



NORTHERN CLIMATE SPECIFICATION UPDATE

ACEEE – Hot Water Forum

Session 5C

Geoff Wickes - NEEA

Ben Larson - Ecotope

Christian Douglas – Ptarmigan Research

February 22, 2015

HOT
WATER
SOLUTIONS

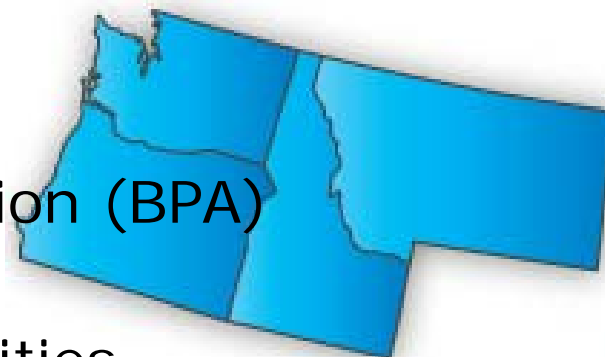
AGENDA

- Overview
- Why a specification?
- Specification evolution
- Version 6.0
- Market perspective
- Look Who is Counting
- Beyond the Northwest
- The road ahead
- Q&A



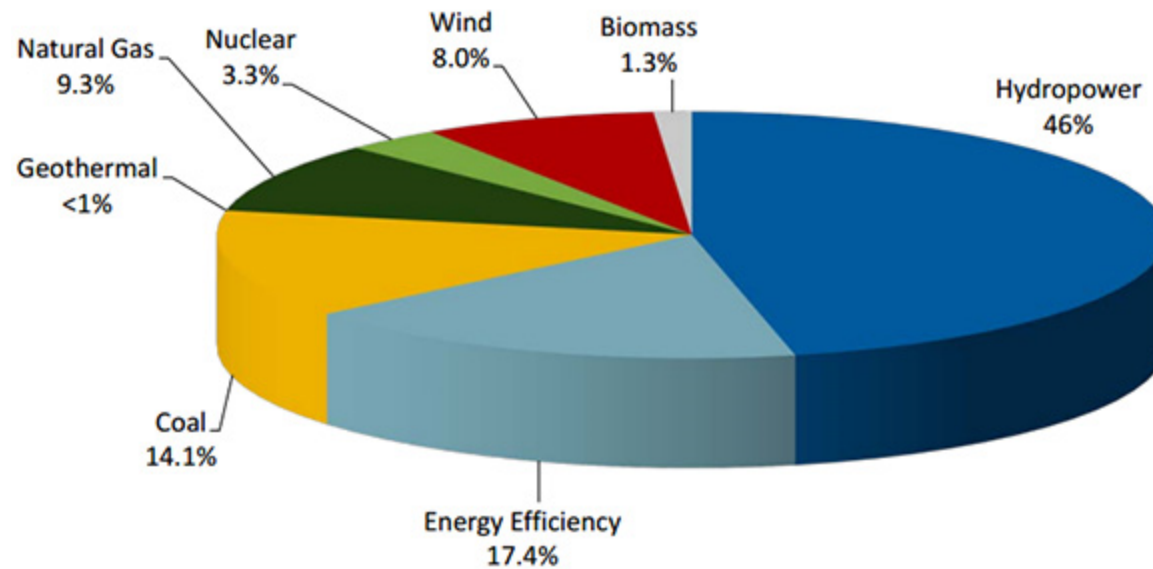
OVERVIEW

- Northwest Energy Efficiency Alliance (NEEA) - Nonprofit organization using **market transformation** to maximize energy efficiency and meet future energy needs
- Funded by:
 - Bonneville Power Administration (BPA)
 - Energy Trust of Oregon
 - More than 100 Northwest utilities
- Covers Idaho, Montana, Oregon and Washington
- Energy efficiency is now the region's second largest power resource



ENERGY EFFICIENCY AS A RESOURCE

- <http://www.nwcouncil.org/news/blog/2014-energy-savings/>
- Second largest resource in Pacific Northwest
- *Reliable* savings required



Slide 4

BL1

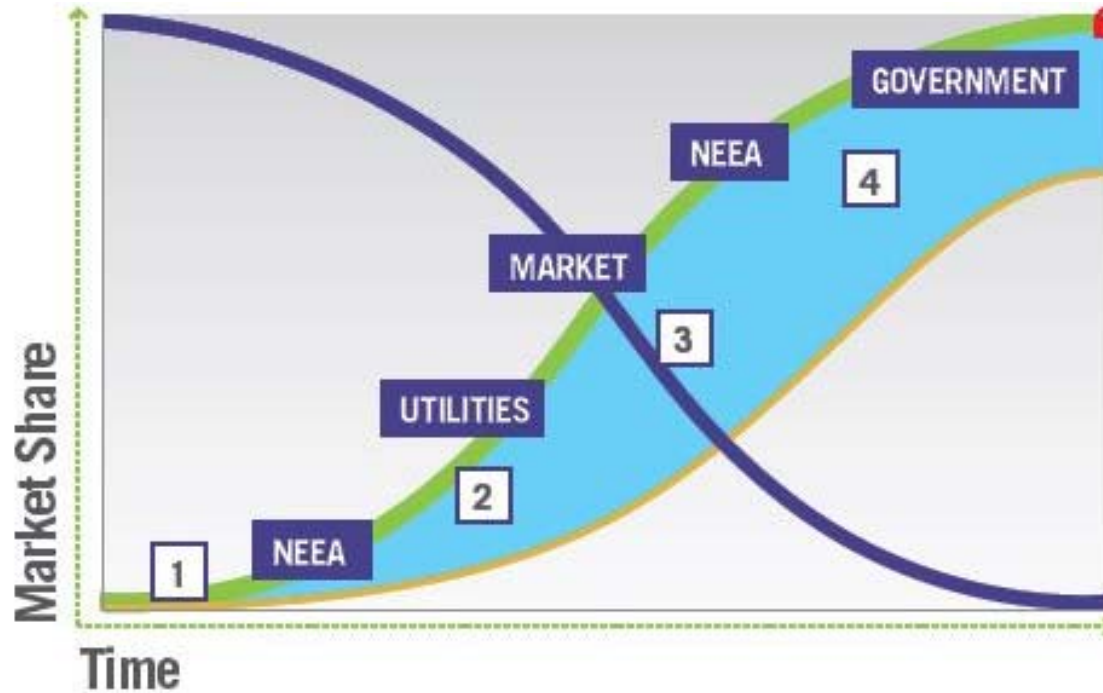
Slide for Geoff or Christian

This motivates why we need reliable energy savings - we depend on them

Ben Larson, 1/27/2016

OVERVIEW (NEEA'S ROLE)

