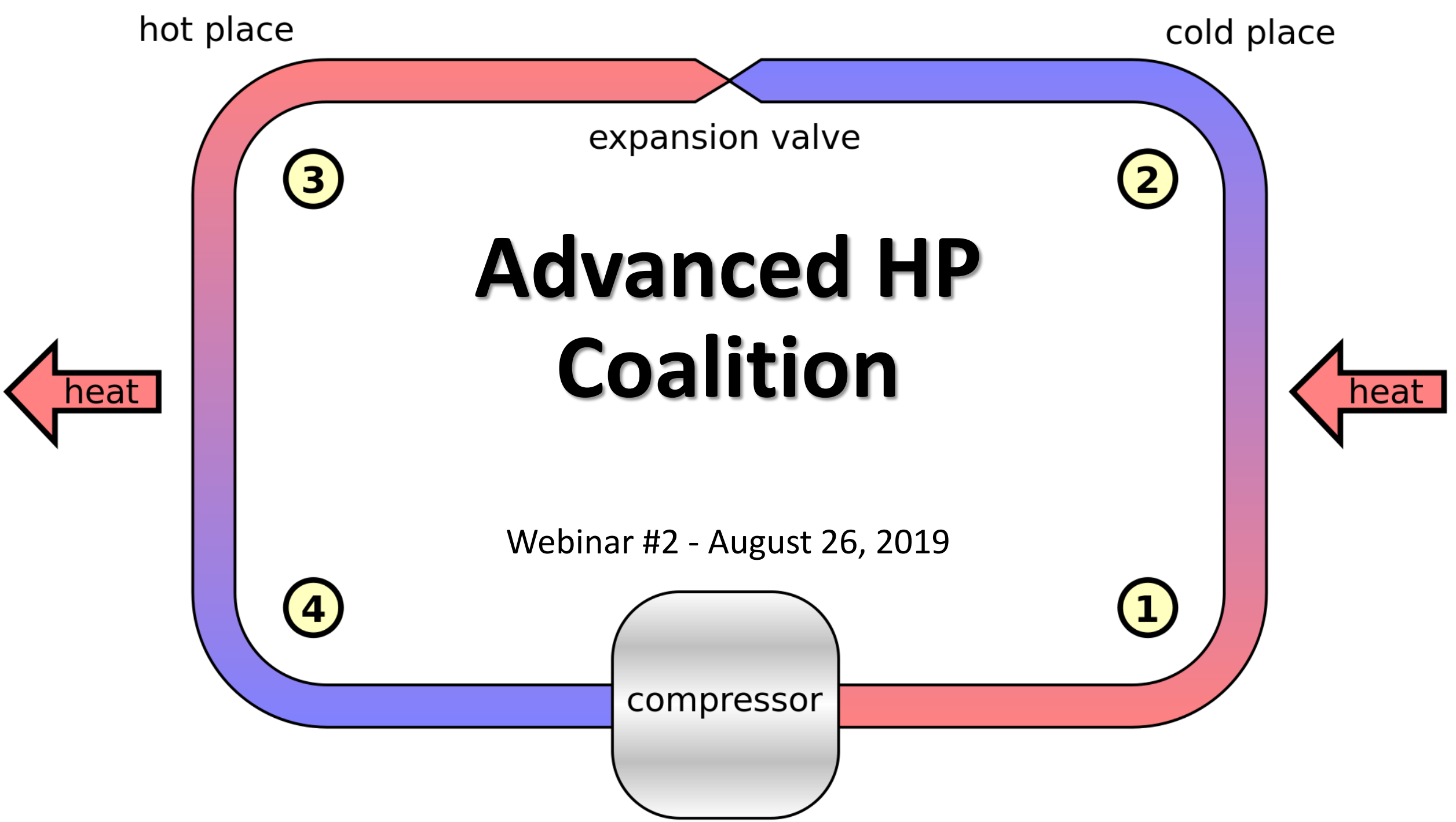

hot place
cold place
expansion valve
3
2
Advanced HP Coalition
heat
heat
Webinar #2 - August 26, 2019
4
1
compressor

Acknowledgment

We all have lots of **other** work
that needs to get done.

Webinar Agenda

- Overview for new folks — 10 min
- Workgroup Updates — 30-40 min
  1. Test Procedure
  2. Equipment Roadmap
  3. Design and Installation
  4. Consumer and Installer Understanding
- Discussion and Sharing — 20 min
  - 2020 Workplans
  - HP Related Events, Workshops, Conferences
  - General Discussion

“Coalition of the Willing”*

*We are not a formalized organization

New members are welcome

Why a HP Coalition?

1. Share common learnings
2. Pool resources
3. Convey scale and potential to manufacturers

Why Now?

1. Enormous Potential
2. We Need Real World Performance
   - HP performance metric not accurately characterized by HSPF and SEER
   - CSA EXP-07 Test Procedure is finally done
3. Technology is “rapidly” changing what is possible
   - Variable Capacity Cold Climate heat pumps
   - Advanced HX
   - Refrigerant changes
   - Connected Intelligence

Technical Potential

(US Technical Potential – Quadrillion Btus)

Paper can be found in ACEEE 2018 Proceedings
"Air Source Heat Pump's Transformative Potential"

Technology	Current Use	Future Use	Technical Potential
EVs[1]	15	3	12
Photovoltaics[2]	-0.3	-9	9
Heat Pumps[3]	11	3	**8**
LED Lighting[4]	3.3	1.4	2

