Pacific Northwest
NATIONAL LABORATORY

U.S. Department of Energy Heat Pump Water Heater Installation Tool

November 4, 2024

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U.S. DEPARTMENT OF ENERGY BATTELLE

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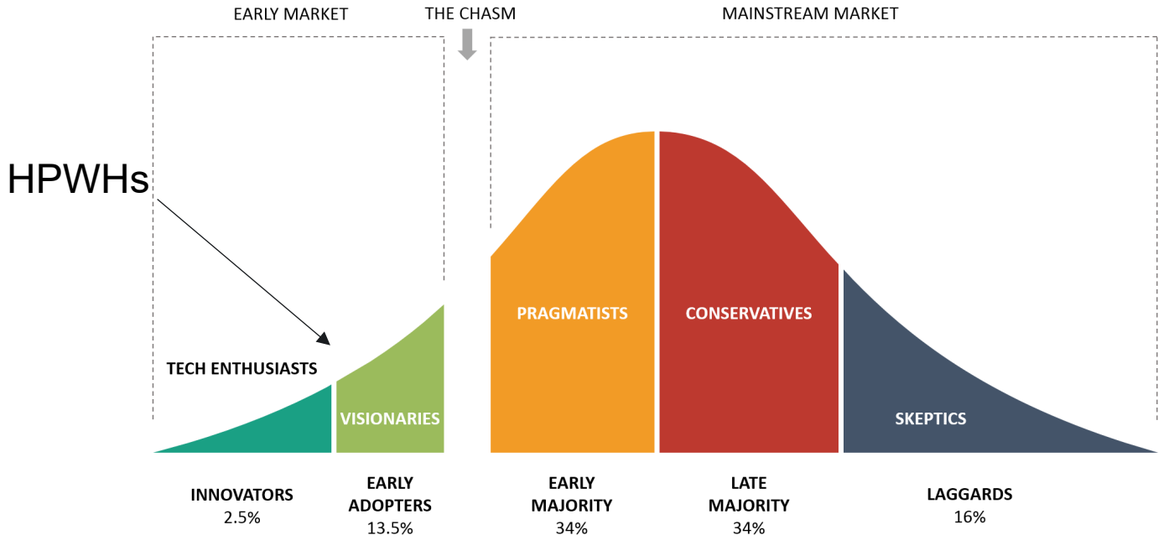
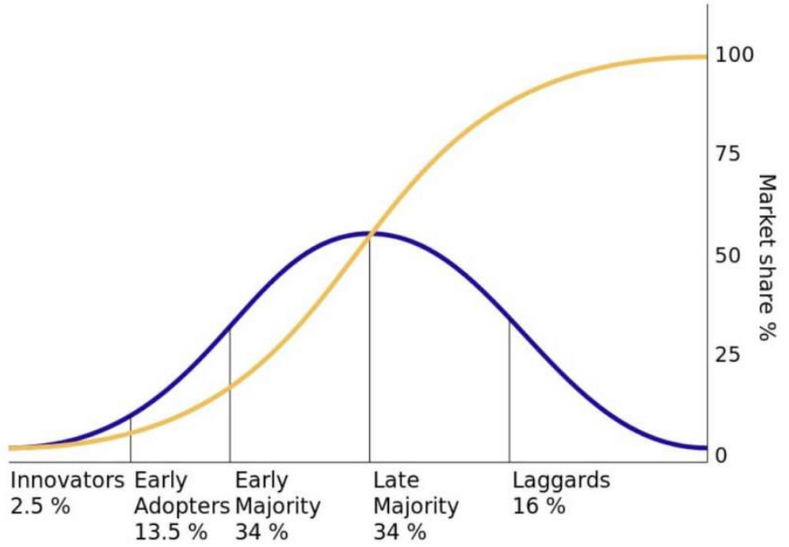
Agenda

- Background
- Purpose of the Tool
- Key Barriers Addressed by Tool
- Tool Inputs
- Tool Results
- Next Steps

