



**BUILDING
DECARBONIZATION
COALITION**

nbi new buildings
institute

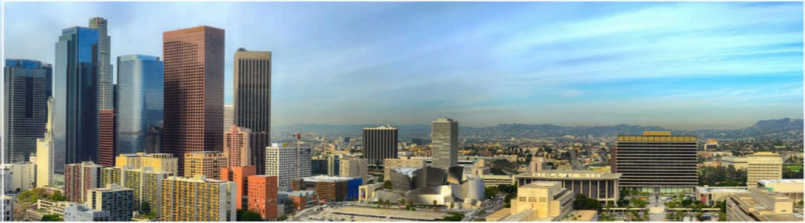


Building Decarbonization Coalition and New Buildings Institute Present:

The Retrofit-ready Heat Pump Water Heater:
120 Volts to the Future

OUR MEMBERS



Figure 1: Decarbonization Targets Within the Building Sector

	R		Commercial
New Buildings	20 B		Zero Emissions Building Code
Retrofits	%		Levels from the overall : from building sector from building sector from building sector
<ul style="list-style-type: none"> • Increase the space heating from 50% in 2025 to 100% in 2030. • Increase the space heating from 10% in 2025 to 100% in 2030. 			<ul style="list-style-type: none"> • 25% for space heating in 2025 and 100% in 2030 • 25% for water heating in 2025 and 100% in 2030

Roadmap Goals

Goal 1: Build customer, builder, contractor and policy-maker awareness and interest in decarbonization.

Goal 2: Ensure that customers receive a good value from adopting building decarbonization measures.

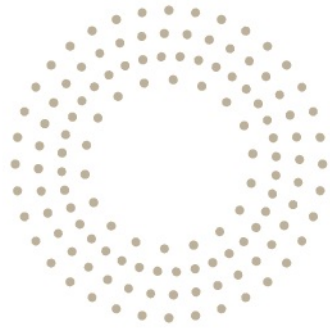
Goal 3: Ensure that building decarbonization provides a better value to builders and contractors than fossil-fuel heating.

Goal 4: Prepare supply-chains and ensure delivery agents are ready to meet rising demand for carbon-free building technologies with a quality product.

Goal 5: Align Policy to meet other goals.

Upcoming Webinars

June 10, 2021 – 10-11:00 am PT



**Bellwether
Coffee®**

buildingdecarb.org/upcoming-events

Webinar Logistics

- Everyone is muted
- Please ask your questions via chat and we will ask speakers to answer at the end of remarks
- This webinar is being recorded
- Members of the Coalition can access the recording on the website
-and lots of other great benefits



Building Decarbonization Coalition Presents

Join us!

[Buildingdecarb.org/join](https://buildingdecarb.org/join)



ADVANCED WATER HEATING INITIATIVE™

Retrofit-Ready HPWH Field Study and Commercialization



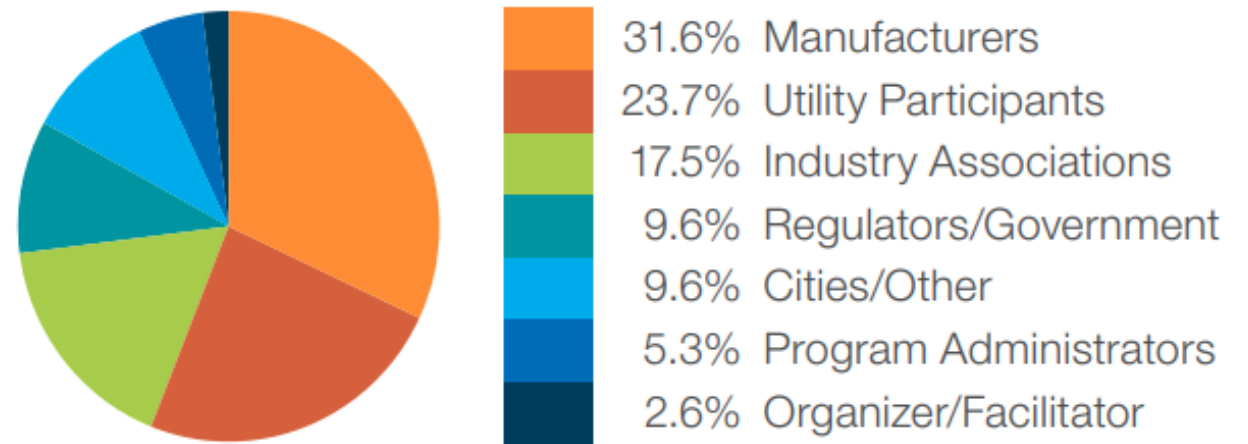
Amruta Khanolkar
New Buildings Institute,
Technical Project Manager

Advanced Water Heating Initiative



- 50+ organizations working to accelerate market adoption of efficient heat pump water heaters
- AHWI's vision: HPWHs are the preferred choice in all water heating applications