1 Light Vehicle Transportation
2 Utility, Commercial and Residential ---- 2050 USDOE SunShot goal
3 Residential and Commercial Space and Water Heating
4 Lighting in Commercial and Residential Buildings

Note ACEEE paper presented "achievable potential" which assume 50% market share

What is Possible

	Today's Market	Market Barriers	Future Market
Technology Capability	Real World SCOP = ~2.2 Min Temp = 5 F Poor turndown capabilities		Real World SCOP = 3.2 Extended Capacity Range Demand Responsive Automatically Optimized
Consumer Experience	Expensive Confusing Noisy "Cold Blow" when defrosting		Easily Identified Readily Available Differentiated Dealers
Support Programs	SEER/HSPH Spec Driven Install Requirements Post install verification Complicated Evaluation		Improved Metrics Post install data Performance incentives Utility DR integration

UC Davis Workshop Highlights

- What we know
  - HSPF and SEER are poor proxies
  - We don’t really know what the best solution is
  - Increased pressures for in Demand Responsiveness & Decarbonization
- What is emerging
  - Convergence of multiple technologies will transform current products
  - New Canadian Test Procedure may provide a better performance proxy
- Workgroups Established
  - Test Procedure
  - Equipment Roadmap
  - Design and Installation
  - Consumer and Installer Understanding

Workgroup Updates

Test Procedure
Equipment Roadmap
Design and Installation
Consumer and Installer Understanding