Background

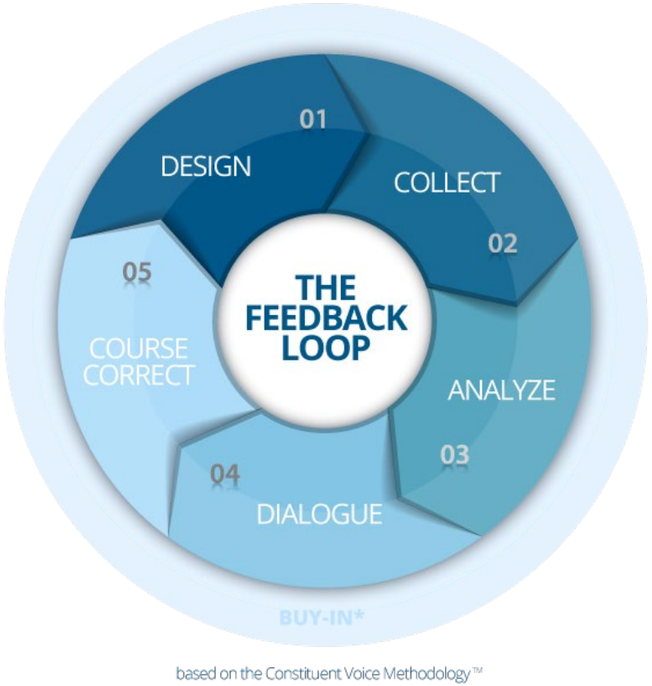
- Heat pump water heaters (HPWH) consume 60-70% less electricity than electric-resistance water heaters, and reduce greenhouse gas emissions substantially compared to gas water heaters
- Major manufacturers have offered HPWHs since 2009, and more than 200 models are in the market
- HPWHs have a low (~4%) but rapidly growing market share (35% growth from 2022 to 2023)
- Inflation Reduction Act incentivizes HPWHs for 10 years, reducing the first cost barrier
- DOE published a final rule requiring minimum energy efficiency standards that only HPWHs can achieve for electric storage water heaters greater than 35 gallons (compliance date: May 6, 2029)





Purpose

- In retrofit scenarios, HPWHs are more complicated to install than a like-for-like replacement – so installers are less likely to recommend them!
- Identified a need for comprehensive guidance on HPWH sizing and installation process for the supply chain, namely:
  - Installers and installer call center staff
  - Sales associates (retail and wholesale)
  - Do-it-yourself homeowners
- Tool was built upon industry best practices and latest research
- Refine the tool through feedback from installers, wholesalers, REEOs, program managers, and other subject matter experts



Source: energy.gov

Key Barriers Addressed by Tool

- To address HPWH installation across the U.S., guidance is needed for how to approach different home installation scenarios, focusing on key barriers:
  - Sizing to home's peak water heating load
  - Space constraints
  - Air volume or airflow requirements
  - Condensate management
  - Electrical considerations
- Tool results are tailored to each installation by asking **simple questions** about the home and existing water heater
- Installers or call center staff with limited HPWH experience can **learn** how to address various installation scenarios

Barriers – Sizing

- Start with bedrooms and bathrooms – Uniform Plumbing Code (UPC)

# Bathrooms	1 to 1.5			2 to 2.5			3 to 3.5			
# Bedrooms	1	2	3	2	3	4	3	4	5	6
UPC Min FHR	38	49	49	49	62	74	62	74	74	74

First hour rating does not tell the whole story for HPWHs!

- Developed adjusted HPWH first-hour delivery capability based upon design day (i.e., normalized worst-case) conditions for peak water heating load
  - Ratio of HPWH design-day delivery capability to HPWH's FHR test delivery capability
  - Apply ratio (i.e., multiplier) to the UPC recommended FHR
- Matched the adjusted first-hour delivery capability with the FHR of major product types:
  - 240-volt 20-30A or 240-volt 15A
  - Plug-in 120-volt shared-circuit 15A

Barriers – Space Constraints

- HPWHs are taller and wider than conventional water heaters
  - Typical 40-gal gas storage water heater is 60" tall x 20" in diameter
  - Typical 50-gal electric-resistance storage water heater is 62" x 22"
  - In contrast, 65-gal HPWH with a similar FHR is 72" x 26" in diameter
- Additional clearance needed for installing condensate drain line and accessing air filter on top for certain HPWH models
- Split-systems are an option for exceptionally constrained installs

Source: EnergyStar.gov

Barriers – Air Volume or Airflow

- HPWHs have air volume requirements
  - For 240V HPWHs, energy efficiency is primarily affected
  - For 120V HPWHs, both energy efficiency and hot water delivery are affected
- When the HPWH location is air volume constrained, interventions can provide necessary airflow:
  - Louvered door
  - Ducts
  - Grilles