COUNT OF ORGANIZATION TYPES



- Led by New Buildings Institute

AHWI Sponsors/Partners



Link: <https://newbuildings.org/resource/advanced-water-heating-initiative/>

Retrofit-Ready Opportunity



118 million

Households with existing water heaters

4.6 million

Commercial with existing water heaters



40 million

Households with water heater >10 years old

7+ million

Water heaters replaced annually

1 GT

Carbon emissions saved over 12-year Lifetime

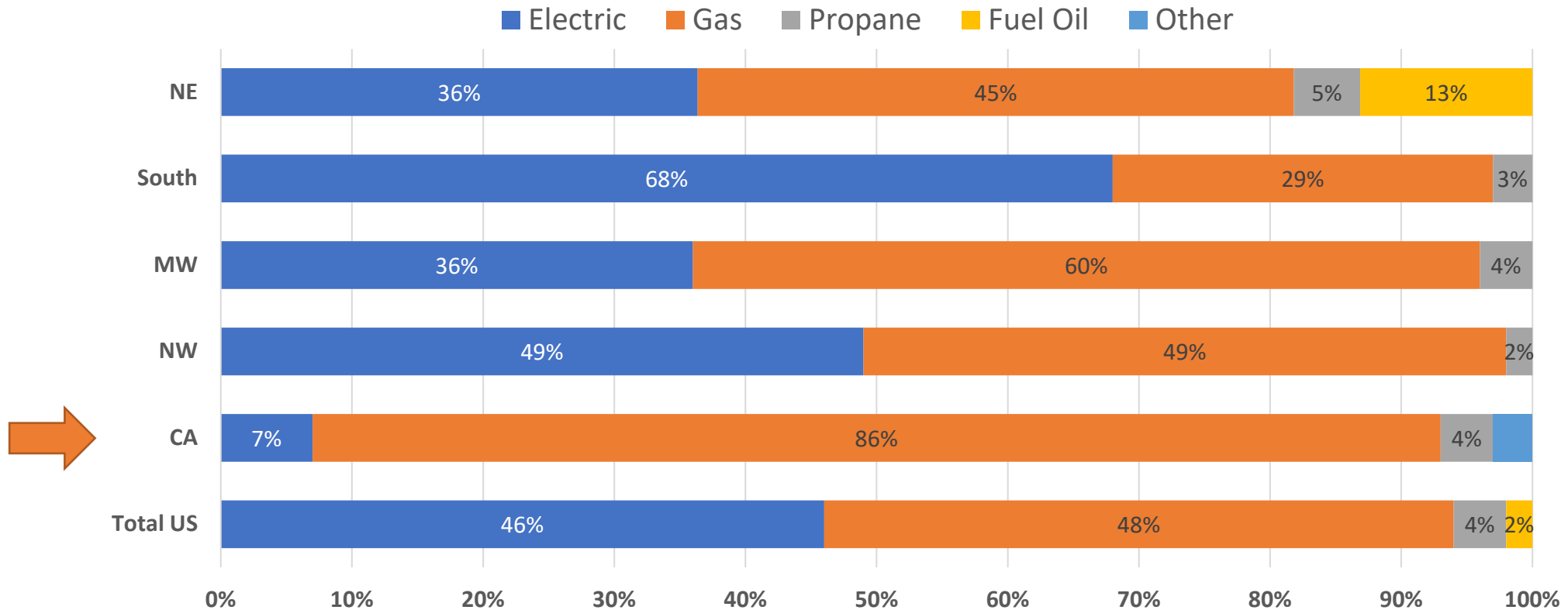
18



Coal fired power plants annually

Water Heating Fuel Mix

National Residential Water Heating Stock

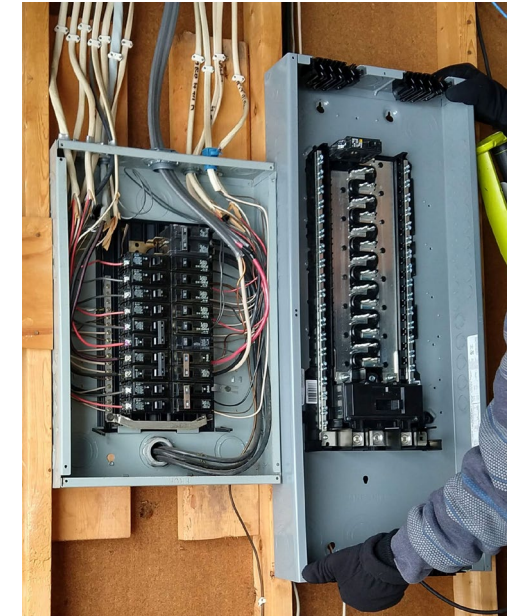
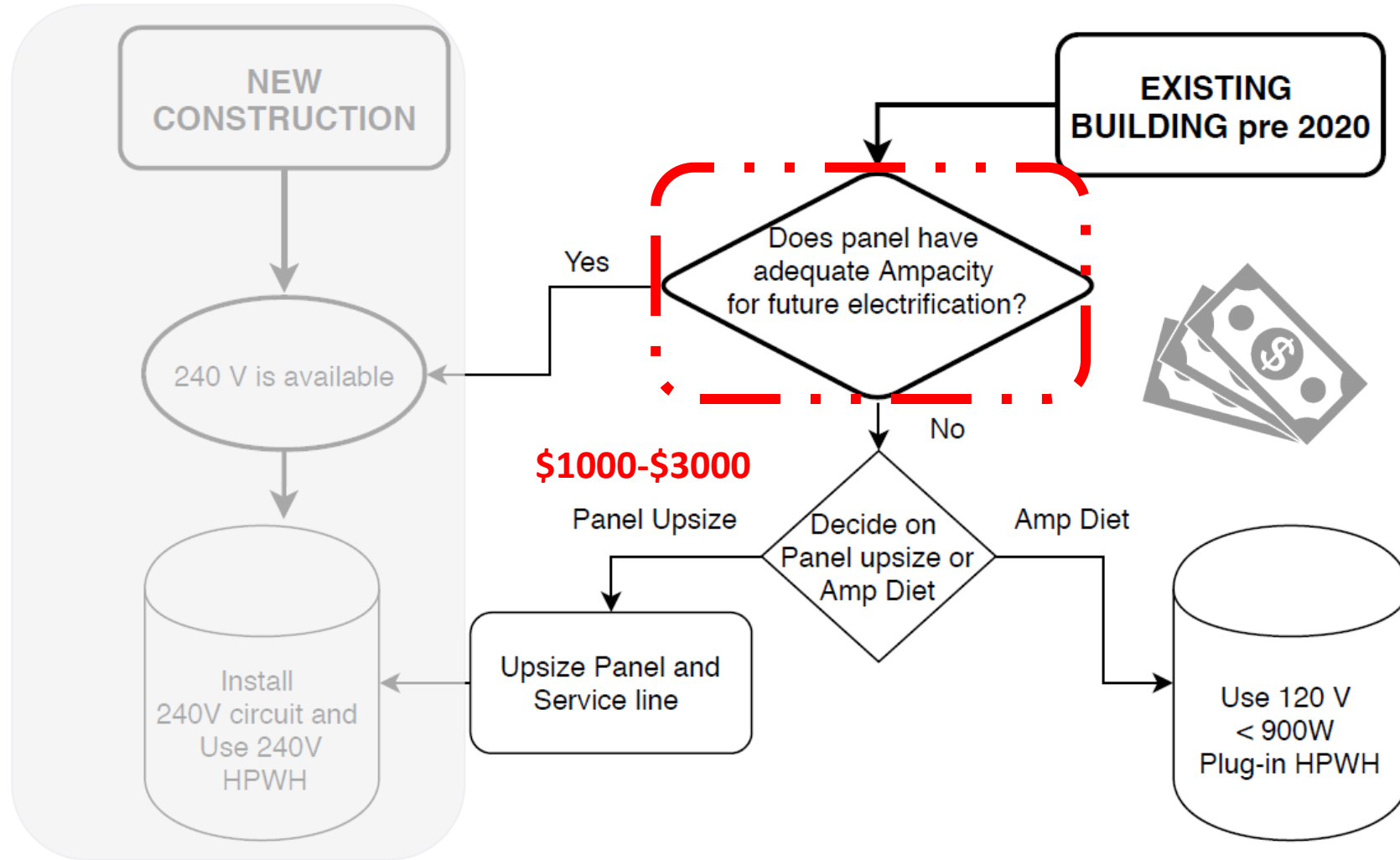


Source: NBI 2020 – based on data from RASS 2009 and 2015 RECS

Water heating with natural gas represents one of the largest GHG emissions end use in a typical residence in CA

Why is the 120V Product Needed?

