



HEMS Integration with Electric Space and Water Heating

David Lis, NEEP

Emily Kemper, CLEAResult

Air-Source Heat Pumps for Cold Climates?



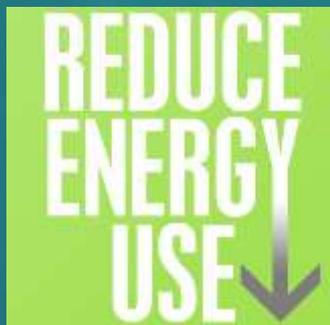
- Recent advances in technology (i.e. inverter-driven compressor motors) have made ASHPs a legitimate heating alternative in cold climates



NEEP'S Perspective on Air-Source Heat Pumps



- Expanded use of this technology in the region could be a potential pathway to multiple outcomes:



NEEP's Air-Source Heat Pump Market Transformation Initiative



What about ASHP performance below 17°F?



NEEP's Cold-Climature ASHP Specification and Product List

The screenshot shows a web browser displaying the NEEP website at www.neep.org/initiatives/high-efficiency-products/emerging-technologies/ashp/cold-climate-air-source-heat-pump. Below the website content, an Excel spreadsheet titled "ColdClimateAir-SourceHeatPumpSpecificationListing-Updated 10.26.17" is open. The spreadsheet contains a table of ASHP products with the following columns: Manufacturer, Brand (if applicable), Model Name, AHRI Certificate No., Outdoor Unit Model, Indoor Unit Model(s), AHRI Type, HSPF (Region IV), SEER, EER @ 95°F, and Cooling Capacity (BTU/h).

DISCLAIMER: Some of the performance values reported as part of the Cold-Climature ASHP Specification are NOT derived from industry standard test procedures or third-party tested/verified (i.e. performance values at 5°F). Performance values in grey are the ones not found in the AHRI database as of June 12, 2017.

Manufacturer	Brand (if applicable)	Model Name	AHRI Certificate No.	Outdoor Unit Model	Indoor Unit Model(s)	AHRI Type	HSPF (Region IV)	SEER	EER @ 95°F	Cooling Capacity (BTU/h)
Amana Heating and air	Amana	AV2C28	16324704	AV2C280241A*	CA*F3642*160**MBVC1200**1A**TX	HRCUA-CB	10	21	13	23,400
Amana Heating and air	Amana	AV2C28	16324705	AV2C280361A*	CA*F3743*160**MBVC1600**1A**TX	HRCUA-CB	10	21	14	35,400
Amana Heating and air	Amana	AV2C28	16324706	AV2C280481A*	CA*F4951*160**MBVC2000**1A**TX	HRCUA-CB	10	20	13	46,500
Amana Heating and air	Amana	AV2C28	16324707	AV2C280601A*	CA*F4951*160**MBVC2000**1A**TX	HRCUA-CB	10	20	12.5	52,500
American Standard	American Standard	AccuComfort P	6749789	4A6V0324A1	*AMBC030V21	HRCUA-CB	10	19.25	13.75	24,200
American Standard	American Standard	AccuComfort P	6749791	4A6V0348A1	*AMBC048V41	HRCUA-CB	10	19.25	12.5	47,000
American Standard	American Standard	AccuComfort P	6752232	4A6V0336A1	*AMBC036V31	HRCUA-CB	10	18	13	35,000
American Standard	American Standard	AccuComfort P	6752233	4A6V0348A1	*AMBC048V41	HRCUA-CB	10	18	12.5	47,000
American Standard	American Standard	AccuComfort P	6759455	4A6V0324A1	*AMBC030V21	HRCUA-CB	10	18	13	23,800
American Standard	American Standard	AccuComfort P	6759457	4A6V0348A1	*AMBC048V41	HRCUA-CB	10	18	12.5	47,000
American Standard	American Standard	AccuComfort P	6796524	4A6V0336A1	*UD2C030ACV4 4TXCC007CC3	HRCUA-CB	10	20	13	34,600
American Standard	American Standard	AccuComfort P	6796526	4A6V0336A1	*UD2C108ACV5 4TXCC007CC3	HRCUA-CB	10	20	13	34,800
American Standard	American Standard	AccuComfort P	6796528	4A6V0336A1	*UD2C030ACV4 4TXFH038C23	HRCUA-CB	10	20	13	35,400
American Standard	American Standard	AccuComfort P	6796559	4A6V0337A1	*AMBC030V21	HRCUA-CB	10	18	13	35,400
American Standard	American Standard	AccuComfort P	6796560	4A6V0337A1	*UD2B030ACV3 4TXCB006CC3	HRCUA-CB	10	18	12.5	34,800
American Standard	American Standard	AccuComfort P	6796562	4A6V0337A1	*UD2C030ACV4 4TXCC007CC3	HRCUA-CB	10	18	13	34,600
American Standard	American Standard	AccuComfort P	6796563	4A6V0337A1	*UD2C108ACV5 4TXCC007CC3	HRCUA-CB	10	18	13	34,800
American Standard	American Standard	AccuComfort P	6796565	4A6V0337A1	*UD2C030ACV4 4TXFH038C23	HRCUA-CB	10	18	13	35,400
American Standard	American Standard	AccuComfort P	6992577	4A6V0336A1	*AMBC030V21	HRCUA-CB	10	20	13	35,400
American Standard	American Standard	AccuComfort P	7035709	4A6V0336A1	*DD2C108ACV5 4NXC005A83	HRCUA-CB	10	18	12.5	35,800
American Standard	American Standard	AccuComfort P	7149426	4A6V0336A1	*AMBC030V21	HRCUA-CB	10	18	13	34,600