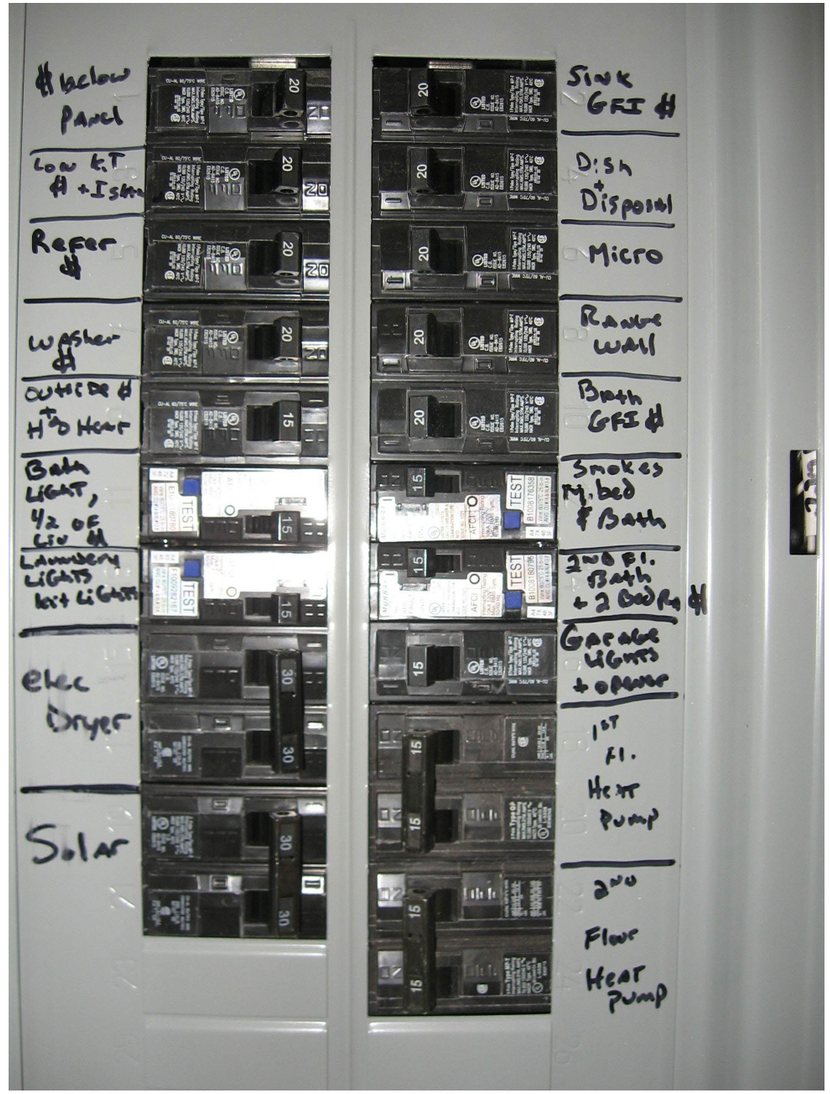
Example: Water heater location with airflow and space challenges

Barriers – Condensate Management

- HPWHs produce pH neutral condensate (i.e., distilled water)
- Location may not have direct access to an existing condensate drain
- Options for draining condensate, whether pumped or gravity-fed:
  - Floor drain
  - Utility sink
  - Clothes washer drain line
  - HVAC drain
  - Sink drain
  - Sump pump basin
  - Outside in warm climates

Barriers – Electrical

- Replacing fossil fuel water heaters with HPWHs calls for assessing home's electrical panel capacity to determine the appropriate HPWH type (120V versus 240V)
- In older homes without electrical panel updates or subpanels, panel capacity may be a limitation
- Tool's calculations are based on the National Electric Code (NEC) with some simplification



Tour of the Tool - Introduction

ENERGY.GOV
Office of ENERGY EFFICIENCY & RENEWABLE ENERGY
Building America Solution Center
Help User Enter keywords
PROGRAMS & GUIDES RESOURCES PUBLICATIONS & RESEARCH

EERE » BTO » Building America » Solution Center Home » Heat Pump Water Heater Installation Tool

Heat Pump Water Heater Installation Tool

Welcome! The goal of this tool is to help you through the decision-making process for **heat pump water heater (HPWH)** product selection and installation.

- About This Tool

Before using this tool, please collect pictures of the water heater location, electrical panel, and existing water heater nameplate.

Who this tool is for:

- Installers
- Installer call center agents
- Sales associates (retail and wholesale)
- Homeowners

Estimated time to complete the form:

- Up to 10 minutes

Results include:

