



Northeast and Mid-Atlantic Heat Pump Water Heater Market Strategies Report

Northeast Energy Efficiency Partnerships
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About NEEP

Northeast Energy Efficiency Partnerships (NEEP) is a non-profit organization that works to accelerate energy efficiency in the Northeast and Mid-Atlantic states. NEEP provides support to the region in four key areas: speeding the adoption of high-efficiency products, reducing building energy use, advancing knowledge through best practices and generally increasing the visibility of the benefits of efficiency.

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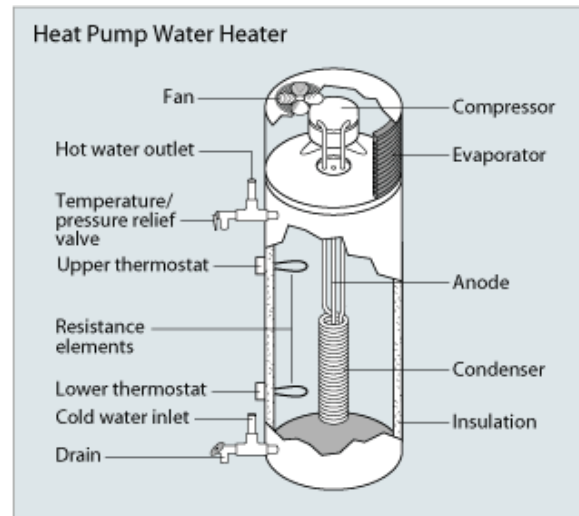
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1. Executive Summary

The latest generation of Heat Pump Water Heaters represents an exciting new opportunity for the Northeast and Mid-Atlantic region to achieve significant energy and cost savings. Completely transforming the residential electric water heating market in this region from the incumbent electric resistance water heater to the more efficient heat pump water heater technology would result in nearly 340 million kWh in annual electricity savings, the equivalent of over 41,000 households' annual electricity use.¹



Source: [U.S. Department of Energy](#)

With all of the promise associated with this technology, the market for HPWHs is still very immature, with market penetration at less than 1 percent. Regional stakeholders find themselves simultaneously eager to heavily promote this technology to drive market adoption yet cautious to avoid pitfalls that other promising emerging technologies have experienced. History has given us too many examples of emerging technologies that have been poorly introduced to the market, delaying and in some cases altogether preventing their potential from ever being realized. Because of the stakes involved, NEEP, with input from a range of regional stakeholders, developed this forward looking market strategy report to thoughtfully hasten the uptake of HPWHs. The report theorizes that such a deliberate approach will enable long term market growth leading to market transformation.

New efforts to drive HPWHs into the market will unfold amidst changing federal minimum efficiency standards for residential water heaters set by the U.S. Department of Energy (U.S. DOE). If the region is to impact the next rulemaking process that will be completed in 2018, we must successfully drive market adoption of HPWH for all sizes - large and small. The more market evolution the Northeast and Mid-Atlantic regions can help drive over the next three-four years, the more directly the region can impact the federal standards revision process. A revision to the national standards would not only bring exciting savings to our region, but leverage over four times that amount of energy savings for the rest of the country.

A closer look at the current products, delivery chain and consumer base exposes a number of important barriers that have been, and continue to be, obstructing HPWH uptake in the region. An Advisory Group of stakeholders from across the region identified a comprehensive list of barriers and then prioritized that list to identify the most crucial barriers to address.

¹ For residential units 50 gallons and larger



The report focuses on developing strategies to address these key barriers:

- Lack of Consumer Awareness/Education
- Lack of Midstream Market Actors Awareness/Expertise
- High Incremental Cost in Relation to Electric Resistance Water Heaters (ERWH)
- Inconsistent Product Performance (when operated in conditions typical of colder climates)

Fortunately, the region does not have to start from scratch. A diverse group of market actors across the Northeast/Mid-Atlantic are already executing a number of promotional activities to address the identified barriers. A review of these existing market strategies already being deployed by various market actors is presented and examined.

Following the survey of existing activities, the report presents conclusions through a series of recommended strategies to accelerate market uptake of HPWHs in the Northeast and Mid-Atlantic region. The strategies developed by NEEP with input from a broad spectrum of regional HPWH stakeholders recognize the importance of working in a coordinated fashion to build market momentum to effectively transform this market.

The summary table below lays out our recommended strategies to address the critical barriers affecting the development of the HPWH market. NEEP suggests that the implementation of these strategies by the collective HPWH community will accelerate market uptake of HPWHs and enable the region to achieve complete market transformation by 2021.²

² For units 50 gallons and larger

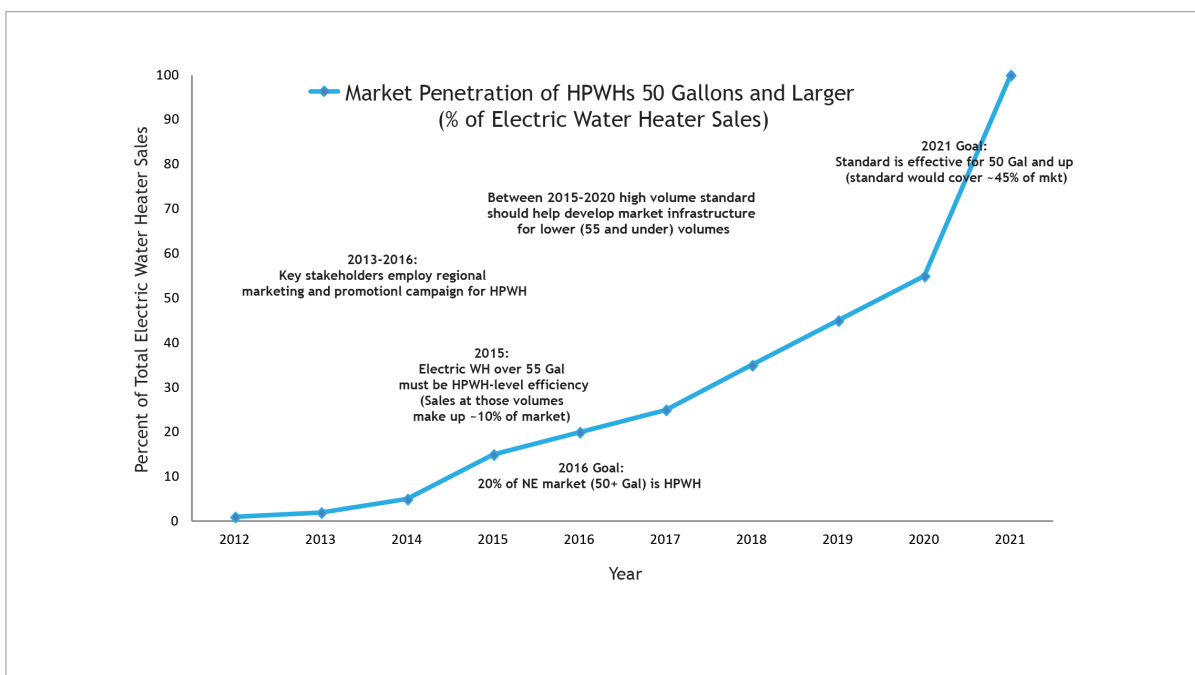
Strategies to Transform the Northeast & Mid-Atlantic Electric Water Heating Market

Barriers	Recommended Strategies
1) Lack of Consumer Awareness and Education	<p>Ramp up consumer awareness of, and demand for, HPWHs</p> <ul style="list-style-type: none"> • Develop and communicate a compelling consumer proposition centered on financial payback and the superior utility offered by the technology • Implement “Surround Sound” HPWH Marketing Campaign
2) Lack of Midstream Market Actors Awareness/Expertise	<p>Develop capable and motivated supply chain to deliver excellent HPWH consumer experience</p> <ul style="list-style-type: none"> • Communicate clear business case to supply chain actors • Expand midstream training
3) High Incremental Cost in Relation to ERWHs	<p>Offset initial higher product cost to consumers</p> <ul style="list-style-type: none"> • Strong rate-payer energy efficiency program support/promotion is critical to boost HPWH uptake in the near-term • Expand financing and leasing opportunities
4) Inconsistent Product Performance (when operated in colder climate conditions)	<p>Focus on product quality to achieve high level of customer satisfaction</p> <ul style="list-style-type: none"> • Consistently define, and endorse, product quality throughout region • Utilize and develop “stretch” specifications
5) Lack of Field Data Regarding the Impact of HPWH on Whole House Energy Use and Comfort	<p>Conduct research to provide data needed to develop realistic consumer expectations and more accurate evaluation.</p>
6) Market Confusion Due to Diversity of Promotional Efforts	<p>Build market momentum through inter/intra-regional communication and coordination</p> <ul style="list-style-type: none"> • Coordinate regional activity through Northeast HPWH Working Group • Track market progress • Expand interregional coordination
7) Lack of Efficiency Program Goals Tied to Federal Standards to Complete HPWH Market Transformation	<p>Support Federal Standards Rulemaking Processes with coordinated regional data and comments regarding residential HPWH</p> <ul style="list-style-type: none"> • Clarify and collect data needed to inform federal standards development for residential water heaters • Coordinate data transmittal and comments to U.S. DOE from across the region to inform federal standards process



NEEP projects that earnest implementation of the recommended market strategies outlined above will produce the necessary market conditions in order for market transformation to occur. The graph below depicts a potential market transformation curve, or “theory of change”, illustrating several key inflection points that are essential to drive market penetration from less than one percent in 2012 to a federal standard that require 100 percent penetration in 2021.

Graph ES-1. Potential Market Trajectory of 50 Gallon Electric Water Heaters



2. Introduction

Heat Pump Water Heaters (HPWH) represent an exciting opportunity to achieve significant energy savings in the Northeast and Mid-Atlantic³ region of the country. As efficiencies improve across many of the common household appliances, water heating is now the second largest residential energy user, trailing only space heating. Analysis shows that a complete conversion of units 50 gallons and larger from standard electric resistance water heating technology to high efficiency electric water heating technology would secure nearly 340 Million kWh in annual electricity savings across the region, the equivalent of over 41,000 household's annual electricity use. Summer peak demand would be reduced by 30 MW.

Potential energy and demand savings on this scale should be welcomed and encouraging news for a number of important stakeholders including: state energy offices/agencies with aggressive energy and climate policy directives; energy efficiency programs tasked with ever increasing savings goals; the various HPWH market actors looking for premium technology offerings; and most importantly, consumers who are increasingly demanding energy efficiency in household appliances. Though a range of HPWH products are produced and marketed by several manufacturers for residential and small business use, regional uptake of this technology remains slow. Market penetration of HPWHs in the regional electric water heater market is negligible.