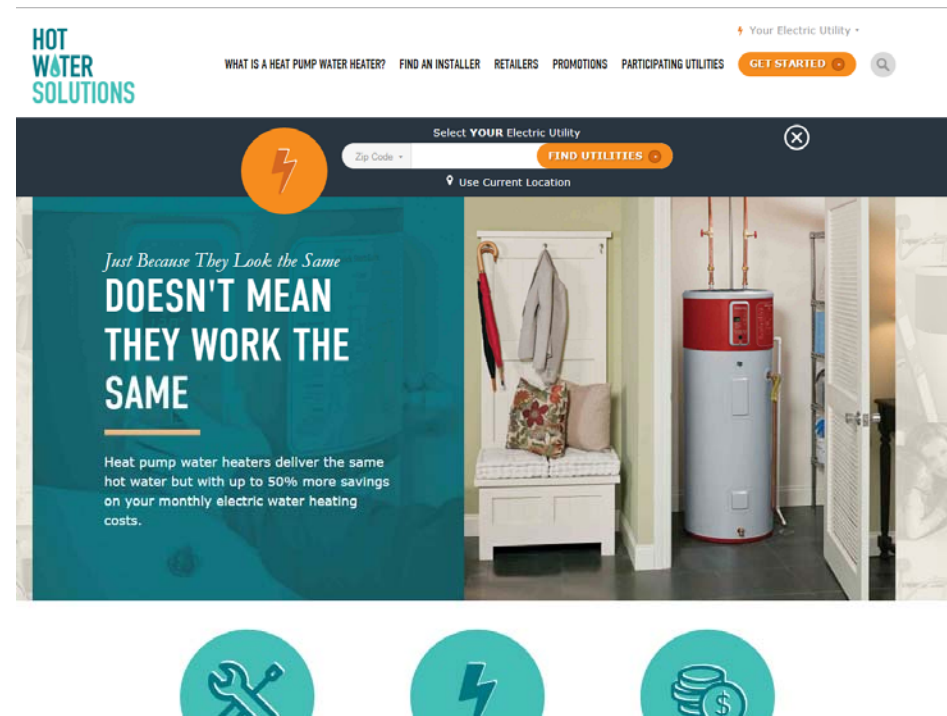
- The heat pump water heater (HPWH) opportunity



- 1** Pre-Commercialization: Technical Assessment / Market Test
- 2** Addressing Market Barriers: Awareness / Availability/Information
- 3** Accelerated Market Adoption: Price / Features / Competition
- 4** Codes and Standards: Code development / Code adoption

OVERVIEW

- Hot Water Solutions – market facing and Supply Chain initiative
- Increase adoption of heat pump water heaters
- Influenced the sale and installation of ~9,500 heat pump water heaters to date
- Improve the performance and acceptance of HPWH's in the Market



WHY A SPECIFICATION?

- Ensure energy savings & customer satisfaction in cooler “Northern” climates
 - Reliable energy savings in real world, real climate conditions
 - Ensure customer satisfaction with hot water delivery, performance, noise, reliability, etc.
 - Performance that lead to incentives to promote efficiency

SPECIFICATION EVOLUTION



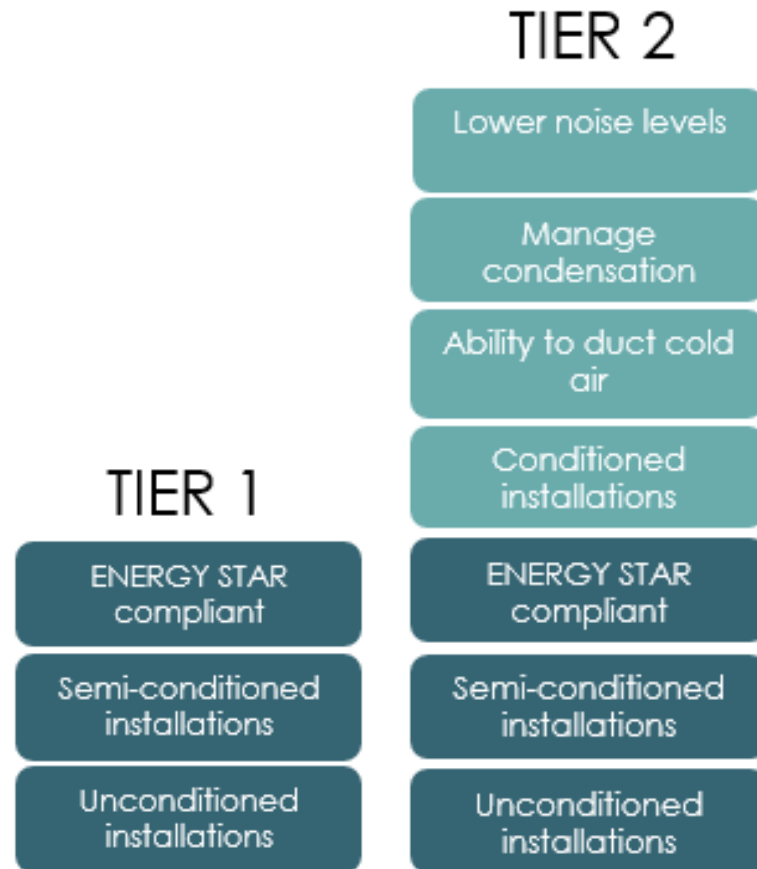
WHY A SPECIFICATION?

Consumer comfort and satisfaction

- Hot water delivery
- Ease of installation
- Lower total cost of ownership
- Serviceability
- Exhaust air
- Noise

Performance

- Efficiency
- Reliability
- Freeze protection
- Condensate management
- User controls
- Grid aware and friendliness



NCS provides guidance to manufacturers developing HPWH for the cooler Northern market

WHY A SPECIFICATION (CURRENT VER)?