- HPWH size
- HPWH type
- Further installation guidance

Installers unloading a heat pump water heater.
Image credit: Hot Water Solutions

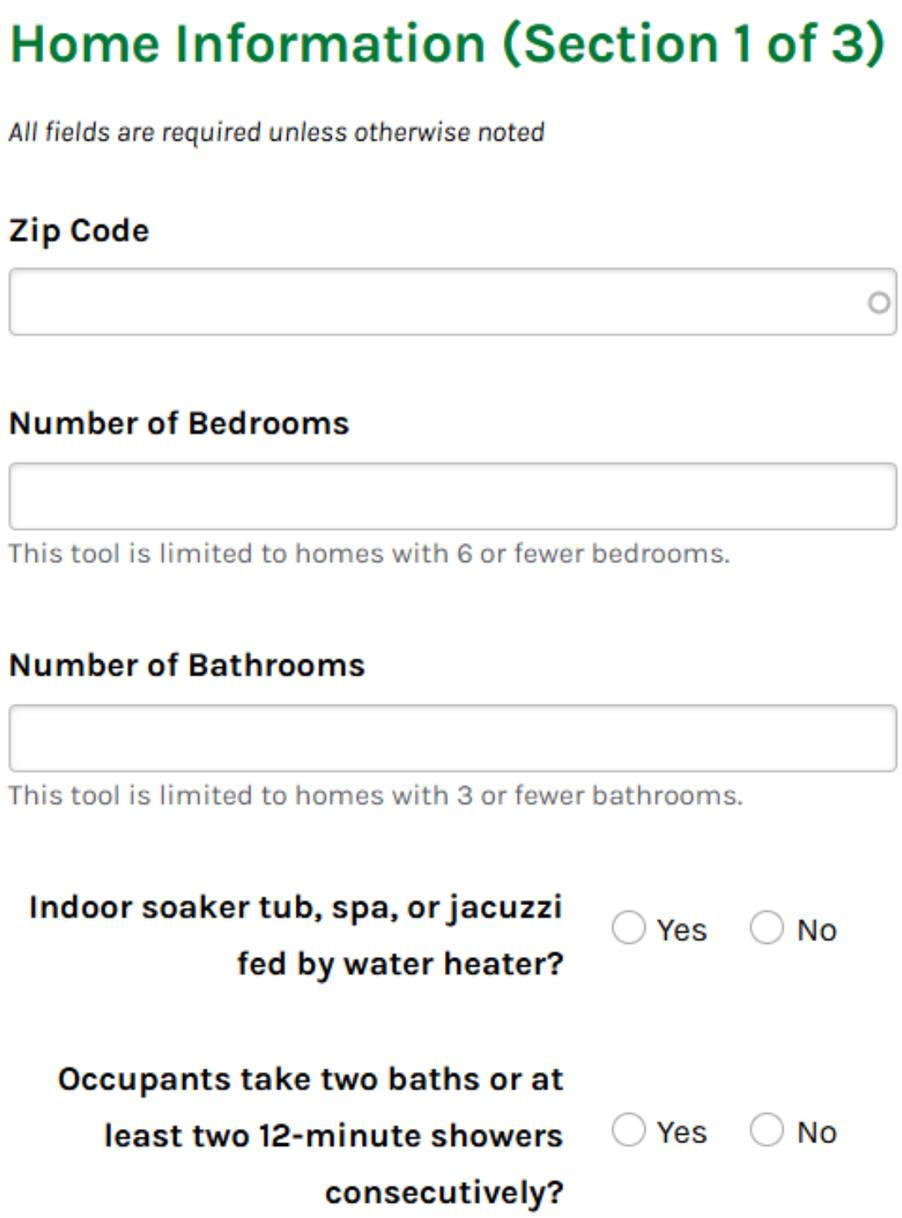