To address this important opportunity for energy savings, this report presents recommended strategies to accelerate market uptake of HPWHs in the Northeast and Mid-Atlantic region. The strategies developed by NEEP with input from a broad spectrum of regional HPWH stakeholders recognize the importance of working in a coordinated fashion to build market momentum to effectively transform this market.

As is the case for many emerging technologies, a range of product quality and performance exists in this fledgling market. In the early stages of any product introduction, experiences of early adopters are crucial to a market's continued growth. The energy efficiency industry has witnessed numerous instances of poor market introductions which set back the broad market adoption of otherwise exciting, energy savings technologies by several years. In fact HPWH, first introduced in the 1980s, represent a classic example of a poorly executed market introduction. These strategies recommended herein build on the lessons from that era which include (1) focusing on mature, market-tested products ready for broad deployment, and (2) building an adequate and responsive market infrastructure prepared to deliver and support products in a manner that achieves a high level of customer satisfaction. If caution is not taken, in the excitement to achieve energy savings, markets risk unnecessary setbacks. In that context, it is important to address the unique challenges of operating HPWH products in colder, humid climate characteristic of the Northeast.

³ Regions include Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New York, New Jersey, New Hampshire, Pennsylvania, Rhode Island, and Vermont



The federal efficiency standards rulemaking process, set to launch in 2016 and be finalized in 2018, provides the region an opportunity to measure the progress of our regional strategies.

New efforts to drive HPWHs into the market will unfold amidst changing federal minimum efficiency standards for residential water heaters set by the U.S. Department of Energy (U.S. DOE). In 2015, new federal standards (set in 2010) for electric residential water will become effective. This includes a standard for large electric water heaters (over 55 gal) at a level that essentially requires HPWH technology. In 2016, U.S. DOE's process to further update electric water heater standards will begin - presenting the opportunity to establish in 2018 a similar high standard for more common smaller water heaters (50-55 gal) effective 2021 - resulting in very significant savings regionally and nationally. This report recommends immediate action to spur significant regional market adoption of HPWHs 50 gallons and larger. This will support the potential adoption of federal minimum standards for electric water heaters 50 gallons and larger effective in 2021 at levels similar to the high efficiency standard for 55+ gallon water heaters effective in 2015. Electric water heating units 50 gallons and larger represent approximately 43 percent of total market shipments and 53 percent of total models⁴.

If the region is to impact the next rulemaking process that will be completed in 2018, we must successfully drive market adoption of HPWH for all sizes - large and small. The more market evolution the Northeast and Mid-Atlantic regions can help drive over the next three-four years, the more directly the region can impact the federal standards revision process. The full conversion savings referenced above assume the region's ability to secure increased stringency in the next federal standards revision. Increased stringency in the standards will only come if the market for and infrastructure supporting HPWHs has sufficiently matured. A revision to the national standards would not only bring exciting savings to our region, but leverage over four times that amount of energy savings for the rest of the country in the process.

To realize these potential energy savings across the region, several key market challenges must be effectively addressed. With a broad range of stakeholders active in this young market, coordination and consistency could well be the catalyst for growth of HPWHs. Instead of individual market actors taking on the challenge of market growth alone, regionally consistent market strategies will most effectively build the infrastructure and market buzz necessary to successfully drive high volumes of HPWH into the market.

4 DOE Residential Water Heater Final Rule 2010, Chapter 3 Technical Support Document

A successful regional effort would result in both near term benefits as well as longer term benefits. Programs could achieve savings in the near term and the market could be sufficiently matured to impact decisions made on the next minimum standard revision, establishing HPWH-level efficiency as the baseline in 2021⁵.

With a clear understanding of the current situation, this report seeks to provide a roadmap for the diverse group of HPWH market actors in the Northeast and Mid-Atlantic markets. The report provides regionally specific strategies to overcome the most pressing market barriers for HPWHs. The Report includes a situational analysis of where the market is currently, a determination of priority market barriers that stand in the way of more widespread adoption and finally market intervention strategies to address those barriers. Essentially providing answers to simple questions such as; why is market uptake of HPWH so slow and what can market actors do about ensuring an aggressive market transformation trajectory? We have taken lessons learned from other successful and unsuccessful market transformations to help guide this roadmap.

The Project forecasts that with regionally coordinated market intervention strategies, we can collectively expect accelerated market traction of this energy saving technology. If successful, the region stands to benefit greatly from a market transformed to higher efficiency electric water heating.

The audiences for the report include key market and policy actors involved with HPWHs:

- Energy Efficiency Program Administrators
- Energy Efficiency Program Advisors/Regulators
- State Energy Policy Makers
- Manufacturers
- Retailers
- Distributors
- Installers

Utilizing an advisory committee made up of a cross section of regional HPWH stakeholders, NEEP led a months-long process to develop this Regional Strategies Report. To gather important market intelligence, NEEP assembled a Project Advisory committee made up of representatives from many of the key stakeholder groups associated with HPWH; Manufacturers, Retailers, Installers, Energy Efficiency Program Administrators, etc. The Advisory Committee's function helped to inform and steer NEEP's development of the Regional Strategies Report.

5 For residential electric water heaters 50 gallons and larger



3. Situational Analysis and Market Assessment

This chapter provides a high level market profile for residential electric water heaters in the Northeastern U.S. including an analysis of energy saving opportunities associated with newer, more efficient alternatives, namely heat pump water heaters (HPWH). It complements a recently published report by the [U.S. Department of Energy; A Building America Measure & Strategy Guide: Heat Pump Water Heaters in New and Existing Homes](#)⁶, by providing additional regionally specific analysis for the Northeast.

The analysis herein shows that a complete conversion from standard technology to high efficiency electric water heating technology would secure 340 million kWh in annual electricity savings across the region, the equivalent of over 41,000 households' annual electricity use. Associated savings in greenhouse gas emissions total 234,000 metric tons of CO₂,⁷ in addition to 30 MW of summer peak demand savings.

In addressing the market opportunity for HPWH, this section also outlines the highest level consumer value proposition offered by HPWH by presenting the most recent estimate of energy and costs savings compared to the incumbent ERWH. Life cycle cost is of central importance to the consumer value proposition. It also discusses the role and impact of federal appliance efficiency standards as well as the important role of voluntary programs to set the technical bar for quality product performance. It concludes by describing the infrastructure that delivers water heaters to consumers and the important role they play in product selection.

Significance of Water Heating on Residential Electricity Use

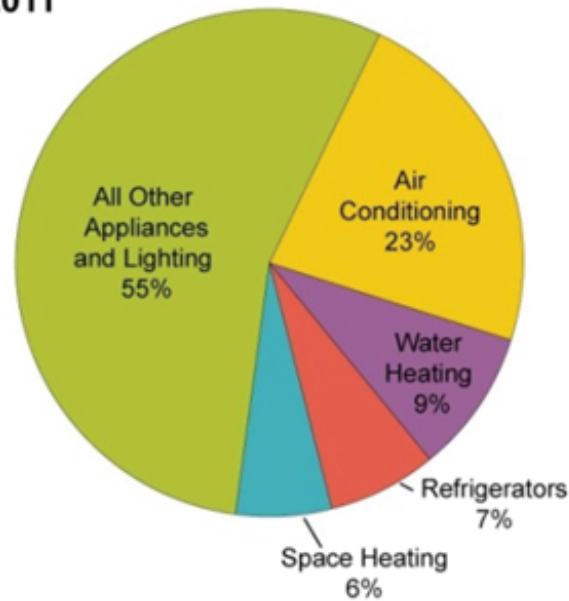
Averaged across the U.S., water heating is the second largest contributor to residential electricity consumption, trailing only space cooling ([Graph 1](#)). A more detailed breakdown for the Northeast and Mid-Atlantic would likely reflect an even larger percentage for water heating, with much less significant cooling loads in the Northeast and Mid-Atlantic than other regions. Recent advances in appliance and lighting efficiencies, as well as the effects from increasing energy codes and standards, are simultaneously reducing their relative contributions to building electricity consumption. Without improvements in efficiency, water heating would be responsible for a significant and growing slice of the residential electricity load.

⁶ Building America is an effort of the Building Technologies Program which lives in the DOE's Office of Energy Efficiency and Renewable Energy (EERE)

⁷ [U.S. Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator](#)

Graph 1. Residential Electricity Consumption by End Use

How Electricity Is Used in Homes, 2011



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2012, Early Release*, Table 4.

Prevalence of Electric Water Heating in the Northeast and Mid-Atlantic

According to the EIA's 2009 Residential Energy Consumption Survey (RECS), 5.1 million homes (or 25 percent of all homes in the region) utilize electricity to fuel their water heaters across the region. 25 percent of Northeast homes compares to 41 percent nationally.

Table 1.
Market Size: Percent of Households with Electric Resistance Water Heaters
(by Census Region)⁸

Region	Percentage of Households with Electric Water Heating
Northeast ⁹	25%
Midwest	29%
South	65%
West	28%
National	41%

⁸ Residential Energy Consumption Survey Housing Characteristics, Water Heating by Census Region (2009);

⁹ Includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania

Table 2.
Market Size: Percent of Households with Electric Resistance Water Heaters
(Northeast and Mid-Atlantic Breakdown)¹⁰

State/Region	Percentage of Households with Electric Water Heating
Massachusetts	20%
Connecticut, Maine, New Hampshire, Vermont, Rhode Island	30%
New England Combined	25%
New York	17%
New Jersey	13%
Pennsylvania	41%
Mid-Atlantic Combined	24%
Northeast Combined	25%
Maryland, Delaware, Washington DC, West Virginia	65%

The HPWH Superior Energy Efficiency Opportunity

From DOE's Building America Measure and Strategy Guide; Heat Pump Water Heaters in New and Existing Homes (SWA, 2011)

Heat pump water heaters (HPWHs) promise to significantly reduce energy consumption for domestic hot water (DHW) over standard electric resistance water heaters (ERWHs). While ERWHs perform with energy factors (EFs) around 0.9, new HPWHs boast EFs upwards of 2.0. High energy factors in HPWHs are achieved by combining a vapor compression system, which extracts heat from the surrounding air at high efficiencies, with electric resistance element(s), which are able to help meet large hot water demands.