Tier	Minimum Northern Climate EF	Minimum Northern Climate Specification Features	Minimum supported installation locations	Sound levels
Tier 1	1.8	<ul style="list-style-type: none"> ENERGY STAR compliance 	<ul style="list-style-type: none"> Semi-conditioned Unconditioned >1000 cu ft. (e.g., garage) 	dBA < 65
Tier 2	2.0	<p><u>Tier 1 features, plus:</u></p> <ul style="list-style-type: none"> Minimal use of electric heating elements Freeze protection Exhaust ducting option Compressor shut-down/notification 10 year warranty Condensate mgmt. 	<ul style="list-style-type: none"> Conditioned Semi-conditioned Unconditioned <1000 cu ft. (e.g., utility room) 	dBA < 60
Tier 3	2.4	<p><u>Tier 2 features, plus:</u></p> <ul style="list-style-type: none"> Intake ducting option Air filter mgmt 	<ul style="list-style-type: none"> Conditioned Semi-conditioned Unconditioned 	dBA < 55

VERSION 6.0 (SOON TO BE RELEASED)

- Northern Climate Specification Version 6.0 is currently being circulated to partners and stakeholders for feedback. Proposed updates include:
 - Additional Tiers for improved efficiency levels (Road Map and Direction)
 - Clarify test procedure so manufacturers can better design products
 - Open testing to other certified labs
 - Clarify definitions of terms (unconditioned, semi-conditioned and conditioned space)
 - Inclusion of Demand Response language
 - Define performance challenge process
 - Warranty requirement clarification
 - Tier 3 products must be shipped in Tier 3 mode and return to tier 3 after 48 hours if changed

VERSION 6.0

GW4

- Get into play end of Q1 2016
- Qualified Products List will continue to be updated by NEEA

Northern Climate Qualified Heat Pump Water Heater List						
Last Updated: July 27, 2015						
Northern Climate Product Tier	Product Brand	Model	Volume (gallons)	Northern Climate Energy Factor	Northern Climate Delivery Rating	Qualified Date
Tier 3	Bradford White	RE2HS0R10B*	50	2.7	2.5	5/15/2015
	Bradford White	RE2H80R10B*	80	2.7	4.0	5/15/2015
	General Electric	GEH500FEJXXX*	50	2.7	2.5	2/23/2015
	General Electric	GEH500EEJXXX*	50	2.7	2.5	2/23/2015
	General Electric	GEH800FEJXXX*	80	2.7	4.0	2/23/2015
Tier 2	Bradford White	RE2HS0R10B	50	2.2	2.0	5/15/2015
	Bradford White	RE2H80R10B	80	2.0	4.0	5/15/2015
	General Electric	GEH500FEJXXX	50	2.2	2.0	2/23/2015
	General Electric	GEH500EEJXXX	50	2.2	2.0	2/23/2015
	General Electric	GEH800FEJXXX	80	2.0	4.0	2/23/2015
Tier 1	General Electric	GEH800EEJXXX	80	2.0	4.0	2/23/2015
	American	HPE10280H045DV	80	1.8	4.0	2/1/2012
	American	HPE10260H045DV	60	2.0	3.0	2/1/2012
	American	HPSE10280H045DV	80	2.1	4.0	3/17/2015
	American	HPSE10266H045DV	66	2.0	2.0	3/17/2015
	American	HPSE10250H045DV	50	2.0	2.5	1/27/2014
	A.O. Smith	PHPT-80	80	1.8	4.0	11/10/2011
	A.O. Smith	PHPT-60	60	2.0	3.0	2/1/2012
	A.O. Smith	SHPT-80	80	2.1	4.0	3/17/2015
	A.O. Smith	SHPT-66	66	2.0	2.0	3/17/2015
	A.O. Smith	SHPT-50	50	2.0	2.5	1/27/2014
	General Electric	GEH500EEDSR	50	1.9	2.5	5/10/2012
	General Electric	GEH500EEDSC	50	1.9	2.5	5/10/2012
	Kenmore	153.32118	80	1.8	4.0	2/1/2012
	Kenmore	153.32116	60	2.0	3.0	2/1/2012
	Kenmore	153.321151	50	2.0	2.5	1/27/2014
	Lochinvar	HPA080KD	80	2.1	4.0	3/17/2015
	Lochinvar	HPA066KD	66	2.0	2.0	3/17/2015
	Reliance	10 80 DHPT	80	1.8	4.0	2/1/2012
	Reliance	10 60 DHPT	60	2.0	2.0	2/1/2012
	Reliance	10 80 DHPST	80	2.1	4.0	3/17/2015
	Reliance	10 66 DHPST	66	2.0	2.0	3/17/2015
	Reliance	10 50 DHPST	50	2.0	2.5	1/27/2014
	Rheem	HBS0RH	50	2.2	2.5	4/15/2013
	Rheem EcoSense	HBS0ES	50	2.2	2.5	4/15/2013
	Richmond	HBS0RM	50	2.2	2.5	4/15/2013
	Ruud	HBS0RU	50	2.2	2.5	4/15/2013
	State	EPX 80 DHPT	80	1.8	4.0	2/1/2012
	State	EPX 60 DHPT	60	2.0	3.0	2/1/2012
	State	SPX 80 DHPT	80	2.1	4.0	3/17/2015
	State	SPX 66 DHPT	66	2.0	2.0	3/17/2015
	State	SPX 50 DHPT	50	2.0	2.5	1/27/2014
	Stiebel Eltron	Accelera 220 E	58	2.6	3.0	7/27/2015
	Stiebel Eltron	Accelera 300	80	1.9	5.0	2/27/2012
	U.S. Craftmaster	HPE2K80HD045V	80	1.8	4.0	2/1/2012
	U.S. Craftmaster	HPE2K60HD045V	60	2.0	3.0	2/1/2012
	U.S. Craftmaster	HPSE2K80HD045VU	80	2.1	4.0	3/17/2015
	U.S. Craftmaster	HPSE2K66HD045VU	66	2.0	2.0	3/17/2015
	U.S. Craftmaster	HPSE10250H045V	50	2.0	2.5	9/18/2014
	Whirlpool	HPE2K80HD045V	80	1.8	4.0	2/1/2012
	Whirlpool	HPE2K60HD045V	60	2.0	3.0	2/1/2012
	Whirlpool	HPSE2K80HD045V	80	2.1	4.0	3/17/2015
	Whirlpool	HPSE2K66HD045V	66	2.0	2.0	3/17/2015
	Whirlpool	HPSE2K50HD045V	50	2.0	2.5	1/27/2014

*The GE and Bradford White models must be placed into the "Cold Climate Efficiency" mode to achieve Tier 3 performance levels. In Std Hybrid Mode, the units achieve Tier 2 performance levels.
 **XXX on GE Models are wild cards for: distribution, color, location, date of manufacture and other variables. Key part numbers are the first 9 digits

Northern Climate Delivery Rating Sizing Guidelines**

If the unit installed is too small for the home the heat pump mode may turn off and the electric heating mode will take over in order to meet demand.

