HEMS Integration with Electric Space and Water Heating

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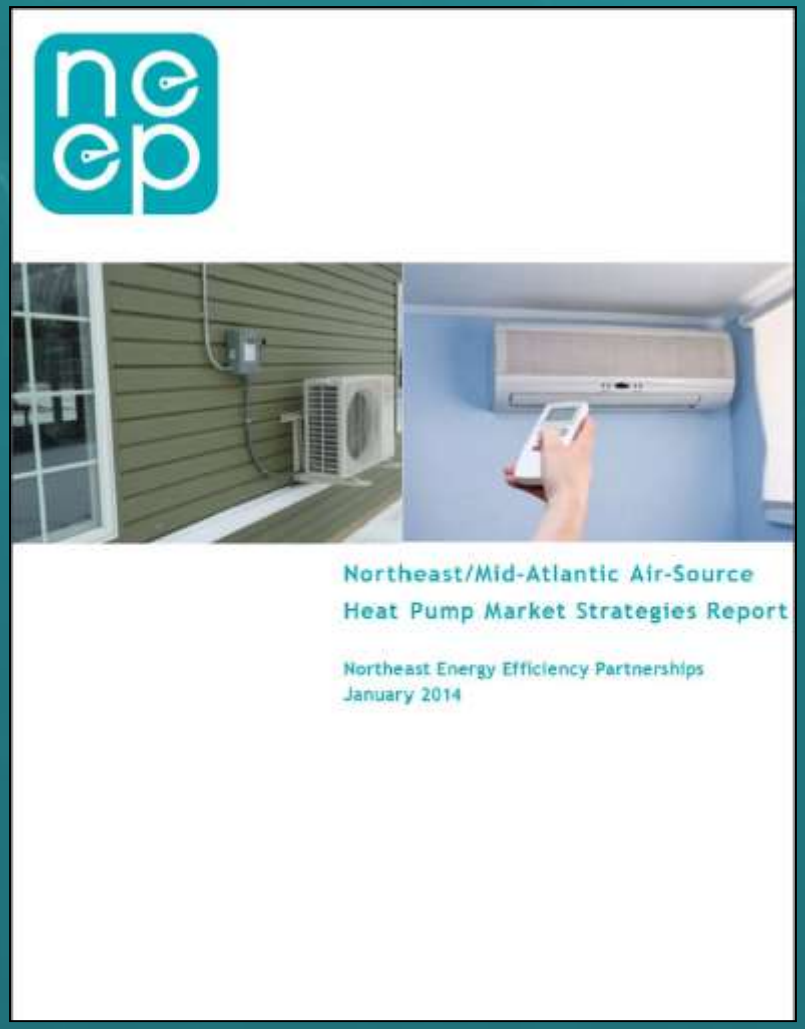
Air-Source Heat Pumps for Cold Climates?

- 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

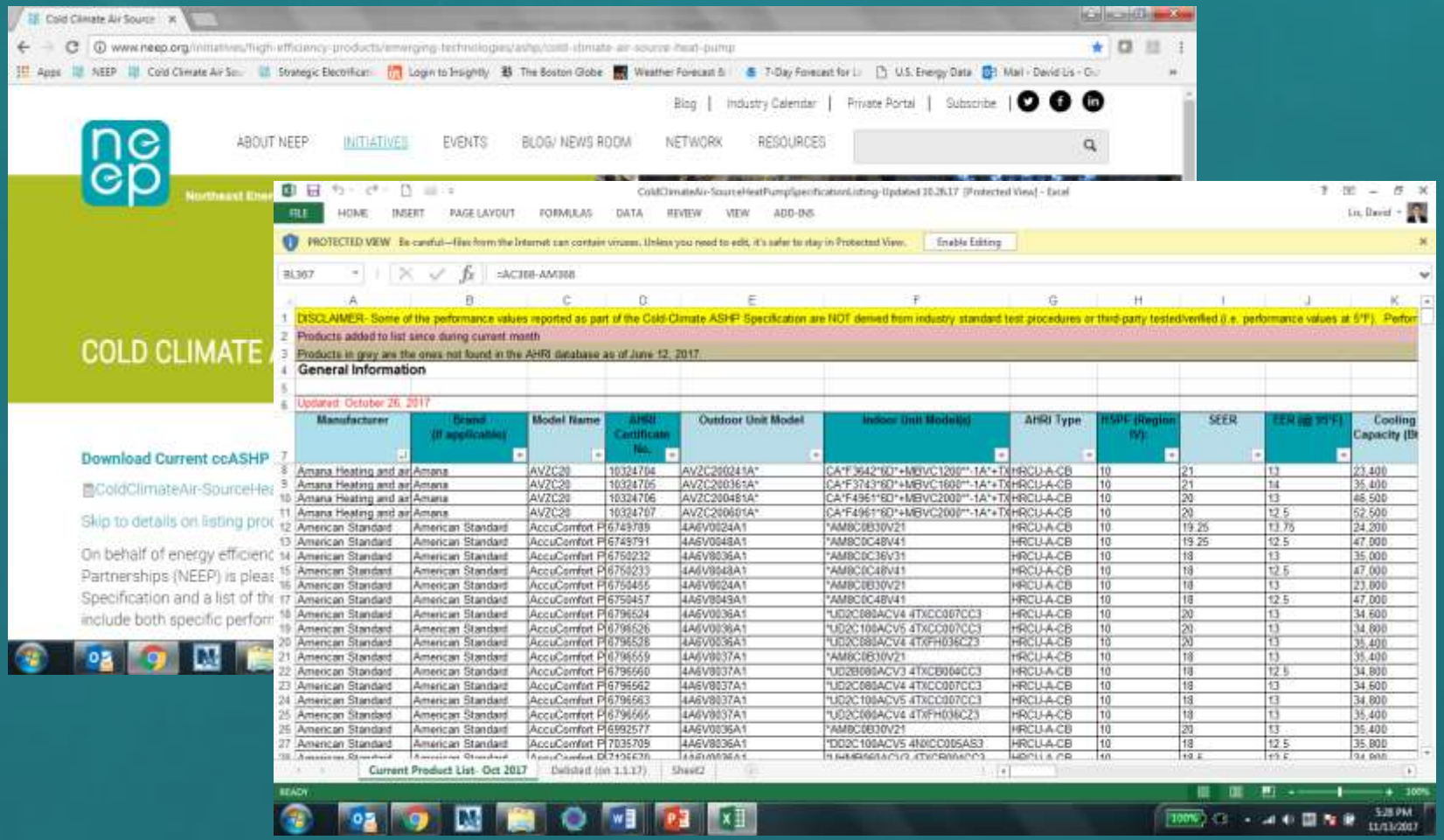
- Expanded use of this technology in the region could be a potential pathway to multiple outcomes:

NEEP's Air-Source Heat Pump Market Transformation Initiative



What about ASHP performance below 17˚F?

NEEP's Cold-Climate ASHP Specification and Product List



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	Description	# homes	Average Annual Production (Gallons of Oil Equivalent)* 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!

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Making Water Heaters Smarter

Emily Kemper

We change the way people use energy™

Agenda

- Overview
- Smart Water Heater Controls
- Program Implications

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Smart Water Heater Controls

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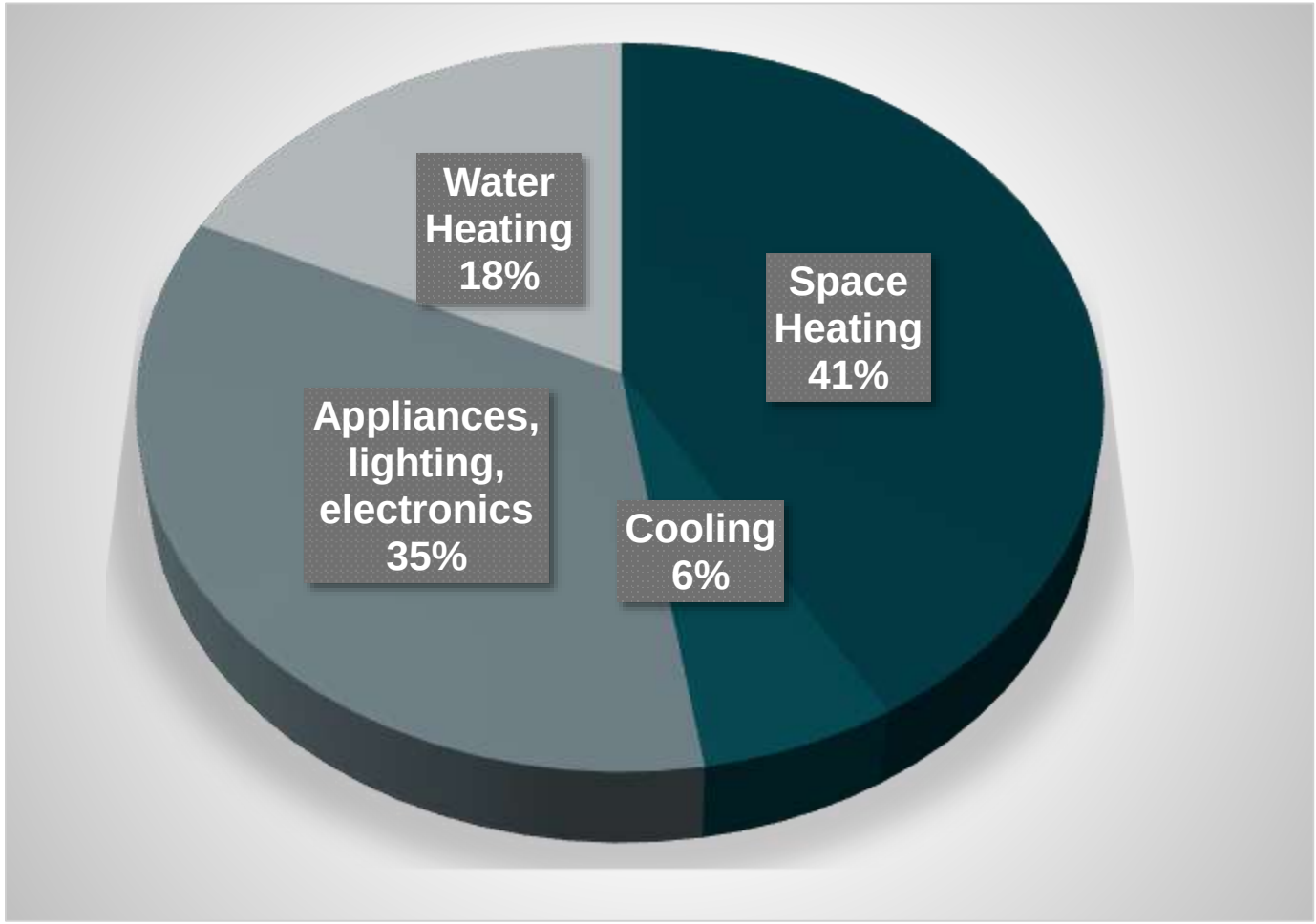
US Consumption by End Use - Residential