Test Procedure Workgroup

VISION

In 5 years, CSA EXP-07 is adopted and broadly used buy industry

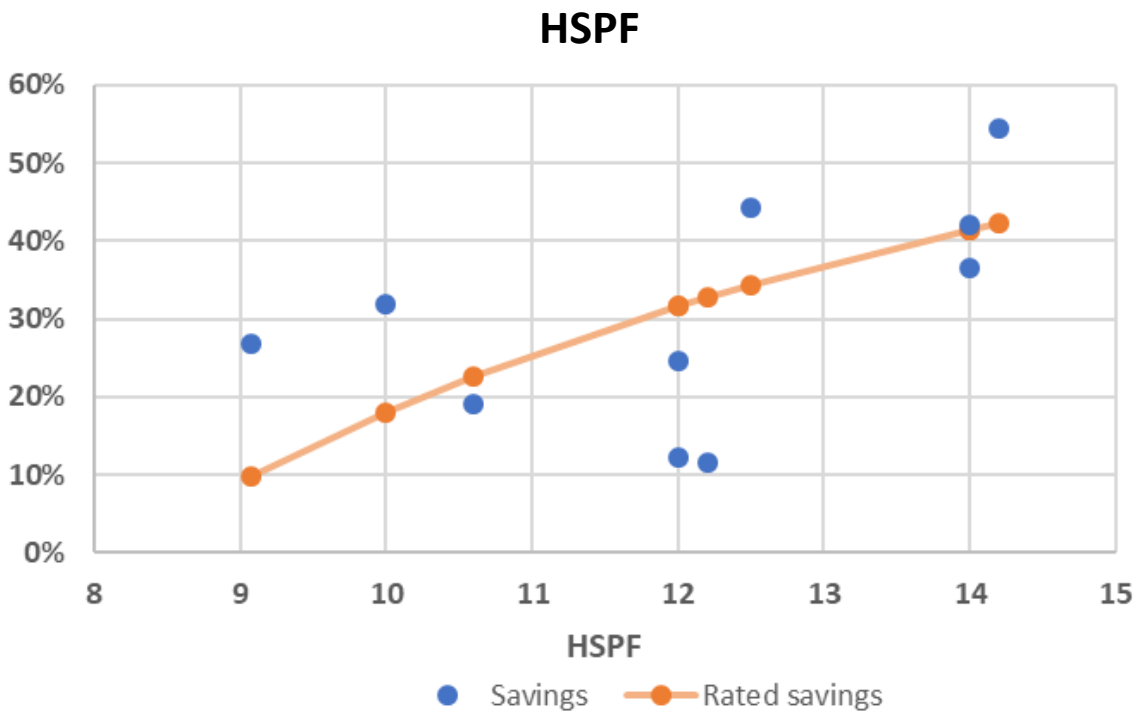
2019 ACTIVITIES

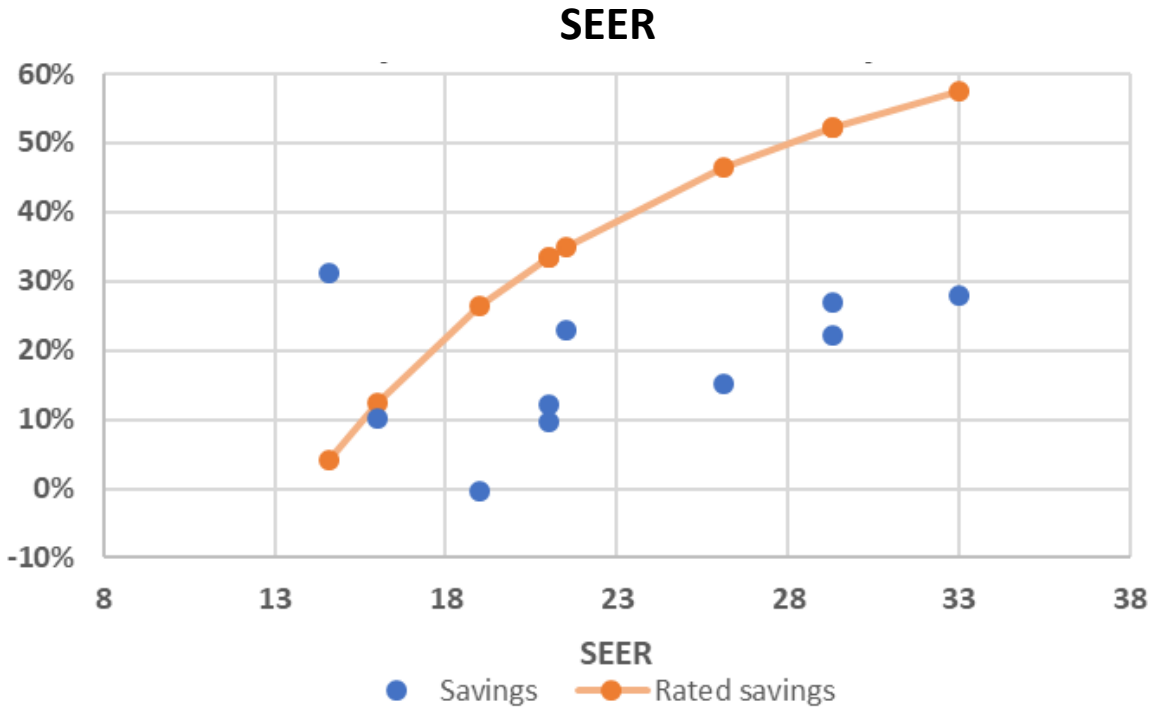
- Develop Value Proposition
- Get Manufacturer Feedback
- Conduct testing of HPs with CSA EXP-07
  - Lab experience
  - Validation – 3Rs
- Plain Language Guide
- Preliminary Findings Report

Members
- Natural Resources Canada
- BC Hydro
- Northwest Energy Efficiency Alliance
- Northeast Energy Efficiency Partnership
- Pacific Gas & Electric
- So Cal Edison
- Underwriters Laboratory
- Purdue University

SEER and HSPF

Are these adequate proxies ?





California Central Valley Laboratory Houses

Available Reports:
http://www.etcc-ca.com/reports/variable-compressor-speed-heat-pumps

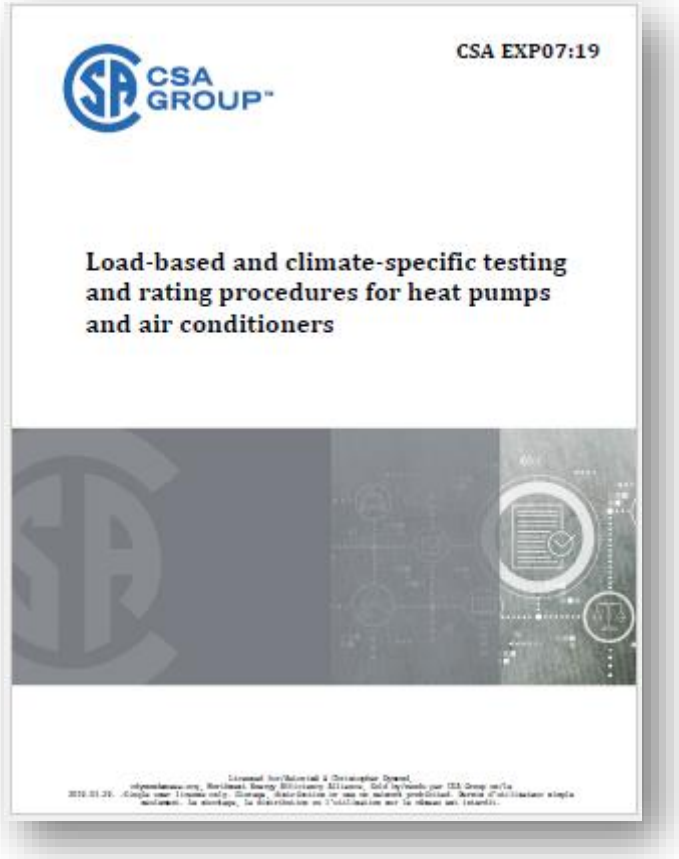
https://www.etcc-ca.com/reports/central-valley-research-homes-evaluation-ducted-and-ductless-configurations-variable

Better Metrics --- Value Proposition

- Metrics (“measuring sticks”) that reflect actual performance benefit
  - consumers
  - programs
  - utilities
  - leading manufacturers
  - general market health
- A basket of metrics is needed to capture all values
  - QI
  - Diagnostics
  - grid services
  - EM&V