Bedrooms	Bathrooms	Min. Recom. Delivery Rating
1 + 2	1 + 2.5	2
3	1 + 3.5	3
4 + 6	2 + 3.5	4

**The Northern Climate Delivery Rating is the number of hot showers (rounded to the nearest 0.5) shower the unit is able to deliver in cool ambient conditions, using default settings, before the electric heating element turns on.

Slide 12

GW4

Insert latest version of the QPL

Geoff Wickes, 2/12/2016

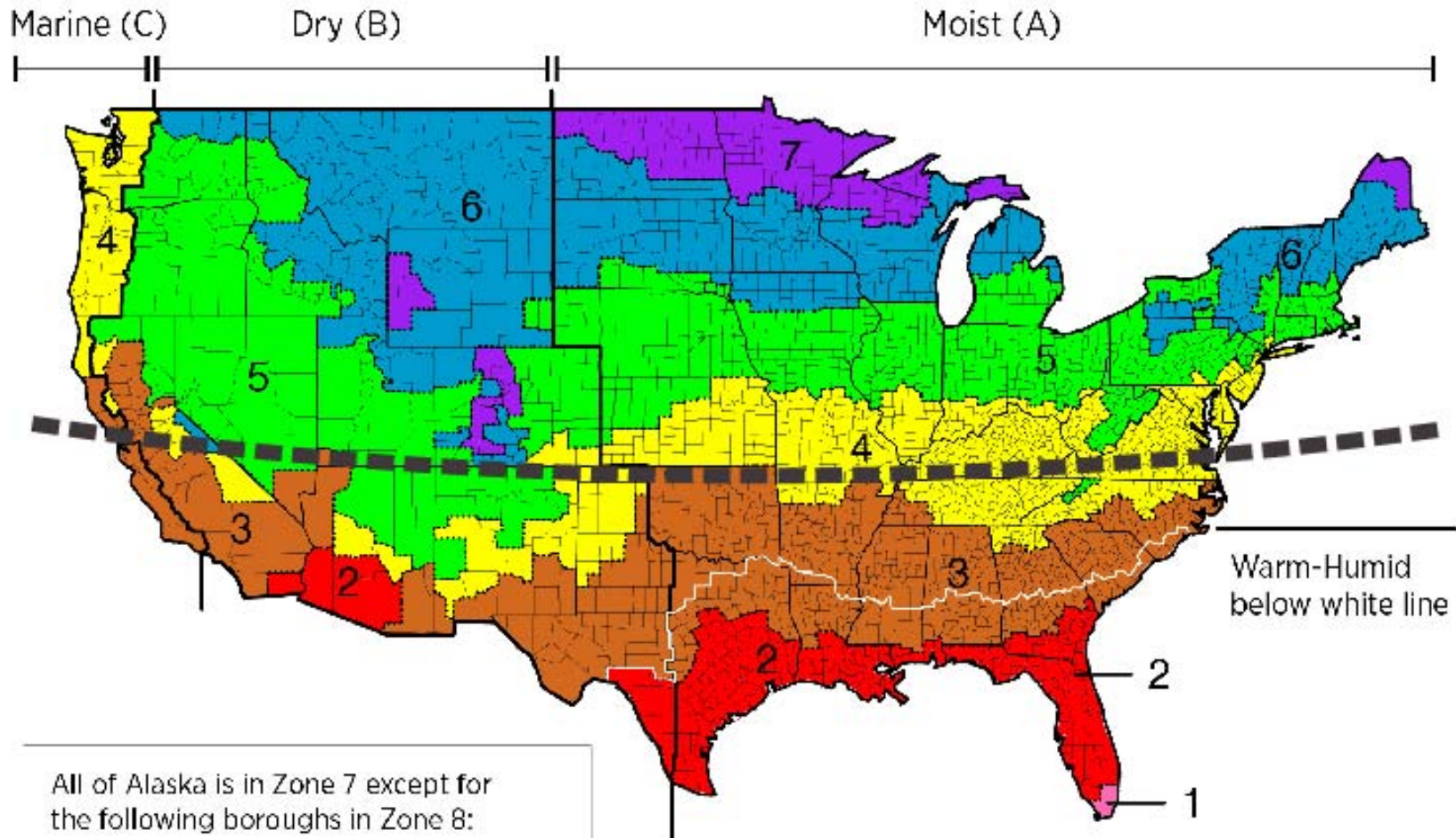
BEYOND THE NORTHWEST

Utilities have confidence in referencing the Northern Climate Spec

- Best choice for customer in terms of quality and product satisfaction
- Highest energy savings
- Standards applicable in other states
- NEEA's robust relationship with manufacturers ensures superior product
- 2015 Standards



NORTHERN CLIMATE APPLICATION SWATH



All of Alaska is in Zone 7 except for the following boroughs in Zone 8:
Bethel, Northwest Arctic, Dellingham, Southeast Fairbanks, Fairbanks N. Star, Wade Hampton, Nome, Yukon-Koyukuk, North Slope

Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands

THE ROAD AHEAD

- Finalize version 6.0
- Influence / accelerate distribution supply chain
- Gain installer confidence
- Create more market demand



NORTHERN CLIMATE SPECIFICATION DETAILS AND BEHIND THE SCENES

Ben Larson, Director of Research at Ecotope
Contact: ben@ecotope.com

TEST LIST

- 24 Hour Simulated Use Tests
 - DOE Draw Pattern at Standard Conditions
 - 67.5 °F ambient and 58 °F inlet water
 - DOE Draw Pattern at Colder Conditions
 - 50 °F Ambient and 50 °F Inlet Water
- 1st Hour Rating
- Delivery Rating (# of efficient showers)
- Freeze Protection*
- Compressor Low Temperature Operating Limit
- Airflow Measurement*
- Sound Level