Traditionally, electric water heaters have been designed to only meet the federal standard for efficiency. Electric storage water heaters or electric resistance water heaters (ERWH) have long dominated the electric water heating category in the U.S. Out of an estimated 4.1 million electric water heaters sold in the U.S. in 2009, over 99 percent of them were ERWH¹¹. As is detailed below, compared to ERWH, HPWH technology offers life-time energy and operation cost savings on the order of 15,000-20,000 kWh and \$1000-\$1500 respectively, as well as peak demand savings of approximately .17 kW.

¹⁰ Residential Energy Consumption Survey Housing Characteristics, Water Heating in Northeast Region (2009);

¹¹ DOE's Appliance Rebate Program Planning Tool for State and Territory Energy Offices (2009) ([available for download](#)).

Table 3 reflects the determinations made in a number of energy efficiency program savings assumptions documentation (commonly known as Technical Resource Manuals—TRM) developed throughout the region and beyond to quantify savings associated with various measures. Table 3 illustrates among other things:

- Simple pay back periods range from 3.7 to 5.8 years according to several regional TRMs, largely driven by the differences in incremental cost assumptions.
- Annual energy savings estimates from regional sources are relatively consistent, falling in the 1600-2000 kWh range.
- Lifetime energy cost savings are consistent between the regional TRMs because while energy savings are higher in the Mid-Atlantic, the cost of electricity is lower. Conversely, in the TRMs representing the Northeast, rates are higher, but annual energy savings are lower. See Graph 2 on [page 14](#) for a graphical representation of how lifetime costs accrue over time, using the Massachusetts evaluation figures.
- ENERGY STAR® estimates assume much higher baseline energy use for both ERWHs and HPWHs. This may be associated with higher hot water use assumptions.



Table 3.
Consumer Value: Electric Water Heater Energy and Cost Comparison

ENERGY STAR Estimates ¹²	Standard ERWH (50 Gallon)	HPWH (50 Gallon)
Energy Factor (EF)	.904	2.0 (ENERGY STAR Criteria)
Annual Energy Consumption (kWh)	4,857 kWh	2,195 kWh
Annual Energy Savings (kWh)	N/A	2,662 kWh
Assumed Cost of Energy	\$0.1068/kWh	\$0.1068/kWh
Annual Cost of Operation (\$)	\$505	\$228
Annual Cost Savings (\$/yr)	N/A	\$277
Life Expectancy (yrs)	13 years	10 years
Lifetime Energy Savings (kWh)	N/A	26,620 kWh
Lifetime Energy Cost Savings (\$)	N/A	\$2,768
Average Installed Cost (\$)	\$650	\$1,500
Average Installed Price Premium (\$)	N/A	\$850
Simple Payback (yrs)	N/A	~3 years

Massachusetts Program Estimates ¹³		
Energy Factor (EF)	.91	2.0 (ENERGY STAR Criteria)
Annual Energy Consumption (kWh)	3,330 kWh	1,643 kWh
Annual Energy Savings (kWh)	N/A	1,687 kWh
Assumed Cost of Energy	\$0.1768/kWh	\$0.1768/kWh
Annual Cost of Operation (\$)	\$588	\$290
Annual Cost Savings (\$/yr)	N/A	\$298
Summer Peak Demand Savings (kW)	N/A	.175 kW
Life Expectancy (yrs)	10 years	10 years
Lifetime Energy Savings (kWh)	N/A	16,870 kWh
Lifetime Energy Cost Savings (\$)	N/A	\$2,980
Average Installed Cost (\$)	\$590	\$1,922-\$2,122
Average Installed Price Premium (\$)	N/A	~\$1,510
Simple Payback (yrs)	N/A	~5.7 years

12 Based on [ENERGY STAR® Water Heater Market Profile \(2010\)](#)

13 Based on "Small tank" (50-60 Gallon) values from Heat Pump Water Heaters; Evaluation of Field Installed Performance, Steven Winter Associates, June, 2012

Connecticut Program Estimates ¹⁴		
Energy Factor (EF)	.90	2.0 (ENERGY STAR Criteria)
Annual Energy Consumption (kWh)	3,646 kWh	1,971 kWh
Annual Energy Savings (kWh)	N/A	1,675 kWh
Assumed Cost of Energy	\$0.168/kWh	\$0.168/kWh
Annual Cost of Operation (\$)	\$613	\$331
Annual Cost Savings (\$/yr)	N/A	\$281
Summer Peak Demand Savings (kW)	N/A	.17 kW
Life Expectancy (yrs) ¹⁵	12 years	12 years
Lifetime Energy Savings (kWh)	N/A	16,750 kWh
Lifetime Energy Cost Savings (\$)	N/A	\$2,810
Average Installed Cost (\$)	N/A	N/A
Average Installed Price Premium (\$)	N/A	\$1,632
Simple Payback (yrs)	N/A	~5.8 years

Mid-Atlantic Program Estimates ¹⁶		
Energy Factor (EF)	.904	2.0 (ENERGY STAR Criteria)
Annual Energy Consumption (kWh)	3,460 kWh	1,503 kWh
Annual Energy Savings (kWh)	N/A	1,957 kWh
Assumed Cost of Energy ¹⁷	\$0.129/kWh	\$0.129/kWh
Annual Cost of Operation (\$)	\$446	\$194
Annual Cost Savings (\$/yr)	N/A	\$252
Summer Peak Demand Savings (kW)	N/A	.17 kW
Life Expectancy (yrs)	10 years	10 years
Lifetime Energy Savings (kWh)	N/A	19,570 kWh
Lifetime Energy Cost Savings (\$)	N/A	\$2520
Average Installed Cost (\$)	N/A	N/A
Average Installed Price Premium (\$)	N/A	\$ 925
Simple Payback (yrs)	N/A	~3.7 years

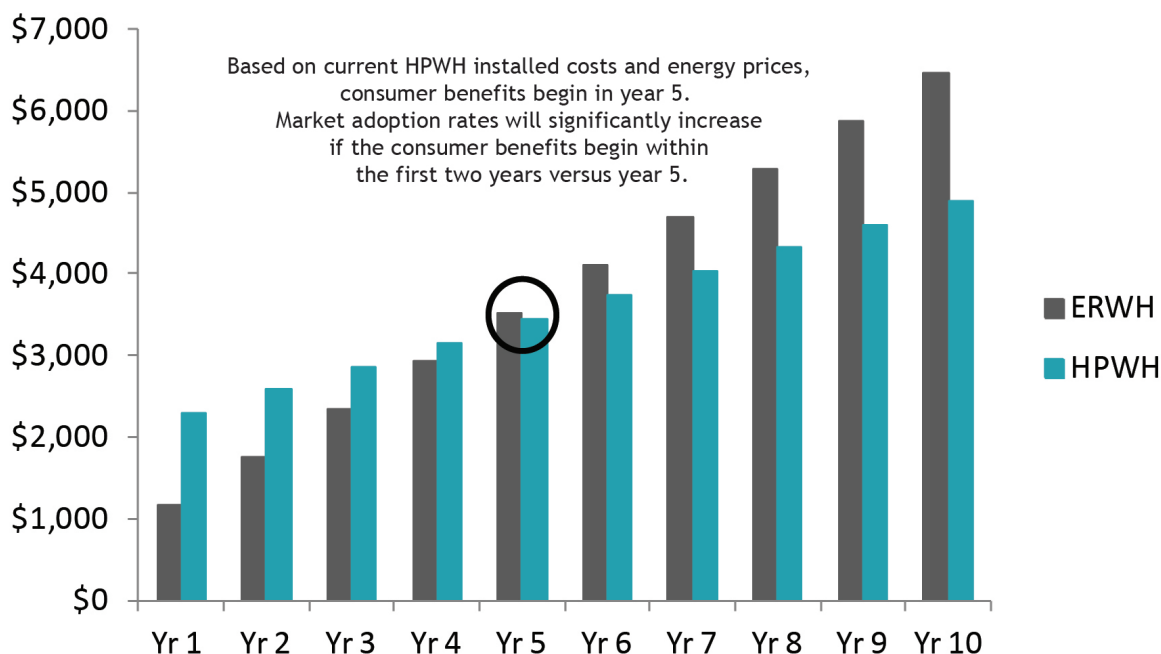
14 Based on [Connecticut Program Savings Documentation for 2012 Program Year](#)

15 Used 10 year lifetime in lifetime calculations to maintain consistency with other estimates

16 [Mid-Atlantic Technical Reference Manual, Version 2](#)

17 U.S. Energy Information Agency's Electric Power Monthly, Chapter 5, Average Retail price of Electricity, April 2012 (<http://www.eia.gov/electricity/monthly/pdf/chap5.pdf>). Average taken of prices in Delaware, Maryland, Pennsylvania and Washington D.C.

Graph 2.
Cost of HPHW Compared to ERWH Over Lifetime of the Product¹⁸



The Consumer Value Proposition of HPWH

Graph 2 above clearly describes one of the key aspects of the value proposition HPWHs offer consumers. While HPWHs may cost more initially, the lower operational costs more than makes up for the incremental cost over time and with respect to the cost of ownership, a consumer should expect to save potentially thousands of dollars.

Besides HPWHs representing a smart financial investment, the technology offers a number of other attractive characteristics that embody value add to consumers. HPWHs also offer consumers:

- “Green”- Exciting new high-tech product that is environmentally responsible
- No sacrifice in amount or delivery of hot water
- Proven/familiar technology (same core technology employed by air conditioners and refrigerators)
- Controllability (provides consumers opportunities to make desired adjustments to water heater operation)
- Associated air conditioning and dehumidification benefits

¹⁸ Utilized findings included in the Heat Pump Water Heaters: Evaluation of Field-Installed Performance, Steven Winter Associates, June 2012.

Setting the Bar for Efficiency and Quality Performance -The Important Role of Product Specifications and Minimum Appliance Efficiency Standards

As heat pumps extract heat from the surrounding air, they inherently provide cooling capabilities to the area in which they are operated. Depending on the time of year (heating or cooling season), this cooling effect can be seen as an energy/comfort benefit or penalty. Another bi-product of this cooling process is dehumidification. Through the use of condensing systems, moisture from the surrounding air condenses and is removed. The use of dehumidifiers is common throughout the region. To more accurately value the benefits and penalties associated with HPWH cooling and dehumidification, further data and product information is needed.