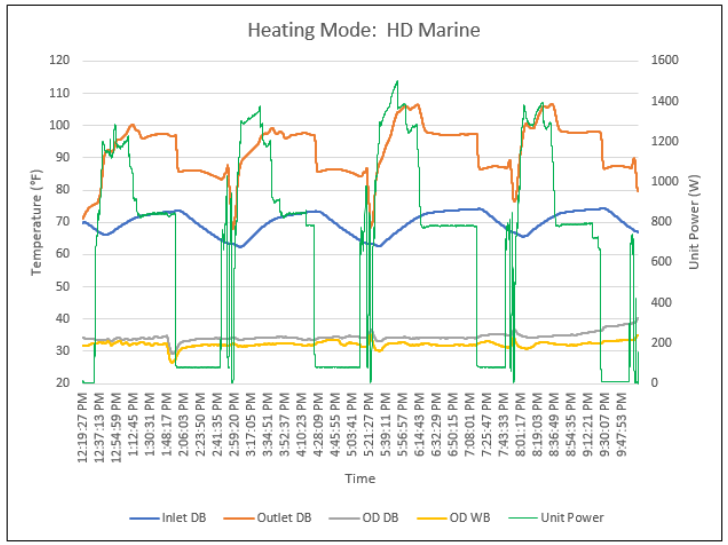
EXP-07 Test and Rating

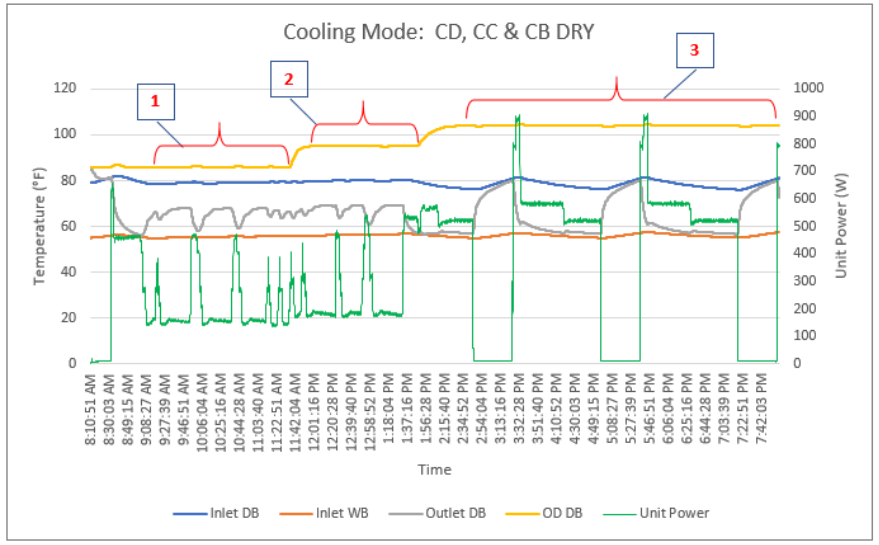
- Dynamic, load based testing
  - Rather than lab induced, fixed speed of compressor and fan, and fixed indoor room condition
- Let unit respond to heating/cooling loads as if it were in a real installation
  - Using “as-shipped” settings
- Test and report data under a wide range of outdoor conditions and building loads
- Report consistent performance data
  - Can be used in hourly building simulations, or design