* Required only for certain equipment

MEASUREMENT & METRIC LIST

Needed in UEF_{NC} calculation:

- UEF_{67}
- UEF_{50}
- Tank Heat Loss Rate (UA)
 - The real one
- Compressor Low Temperature Cutoff

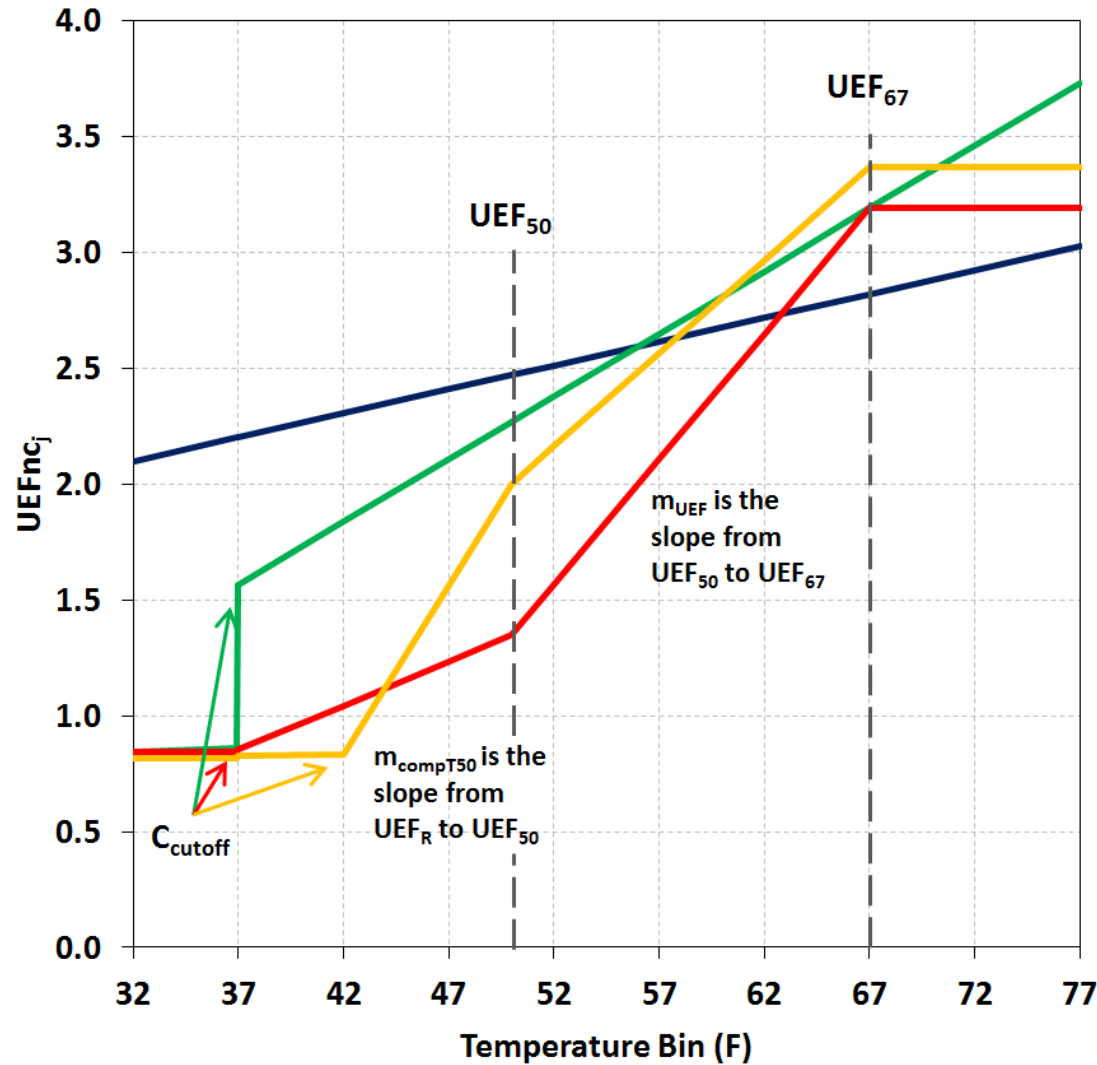
Needed for Tier Placement:

- % of tank drained before resistance elements engage

Used in NEEA and Utility Program Materials:

- # of Efficient Showers (not used in the rating)

CALCULATION PROCEDURE

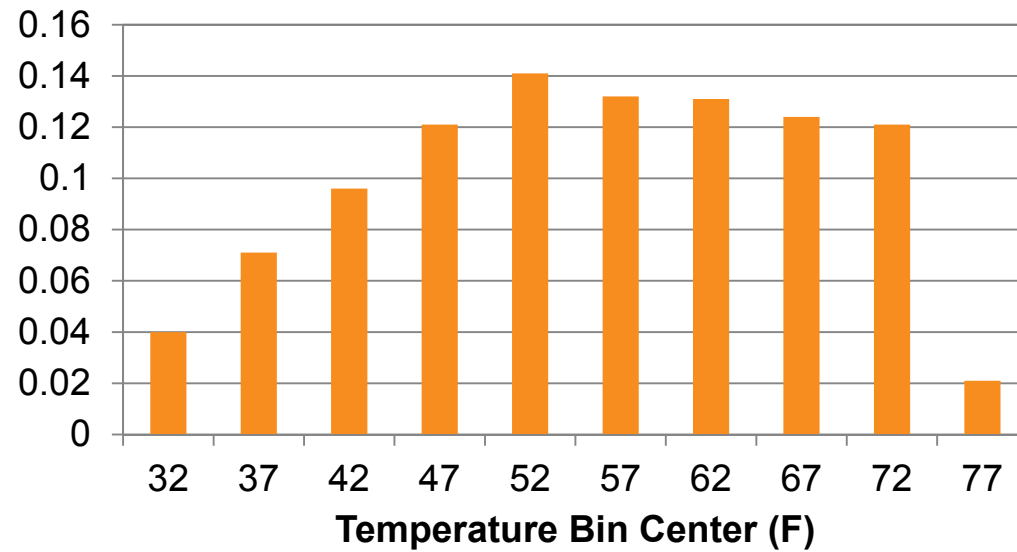


- No Resistance Element Use, $C_{cutoff} \leq 32^\circ\text{F}$
- No Resistance Use at UEF_{50} , C_{cutoff} at 37°F
- Resistance Use at UEF_{50} , C_{cutoff} at 37°F
- Resistance Use at UEF_{50} , C_{cutoff} at 42°F