ASHP Challenges and Opportunities related to Home energy management



- Challenge
 - Range of use of ductless ASHPs to heat homes
- Opportunity
 - Leverage variable capacity systems and connectivity to provide load shifting

Regional ASHP Market Status

- Northeast adoption of ASHPs overwhelmingly Ductless (~90%) vs. centrally ducted (~10%)
- People aren't using DHPs to heat as much as expected
- DHPs only deliver the potential savings when operated properly to optimize savings
- What to do?
 - Better customer education
 - Better controls

Integrated Control Features

Distributed indoor temperature sensors
Outdoor temperature
Current fuel costs
Optimizes operation based on current fuel costs, real time system efficiencies and building load
Demand response enabled
Carbon accounting



Boiler/
Furnace



Ductless
Heat Pump



Internet
Connected

Results from Efficiency Maine Pilot Research



Test	Average Annual Production (Gallons of Oil Equivalent)*				
	Description	# homes	PRE-test	POST-test	Difference
1	Reduce inputs from other sources of heat	5	241	257	16
2	Homeowner training	7	70	108	38
3	Integrated controls for Mitsubishi heat pumps	7	317	607	290

Opportunity: Variable Capacity

- Operational management
 - Load management/load shifting as we move to winter peaking
 - Connectivity necessary



The addition of heat pump electricity load profiles to Great Britain electricity demand: Evidence from a heat pump field trial, October 15, 2017

Thank you!

Dave Lis

djlis@neep.org

Northeast Energy Efficiency Partnerships

CLEAResult[®]

