required, electrical capacity, condensation, cold exhaust air, noise, and plumbing connections. Heat pump water heaters tend to be taller and wider than other water heaters with similar tank capacity. This is due to the heat pump components of the unit, usually found at the top of the water heater. In addition to this, because the heat pump requires additional space to facilitate air ventilation, the volume of space needed to install a HPWH is usually higher than other conventional water heaters of similar size. It is recommended that a HPWH should be installed in a space with 700 cubic feet (19.8 cubic meters) of air space around the water heater. For optimal efficiency, the space should be able to maintain a temperature range of at least 40ºF (4.4ºC). For spaces that do not meet these airflow requirements, see Level 2 for possible modifications to the space.

*Electrical Service*
Currently, most new homes have an electrical service of 200A. However, some older homes may have electrical service of less than 100A. Since power needs to be supplied to both the heat pump system and the backup electrical resistance rod, 240 volts and 30 amps are required for some units. This requirement can limit the installation location, and a residence’s general ability to install a HPWH. To check if a home is ready to accommodate the 240V/30A requirement at a given location, or how to modify the home’s electrical system to do so, refer to the lecture module **Electrical Panels** for further information. Keep in mind that this work should be performed by a trained electrical technician and not the homeowner. Another option is to use alternative equipment, such as a lower input rate 240V/15A HPWH or a 120V/15A HPWH. For more information on 120V HPWH models, see **Learning Objective 1.2**.

*Condensate Management*The creation of condensate is a standard part of HPWHs and should be addressed accordingly when installing a HPWH. To address condensation, a floor or sink drain should be located nearby. In the absence of a nearby drain, a condensate pump can be used (the condensate pump will require its own outlet connection). Additional guidance can be found in the **Installation of HPWH** lecture module.

*Noise Management and Location*Noise created from HPWHs can be substantial and should be accounted for when choosing a location for which to install the water heater. The noise generated is a low soft humming sound, similar to the noise generated by a dishwasher or a refrigerator. The majority of HPWHs generate sound less than 55 dBA[[1]](#footnote-2). The sound is caused by the moving fan and compressor components of the heat pump on the appliance. This source of sound is expected, and not an indicator of an issue or error. Additional, distinctive sounds not caused by the heat pump system can be an indicator of an issue. Because of the sound generated from the heat pump and the cold, dry air exhausted from the fans, it is generally recommended that the unit is installed in a remote part of the house that is adequately conditioned with sufficient space. Avoid locations near a thermostat, as the exhaust may impact HVAC operation. Usually, these requirements make them best for basements or garages.

*Piping Considerations*
If replacing an older water heater, it is important to take note as to the location of the inlet/outlet points on the water heater. In older water heaters, it is common for these connection points to be at or near the top of the water heater, but due to the heat pump components of a HPWH being located at the top, these inlet/outlet points are likely to be found on the side instead. Longer supply lines will need to be installed, using solid and flexible pipe connections, in order to reach the inlet/outlet points. Some models of HPWHs may have top connections for inlet and outlet water, making them easier to install as replacements.

**Problem Set 1.1:**

1. Name three requirements for installing a heat pump water heater?

**Learning Objectives 1.2:**

* Describe current or new technological developments for heat pump water heaters
	+ 120V/15A Models
	+ Grid interaction
	+ Cold climate HPWHs (Split-Type)

**Lecture Notes 1.2:**

References:

ENERGY STAR. *Ask the Experts - Do Heat Pump Water Heaters Work in Cold Climates?*. Accessed 2023. < https://www.energystar.gov/products/ask-the-experts/do-heat-pump-water-heaters-work- in-cold-climates>

*120V/15A Models*
Most HPWH models require a 240-volt connection and a 30-amp circuit. Some newer models of HPWHs offer options that utilize a 120-volt connection and a 15-amp circuit instead. They can plug directly into an existing outlet using a 6 – 8 ft. (1.8 – 2.4 m) cord, though the amperage of the connected circuit should be verified. This change makes them more accommodating and compatible with older homes that may not have the required electrical capabilities to install a standard 240V/30A HPWH. The lower electrical requirements make them more accessible for gas retrofit installations, where an open circuit may not exist. The trade-off on these 120V/15A models is that they have either a smaller electrical resistance heating element to provide backup heat, or no backup element. This lowers their ability to generate hot water on-demand and during non-ideal environmental conditions. The 120V models generally have a lower first hour rating as a result. Efforts to mitigate the lowered on-demand hot water generation include maintaining higher water temperatures while on standby, which can be accomplished using integrated or aftermarket mixing valves.

*Grid Integration*
Grid integration is becoming more desirable in common household appliances, including HPWHs. Additional factors and installation requirements are also needed for grid integration, such as the installation of an American National Standards Institute (ANSI) certified device that allows for communication between appliances and utilities. An example of such a device is a CTA-2045 device. Currently, CTA-2045 devices are the standard add-on for HPWHs to gain the capability to actively interact with the grid and be adjusted in real time by utility providers. Benefits of having grid interaction include having the capability to participate in peak rebate programs administered by local utility providers. These programs offer monetary incentive for gaining control of large electrical appliances during peak power grid usage, in which they reduce the operational demand of interactive units. As this technology becomes more common, and expected as a standard feature, the means to connect to it are becoming more standardized as well. Additionally, newer models are being released with the in-built ability to be remote controlled by connecting to a pre-existing wireless network such as Wi-Fi. This development into smarter home appliances and system can facilitate opportunities to install HPWHs that can integrate with grid responses and take advantage of the benefits associated. For more information on installation requirements for CTA-2045 devices, refer to the **Load Shifting** lecture module.

*Cold climate HPWHs (Split-Type)*
Cold conditions can have a negative impact on the efficiency of HPWHs. Environmental temperatures below zero limit the location in which HPWHs can be installed in a residence in much of the northern and midwestern United States. As advances in refrigeration technology have been made, HPWH have likewise been able to operate effectively at lower temperatures. However, the HPWH releasing cold air into the indoor airspace where it is located is still a significant issue in these colder climates. To address this shortcoming, split-type HPWHs can be used instead. With an indoor water storage tank and an outdoor compressor, these systems can extract heat from outside the house instead of from the indoor airspace. Some split-type HPWHs are effective down to -25°F (-31°C), allowing for effective heat pump water heating even in colder climates in the United States. Additionally, these systems are easier to accommodate for in height constrained space due to the heat pump being separate from the tank, resulting in a shorter unit. But split-type HPWHs can also be significantly more expensive than an integrated system, and the additional cost may be greater than the reduced energy cost. These factors make split-type HPWH applications a niche solution. Some split-type HPWHs are not designed for outdoor operation in all climates, so be sure to verify the equipment specifications.

**Problem Set 1.2:**

1. What key difference in 120V/15A HPWH models makes them good fits for gas retrofit installations?
2. What are two potential use-cases for split-type HPWHs?
1. Hot Water Solutions: Heat Pump Water Heater Installation Best Practices [↑](#footnote-ref-2)