TEMPERATURE BINS

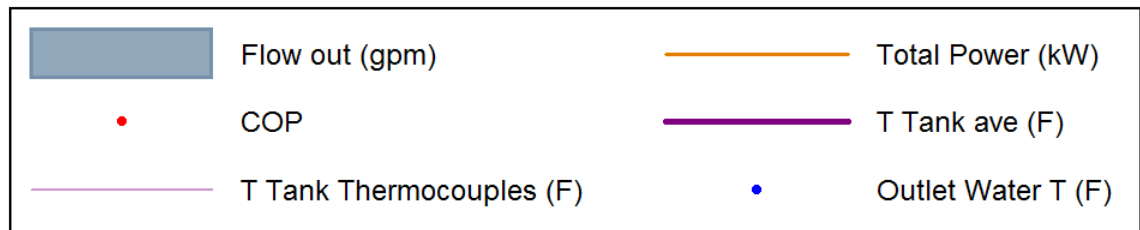
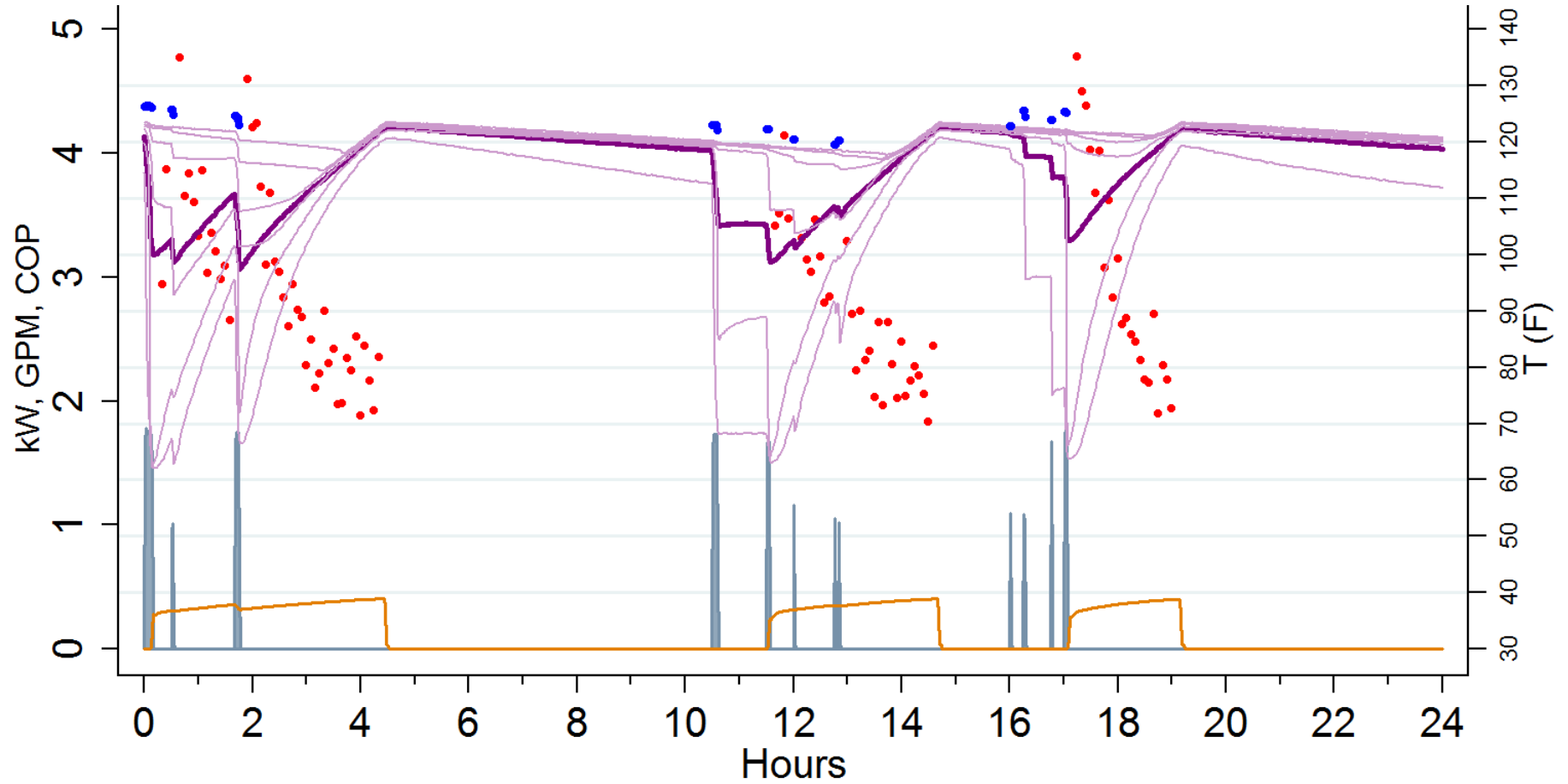
T_j (°F)	f_j
77	0.021
72	0.121
67	0.124
62	0.131
57	0.132
52	0.141
47	0.121
42	0.096
37	0.071
32	0.040