Heat Pump Water Heater Installer Flowchart *A Quick Guide of Considerations & Best Practices*



Technical Specification

Electrical Constraints	Unit shall be able to operate on a shared 120 Volt / 15 Amp circuit.		
Electrical Connections	Unit shall have a cord allowing plug-in to a standard 120V receptacle.		
Space Constraints	<p>To qualify as a “space-constrained” product, the unit shall</p> <ul style="list-style-type: none"> ○ fit within a space of 24” x 26” x 72” inclusive of drain pan and all plumbing connections, and ○ be able to fit through an opening of minimum size as specified by the manufacturer and listed on the Qualified Products List. <p>If larger than these dimensions, the product will be listed without the space-constrained mark.</p>		
Energy Performance		Product First-Hour Rating	Cool Climate Efficiency Requirement
	Tier 1	≥ 51 gallons	CCE ≥ 2.4
		< 51 gallons	CCE ≥ 2.2
	Tier 2	≥ 51 gallons	CCE ≥ 2.6
		< 51 gallons	CCE ≥ 2.4
Sound Level	dBA < 55		
Warranty	10 years parts. 1 year labor		
Demand Response Connectivity (Optional)	CTA-2045, or equivalent, and complying with the proposed California 2019 Title 24 requirements, JA-13, for electric water heater demand management. To be revisited on next specification revision (likely 2021).		
Documentation	<p>Installation manual shall contain necessary references to NEC, UPC, and describe a list of approved installation locations and electrical connection scenarios.</p> <p>It is strongly recommended that manufacturers create technical bulletins, or similar, to assist with installations in various installation locations and housing stock.</p>		

- Written in 2019
- 3-5 products expected between Q2-Q4 2021
- Consistent application of field test and data collection by utility districts across country to accelerate market transformation

[NEEA AWHs Version 7.0, Appendix A: Plug-In Heat Pump Water Heater Specification](#)

120V Field Study Objectives

- Independent field verification to advance market commercialization and program promotion
 - User satisfaction and operating cost
 - Energy and load shifting performance
 - Installer experience
- Demonstration Diversity:
 - Application: single family, multifamily in-unit, manufactured homes
 - Installation location: garage, closet, basement
 - Climate zone



Photo Credit: NEEA

120V Research Methods

- Metering, energy and cost analysis:
 - Hot water runout events
 - Energy performance
 - Potential to load shift
 - Product and installation costs
 - Operating cost analysis (including time-of-use rate structure analysis)
- Surveys of:
 - Customers
 - Installers
 - Manufacturers



Photo Credit: NEEA

Commercialization & Building Demand

- Ensure product meets customer demands
- Support regulatory workpaper process
- Incentive program recommendations and integration
- Raise awareness and advise training efforts
- Bulk purchase order



Join the Effort!



Amruta Khanolkar amruta@newbuildings.org



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DECARBONIZATION

OWNER EXPERIENCE CONSIDERATIONS WHEN REPLACING GAS WATER HEATERS WITH 120V HEAT PUMP WATER HEATERS

Craig Tsai / Tom Zimmer
GE Appliances



DECARBONIZATION TOPICS:

- **Basic conversion considerations...**
- **Primary considerations for 120V HPWH retrofit acceptance**
- **Anticipating the Gas WH Owner Experience (OX)...
...Expectations & Possible reactions...**
- **Comparing HPWH and Gas WH Characteristics**



KEY FACTORS FOR A “NATURAL” CONVERSION

- Performance... Same or improved Owner Experience*
- Installation costs – Panel Capacity / Electrical Requirements
- Energy Cost – Gas / Electric - Time of Use Rates
- Efficiency – Energy Savings
- Acquisition / Installation Cost

* Low star ratings / Negative reviews will be destructive to the effort



KEY FACTORS FOR A “NATURAL” CONVERSION

- Performance... Same or improved Owner Experience

“I’m happy to Decarbonize as long as I don’t have to give anything up or find myself or my family inconvenienced...”

- Same number of hot showers that we’re used to, on the same schedule
- Same number of laundry loads back to back
- Same number of dishwasher loads

“Don’t make me change my life to accommodate your desires...”

“Will this HPWH work as well as my old gas heater?”



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KEY FACTORS FOR A “NATURAL” CONVERSION

- **Installation costs – Panel Capacity / Electrical Requirements**

“Homes have existing electrical service and panels... ..the solution to achieve decarbonization goals for the state should not require high cost electrical upgrades in my home in order to make it happen”

“I’ve got a 120V shared circuit on a 15A breaker near my gas water heater, why can’t I use that?”



KEY FACTORS FOR A “NATURAL” CONVERSION

- Energy Cost – Gas / Electric - Time of Use Rates

“Natural gas is going to cost me the same as electricity would for a HPWH for water heating right now, so why should I switch?”

“I’m in an area affected by Time of Use rates, and TOU rates will make the HPWH cost me more than a gas heater to operate”

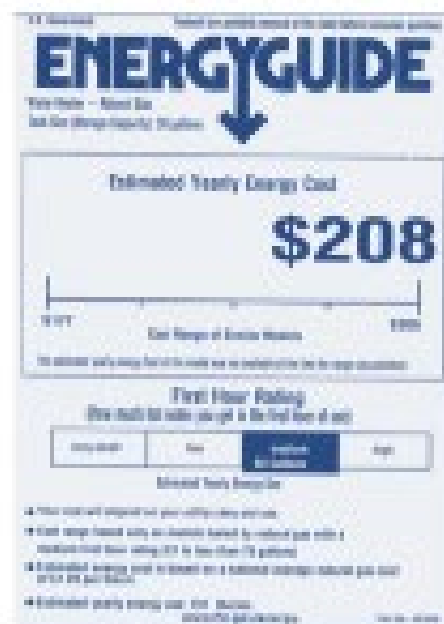
“How long will it take to pay back the difference in my total installed cost, and will the savings be real?”



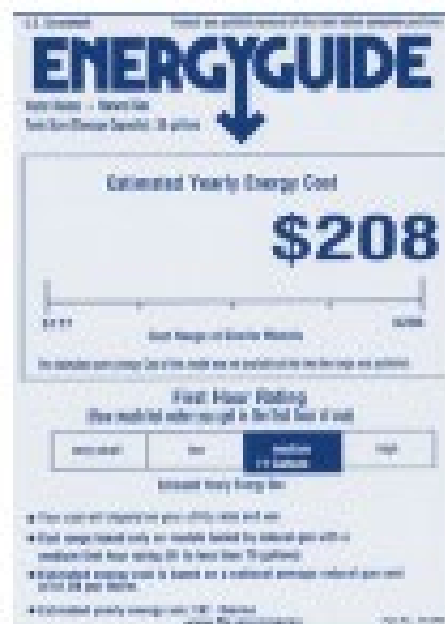
KEY FACTORS FOR A “NATURAL” CONVERSION

- Energy Cost – Gas / Electric – Avg Utility Rates

Consumer Facing Information regarding Annual Cost Of Operation



40 gal Gas
NG



40 gal Gas
NG
ULN



50 gal Electric



50 gal Electric
HPWH

KEY FACTORS FOR A “NATURAL” CONVERSION

- **Efficiency – Energy Savings**

“Is the efficiency claim real? Will it really save me money... and how much?”

“Does being more efficient mean that I’ll run out of hot water?”



KEY FACTORS FOR A “NATURAL” CONVERSION

- Acquisition / Installation cost

“Heat Pump Water Heaters in the size I need cost significantly more and take up more space than the gas water heater I need to replace... why should I pay that difference?”

“I checked with my local plumber, and to install a HPWH, they’re going to charge me an arm and a leg...”