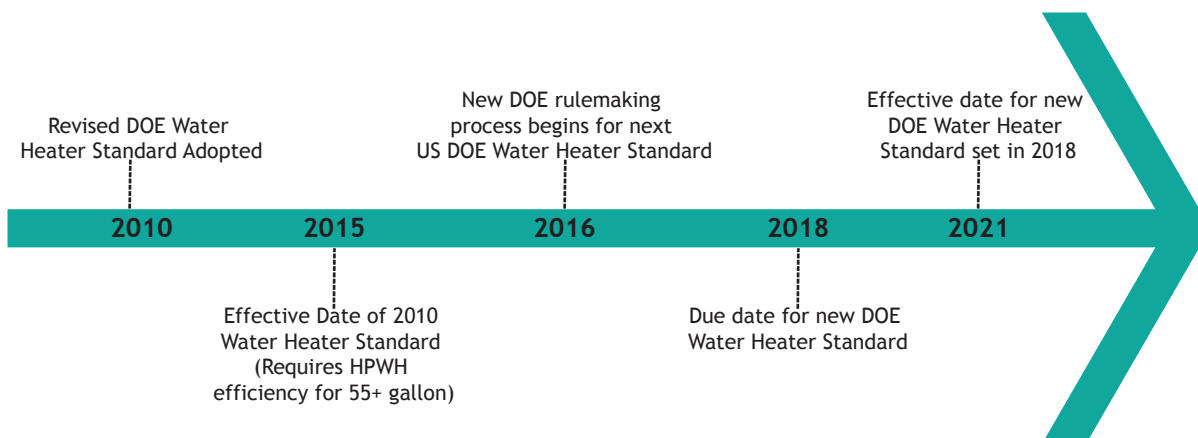
For many consumer products, minimum appliance efficiency standards play a key role to lock in the efficiency gains achieved through efficiency programs and industry promotions to introduce and build market demand for new high efficiency products. This has been the case for refrigerators, clothes washers, HVAC, lighting and even for industrial products such as motors. This regulatory mechanism is aided by voluntary program efforts that early on set the technical bar for quality products via product specifications and test procedures that address key issues regarding efficiency and other key attributes that affect customer satisfaction for product performance and longevity. Such an opportunity exists for HPWH and will be discussed more in the recommended strategies section.

Federal Appliance Efficiency Standards for Residential Water Heaters

Congress first established efficiency standards for water heaters in 1987 that took effect in 1990 and DOE later updated them in 2004¹⁹. The standard for the common 50 gallon tank size was set at .904 for electric water heaters. In April 2010, the U.S. DOE announced new, more stringent federal standards to take effect in 2015. The amended standards are significantly more aggressive, especially for models with volumes larger than 55 gallon storage tanks. The efficiency of larger electric water heaters will increase by more than 120 percent, essentially matching the current efficiency criteria for ENERGY STAR electric water heaters. Heat pump water heating technology is the only current technology capable of meeting these new efficiency levels.

19 DOE Rulemakings documentation; http://www1.eere.energy.gov/buildings/appliance_standards/residential/waterheaters.html

Timeline of Recent and Future Minimum Standards Activity for Residential Water Heaters



ENERGY STAR Criteria - Driving Innovation: The initial [ENERGY STAR criteria](#) for water heaters took effect in January 2009, electric storage being one of the product classes. The same year, a number of major manufacturers (GE, Rheem, A.O. Smith, and Airgenerate) launched integrated HPWH units in North American markets that met the ENERGY STAR criteria. The criteria extended beyond basic energy efficiency to include minimum hot water delivery requirements, warranties, and safety standards. In developing the ENERGY STAR criteria, the DOE included requirements for efficiency (EF 2.0 or better), capacity (first hour rating 50 gallons per hour), longevity (warranty \geq 6 years), and electrical safety (UL 174 and UL 1995).

While these metrics tell much of the story about the capabilities of a HPWH, the ENERGY STAR criteria does not address all performance and comfort issues when it comes to these units operating in environments common to northern climates. One of the chief issues is a HPWH's ability to operate efficiently (in heat pump mode instead of in resistance back up mode) at cooler ambient temperatures. There can be a wide gap in performance between ENERGY STAR qualified units when it comes to their ability to operate efficiently when installed in cooler locations typical of the region.

At the time of publishing, ENERGY STAR was close to publishing its next iteration of the residential water heater performance criteria (Version 2.0). ENERGY STAR has indicated its intention to leave the core technical specifications unchanged for electric storage water heaters, while adding a reporting requirement for compressor cut off temperature. This may represent a potential gauge for how well a unit can operate efficiently at certain ambient temperatures.

Northern Climate Specification - Addressing a Missing Link: In response to this reality, a number of stakeholders across the Northern region, led by the Northwest Energy Efficiency Alliance (NEEA) developed a Northern Climate Specification for HPWHs. NEEA released an

updated version (4.0) of the [Northern Climate Specification](#) in November 2011 that defines three tiers of HPWH performance and includes a revised definition of EF that is applicable to cold climates throughout North America. See [Chapter 5](#) for more discussion on the Northern Climate Specification for HPWHs.

TopTen USA - Defining the Best of the Best: In addition to these efforts, [TopTen USA](#) is helping to set the technical bar by maintaining on its consumer-facing website a list of the 10 best HPWHs that are ENERGY STAR qualified and available for purchase in the U.S.. A subset of the ENERGY STAR list, these HPWH products offer consumers the greatest energy savings available on the market. The site provides some guidance to consumers about the potential effects on efficiency when operating HPWH in colder environments.

[HPWH Delivery Chain \(Midstream Market Actors\)](#)

“Midstream” market actors fall in the middle of the HPWH supply chain, the “middle men” between manufacturers and consumers. This group includes HPWH distributors, installers, and retailers. Since this group often represents the “front line” of consumer interaction when it comes to water heater purchases, it is logical that consumers rely heavily on these communities for information and recommendations. According to ENERGY STAR’s 2010 Market Profile:

Half or all water heaters pass through wholesalers and distributors, with most of these (87 percent) through plumbers to homeowners. The other half are sold through Retailers with most of these (85percent) to homeowners or plumbers. Plumber install at least 60 percent of all water heaters, homeowners install 25 percent. The remaining 15 percent are installed in remodels, new homes, and in multi-family residences possibly in many cases by plumbers.

Emergency Replacement - The Norm: Further complicating the HPWH discussion between retailers, installers and consumers is the fact that water heater replacement often occurs at time of failure, creating “emergency replacement” situations. These situations create a sense of urgency. When a consumer’s number one concern is getting a replacement quickly, introducing new, unfamiliar technologies can be a difficult proposition. Clearly, without a midstream network knowledgeable about and experienced with HPWH, consumers are unlikely to be offered this technology as an option.

While HPWHs are not new, products designed for the residential market have achieved minimal market penetration in the past, primarily because past products were produced by smaller, niche-market manufacturers, encountered reliability issues, and operated with limited market infrastructure. Although HPWHs were first commercialized in the 1980s, they were typically add-ons to existing ERWHs, which required specialized knowledge for installation and often required both an HVAC contractor and a plumber to install the system. The development of drop-in HPWHs allowed for easy installation by a single trade.



Potential Energy/Demand Savings from Implementation of Heat Pump Water Heater Technology in the Northeast

Table 4.
Market Size: Estimated Annual Sales of Electric Resistance Water Heaters²⁰

Northeast States	Estimated Annual ERWH Sales (all volumes)	Estimated Annual ERWH Sales (50 Gallons and larger)
Maryland	96,396	41,450
Pennsylvania	82,519	35,483
New York	58,979	25,361
New Jersey	57,557	24,749
Massachusetts	46,889	20,162
Connecticut	25,265	10,864
Delaware	14,939	6,424
Washington DC	10,127	4,355
Maine	9,499	4,085
New Hampshire	9,495	4,083
Rhode Island	7,582	3,260
Vermont	4,483	1,928
Northeast- Mid Atlantic Region	423,731	182,204

²⁰ DOE's Appliance Rebate Program Planning Tool for State and Territory Energy Offices (2009) ([available for download](#)). State Shipments adjusted based on proportional decline from 2006 GAMA national shipments data (4.8 million shipments) and 2010 AHRI national shipments data (3.7 million shipments).

Table 5.
Energy Savings: Potential Energy Savings Associated with HPWH Selection
(instead of ERWH) (for 50 Gallon units and larger)²¹

Northeast States	Estimated Annual ERWH Sales	Estimated energy savings from conversion (kWh) ²³	Energy Savings (10% conversion rate) (kWh)	Energy Savings (25% conversion rate) (kWh)	Energy Savings (50% conversion rate) (kWh)	Energy Savings (100% conversion rate) (kWh)
Maryland	41,450	1,957	8,111,817	20,279,542	40,559,084	81,118,169
Pennsylvania	35,483	1,957	6,944,057	17,360,142	34,720,283	69,440,566
New Jersey	24,749	1,957	4,843,472	12,108,680	24,217,360	48,434,719
New York	25,361	1,681	4,263,203	10,658,008	21,316,016	42,632,032
Massachusetts	20,162	1,681	3,389,284	8,473,210	16,946,421	33,892,842
Connecticut	10,864	1,681	1,826,223	4,565,558	9,131,116	18,262,232
Delaware	6,424	1,957	1,257,165	3,142,913	6,285,826	12,571,653
Washington DC	4,355	1,957	852,180	2,130,451	4,260,902	8,521,804
Maine	4,085	1,681	686,652	1,716,631	3,433,261	6,866,522
New Hampshire	4,083	1,681	686,315	1,715,787	3,431,574	6,863,148
Rhode Island	3,260	1,681	548,082	1,370,205	2,740,410	5,480,821
Vermont	1,928	1,681	324,049	810,123	1,620,246	3,240,491
Northeast Region	182,204	1,822	33,732,500	84,331,250	168,662,499	337,324,998

²¹ Based on percentage of shipments by water heater volumes in DOE's 2010 Residential Water Heater [Technical Support Document](#) (Chap. 7)

²² Northeast States assigned average savings estimate of MA and CT TRMs, while Mid-Atlantic states assigned savings estimates in Mid-Atlantic TRM. Northeast Region value is the average of MA and Mid-Atlantic

Table 6.
Potential Summer Peak Demand Reductions Associated with HPWH Selection
(instead of ERWH) (for 50 Gallon units and larger)²³

Northeast States	Estimated Annual ERWH Sales	Estimated Summer Peak Demand savings from conversion (kW)	Summer Peak Demand Savings (10% conversion rate) (kW)	Summer Peak Demand Savings (25% conversion rate) (kW)	Summer Peak Demand Savings (50% conversion rate) (kW)	Summer Peak Demand Savings (100% conversion rate) (kW)
Maryland	41,450	0.17	705	1,762	3,523	7,047
Pennsylvania	35,483	0.17	603	1,508	3,016	6,032
New Jersey	24,749	0.17	421	1,052	2,104	4,207
New York	25,361	0.17	431	1,078	2,156	4,311
Massachusetts	20,162	0.17	343	857	1,714	3,428
Connecticut	10,864	0.17	185	462	923	1,847
Delaware	6,424	0.17	109	273	546	1,092
Washington DC	4,355	0.17	74	185	370	740
Maine	4,085	0.17	69	174	347	694
New Hampshire	4,083	0.17	69	174	347	694
Rhode Island	3,260	0.17	55	139	277	554
Vermont	1,928	0.17	33	82	164	328
Northeast Region	182,204	0.17	3,097	7,744	15,487	30,975

²³ Based on percentage of shipments by water heater volumes in DOE's 2010 Residential Water Heater [Technical Support Document](#) (Chap. 7)

4. Identification and Prioritization of Market Barriers

After convening the Project’s Advisory Committee and reviewing the Situational Analysis, the first questions that we addressed were: ‘*Why aren’t HPWH common in the Northeast? And what is holding them back?*’ Chapter 4 presents an overview of key market barriers that exist for HPWH, as well as a prioritization—informed by the Advisory Committee—of which barriers are the most influential. This report focuses on the most inhibiting market barriers to HPWH uptake while making note of others that stakeholders should be aware of.