+ What is a Heat Pump Water Heater?

+ Benefits of a Heat Pump Water Heater

Tool Inputs

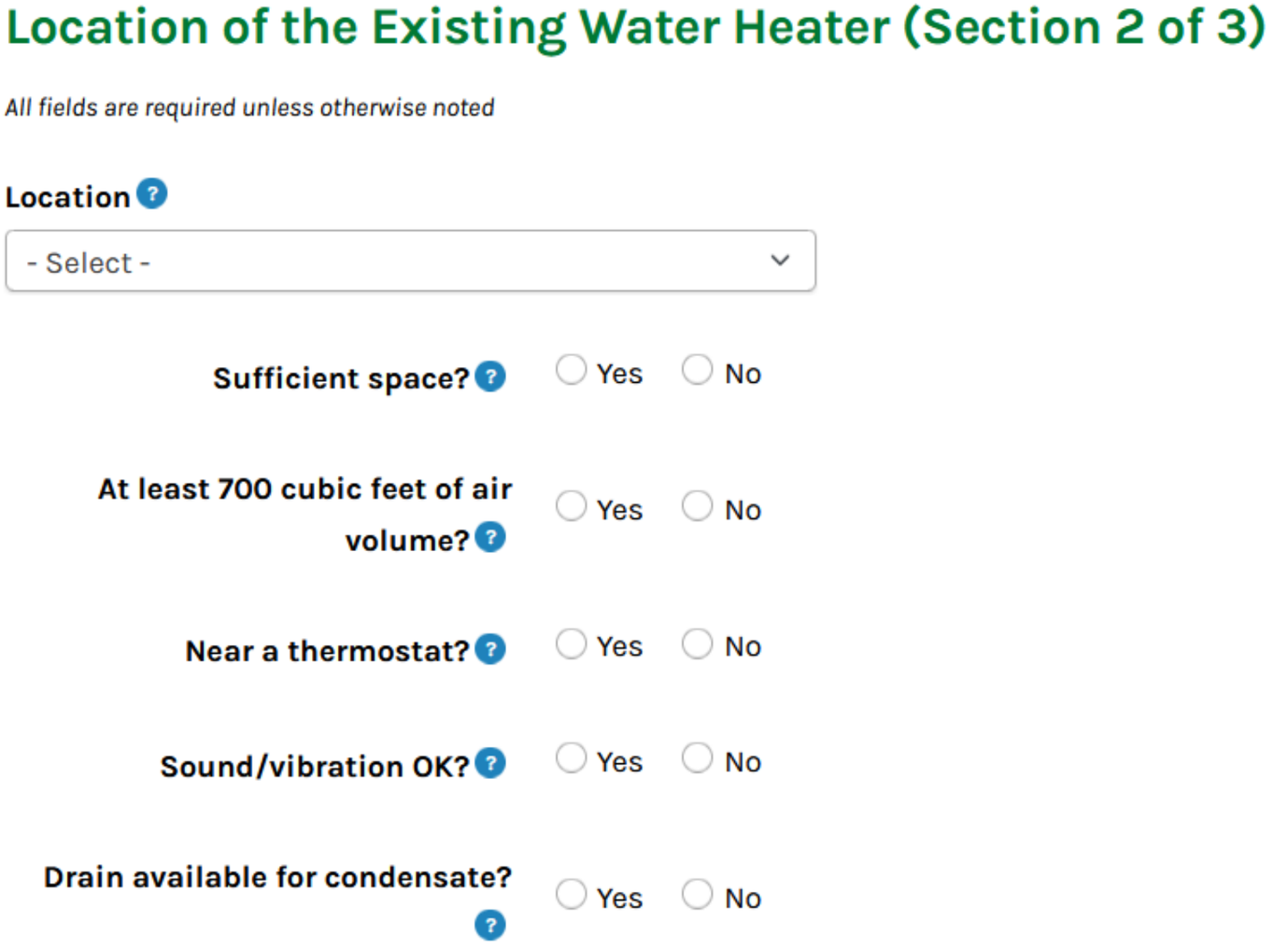
Web address for online version of tool:
https://basc.pnnl.gov/hpwh_installation_tool