Fractional Time in Temperature Bin



EXAMPLE: UEF TESTS

50 F

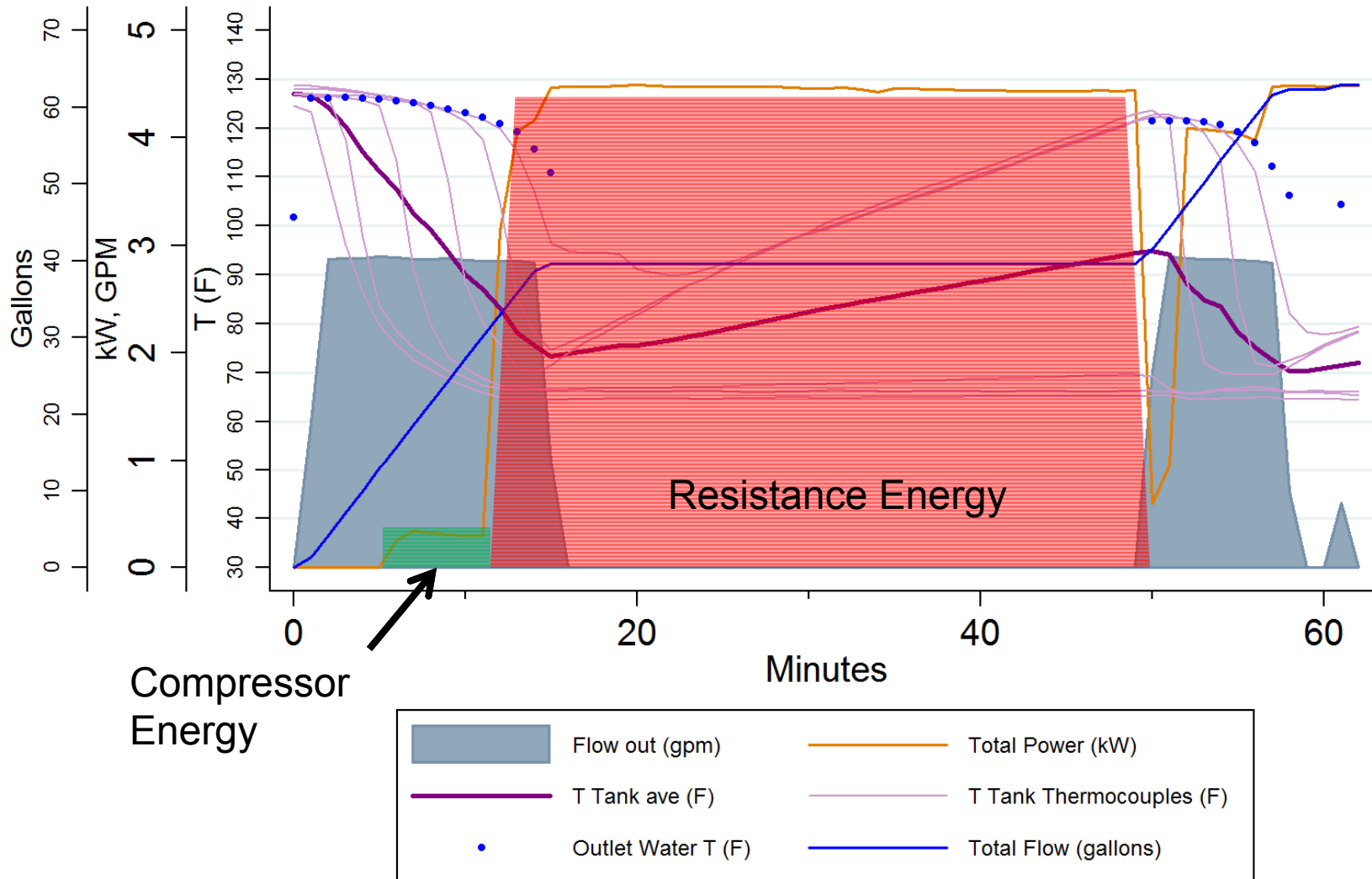


UEF_{NC} CALCULATION EXAMPLE

Value	Measurement
UEF ₆₇	3.5
UEF ₅₀	2.9
Tank UA (Btu/hrF)	4
Compressor Cutoff (F)	42

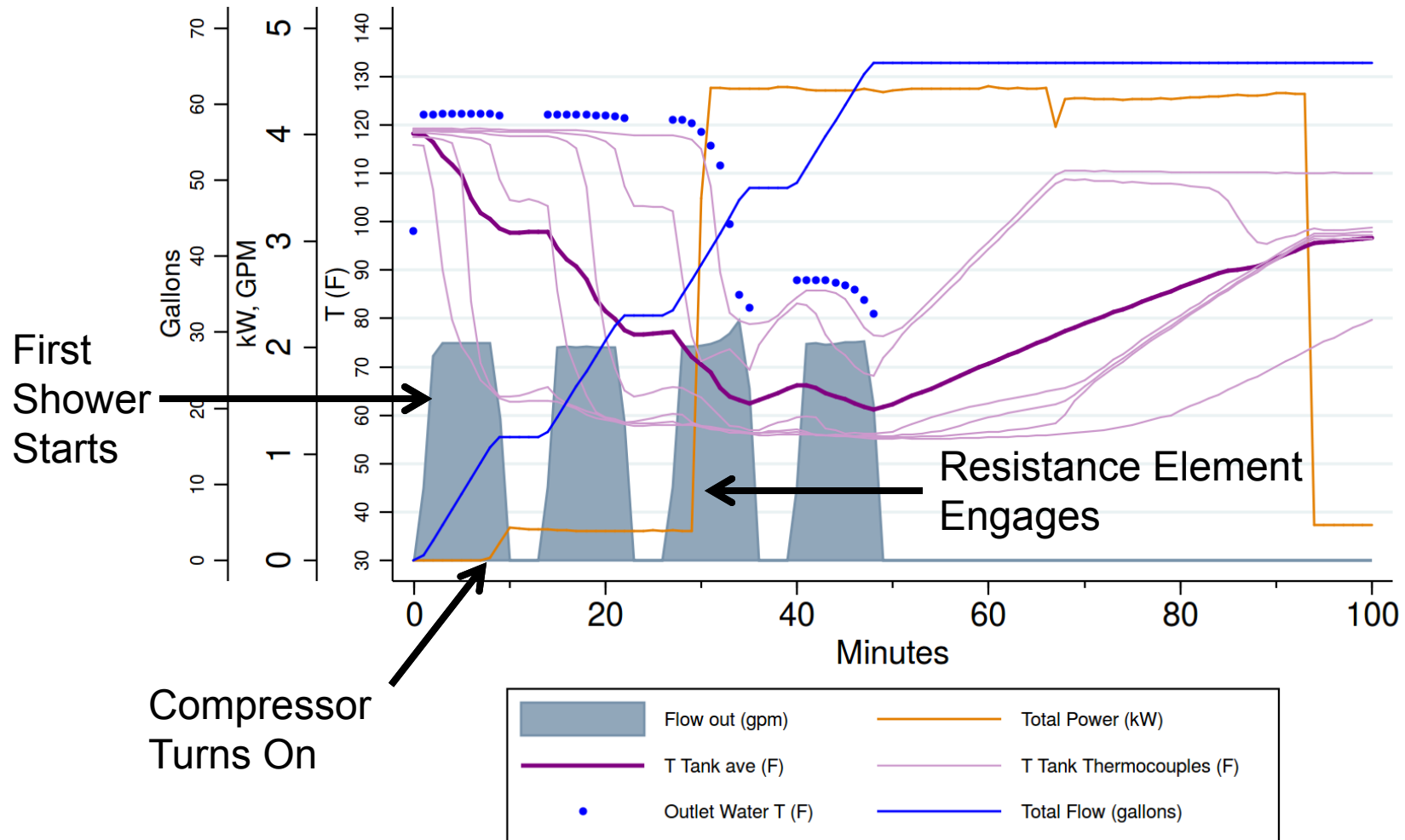
Value	Calculation
UEF _{NC}	2.9
dUEF/dT	0.035