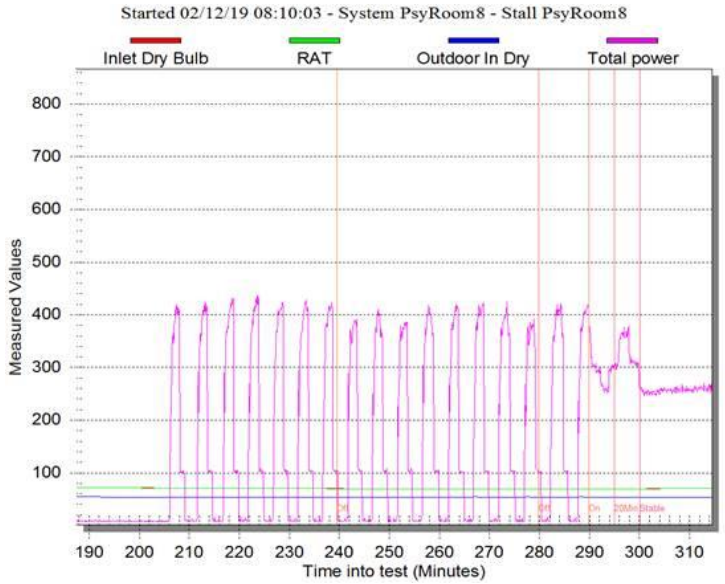


In development for 3 years
Published March 29, 2019

Lab Observation Anomalies







Inconsistent behavior

This makes it challenging to identify test start and stop times

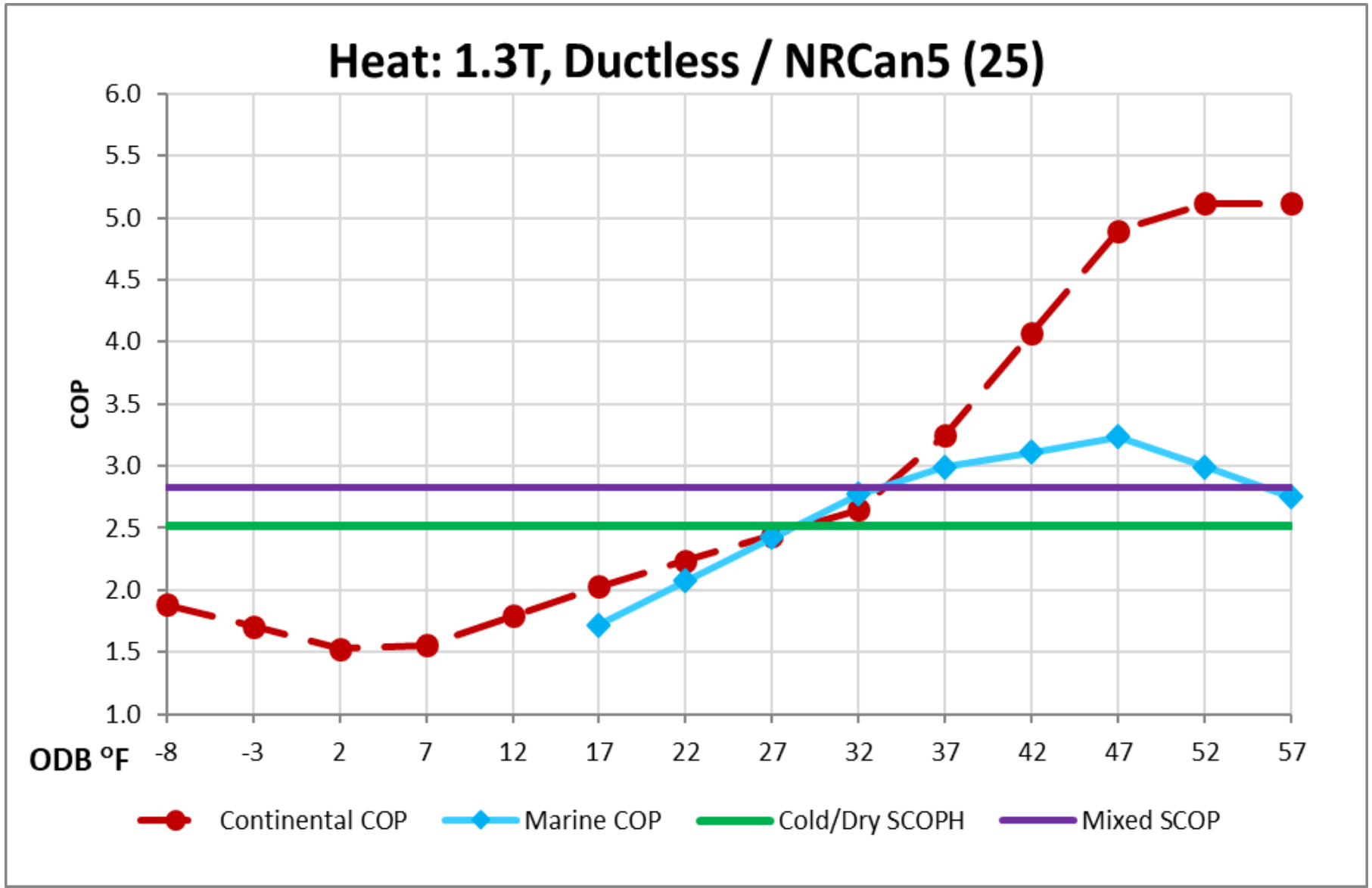
Poor Convergence

Cooling cycle convergence is typically quick
Heating cycle convergence can sometimes take a long time

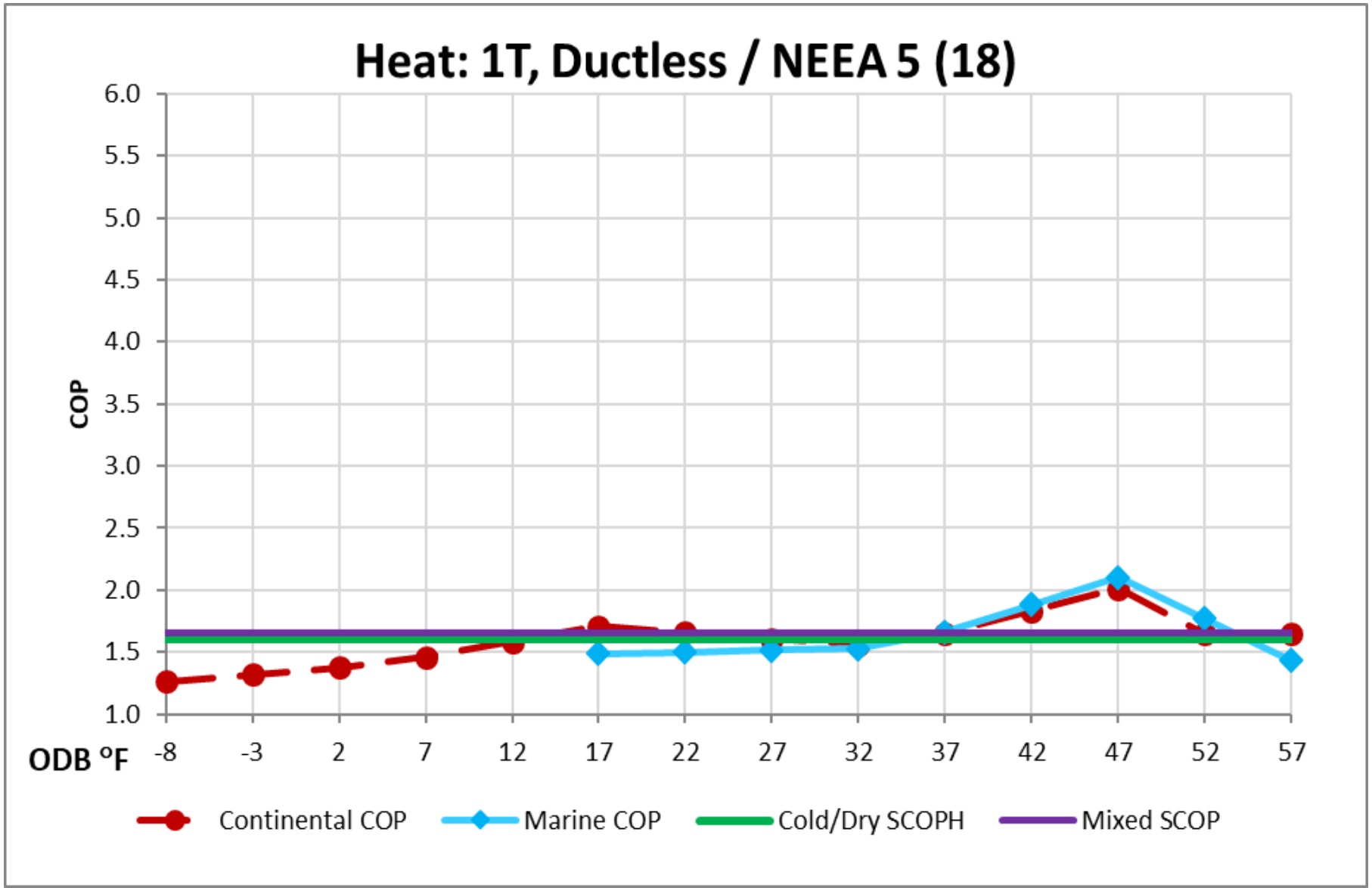
Short cycling

Some equipment operate a long time before settling down to variable speed mode.