In the first section, the tool begins with asking users for high-level information on the home



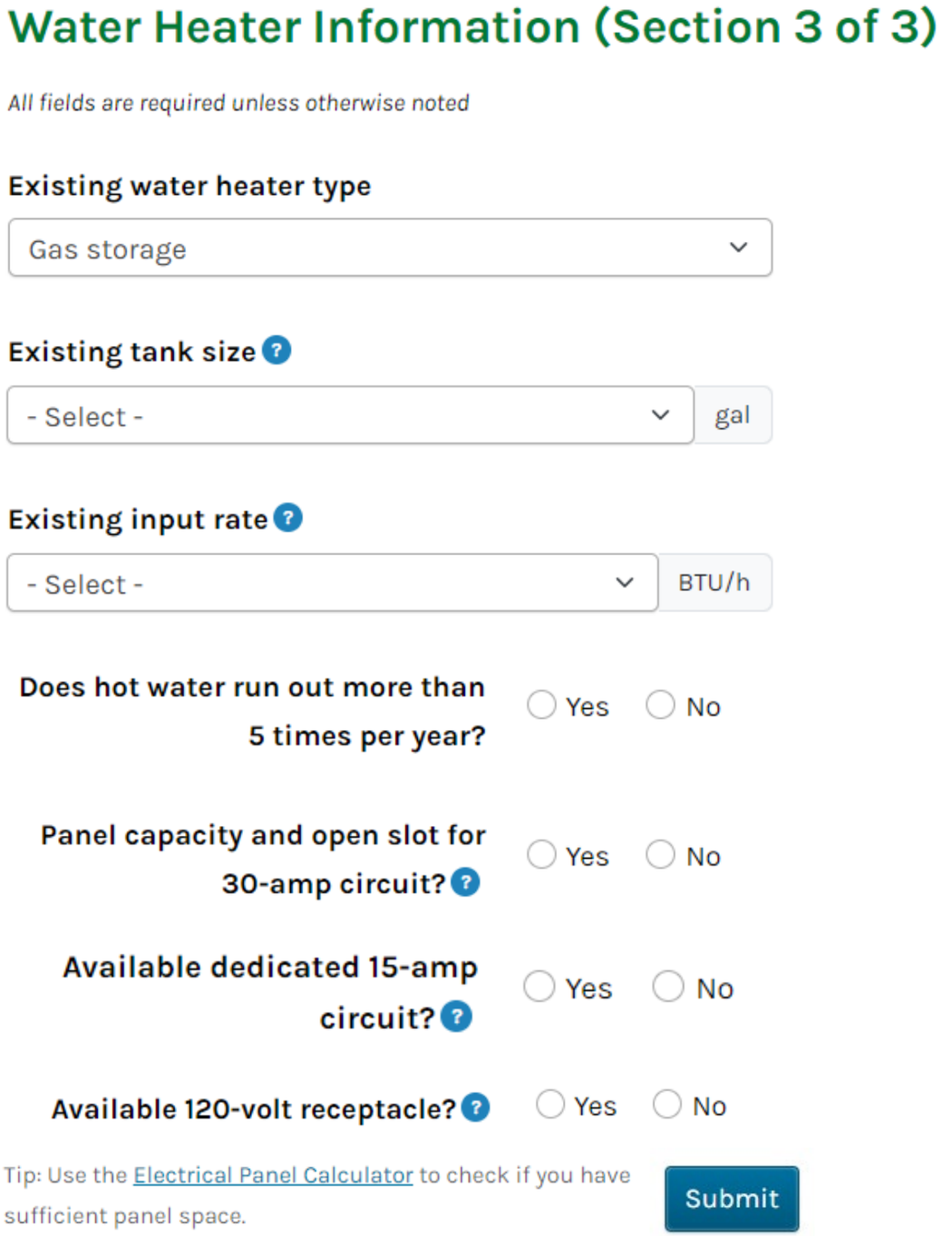
Tool Inputs

In second section, the tool asks users about water heater location



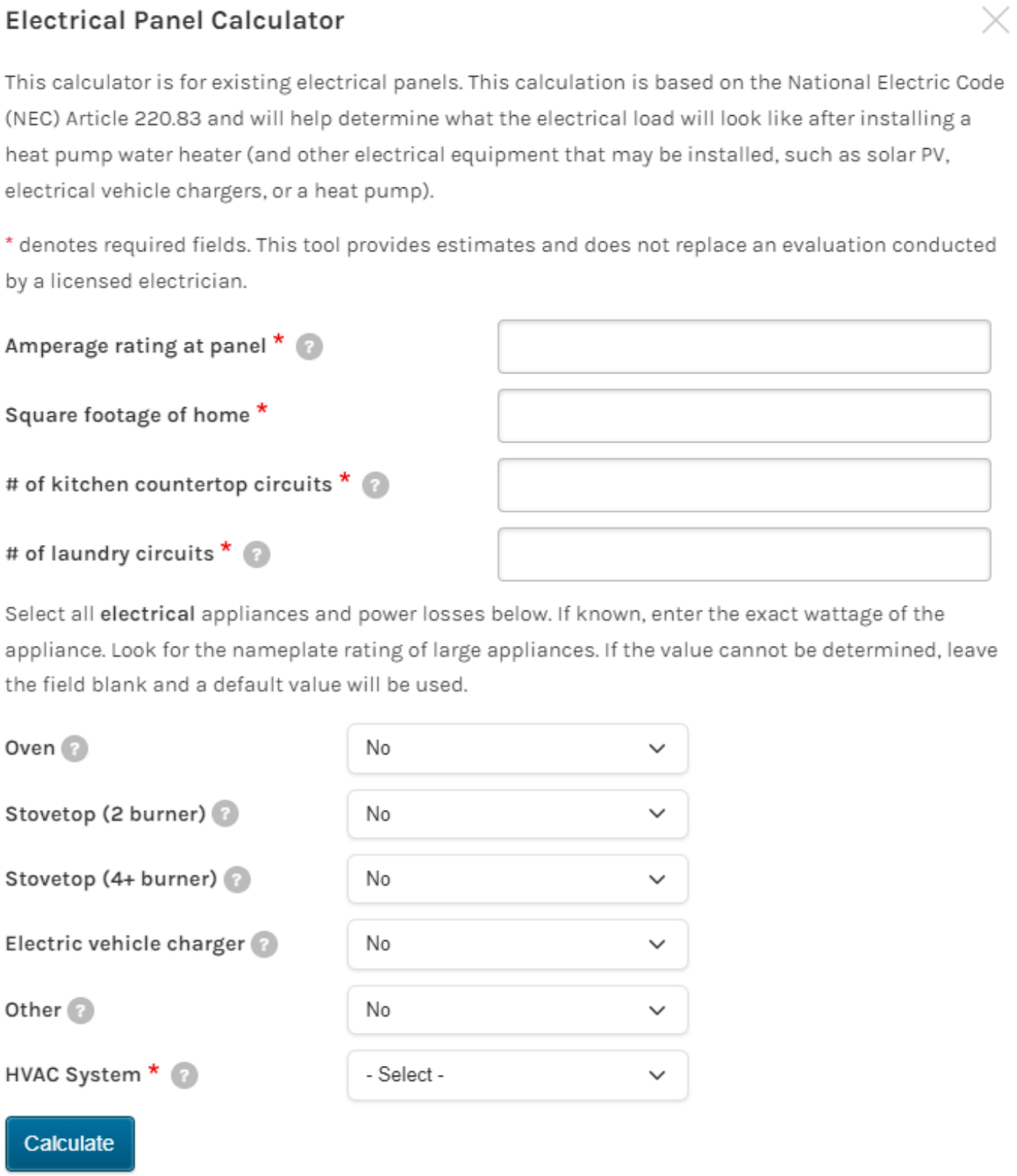
Tool Inputs

In the third section, the tool asks for additional water heater information



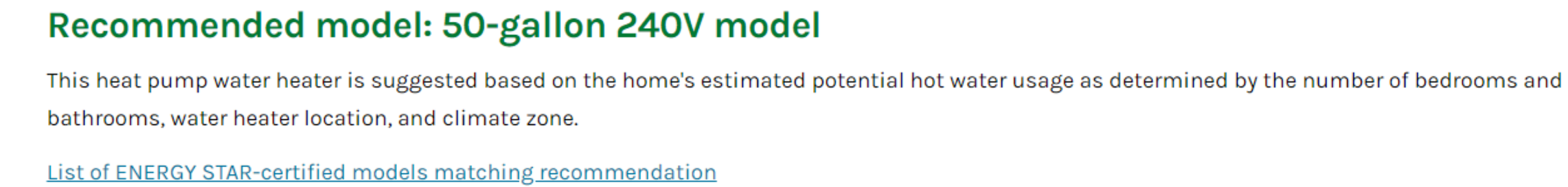
Tool Inputs

In final section, if selected by user, an electrical panel calculator (via pop-out page) is available to help users in need of panel capacity guidance



Tool Results

- After the user selects responses and submits, the tool returns guidance
- First section of the guidance is the Recommended HPWH model based on the home's peak water heating load



Tool Results

Second section is the customized installation guidance with specific guidance on location, condensate, and electrical.

Installation Guidance

The following is general installation guidance. Refer to manufacturer literature for guidance specific to each heat pump water heater model. Ensure that proper permitting occurs and follow all applicable codes.

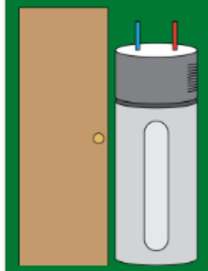
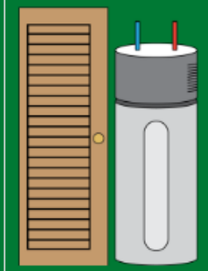
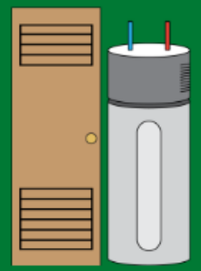
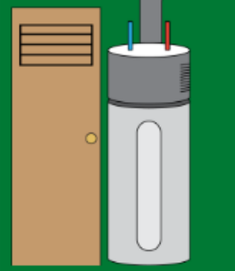
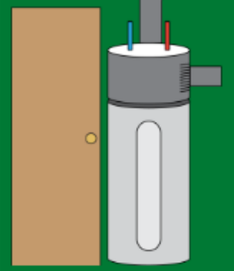
LOCATION GUIDANCE	
Current water heater location is sufficient for installation of a HPWH. Prior to installing the HPWH, refer to best practices.	
Air Volume	Ensure that the air volume in the room is not decreased below the limit by adding items (ex. Storage boxes) to the space. Consult product literature for exact air volume requirements as they vary by manufacturer.