EXAMPLES: % OF TANK DRAINED



>80% of tank emptied before elements engage

EXAMPLE: # SHOWERS



- 2.5 Efficient Showers

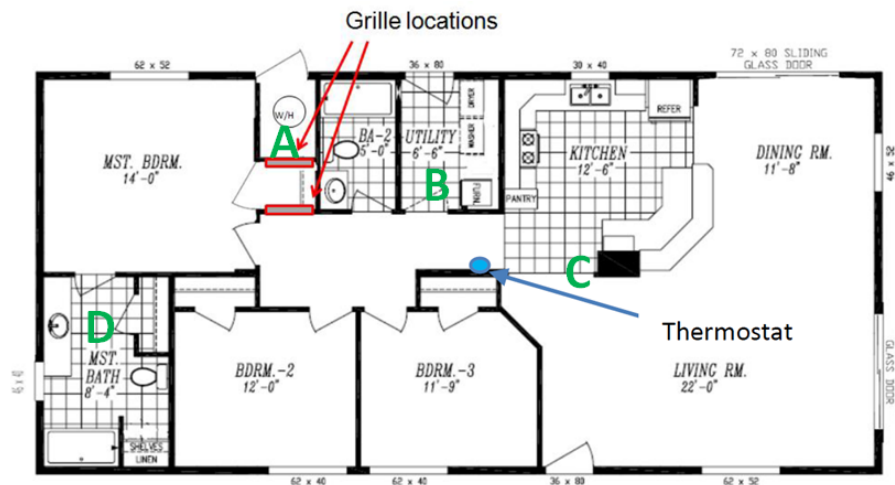
ADDITIONAL RESEARCH SLATED

- Continued lab tests
- Validate / approve independent labs
- Unique solutions market assessment



ADD'L RESEARCH: INTERACTIONS

- With Pacific Northwest National Lab (PNNL)
 - Side-by-side house testing
- How much useful heat does a HPWH scavenge from the house?
- How much useful cooling does it provide?



Test Case Description	Test Location (on Floorplan)	Door Open or Closed?	Purpose of / Reason to Include Test Case
Water Heater Closet	A	N/A	May be most disconnected area from the thermostat
Utility Closet	B	N/A	Most connected to the return duct
Living Room	C	N/A	Probably the most connected area to the thermostat
Master Bath, Door Open	D	Open	Highly buffered/disconnected from the thermostat
Master Bath, Door Closed	D	Closed	Even more buffered from the thermostat

ADD'L RESEARCH: HOW MUCH DOES YOUR MILEAGE VARY?

HOT
WATER
SOLUTIONS



ADD'L RESEARCH: HOW MUCH DOES YOUR MILEAGE VARY?

- What we know:
 - Resistance heat controls have non-linear effects on energy use
- What we don't know:
 - What the conditions are to trigger the resistance heat
- What we are going to do about it:
 - Back to the lab to investigate more draw profile scenarios

RTF PERSPECTIVE

Christian Douglass, Contract Analyst for the Regional Technical Forum (RTF)
Contact: Christian.Douglass@ptarmiganresearch.com

RTF PERSPECTIVE

- Background
 - Formation of the Northwest Power Council & the RTF
 - RTF's roles
 - Who uses the RTF's work
- The RTF's measure development process
 - Who brings measures to the RTF and why
 - The development and evolution of measures
- HPWH's at the RTF
 - History
 - Important work completed to date
 - Outstanding research questions

FORMATION OF THE COUNCIL & THE RTF

- 1980** Northwest Power and Conservation Council (the Council) formed out of the Northwest Power Act passed by Congress as a planning body for the region's development of new energy resources
- 1995** Bonneville Power Administration (BPA) shifted responsibility for financing and acquisition of conservation to its utility customers
- 1996** Congress directed BPA and the Council to convene a Regional Technical Forum (RTF)
- 1999** Council formed the RTF as an advisory committee to the Council

RTF MEMBERS

- A voting body of 30 individuals selected for their technical expertise



CORE WORK OF THE RTF

- Provides centralized, independent technical review of measures used in the region building on empirical data and historic expertise
 - Uses established systematic approach for review
 - Maintains a library of energy savings, costs, and lifetimes for measures
- Provides open and transparent access to all estimates and data
- Builds confidence in the market place for savings values utilities and utility commissions

WHAT THE RTF DOES NOT DO

- Perform direct regulatory function
 - Require use of specific savings estimates or protocols or restrict which measures utilities can install
 - Require use of specific program design
 - Establish rebate, incentive, or willingness to pay levels
- Evaluate savings for ALL measures
- Execute primary research (RTF relies on others for research)

WHO USES THE RTF'S WORK?

Utilities, ETO, BPA, NEEA

- Reduce evaluation costs
- Increase consistency in savings claims and methods

Regulators

- Wide review
- Establish standards for reliability & methods

Evaluators

- Conveys expectations
- Describes methods

THE MEASURE DEVELOPMENT PROCESS

- Regional actors (utilities, ETO, NEEA) bring measures to the RTF for development
- RTF categorizes measures based on the robustness of the data and reliability of the energy savings estimates – and identifies research needs