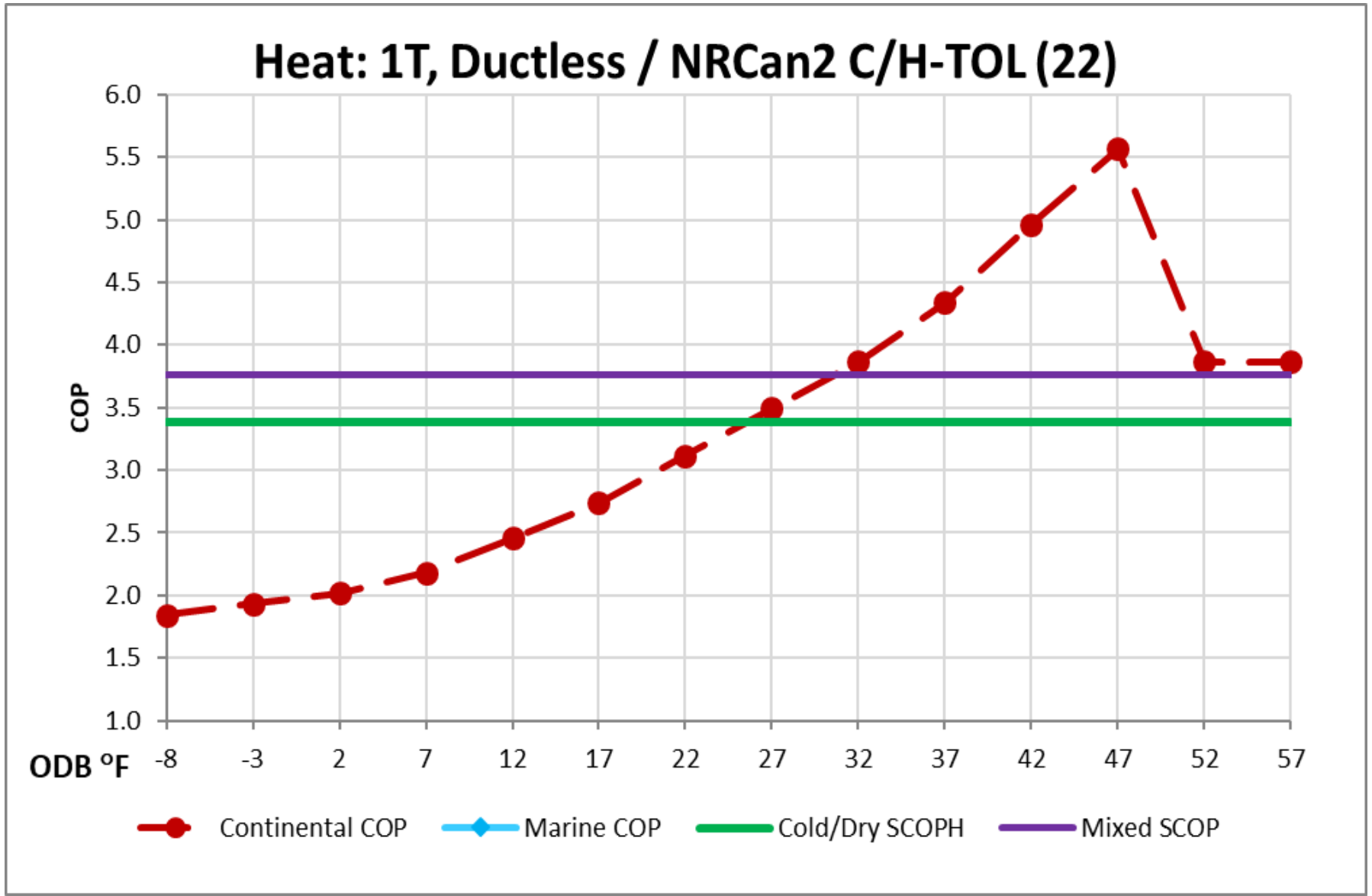
EXP07 Results – NRCan 5 - Heating



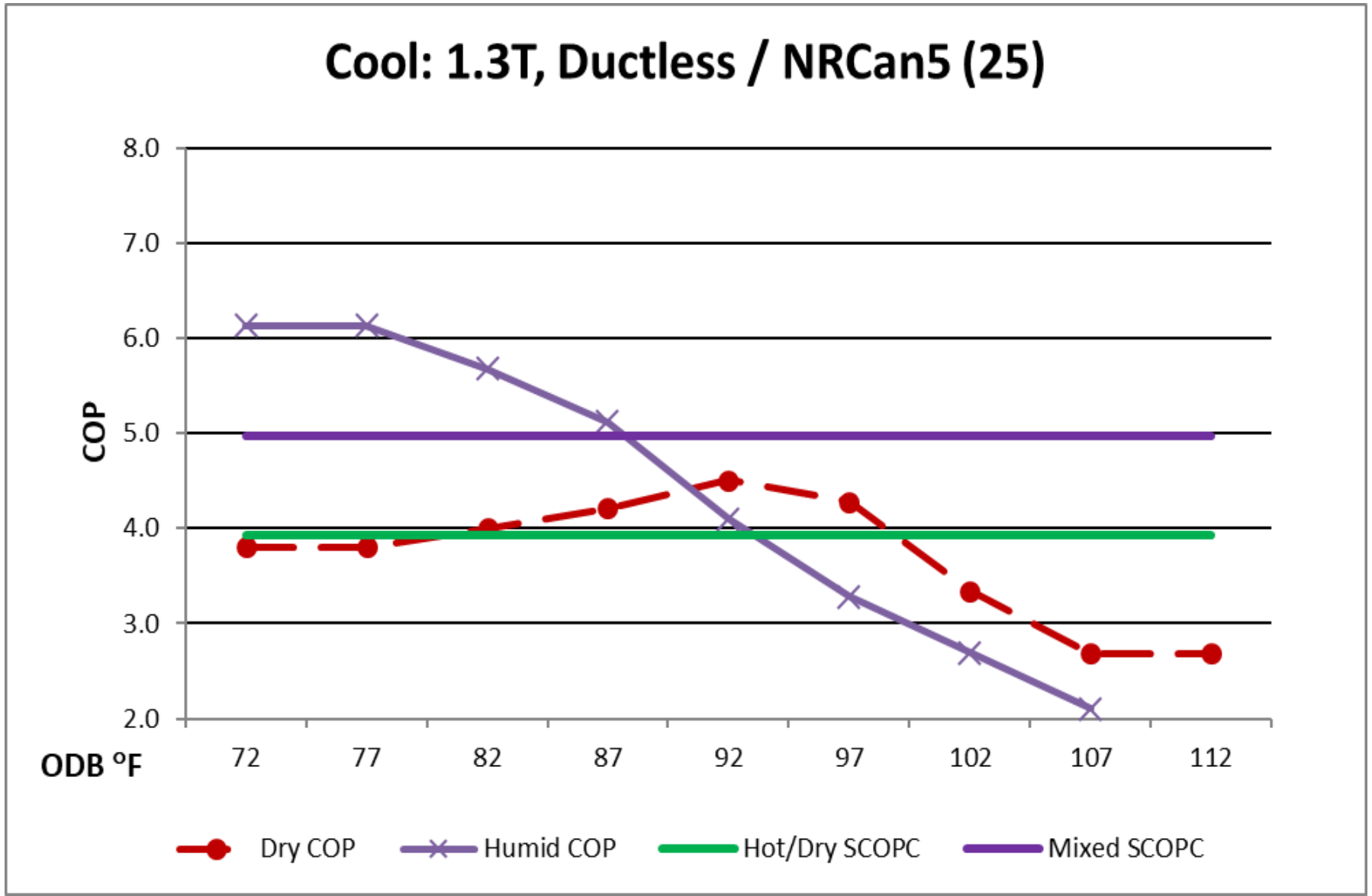