Sound / Vibration	Install a R-10 rigid foam pad and rubber mat/shims underneath the water heater to reduce potential sound and vibration.
CONDENSATE	
Install a condensate cleanout "T" connection to the HPWH condensate outlet so the line can be cleared of blockage if necessary. Use PVC pipe or tubing (typically 3/4-inch diameter or larger) to connect the condensate T connection to the existing condensate drain or line. If the condensate line is gravity fed, the minimum drain line pitch should be 1/8-inch fall for every 12 inches of horizontal run. If the drain line calls for supports, they should installed every 4-feet of horizontal run (while maintaining proper pitch) and every 10-feet of vertical run. If a condensate pump is needed, install a 2 gallon-per-minute pump with the condensate line. If the HPWH is located in a basement, select a pump with double the lift to the highest point in the drainage line. If the HPWH is located near an HVAC system with an existing condensate pump, consider using the same pump for the HPWH condensate line by tying it in with a T connector. Do not utilize an extension cord for the condensate pump unless it is approved by the code.	
ELECTRICAL	
If an existing or new 30-Amp circuit is used, an electrician should route 10-gauge wire and conduit to the 240-volt heat pump water heater, connect the wiring at the water heater's junction box, and ensure the wiring is grounded. The retrofit process will include capping the gas line and sealing the chimney/vent.	

Tool Results

Second section with air volume and/or airflow guidance (if air volume constrained)

LOCATION GUIDANCE

Air Volume Consider interventions to the space to accommodate air volume and airflow.