COMMON GAS INSTALLATION CHARACTERISTICS



120V 15A



120V 15A



- Requires standard 110-Volt electrical outlet (3-prong grounded) for installation

- Top Port Water Connections
- 120V required and available for damper and power vent models
- Air for combustion
- Flammable Vapor / NOx Concerns



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MAKING CONVERSION INSTALLATION “EASY”



- ✓ Top Port Water Connections
- ✓ 120V from existing circuit or pull new tandem breaker circuit from current panel
- ✓ Installation space consideration (space / sound / dehumidification / cooling)
- ✓ Condensate management
- ✓ Capacity / Size / First Hour Rating / Recovery Rate



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FUEL CHOICES AND OWNER EXPERIENCE

Owner Experience



Dedicated 240V circuit



Fuel	Natural Gas	Electric (240V)	HPWH (240V Electric)
Size (for similar OX)	40 gal	50 gal	50 / 80 gal
Heating Capacity (Efficiency)	38000 BTUH (65-75% Efficiency)	15000 BTUH (93-98% Efficiency)	5000 BTUH (350% Efficiency)
Tank heating time (58F-120F)	~30 min	~100 min	~240 / 480 min
First Hour Rating (Recovery rate 90F rise)	~70 gal (38 gph)	~60 gal (15 gph)	67 / 94 gal (5 gph HP only)



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FUEL CHOICES AND OWNER EXPERIENCE

Owner Experience



Shared 120V circuit



Fuel	Natural Gas	Electric (240V)	HPWH (120V Electric)
Size (for similar OX)	40 gal	50 gal	50 / 50+EMV gal
Heating Capacity (Efficiency)	38000 BTUH (65-75% Efficiency)	15000 BTUH (93-98% Efficiency)	5000 BTUH (350% Efficiency)
Tank heating time (58F-120F)	~30 min	~100 min	298 / 544 min
First Hour Rating (Recovery rate 90F rise)	~70 gal (38 gph)	~60 gal (15 gph)	45 / 59-74 gal (5 gph HP only)



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WATER HEATER SPECIFICATION COMPARISON

Gas Water Heaters

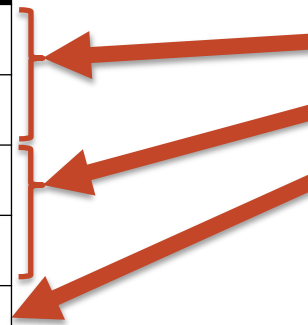


240V Heat Pump Water Heaters (Hybrid)



Volume (Gal)	Height (in)	Width (in)	FHD (Gal)	UEF
30	57	17	62	0.6
30	46	20	55	0.6
40	60	19	68	0.58
40	50	21	64	0.58
50	58	21	85	0.63

Volume (Gal)	Height (in)	Width (in)	FHD (Gal)	UEF
40	63	21	60	3.75
50	62	22	67	3.75
65	65	22	75	3.85
80	75	24	87	4



General guidance:

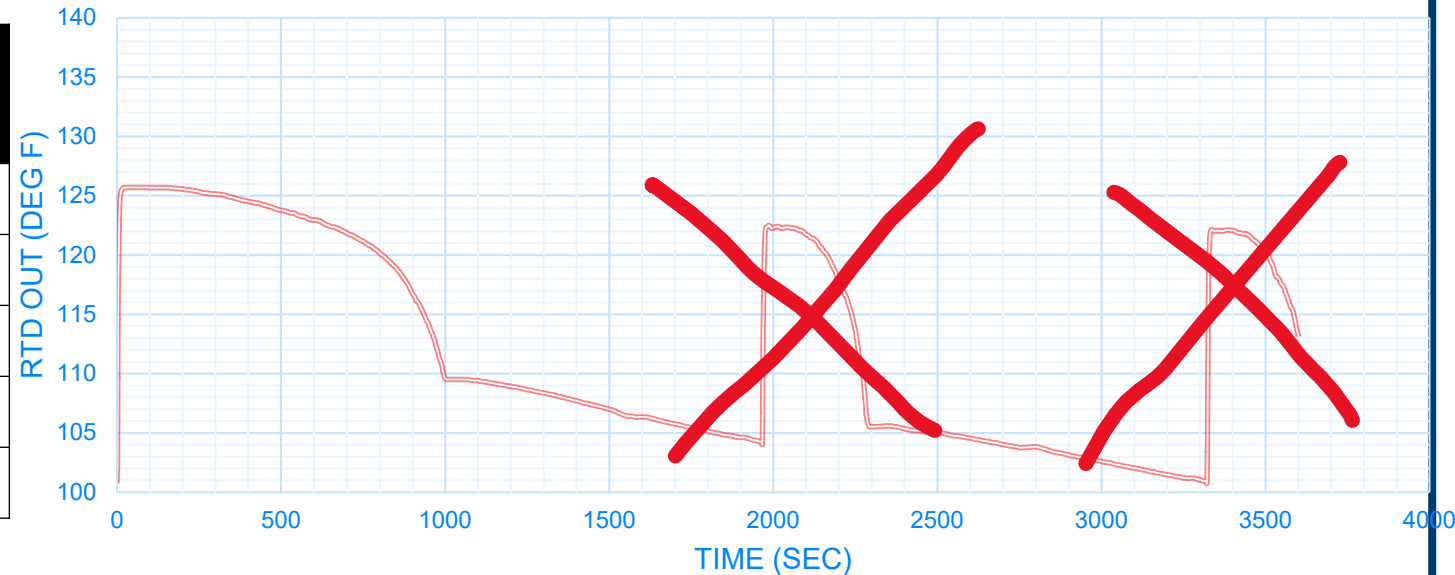
- HPWH is slightly taller (due to sealed system)
- HPWH is wider (improved insulation for efficiency)
- Replace Gas WH by upsizing by one 240V HPWH tank size level

IMPACT OF SHIFTING TO 120V/15A SERVICE

240V/120V Hybrid/Heat Pump FHD

Volume (Gal)	Gas	Hybrid	Heat Pump
30	58		
40	68	60	38
50	85	67	45
65		75	60
80		87	72

50G HPWH 1st Hour Delivery



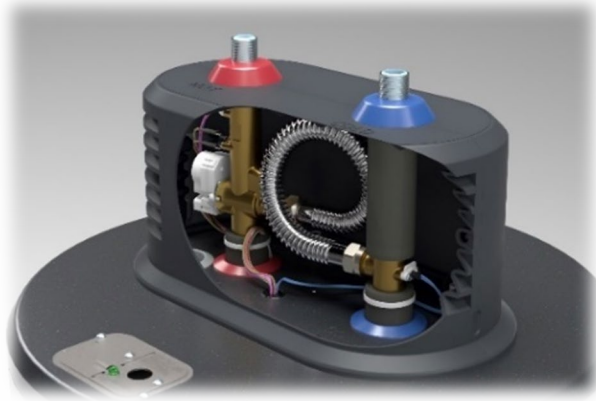
Would need to upsize tank capacity ~2X to get comparable 1st Hour Delivery - this is a significant and likely barrier...