Table 7.
Key Market Barriers Identified by Project Advisory Committee

Financial
<ul style="list-style-type: none"> Initial cost currently much higher than ERWH Consumers lack access to financing
Technical (Product performance and functionality in cold climate operation)
<ul style="list-style-type: none"> Defining product quality/high efficiency Inconsistent measurements of efficiency Hot water delivery (in HP mode) Noise Condensate management/Freeze protection Space/ambient temperature requirements for Install Impact on surrounding air/HVAC Value of ducting Consumer comfort (cold exhaust air) Plumbing differences w ERWH
Consumer
<ul style="list-style-type: none"> Consumer awareness/familiarity Consumer Value Proposition
Supply Chain (contractors/retailers)
<ul style="list-style-type: none"> Installer awareness/experience Providing product/install in an emergency replacement situation Adequate distributor stocking Retailer sales force familiarity Additional maintenance needed
Efficiency Programs/Regulatory
<ul style="list-style-type: none"> Inconsistent program offerings Target of incentive resources (upstream versus downstream) Consumer experience with Program incentives Calculation of energy savings Regulator discomfort with emerging technology

Prioritization of Identified Market Barriers

Based on Advisory Committee members' input, four of the identified market barriers were selected as those that, if effectively addressed, would lead to the greatest acceleration of market uptake.

Lack of Consumer Awareness and Education

Consumers don't know about HPWHs or understand the value proposition



What's a HPWH?!

Lack of Midstream Market Actors Awareness and Expertise

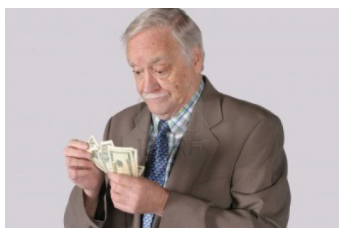
Midstream market Actors don't have enough knowledge of or experience with HPWHs to promote



"Many contractors are not aware of the technology and may even steer folks away from it when they need a replacement"

High Incremental Cost in Relation to ERWHs

HPWHs cost too much upfront



"Sticker Shock"

Definition of Product Quality in Colder Climate

HPWH has reputation of inconsistent performance



"ENERGY STAR criteria does not always differentiate performing products in colder climate installations"

5. Existing Efforts and Resources to Address Key Barriers

To develop regional strategies to address these four key market barriers, NEEP with the Advisory Committee’s input and guidance surveyed existing efforts and strategies currently employed by HPWH market actors to overcome the identified barriers. NEEP convened the Advisory Committee for four separate webinar meetings to review the existing resources and evaluate best practices to adopt and/or identify new or additional strategies for the Northeast. Chapter 5 presents the current state of efforts/existing strategies coming out of each of the topical meetings.

Building Consumer Awareness and Education

Most consumers in the Northeast are simply unfamiliar with HPWHs—what they are, how they work, what their attributes are and whether they represent a good candidate for the technology. Without a broader awareness of this technology and a clearer understanding of the value proposition this technology presents, consumers will continue to choose the incumbent electric water heating technology by default. Here’s a look at the regional/national stakeholders that influence consumer choices in selecting water heating equipment and some of the resources they use to drive consumer awareness and education.

Stakeholders Providing Guidance to Consumers

Installers (Plumbers, HVAC technicians, electricians)

Installing contractors often represent the “front line” of consumer interaction when it comes to water heater purchases. Consumers rely heavily on installing contractors to provide education and guidance through one-on-one consults. Indications are that the installer network is currently raising very little HPWH awareness with their customers.

Retail Locations/Salesforce

Water heaters are increasingly (roughly 50 percent) sold through big-box retail. In-store sales associates and point of purchase materials represent another important opportunity to introduce and educate consumers about HPWHs. Several retailers have employed displays and collateral to highlight this new technology. Retailers are in a good position to present HPWH in the context of the broader world of residential water heaters (i.e. electric, gas, oil, solar).

Utility/Energy Efficiency Programs

Fortunately, several efficiency programs from across the region are already working to provide educational materials to consumers. The education has taken the form of hard copy HPWH 101-type brochures, in-store POP signage, and online information.

- [MassSave](#)
- [Connecticut Energy Efficiency Fund](#) ([Connecticut Light & Power](#) and [United Illuminating](#))



Northwest Energy Efficiency Alliance (NEEA) is a regional energy efficiency organization working in the Northwest U.S. NEEA has been working to provide consumer education around HPWH for several years.

NEEA, in collaboration with its member organizations, developed an educational website about HPWH, [Smart Water Heat](#). The website provides a broad array of resources for consumers.

Manufacturers

Manufacturers communicate to consumers through marketing/advertisements, the signage that accompanies product in retail, on their websites, and indirectly through installers and retailer salespeople (to which they provide various forms of training).

ENERGY STAR

A program of the U.S. Environmental Protection Agency that helps consumers understand and identify energy efficiency in products and buildings. The brand is highly recognized by consumers and is a well known destination for information about energy efficient products. Residential water heaters are a product category that ENERGY STAR has developed technical specifications for as well as buying guidance for consumers. ENERGY STAR's [website](#) includes information specific to HPWH.

Department of Energy's Building America Program

[HPWH Measure Guideline Report](#) provides in depth information on HPWH operation as well as a decision tree for consumers considering the technology.

After surveying the various consumer resources that exist, a number of common threads appear. Most educational resources address three issues: ***General Consumer Awareness, Consumer Value Proposition and Consumer Buying Guidance***. Further detail is provided below.

Specific Consumer Messages

General Consumer Awareness—What is a HPWH?

A heat pump water heater combines a high efficiency air source heat pump with an electric resistance water heater. They utilize heat pump technology to offset water heating costs by transferring heat from the surrounding ambient air to the domestic hot water. Electric resistance is used only as needed, reducing water heating costs.

Consumer Value Proposition—Why should I care as a consumer?

Common selling points that stakeholders have employed to market HPWH

- Exciting new high-tech product
- Save Energy (1500-2000 kWh), Save Money (\$1000-\$1500 over the lifetime of the product)
- Smart investment-energy cost savings will more than pay for extra upfront cost
- No sacrifice in amount or delivery of hot water

- Proven/familiar technology (same core technology employed by air conditioners and refrigerators)

Controllability (provides consumers opportunities to make desired adjustments to water heater operation)

Associated air conditioning and dehumidification benefits

Consumer Buying Guidance—Is a HPWH right for me?

Explaining basic differences between HPWH and ERWH

- HPWHs are a technology that is essentially a one-for-one replacement of the traditional ERWH, yet HPWHs are unique in a number of important ways. It is important to prepare consumers for the differences. Main differences consumers should be aware of include: noise, cold exhaust, condensate, larger unit size, and slightly different install.

Am I a good candidate to purchase a HPWH?

- Installation location must provide adequate air volume, as well as adequate air temperatures.

Properly sizing HPWH

- Spectrum of recommended sizing tools (i.e. Existing tank size, First Hour Rating, Uniform Plumbing Code, Northern Climate Delivery Rating)

Building Midstream Market Actor Awareness and Interest

“Midstream” market actors fall in the middle of the HPWH supply chain, the “middle men” between manufacturers and consumers. This group includes HPWH distributors, installers, and retailers. Since this group often represents the “front line” of consumer interaction when it comes to water heater purchases, it is logical that without awareness and comfort amongst these groups, it is unlikely that accurate information will ever get to the consumer.

Without a contractor network knowledgeable about and experienced with HPWH, consumers are unlikely to be offered this technology as an option. In a similar way that there needs to be a clear value proposition for consumers, there needs to be a clear value proposition for these mid-stream actors as well. Stocking and promoting HPWH cannot be a detriment to a retailer or installer’s bottom line. Moreover, HPWH needs to be a profitable, competitive business opportunity that retailers and installers can readily provide and service. What is truly going to excite the distributors, installers and retailers to invest time and energy into selling this product? It will be important to identify these drivers and employ the appropriate vehicles to reach these audiences.



Market actors and regional/national stakeholders that influence midstream water heater market actors:

- Manufacturers and their trade associations (i.e. AHRI)
- Distributors and their trade associations (i.e. HARDI)
- Installer trade associations (i.e. ACCA and PHCC)
- Retailers
- Utility/Efficiency Programs
- ENERGY STAR
- DOE (Building America Program)

Existing Strategies/Vehicles for Midstream Education

<i>In-Person Trainings</i>
<ul style="list-style-type: none">• Manufacturer trainings to existing networks of contractors• Efficiency program introduction/trainings to existing networks of participating contractors• Retailer introduction/trainings to salesforce staff
<i>Web-Based Training/Information</i>
<ul style="list-style-type: none">• Manufacturers (websites, YouTube, etc.)• NEEA's Regional Smart Water Heat Website
<i>Collateral Documents</i>
<ul style="list-style-type: none">• Joint-Efficiency Program HPWH Selection and Quality Installation Guide• DOE Building America Program's Measure Guidance for HPWH

Common Issues Addressed by Midstream Education

<i>Raising Awareness and Education</i>
<ul style="list-style-type: none">• What is a HPWH?• Explaining differences between HPWH and ERWH• Technical instructions associated with install (size/weight of units, location of inlet/outlet, etc)• Sizing guidance, however specific direction varied across resources• Understanding what makes a good candidates for HPWH install in the unique install environments common in the Northeast• Importance of passing technology provider knowledge along to consumers, where knowledge gap is huge

The Cold Climate Challenge - Defining Quality Product Performance

Like many emerging technologies, HPWH product quality and performance varies greatly across the various manufacturer offerings in the current market. As a region that is working to accelerate market uptake of this technology and affect long term market transformation, it is essential to identify and promote products that meet (and in some cases exceed) consumers expectations. In the case of HPWHs that means functioning similarly to or better than ERWHs. To achieve this, employing mechanisms that help identify product quality based on performance are an invaluable tool to not only consumers, but to each of the key HPWH market actors. The ENERGY STAR program has been a commonly used voluntary framework by energy efficiency stakeholders in the Northeast for over a decade. Based on regional experience working with qualifying frameworks such as ENERGY STAR and others, effective frameworks generally include:

- A common set of technical specification requirements (minimum energy efficiency and performance criteria measured in a consistent way)
- Administered independently of manufacturers

Northeast efficiency programs often tie incentives to products that “qualify” for certain performance frameworks in a given category, to assure and maximize energy savings. Performance specifications also provide a common set of directions to manufacturers who are motivated to qualify their products for special recognition.