EXP07 Results – NEEA 5 - Heating



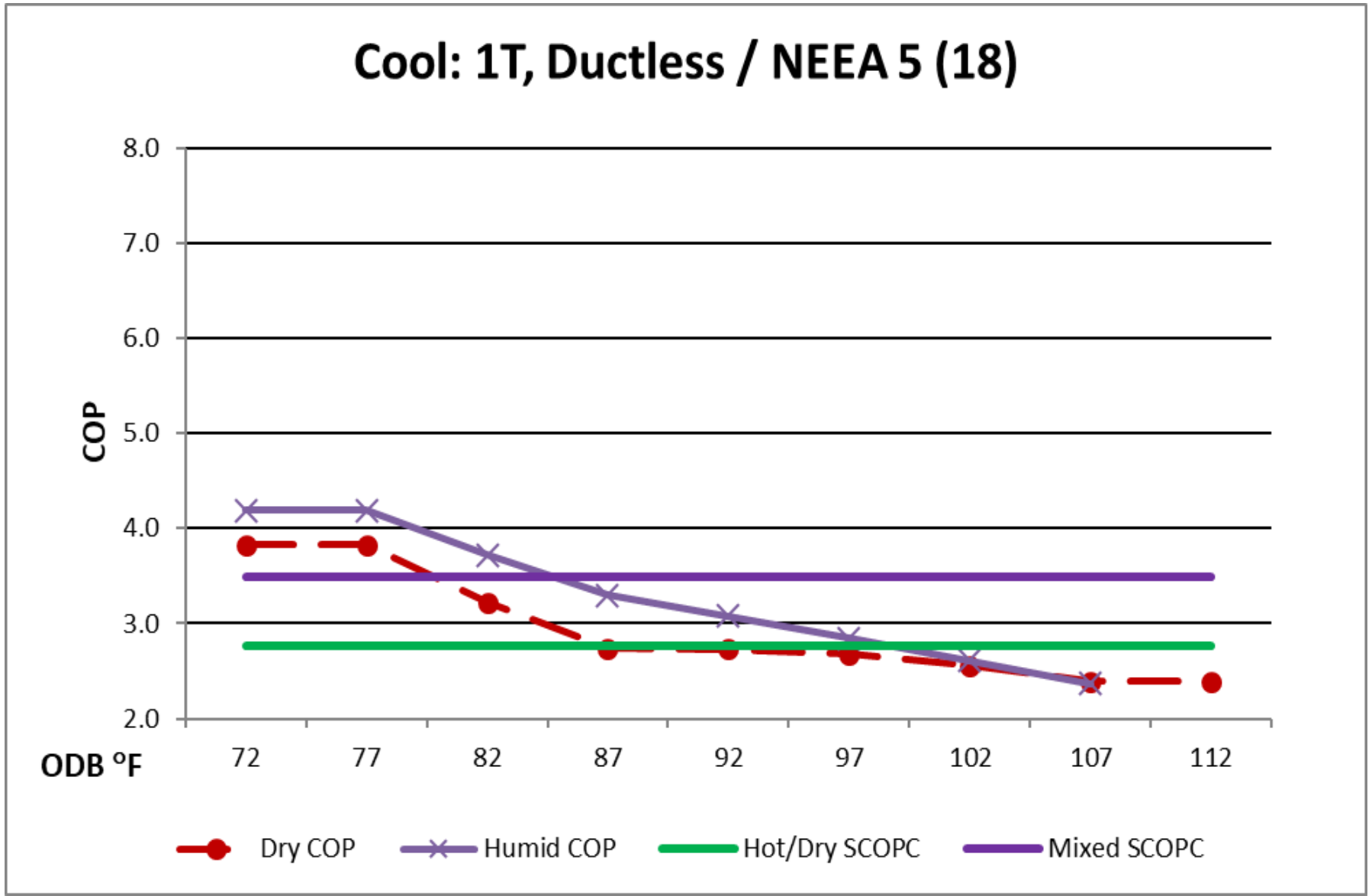