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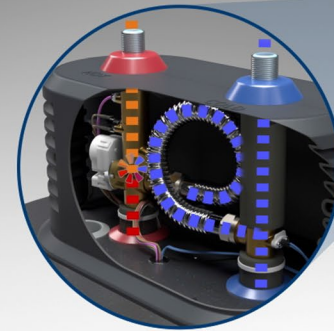
GEA EXCLUSIVE INNOVATION

“Integrated, Electronic Mixing Valve” – *How It Works*

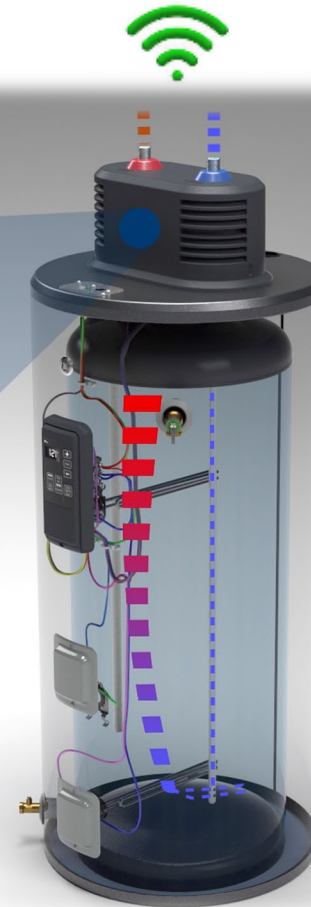


Up to 60% more hot water capacity on extra-high setting*

- Water is stored at higher temperature
- Exiting hot water mixes with cold water, delivering more usable hot water



GE Exclusive Feature
- Patented / I.P. protected



GEA Performs **LIKE a**
80+ gal

50 gal

65 gal

40 gal

50 gal

30 gal

Extra-High

Selected Capacity: Normal



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*vs comparable water heater without mixing valve at 120 F set and 58 F inlet water temperature

GE FLEXIBLE CAPACITY

Impact and Options enabled by applying the GEA mixing valve feature to the 120V HPWH configuration

Gas Water Heaters



Volume (Gal)	Height (in)	Width (in)	FHD (Gal)	UEF
30	57	17	62	0.6
30	46	20	55	0.6
40	60	19	68	0.58
40	50	21	64	0.58
50	58	21	85	0.63

Inlet	Tank	Outlet	Mix Ratio
58	120	120	100%
58	140	120	76%
58	150	120	67%
58	160	120	61%

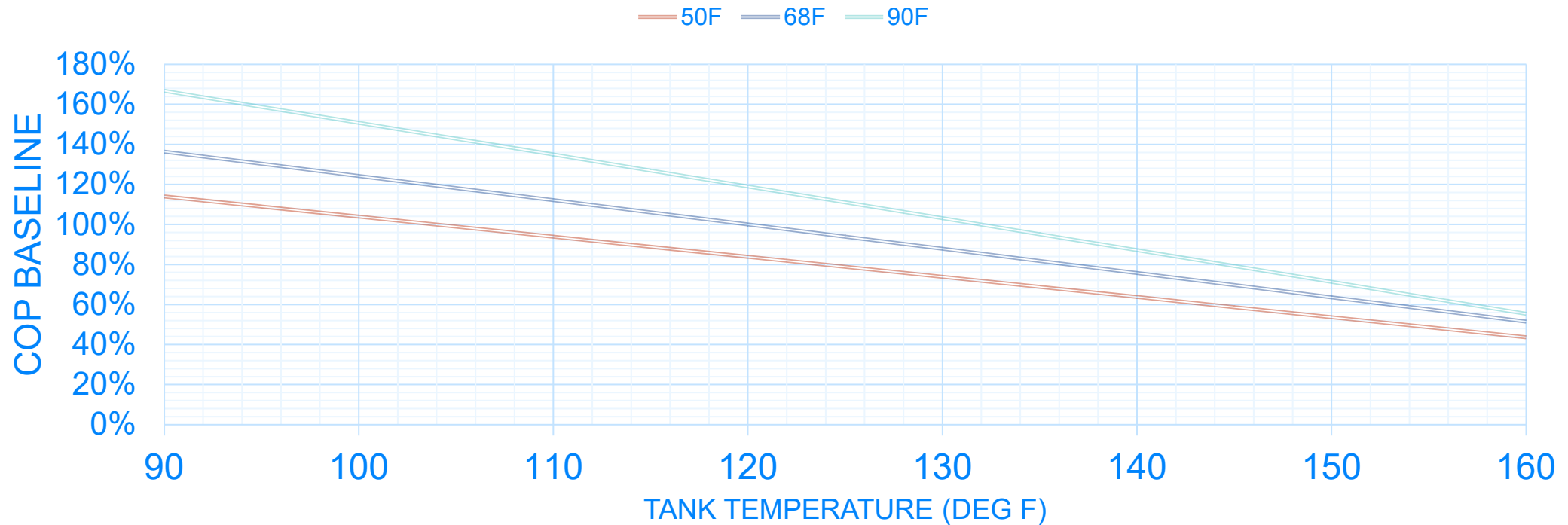
120V/240V HPWH (Heat Pump Only)



Volume (Gal)	120F No Mix	140F Mix	150F Mix	160F Mix
40	38	50	57	62
50	45	59	67	74
65	60	79	90	98
80	72	95	107	118

HIGH TANK TEMPERATURE: HPWH ENERGY EFFICIENCY

HPWH COP Efficiency



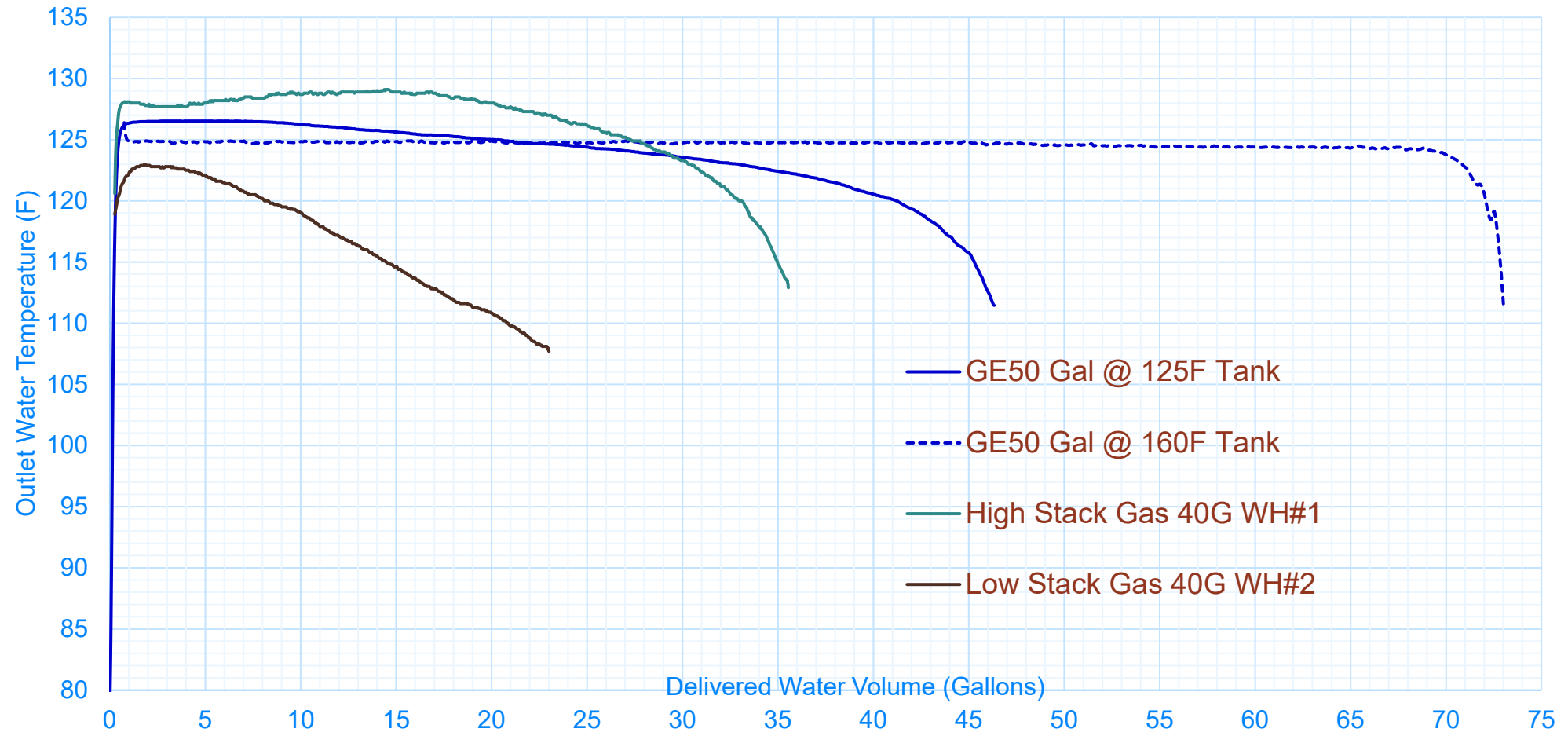
Driving HPWH at higher temperatures does introduce an energy penalty...