As mentioned earlier, HPWHs come with a number of operational differences that distinguish this current generation of technology from ERWH. They include:

- Presence of intermittent compressor noise (~60 db or comparable to a room air conditioner)
- Presence of condensate and need for drainage
- Need for adequate air supply within install location
- Greater size/weight of unit
- Associated air conditioning and dehumidification benefits

When operated in install locations common to colder climates, HPWH face additional challenges:

- Efficiency performance of HPWH can be adversely affected in lower ambient air temperatures
- Cold air exhaust during heating season may affect consumer comfort
- Warm air intake during heating season may impact whole house energy usage, as HPWH requires space heating systems to operate more to maintain in-door temperature.



A framework for HWPW that effectively differentiates high performing products from those products that may disappoint Northeast consumers needs to include metrics that take these operational realities into account. Stakeholders are currently utilizing a variety of frameworks to identify efficiency and quality in the HPWH market. The following table presents four existing frameworks (ENERGY STAR, ENERGY STAR “plus”, TopTen USA and the Northern Climate Specification for HPWH) that are currently being deployed and presents their benefits and drawbacks.

Table 8:
Comparison of Existing HPWH Specification Frameworks

ENERGY STAR®	
Benefits	Drawbacks
Strong brand recognition	No sensitivity to climatic variation (nationally relevant spec). Does not address all cold climate performance issues.
Addresses energy efficiency (Min. Energy Factor req.)	Efficiency rating based on DOE Test Procedure (ambient air temp not reflective of cold climate operation, draw profile not reflective of typical usage). However imperfect, it does offer a direct efficiency comparison.
Addresses hot water delivery (50 Gal. FHR req.)	FHR does not reflect which heating element is used to meet demand. It is also highly dependent on tank size.
Addresses reliability (6 year Warranty)	
Northeast program experience (CT, MD, etc.)	
Addresses low temp Heat pump operation; Compressor shut off temperature Reporting requirement (In Version 2.0, effective July, 2013)	
May be an avenue to include “connected” capability requirements, as they are exploring for other product categories	
ENERGY STAR “plus”	
Benefits	Drawbacks
Leverages ENERGY STAR brand.	Market confusion; introduces additional complexity especially in program areas that have historically only promoted base ENERGY STAR products

Some programs have experience promoting subsets of ENERGY STAR.	Limited program experience (MA/RI utilizing in 2012)
Additional performance requirements on top of base ENERGY STAR to ensure energy savings/ consumer confidence in colder climate - Higher EF (2.3) and product longevity (10 year Warranty)	

Northern Climate Specification for HPWH

Benefits	Drawbacks
Specification being promoted in the Northwest	Fledgling “brand”, no experience in Northeast energy efficiency programs
Climate-sensitive rating method	Presents additional testing burden for manufacturers.
Utilizes a climate sensitive variation of the Energy Factor (Northern Climate Energy Factor)	Additional testing burden. Questions raised about the applicability of the NC EF to the Northeast.
Tier 1 only adds a few req. to ENERGY STAR (Northern Climate Energy Factor req. and noise limit)	Questions raised about the applicability of the NC EF to the Northeast.
Tier 2 addresses additional criteria <ul style="list-style-type: none"> • *condensate management- blockage alert • *restriction on resistance heating- • *compressor shut-down alarm • *Air filter alarm • *Exhaust ducting capability required in Tier 2- increased savings • *Intake exhaust ducting capability required in Tier 3-increased savings 	<ul style="list-style-type: none"> • Low market availability of tier 2/3 products (only one product currently qualifies at Tier 2, none at Tier 3). • Uncertainty how additional req. will effect average costs. • Exhaust ducting capability required in Tier 2- Uncertain impact on whole house energy use • Intake exhaust ducting capability required in Tier 3 - uncertain energy penalty for wall opening
Includes Tiers- allows for some flexibility (current generation and aspirational levels)	Includes Tiers- adds complexity to marketplace
ENERGY STAR base requirement	

TopTen USA	
Benefits	Drawbacks
Energy and economic savings estimates are based on federal performance rating methods	Lacks sensitivity to climatic variation (nationally relevant spec). Does not address all cold climate performance issues
Efficiency programs in Connecticut launching promotion of TopTen USA HPWHs	Minimal energy efficiency program promotional experience
Consumer friendly website tool identifies the very most energy efficient water heaters in a simple format	
All products in electric storage water heater category meet ENERGY STAR Criteria	
Site ensures product availability	

Supplemental/ Alternative Approach- Restriction of Install Location	
Benefits	Drawbacks
More secure energy savings as products would be limited to only installation locations most likely to provide optimal efficiency	Restricting potential retrofit opportunities
Elimination of possible hazards (below freezing ambient conditions)	Does not encourage product improvements

Driving Down the High Initial Cost to Purchase a HPWH

The estimated cost for 50 gallon HPWHs, installed, can run between \$1500 and \$2200 in the Northeast and Mid Atlantic region. With an installed ERWH running between \$600 and \$800, incremental cost falls in the \$1000 neighborhood. For most consumers, and installers, this upfront cost premium represents an extravagant expense and closes the door to learn more about the lifetime cost savings and other benefits of HPWH.

Industry representatives agree that our best shot at driving consumer costs down in the mid-to long-term is to drive up sales volumes in the near term. By increasing HPWH sales volumes to reach economies of scale on both product cost and installation costs, they predict overall costs may drop significantly to become more competitive with ERHW. This begs the question, how are stakeholders finding creative ways to offset higher upfront cost in the near term?

Several stakeholders have employed a variety of tools and resources to alleviate the upfront cost challenge.

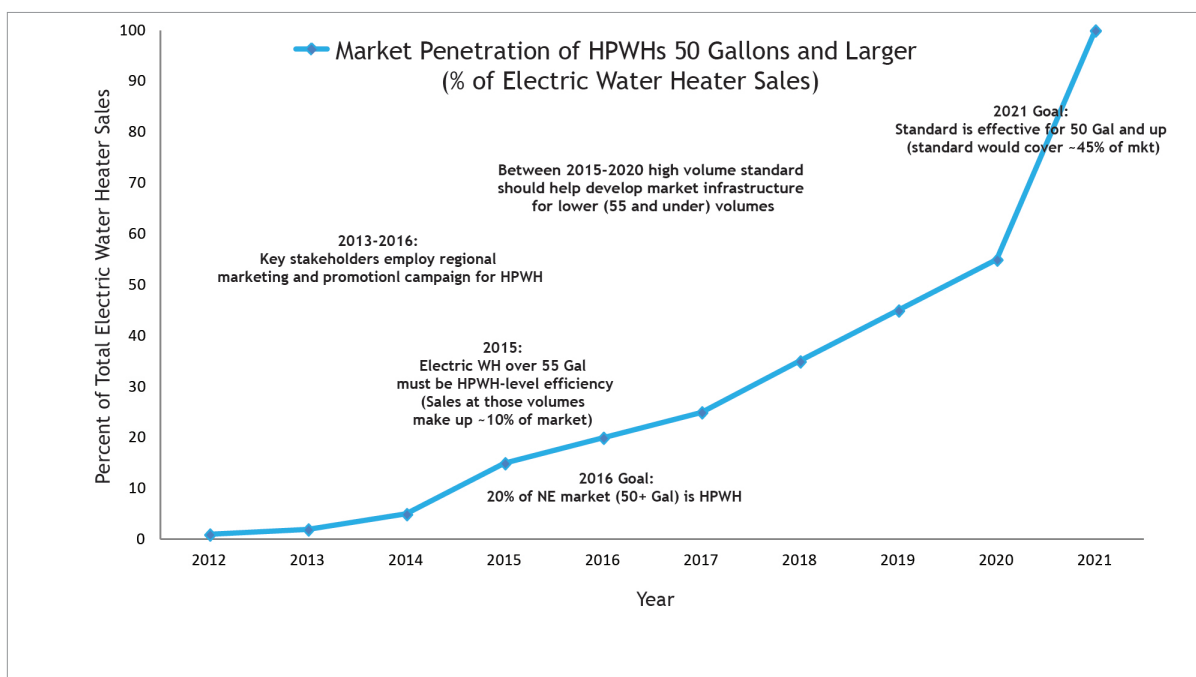
- ***Utility/Efficiency Program Incentives***
 - Consumers Rebates
 - See Summary of Program Rebates in Northeast (Appendix B)
 - Range between \$300-\$1000
 - Rebates offered in the Northwest (Utility rebate listings on Smartwaterheat.org)
 - Installer Incentives
 - Smart Water Heat (NEEA) plans to move to more upstream/midstream model, offering incentive \$'s to manufacturers/distributors/installers.
 - In parallel with utility programs offering consumer rebates.
- ***Manufacturer/Retailer Consumer Promotions***
 - Special Promotions have included Program participation as third party in some cases, leveraging multiple trusted brands.
- ***Financing Options***
 - Efficiency Program Financing offerings
 - MassSave offers 0 percent financing through [HEAT Loan program](#)
 - [Connecticut Housing Investment Fund](#) , supported by the Connecticut Energy Efficiency Fund, offers 2.99 percent financing for most Connecticut residents
 - Vermont [PACE Communities](#)
- ***Leasing***
 - Hot water system leasing is another possible avenue to offset the higher first cost of HPWH and build market momentum. In the past, electric utilities routinely leased electric water heaters to their customers. While such programs were re-tired by regulators as unnecessary, in more recent years, the market introduction of solar water heating and photovoltaic systems for residential and small business adoption has been supported by leasing options offered by product installers. Likewise, HPWH manufacturers and installers may consider offering leasing arrangements for residential HPWH installations.²⁴

24 See for example HPWH leasing arrangements offered by AWHR a Pennsylvania based company at: <http://www.awhr.com/awhr-water-heaters.html>

6. Market Transformation

NEEP projects that earnest implementation of the recommended market strategies outlined in [Chapter 7](#) will produce the necessary market conditions in order for market transformation to occur. The graph below depicts a potential market transformation curve, or “theory of change” illustrating several key inflection points that are essential to drive market penetration from less than one percent in 2012 to a federal standard that require 100 percent penetration in 2021. To better describe the timing of these activities/catalysts and their affect on the market, a timeline is presented below. Think of this theory of change as the story we would tell in 2021 of how the water heating market was transformed to HPWH.