Making Water Heaters Smarter

Emily Kemper

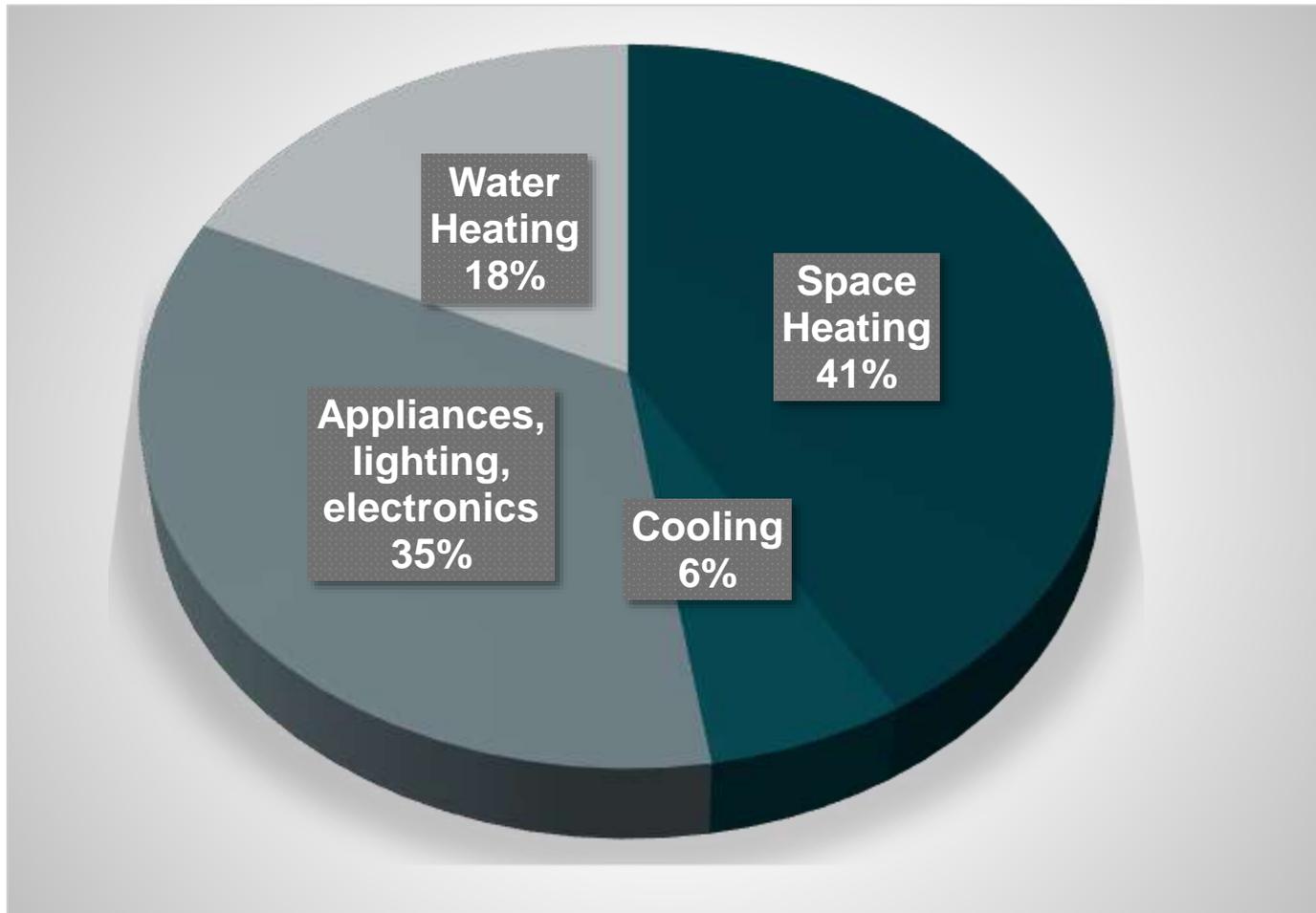
We change the way
people use energy™

- Overview
- Smart Water Heater Controls
- Program Implications

Agenda

Smart Water Heater Controls

US Consumption by End Use - Residential



Source: EIA

What If Water Heaters Were *Smart*?

Water Heaters in the Smart Grid



Source: Aquanta

EPRI Standard CTA-2045 port

- To help technologies talk and to advance grid connectivity, EPRI is co-developing and demonstrating a new interface, or *port*, based on a 2013 Consumer Technology Association standard known as [CTA-2045](#) (formerly CEA-2045).
 - The port enables customer appliances to connect to any communication network
 - Makes it possible for thermostats, water heaters, electric vehicle chargers, pool pumps, and other devices to participate collectively in automated demand response programs or other services



CTA-2045

- This is not a *device*, but a protocol
- No data available yet on whether there is wide adoption amongst water heater manufacturers
 - But, we know that A.O. Smith and Sears Kenmore are using it



Aquanta

- Aquanta is a water heater controller that employs learning algorithms to establish hot water use profiles of the home, and optimizes the water heater's energy use accordingly.
- Can be switched on/off via smart phone/tablet
- Can adjust setpoint and set schedules



Works With:

- Conventional electric storage water heaters
- Natural gas storage water heaters with electronic ignition controls

Not Compatible With:

- Atmospheric-vented natural gas water heaters models with old-style, mechanical controls
- Heat pump water heaters
- Tankless or instantaneous water heaters
- Boiler-fed water heaters
- "Combi" systems

Carina Hot Water Solutions

- Water Heater Information Solution for Energy = WISE controller
- WISE is geared towards utilities, not consumers
 - Water heater controller, used for electric power capacity management, that employs real-time control applications and sophisticated analytics to control power consumption of electric water heaters and provide peak saving or shifting
 - Connects water heaters to the grid

Works With:

- Conventional electric storage water heaters
- Heat Pump Water Heaters

Not Compatible With:

- Gas storage water heaters
- Any tankless or instantaneous water heaters



For technical specifications, payback calculations or sales information, email us at info@carinatek.com



1381 Northway St. Suite 4-13
Haverhill, MA 01831
866.915.5464 Ext. 117
www.carinatek.com

Program Implications

Aquanta: Program Implications

- Recently completed pilot with MN CEE
- Could have broad appeal to utilities
 - Energy savings applicable to both gas and electric utilities
 - In the residential space most (if not all) water heater savings come from equipment change-outs
- DR potential (electric)
- Has potential as a direct install measure (low income)

Carina WISE™: Program Implications

- Launched in 2008 in TVA pilot
 - Total of 5,000 units
 - EPRI published final report in 2012 (“Smart Two-Way Water Heater Cycling Analysis”)
- Can appeal to utilities as a grid resource
 - Controller uses the water heater to act as a battery to store additional heat in water by adding heat during non-event periods and release that stored energy during non-event periods = thermal storage
- Carina system communicates with customer water heaters to conduct load shifting in demand events
 - Could utilities also use this as a communication device in programs?

Summary:

Further Smart Home Integration Opportunities

- Smart water heaters present opportunities for energy efficiency, thermal storage, demand response, and peak load management
 - For this reason, many utilities are interested in using water heaters in new program types
- We're keeping an eye out for other smart water heater innovations
 - Like Rheem's EcoNet: <http://www.rheem.com/EcoNet/Home>

Do you know of any other smart water heater technologies?

Thank you!

Emily.Kemper@clearResult.com

Discussion

- What steps can the **HEMS industry** start to take to enable these transitions to smart, electric space and water heating?
- What steps can **programs** take?
- Audience Q&A