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1ST DRAW TEMPERATURE PROFILE COMPARISON

Gas WH Versus GE Flexible Capacity HPWH - 1st Draw Comparison
- Inlet water 58F at 3gpm



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GEOSPRING™ HPWH

- **Power Options:**
 - 120V (Shared circuit) plug-in
 - 208/240V (Dedicated circuit)
- **Integrated Electronic Mixing Valve**
 - Flexible Capacity (GEA exclusive)
- **Tank Sizes:** 40, 50, 65, 80 Gallons
- **CTA-2045 module**
 - DOE e-Star connected specification
 - NEEA Advanced WH specification
- **Built-in WIFI module**
 - Enables connection to GEA SmarthQ or other cloud services
- **Top Port water connections**



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Note: Product under development – not yet available

THANK YOU



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Heat Pump Water Heaters

Arthur Smith
May 13, 2021

Full Portfolio of Heat Pumps for Different Applications

Standard Residential
240V HP

Residential New
Construction

Residential
Retrofit

Plug-in 120V

Multifamily



Heat Pump
Technology

Commercial
Split System



Unitary
Commercial

Standard Residential – 240V

- High Efficiency – 3.45 UEF
 - Reduce water heating costs up to 73% compared to a standard electric
 - Reduce CO₂ emissions by more than 50% compared to a standard gas
- 50, 66, and 80 gallon models
- NEEA Tier 3 qualified
- Quiet Operation – 51 dBA
- Confined Space Capable – Accessory ducting kit



JA13 Certified Residential – 240V

- **Wi-Fi and Bluetooth connectivity**
- **Connect through free A. O. Smith app**
- **Time-of-use Schedules**
 - Easily find your utility and push rate schedule to water heater in the app
 - Reduces operating costs by heating during low-cost periods and limiting operating during peak rate periods
- **Demand Response Capable**
 - OpenADR 2.0b VEN certified



Unitary Commercial

- ENERGY STAR® Qualified
- High Efficiency – 4.2 COP
- Integrated design for easy installation
 - 119-gallon tank enables heat pump to operate more frequently than backup electric elements to improve system efficiency
- 150 gallon First Hour Delivery
- HP + 12kW backup elements = 20 kW total heating capacity
- Multiple operating modes to balance efficiency and hot water delivery



Commercial Split Systems

- Packaged system solutions
- Air and Water Source Split System Heat Pumps
- Sized for Commercial and Multifamily Applications
 - 25,000 to more than 2,000,000 BTU/h heating capacities
 - Modular design
- Suitable for indoor and outdoor applications
- Double wall stainless steel condenser for potable water applications
- Compatible with Single-Pass or Multi-Pass systems



Heat Pump



Storage Tank

Residential – 120V Plug-In Applications

- Designed for homes that currently have a gas water heater
- Common challenges
 - Limited space
 - Home's electric panel may not have 30A available for a water heater
 - Expensive to hire an electrician to run a 240V dedicated circuit for a water heater and upgrade electric panel if necessary
- Homes upgrading from a standard electric water heater should use the standard 240V heat pump models



Residential – 120V Plug-In HPWH

COMING SOON

- Designed to meet NEEA AWHs v7.0 Plug-In specification
- Plugs into standard residential outlet (120 volt 15 amp shared circuit)
 - Work within a home's existing electrical system
 - One-trade or DIY instantiation
- 40-80 gallon model sizes
 - Options to fit within existing gas water heater installation footprints
- First Hour Ratings in line with UPC sizing requirements
- JA13 and CTA-2045 Capable
 - Time-of-use Rate Scheduling
 - Utility Demand Response ready



How to Drive Heat Pump Adoption

- **New Construction Programs**
 - Easiest time to install a HPWH
 - Products already commercially available
- **Instant Rebate Programs**
 - Up-front cost is largest barrier for many customers
 - Downstream mail-in rebates have shown that they do not influence the purchase decision
 - Upstream or midstream programs (reference Efficiency Maine, Efficiency Vermont, Energize Connecticut, NEEA and Energy Trust of Oregon for best practices)
- **Focus on both Wholesale and Retail channels**
 - Market is split between these channels and it is essential to reach all customers
- **Advertising**
 - Drive proactive replacements when consumers can understand the value prop before an emergency
- **Contractor Training**
 - Leverage AOS installer network
 - Demonstrate that HP operating costs in CA are lower than natural gas (may require TOU pricing)



Rheem ProTerra Plug-In

Introducing the all-new
Rheem[®] ProTerra[™]
PLUG-IN HEAT PUMP WATER HEATER





The right unit for the application

ProTerra Plug-In– Dedicated Circuit

- Up-to 3x quicker recovery time
- Can survive multiple continuous draws, will be better for replacement of gas model

ProTerra Plug-in with HydroBoost – Shared Circuit

- Suitable for 15A shared circuits with lower current draw
- Higher FHR

PLUMBERS



I like having more options. Having the ability to choose the best unit for the application.

I would tend to lean towards the dedicated circuit model, but like having the shared circuit model for when a dedicated circuit is not available

I like that depending on circuit availability I can choose a model that simply plugs in, dramatically decreasing install cost.