Graph 3. Potential Market Trajectory of 50 Gallon Electric Water Heaters



2013

HPWH Market Share of Electric Water Heaters Sold Increases to Two Percent Involving Multiple Products and Manufacturers

- Efficiency programs across the region offer incentives, financing or leasing that increase customer awareness and reduce the higher purchase cost of HPWH with a goal of increasing market share to two percent
- Manufacturers work with trade allies and associations to increase the number of trained firms certified to specify and install residential HPWH with rewards for market sales
- ENERGY STAR develops consumer guidance around compressor cut off temperature, helping to ensure appropriate HPWHs are installed in the variety of cold weather applications
- Efficiency Programs, manufacturers and trade allied adopt and implement Regional HPWH Marketing Campaign with consistent consumer messages
- Stakeholders adopt “stretch” specifications to encourage improvements to HPWH product performance. Performance improvements, especially improvements targeting cold climate issues will strongly bolster our efforts to affect the federal standards process.

2014

HPWH Market Share of Electric Water Heaters Sold increases to 5 Percent and Installed Costs Decline with Increased Market Competition

- Incentive, financing and leasing programs and Regional Marketing Campaign continue with changes informed by 2013 market response
- The number of trained and certified installers for HPWH products continues to grow as does the number of HPWH retailers/distributors
- Manufacturers introduce new enhanced HPWH products with additional features valued by consumers that increase energy savings (e.g., dehumidification, “connected” features). Simultaneously, technology strategies are developed to address energy use impacts on home heating during winter months.
- As HPWH uptake increases, economies of scale begin to depress upfront costs of HPWH, making the installed cost considerably more attractive (as payback period falls).
- Weatherization and other public programs adopt HPWH as a priority water heating appliance for installation in appropriate applications
- Stakeholders define and collect information to support federal standards setting



2015

HPWH Market Share of Electric Water Heaters Sold Increases to Five Percent and U.S. DOE Implements New Appliance Efficiency Standard for High Volume Electric Water Heaters

- The 2015 Water Heater efficiency standard for electric water heaters over 55 Gallons takes effect - requiring efficiency levels met only by HPWH technology
- Leasing programs and Regional Marketing Campaign continue with changes informed by 2014 market response (incentives and financing end as HPWH payback period has become compelling)
- The large majority of reputable installers are trained and certified to install HPWHs in a range of applications
- HPWHs are offered by the large majority of retailers and distributors
- Stakeholders define and collect information in advance to support federal standards setting

2016-2018

Northeast and Mid-Atlantic Stakeholders Engage Federal Standards Rulemaking Process

- Broad stakeholder activity has driven market penetration to 20 percent
- Region engages federal standards setting process with coordinated input and data
- Market delivery infrastructure matures as all large volume electric water heaters are HPWHs
- Regional marketing campaigns wind down
- Weatherization and other public programs continue to make HPWH a priority measure for homes served
- Efficiency programs continue to offer technical support and incentives as needed with HPWHs
- DOE finalizes efficiency levels reflective of HPWH efficiencies for units 50 gallons and larger to take effect in 2021

2016-2019

Market Transformation Takes Hold

- Market delivery infrastructure matures as all large volume electric water heaters are HPWHs
- Regional marketing campaigns wind down
- Weatherization and other public programs continue to make HPWH a priority measure for homes served
- Efficiency programs continue to offer technical support and incentives as needed with HPWHs
- HPWHs are recognized as a mature technology that meets hot water needs of consumers at a fraction of the energy. Payback period on the investment is now approximately two years, a level most consumers will feel compelled to act.

7. Regional Strategies to Address Market Barriers

To effectively address the critical market barriers for HPWHs and achieve desired market transformation, NEEP - with input and guidance from the Northeast-Mid-Atlantic HPWH Advisory Committee - has developed a series of recommended market strategies for the region. The regional strategies presented build off of the significant amount of work already committed to these challenges, as evidenced in Chapter 5. Our theory is that by implementing these strategies with some amount of regional consistency, market momentum can be achieved, resulting in accelerated HPWH uptake. As described in the introduction, a successful regional effort will not only achieve significant near term energy savings, but will enable the revision of federal efficiency standards to “lock in” even greater long term savings. Lastly, NEEP projects a potential market transformation curve that specifies implementation timing of the key market strategies.

Regional Strategy #1
Ramp up consumer awareness of, and demand for, HPWHs

CHALLENGE

Consumers don't know about HPWH or understand the value proposition offered by the product

Key Action Items

1) Develop and communicate a compelling consumer proposition centered on financial payback and the superior utility offered by the technology.

Consumer demand must eventually drive the broad adoption of HPWH in the region. To create greater excitement and demand for this technology, Northeast stakeholders need to develop and communicate a clearer value proposition for HPWHs to the consumer.

- Smart Investment; A compelling consumer value proposition depends on its financial promise. Today's HPWHs represent a smart financial investment for consumers, boasting estimated simple paybacks between three and six years.
- Superior Utility; Until simple payback on HPWHs can be shortened to less than 2 years, a period of time which motivates most consumers to make a switch, stakeholders across the delivery chain should highlight/leverage the unique benefits of HPWHs that bring superior/additional utility and consumer value to electric water heating. Some of the important capabilities that should be communicated include:
 - Dehumidification capabilities of HPWHs. Northeast basements are notorious for being damp throughout the warmer months, with many residents opting to maintain a comfortable and safe living space through the use of a dehumidifier. During operation, HPWH act as a dehumidifier and may be able to displace existing dehumidifier units and the approximately 1000 kWh of associated annual energy use. This is a significant value add to many consumers in the region.
 - Controllability/"Connectability" of HPWHs. While consumers are increasingly seeking high-tech high efficiency in their homes and appliances, a "controllable" water heater may provide additional consumer utility not available in traditional ERWH. As more and more consumers are connected to smarter meters and grids, HPWHs also provide greater product intelligence to effectively interact with and take advantage of these technologies.
 - Attractive alternative to oil-fired water heating. As increasing numbers of consumers look for ways to reduce their dependence on home heating oil, HPWH represent an exciting path away from oil-fired water heaters.

2) Implement "Surround Sound" HPWH Marketing Campaign. All key market actors (manufacturers, retailers, installers, energy efficiency programs) should devote resources and coordinate consumer messages to raise the market profile of HPWHs as a cost-saving, "green" technology, through a variety of marketing channels. A simple and consistent "surround sound" message, delivered by multiple trusted market actors, region-wide, will raise familiarity and create excitement with consumers.

- Program Administrators from region come together to establish Campaign messages; Either through the use of a jointly hired marketing firm or through the regional HPWH Working Group, efficiency programs develop core concepts, messages and materials for a "surround sound" marketing campaign that all can use as part of a coordinated but independently implemented marketing campaign. Through the use of existing implementation support contractors or supplemental "circuit riders", it will be important for regular reinforcement of the campaign messages with retailers and installers to synch their marketing to the regional HPWH campaign.
- Utilize existing educational materials that have already been developed by stakeholders (See Chapter 5).
- Leverage marketing value of the ENERGY STAR platform and energy efficiency program brands to reassure potential consumers.
- Identify, and market to, early adopters and high value niche markets that would likely achieve the greatest energy savings and find the greatest value in unique attributes of HPWHs. Manufacturers should work with midstream partners to identify potential "early adopters" and high value niche markets (e.g., those with larger hot water demand).

Other Recommendations

To avoid the issues associated with emergency replacement scenarios, messaging should prioritize planned water heater replacements with HPWH.

Continue to market HPWH as both a retrofit (replacement for ERWH or oil heating system) and new construction and renovation/remodel opportunity.

Regional Strategy #2

Develop capable and motivated supply chain to deliver excellent HPWH consumer experience

CHALLENGE	Market actors don't have enough knowledge of, or experience with, HPWHs to become technology ambassadors
Key Action Items	
<p>1) Communicate clear business case to supply chain actors. In a highly time and price-conscious installer/service market, Northeast stakeholders need to clearly communicate a compelling business case for midstream market actors. It is essential that stakeholders provide convincing reasons for this community to adopt new practices. Until this community is more fully invested in this technology, the region will be without a key advocate to promote these products. The following “selling points” should continue to be used to tout the wisdom of marketing, selling, installing and servicing HPWHs.</p> <ul style="list-style-type: none"> • Competitive Positioning: HPWHs represent an exciting next generation product that will help position companies as cutting-edge. • Profitability: HPWH products provide higher margins compared to the sale and installation of ERWH. • Strong Consumer Value Proposition: This technology will save your customers energy and money as well as provide several additional benefits, not available in ERWHs (i.e. dehumidification, controllability, etc.). • Preparation: Heat pump technology will be standard in units over 55 gallons in 2015. Distributors and installers would be wise to be well prepared and positioned for this eventuality by becoming comfortable with the technology in the meantime. • Promotional Support: Various entities (primarily energy efficiency programs) are offering lucrative incentives and financing options to help support consumers purchase and install of HPWHs. • Strategic Alternative to Heating Oil: This technology represents an alternative for consumers looking to transition away from oil-fired water heating systems 	
<p>2) Expand Midstream Training. Ensuring this community is trained on the installation and service of this technology is essential to a capable infrastructure. Stakeholders must expand trainings aimed at midstream market actors, as installers and retailer salespeople still represent the “front line” in water heater guidance/education to consumers.</p> <ul style="list-style-type: none"> • Key Messengers: Local trade associations, distributors and plumbing companies carry significant weight with their installing contractors. Trainings should be delivered through or in conjunction with these trusted actors. 	
Other Recommendations	
<p>To bolster the business case for promoting/installing HPWHs, stakeholders should work to develop case studies and market analyses to show the business opportunity associated with HPWH.</p>	
<p>Methods for properly sizing HPWHs should be standardized (and reinforced through energy efficiency promotion requirements).</p>	