Source: EIA

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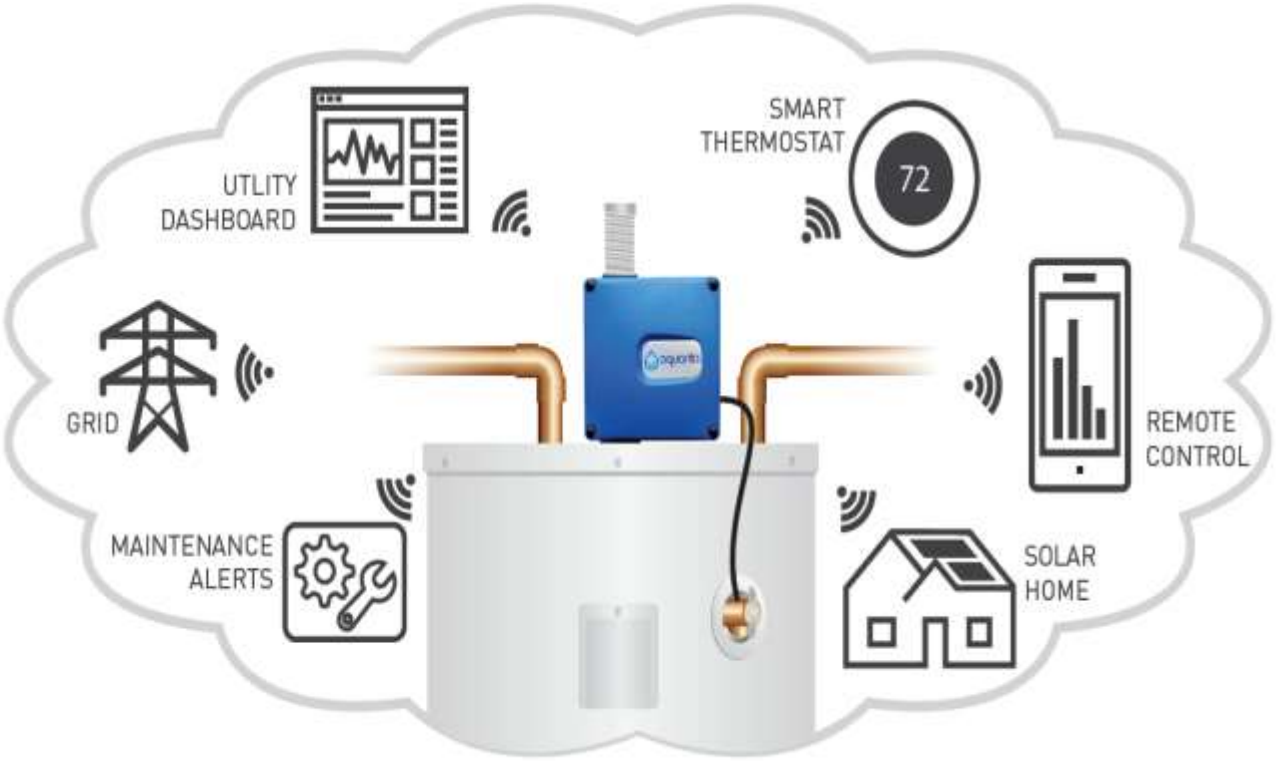
What If Water Heaters Were ***Smart***?

Water Heaters in the Smart Grid



Source: Aquanta

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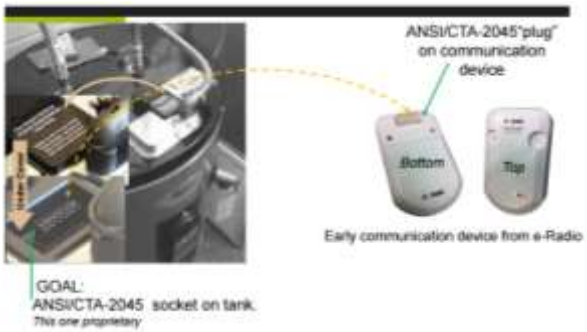
EPRI Standard CTA-2045 port

- 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



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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

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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

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Program Implications

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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)

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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?

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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?

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Thank you!

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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