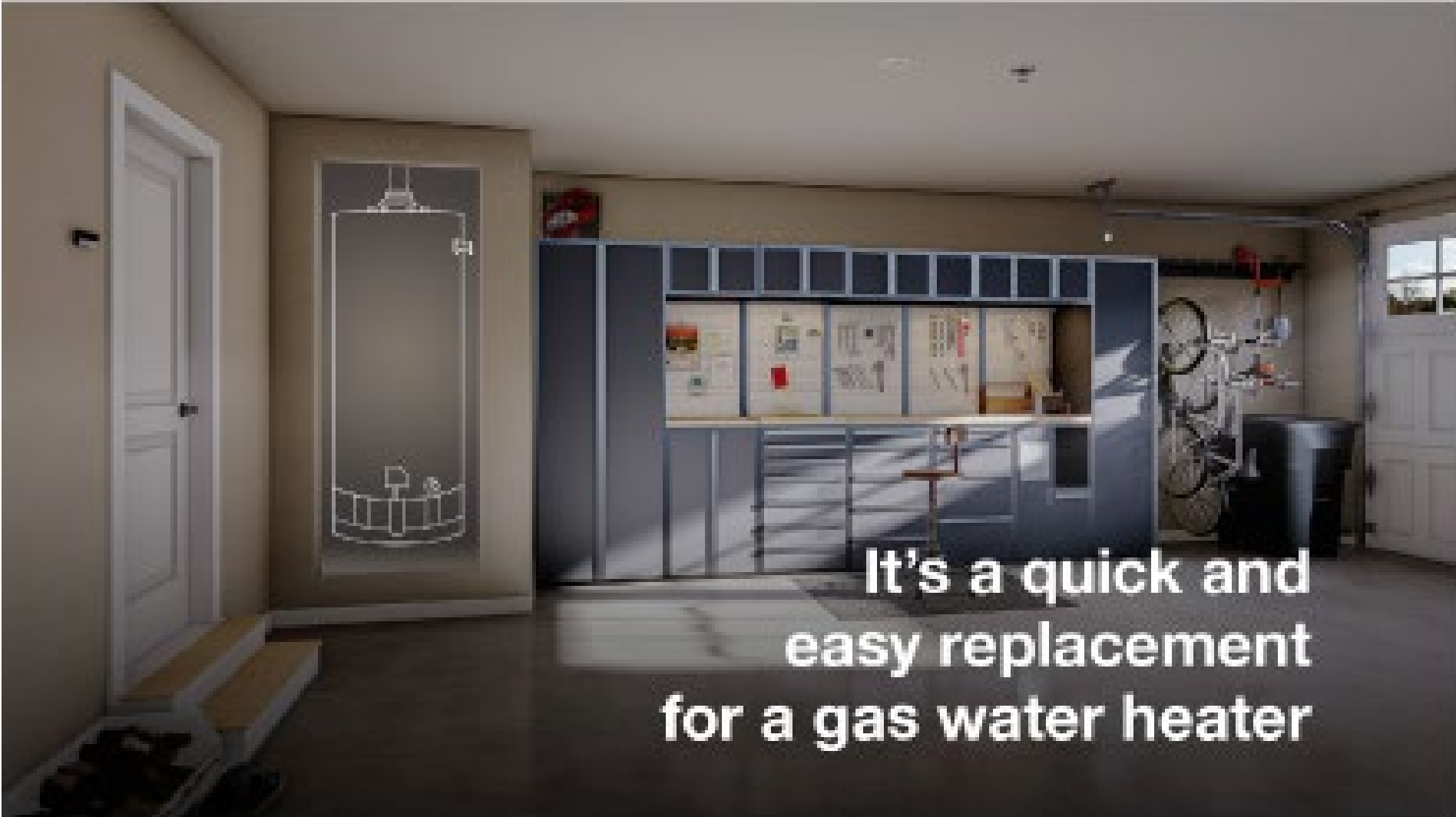
I like how easy the unit is to install.