Regional Strategy #3

Focus on product quality to achieve high level of customer satisfaction

CHALLENGE

Stakeholders want to ensure consumer satisfaction when operating HPWHs in the more challenging conditions common to the Northeast and Mid-Atlantic region

Key Action Items

- 1) **Consistently define, and endorse, product quality throughout region.** Providing consumers with an objective method for identifying quality HPWH products that will perform, up to and beyond consumer expectations, is essential to ensuring long term market growth. While technical frameworks already exist in the market, they have not always accurately measured HPWH capabilities (i.e. ability to operate in heat pump mode) when operated in conditions common to the Northeast and Mid-Atlantic region. To provide clear direction to the various market actors, stakeholders throughout the region should promote a single, consistent construct to “define” HPWH product quality in the Northeast. The framework needs to include technical requirements for energy efficiency AND performance criteria.
 - ENERGY STAR qualification ensures base level of quality. Based on extensive program experience and familiarity utilizing the ENERGY STAR Labeling program, and on recently added additional requirements¹⁰ that ENERGY STAR will be instituting in 2013, the region is encouraged to work through the ENERGY STAR framework to promote quality HPWH products in the Northeast and Mid-Atlantic.
 - Utilize lower compressor cut off temperature as essential compliment to ENERGY STAR. It is vital that stakeholders utilize the lower compressor cut off temperature as a tool to help select HPWH products that will operate efficiently in their particular installation situation (common ambient temperatures can range between 50-65 degrees).
 - Regional stakeholders should work closely with ENERGY STAR to develop consumer guidance on how to use the HPWH’s lower compressor cut-off temperature to aid in product selection.
- 2) **Utilize/develop “stretch” specifications to encourage improvements to HPWH product performance.** While the most recent ENERGY STAR specification revision (Version 2.0) should enable the objective of driving high sales volumes of current technology (with an awareness of up-front costs) into the market, the region should simultaneously provide direction to industry on desired improvements to current technology (“stimulating advanced product designs”). See Chapter 5 for areas of potential improvement.
 - TopTen USA and the Northern Climate Specification for HPWH should be considered as potential vehicles to communicate such performance needs to industry.

Regional Strategy #4 Offset initial higher product cost to consumers	
CHALLENGE	Initial installed cost of HPWHs to consumers can be three times the cost of the incumbent technology (ERWHs)
Key Action Items	
<p>1) Strong rate-payer energy efficiency program support/promotion is critical to boost HPWH uptake in the near-term.</p> <ul style="list-style-type: none"> Program Administrators/Planners should prioritize direct consumer incentives downstream in the near-term as the market is still fairly immature in the region. Consumer rebates with program backing provides important legitimization to consumers and enables the collection of important information for the utility/efficiency programs. Efficiency programs should actively explore cooperative promotions involving manufacturer, retailer and efficiency program(s), as they can leverage resources across multiple parties. Promotional support should be tied to strong performance specification appropriate for the Northeast region. As the Northeast region works towards two parallel objectives simultaneously—achieving near term energy savings through increased sales volume AND long term market transformation—caution should be taken not to sacrifice important aspects of product quality, in a rush to lower upfront costs. NEEP to conduct outreach to energy efficiency program advisors/state regulators arguing for the need of continued programmatic promotion of HPWH (particularly to make regulators comfortable with fuel switching scenario). <p>2) Expand financing and consider leasing opportunities (i.e. through efficiency programs, retailers, etc.) to spread cost out over time while consumers achieve energy cost savings.</p> <ul style="list-style-type: none"> Efficiency program administrators could encourage HPWH leasing by offering incentives to midstream actors for leased systems properly installed by qualified firms. 	
Other Recommendations	
<p>Efficiency programs should explore tiered incentives for higher performing products. Higher incentive levels would have to be based on product's ability to deliver improved functionality and more importantly, increased energy savings.</p> <p>Accelerate and standardize “connected” capabilities in HPWHs. As ENERGY STAR is already looking at this issue for several other product categories, this framework provides an existing avenue to address this. Peak demand savings, enabled through connectivity, would allow efficiency programs to offer larger incentives as demand savings are especially valuable to their portfolios.</p> <p>Stakeholders should actively seek scenarios that provide high levels of installation repeatability that may keep install costs at a minimum and provide valuable installer experience (i.e. public housing).</p>	



Regional Strategy #5

Conduct research to provide data needed for more accurate technology evaluation

CHALLENGE

Quantification of HPWH energy use and impacts on whole house energy use is incomplete

Key Action Items

- 1) **Fill remaining information gaps with targeted HPWH research.** To offer a more accurate energy use/cost profile (i.e. payback period) of HPWHs to consumers, more information is needed to quantify a number of associated energy benefits/penalties due to HPWH operation in the Northeast and Mid-Atlantic. More accurate energy performance expectations will lead to more certainty for consumers, as well as energy efficiency program administrators. Overpromising financial benefits will damage consumer perceptions. Because HPWH operation impacts HVAC and dehumidifier energy use/costs, in some cases positively and in others negatively, stakeholders should undertake/support additional field research or whole house energy modeling.

Potential research areas that stakeholders should investigate:

- Quantification of HPWH dehumidification benefits
- HPWH operation in semi-conditioned space (unconditioned basement). What are whole home space heating impacts? Would exhaust ducting be beneficial to whole house energy use?
- HPWH operation in a conditioned space. Would intake/exhaust ducting be beneficial to whole house energy use?

Independent entities such as EPA/ENERGY STAR, Department of Energy and/or Energy Efficiency Programs should help fund/support such research. NEEP's EM&V Forum is a potential avenue to conduct this needed research regionally.

Other Recommendations

NEEP to continue tracking of field tests and evaluations both in and out of the region (e.g. EPRI research)

Regional Strategy #6

Build market momentum through inter/intra-regional communication and coordination

CHALLENGE

Potential for market confusion due to diversity of promotional efforts

Key Action Items

- 1) **Coordinate regional activity through Northeast/Mid-Atlantic HPWH Working Group.** To effectively implement the elements of the Regional Strategy Recommendations effectively, ongoing Regional communication will be crucial. Stakeholders should continue to stay engaged with the larger community through the NEEP-facilitated Regional HPWH Working Group.
- 2) **Track market progress.** NEEP will continue to track electric water heating market to gauge effectiveness and progress of regional strategies. Quarterly meetings/webinars and annual regional updates will facilitate learning and best practices across the region to help evolve the strategies.
- 3) **Expand inter-regional coordination.** Coordination should extend beyond our immediate region to leverage the experience and expertise of efforts being conducted at the national level or in other parts of the country (i.e. ENERGY STAR, TopTen USA, Northwest, Midwest, California).
 - NEEP should organize opportunities for information sharing and strategic planning across interested entities.

Regional Strategy #7

Support federal standards rulemaking processes with coordinated regional data and comments regarding residential HPWH

CHALLENGE	To ensure complete market transformation, and the associated savings, of medium and large-sized residential electric water heaters
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Key Action Items

- 1) **Engage federal process to revise minimum efficiency standards for residential water heaters.** For the market progress that the region achieves to inform the next standards process, stakeholders must engage the next federal standards rulemaking revision process for residential water heaters. The Final Rule of the revision is due in 2018, although it will likely launch in 2016.
 - The Northeast Appliance Standards Project, managed by NEEP, provides an existing forum for stakeholder engagement of the federal standards process. It will be important to develop and submit written comments and data to the U.S. DOE at several stages of the rulemaking.
 - Among other data and information that will help the US DOE establish an appropriately stringent efficiency level as part of their upcoming standard revision process, the Northeast and Mid-Atlantic region should concentrate on developing market research that demonstrate;
 - Consumer satisfaction of HPWHs in cold climate market
 - Presence of a capable delivery and service infrastructure
 - Tracking of latest retail and installation costs
 - Better quantification of whole home energy impacts due to HPWH operation

NEEP can support and coordinate this through its Emerging Technology and Regional Appliance Standards Projects.



Appendix A: Existing Resources

- DOE's Building America Measure and Strategy Guide; Heat Pump Water Heaters in New and Existing Homes (SWA, 2012)
- DOE R&D Roadmap for Water Heaters (Sept 2011)
- Introduction to Emerging Technology Savings Assumptions Report (Draft) - **Final Drafting Process, Not Yet Public**
- NEEA's 2011 Water Heater Market Update
- DOE/NREL Laboratory Performance Evaluation of Residential Integrated Heat Pump Water Heaters
- Heat Pump Water Heaters and American Homes: A Good Fit? (2010 Summer Study Paper by LBNL)
- ENERGY STAR Market Profile (2010)
- ENERGY STAR Partner Resource (2009)
- ENERGY STAR Residential Water Heaters: Final Criteria (2008)
- ENERGY STAR Residential Water Heaters: Final Criteria Analysis (2008)
- Energy Information Agency's Residential Energy Consumption Survey (2009)
- DOE Water Heater Technical Support Document (2010)
- DOE State Energy Efficient Appliance Rebate Program Planning Spreadsheet
- EPRI Paper- HPWH: Laboratory and Field Evaluation of New Residential Products

Appendix B: Northeast Program Activity Summary - Heat Pump Water Heaters

State	2011 Promotional Activities	2012 Promotional Activities
Connecticut	\$400 Mail-In Rebate (ENERGY STAR Qualified)	\$400 Mail-In Rebate (ENERGY STAR Qualified)
Massachusetts	No promotional activities, Programs Conducted in-field testing project (14 units)	\$1000 Mail-In Rebate (ENERGY STAR “plus” requirements; See Chapter 5)
Rhode Island	No promotional activities, Programs Conducted in-field testing project (14 units)	\$1000 Mail-In Rebate (ENERGY STAR “plus” requirements; See Chapter 5)
Vermont		
New Hampshire		
Maine	\$300 Mail-in Rebate offered with ARRA funding (ENERGY STAR-Qualified)	
New Jersey	\$250 Mail-in Rebate offered with ARRA funding (ENERGY STAR-Qualified)	
New York	\$400 Mail-in Rebate available for Hurricane Irene victims (ENERGY STAR-Qualified)	NYSERDA offering upstream cost share incentives (mark down/buy down)
New York (Long Island)		
Pennsylvania	\$300 Mail-In Rebate (ENERGY STAR-Qualified)	\$300 Mail-In Rebate (ENERGY STAR-Qualified) Subject to change
Maryland		\$350 Mail-In Rebate (ENERGY STAR-Qualified)
Washington D.C.		