	 Enclosed room	 Fully louvered door	 Upper and lower door grilles	 Inlet or exhaust ducting and half-louvered door or single door grille	 Inlet and outlet ducting
> 700 ft^3	✓	✓	✓	✓	✓
84 - 700 ft^3		✓	✓	✓	✓
< 84 ft^3				✓	✓
Minimum Room Dimensions (ft)	8 x 8.75 x 10	3 x 3.5 x 8	3 x 3.5 x 8	None	None

Ducting should occur within the conditioned space to prevent positive or negative pressurization of the home. Use insulated flex duct (e.g., R-6) or insulate rigid duct to prevent condensation. Upper and lower door grilles should provide 250 square inches total Net Free Area (e.g., two 18 inch x 8 inch grilles), and have 5 feet of separation.

Tool Results

Final section includes non-customized, static information:

Installation Best Practices

Note: this is not the full list!

Verify that the following installation best practices are followed to ensure proper heat pump water heater operation:

- Proper wire gauge is used and wire is grounded for safety.
- Temperature and pressure relief (T&P) valve is operational and drains properly.
- Condensate is safely conveyed to the drain, sink, or exterior.

Incentives and Tax Credits

- ENERGY STAR Rebate Finder
- ENERGY STAR Heat Pump Water Heater Tax Credits

Installer Finder

- ENERGY STAR Installer Finder
- Consider printing or creating a PDF of the tool's results to provide to the installer. The Print/PDF button is in the upper right corner.

Informational Resources

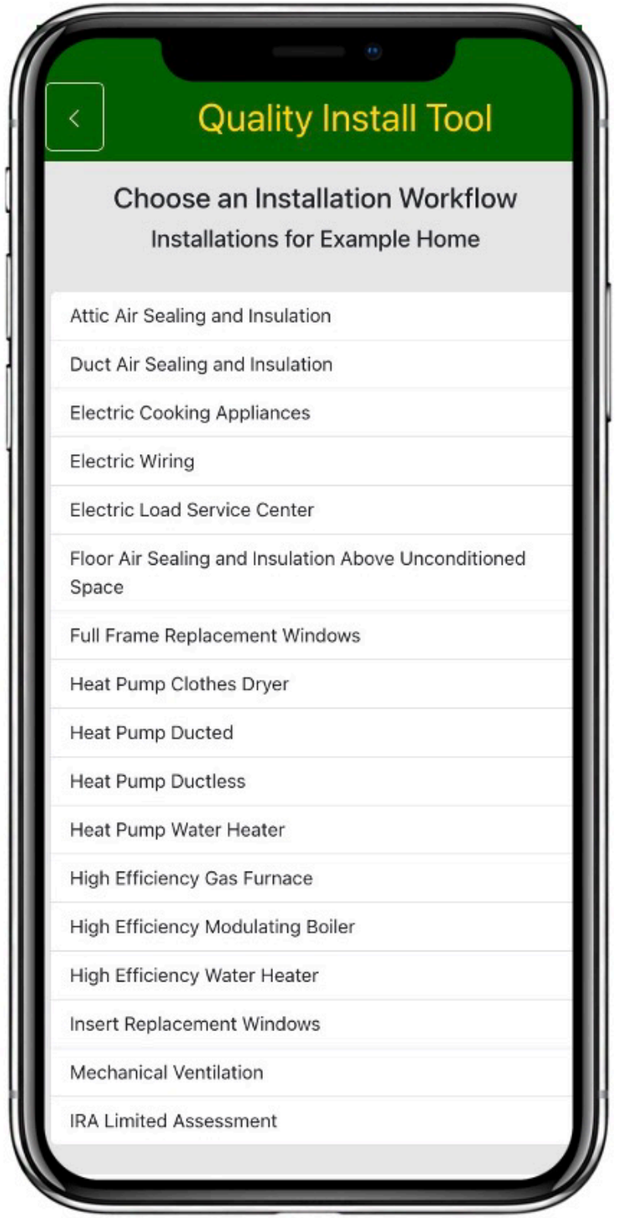
- RHA Best Practices for the Retrofit Installation of Heat Pump Water Heaters
- Hot Water Solutions Training Resources

Next Steps

- Help us publicize and promote the tool!!!
  - Presentations
  - Demonstrations
  - Outreach to stakeholders to include tool in their programs and on their websites
    - Energy efficiency programs
    - Training programs
    - Utility rebate or incentive offers
    - Others
- Continue improving tool through user feedback
- Tool is available at the following web address: https://basc.pnnl.gov/hpwh_installation_tool

Other Helpful DOE Tools

- Quality Installation Tool
  https://quality-install-tool.pnnl.gov/
- Validates the quality installation of equipment and retrofits via photo prompts
  - HPWHs
  - HPs
  - Envelope and upgrades
  - Electrical and electrical appliances
- Cold Climate Heat Pump Decision Tool
  https://basc.pnnl.gov/cchp_decision_tool
- Retrofit Decision Tool
  https://basc.pnnl.gov/retrofit_decision_tool



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Thank you

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