Homeowner





Easy Gas Replacement



**It's a quick and
easy replacement
for a gas water heater**



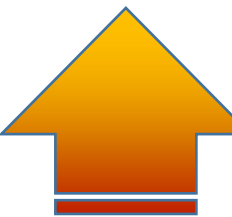
Just Plumb it and Plug it in



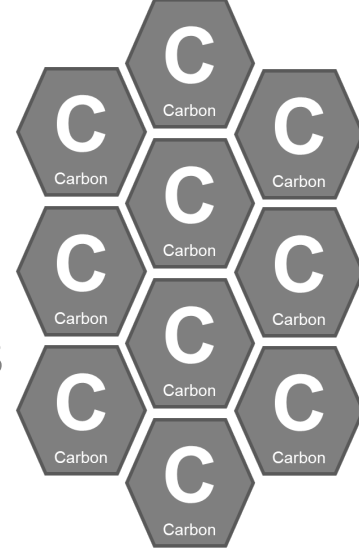


Reap the Benefits, don't compromise comfort

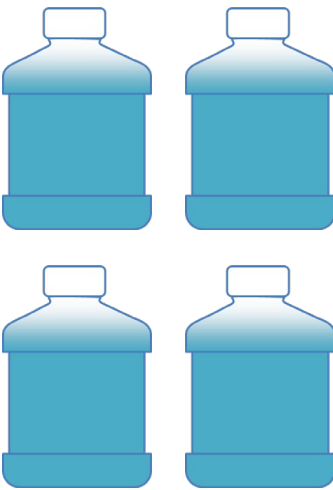
Energy Efficiency



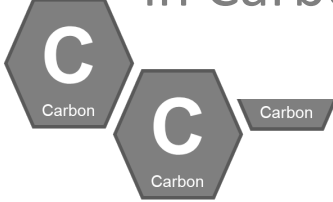
High Carbon Emissions



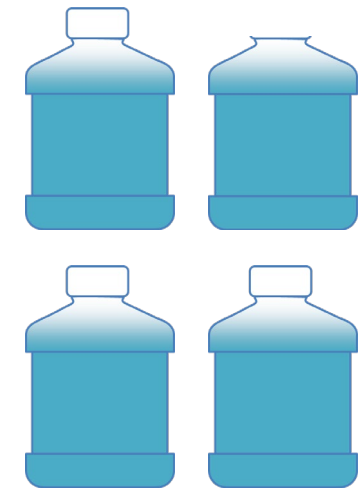
High Hot Water Availability



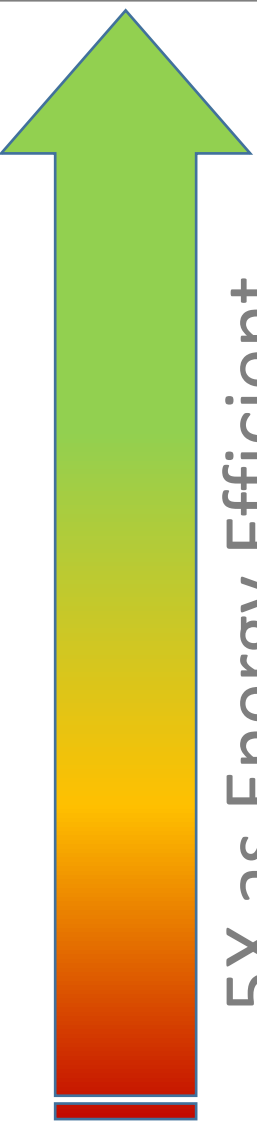
79% Reduction in Carbon



No need to compromise comfort



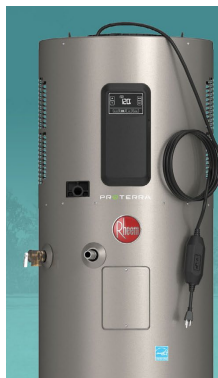
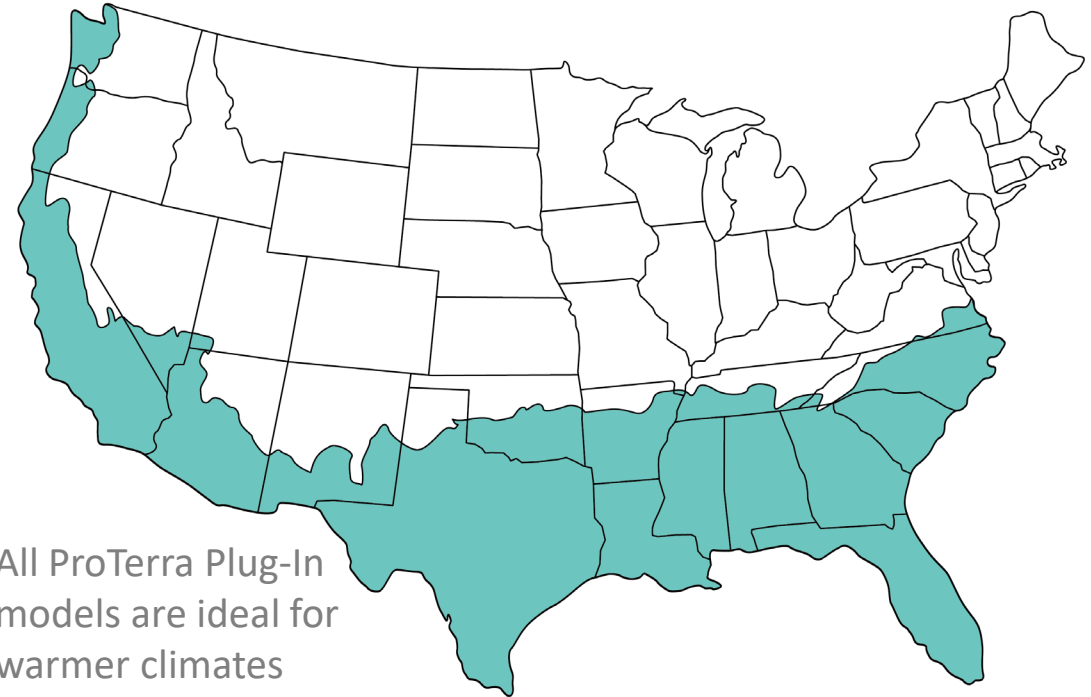
5X as Energy Efficient



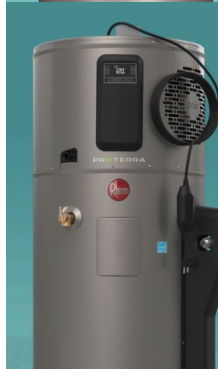


Pick the right unit for your application

- ProTerra Plug-In - NEEA testing complete
- ProTerra Plug-In with HydroBoost - NEEA testing in process – completed by end of May
- Both meet NEEA Tier 2



40G 	50G
----------------	----------------



40G 	50G 	65G 	80G
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Started Field Trials in February 2020

Orange, CA



Riverside, CA



Anaheim, CA



San Jose, CA



13 Installed
Currently

At least 6
more planned
by June 2021

Johns Creek, GA



Alpharetta, GA



Atlanta, GA



Milton, GA



Waterbury, CT





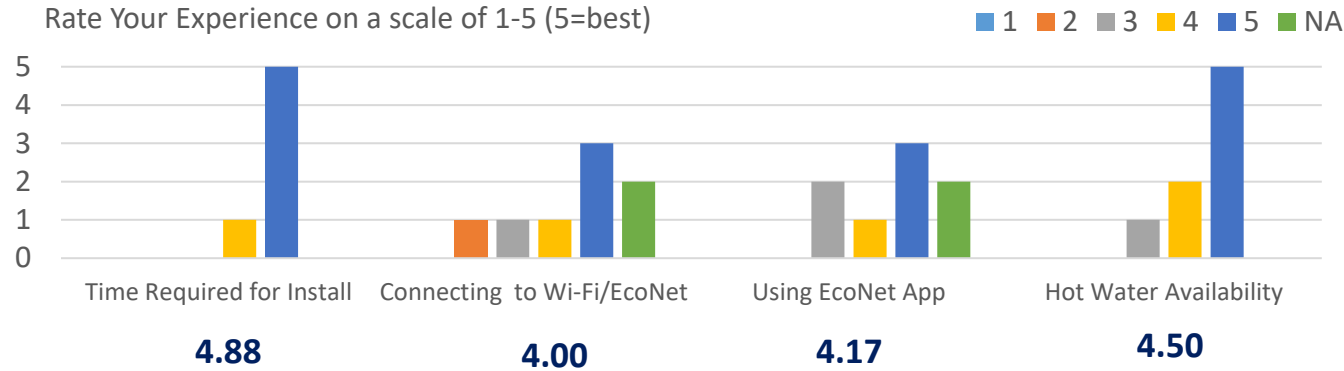
Homeowners Field-Test Survey Results

Overall Rating

4.5★
average rating



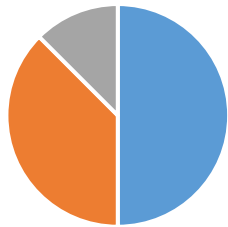
Rate Your Experience on a scale of 1-5 (5=best)



Favorite aspects of owning this water heater (could pick 2) – 13 votes total

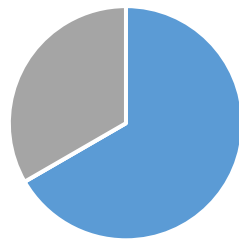
- #1 Being on the front-end of ground-breaking technology of water heating (8)
- Connected/Smart Features (2)
- The fact that it's Sustainable (2)
- It helps with the air quality in my home (1)

Which best represents your experience with the unit's ability to deliver hot water?



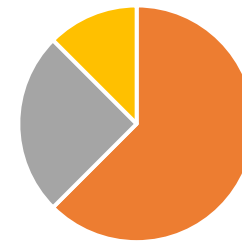
- Have not run out
- Have only run out in occasional high-use situations
- Have to be conscious of usage to make sure I don't run out

Do you feel like this product contributes to your overall sustainability efforts at home?



- Yes
- No
- Not Sure

How would you rate the noise produced by the unit?



- Haven't Noticed
- Noticed Occasionally - doesn't bother me
- Noticable, but not enough to worry
- Too noisy - needs to be quieter

When do you notice the unit start to run?

- It only runs right after I have used hot water (3)
- Based on the schedule I have set up
- I haven't noticed
- It runs right after we have used a significant amount of water... since the weather is cooling off it runs occasionally at random times.





Rheem – the right solution for you



Making it a sustainable choice for your home*





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Q & A