EXP07 Results – NRCan 2 - Heating



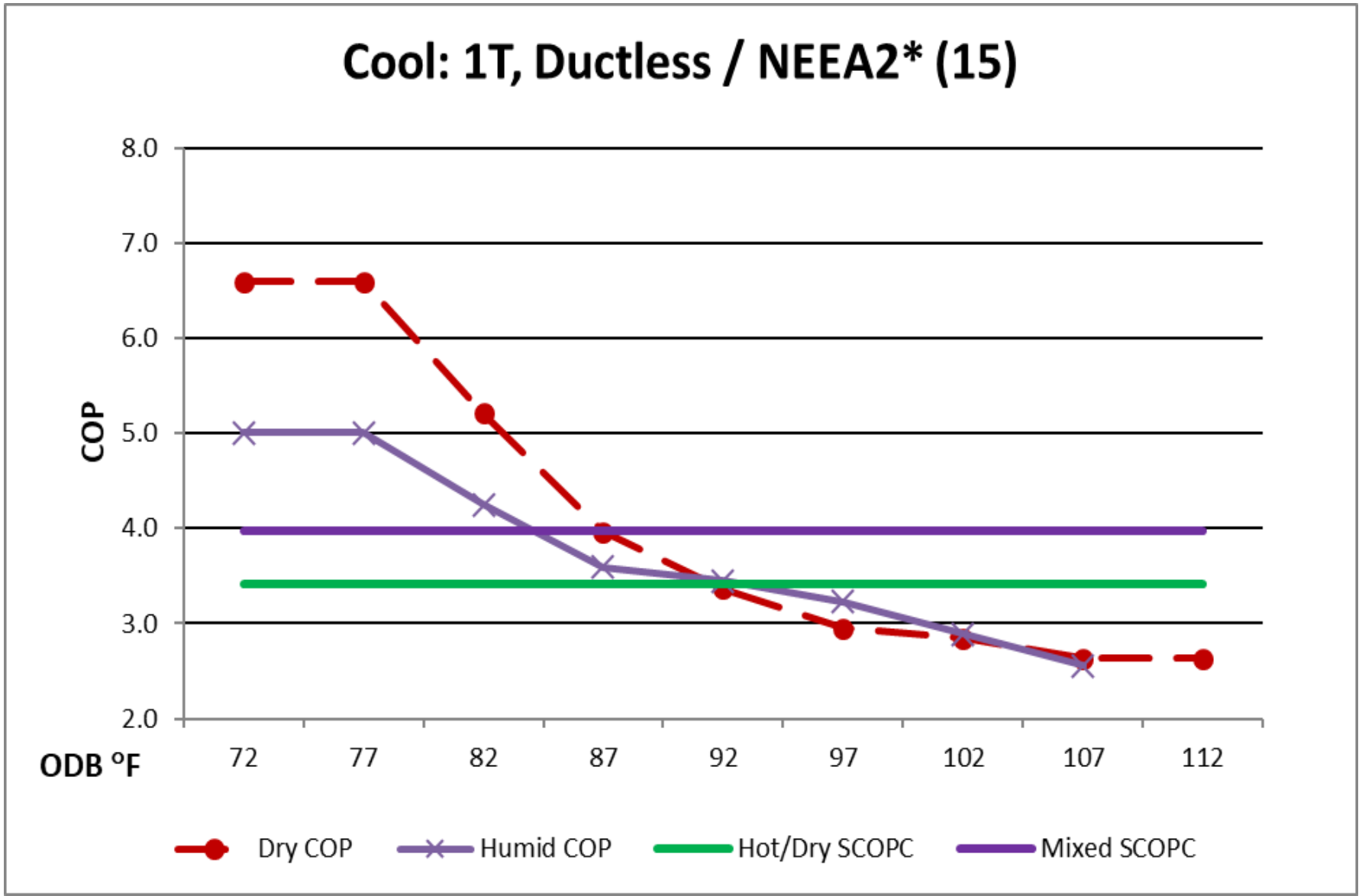
EXP07 Results – NRCan 5 - Cooling



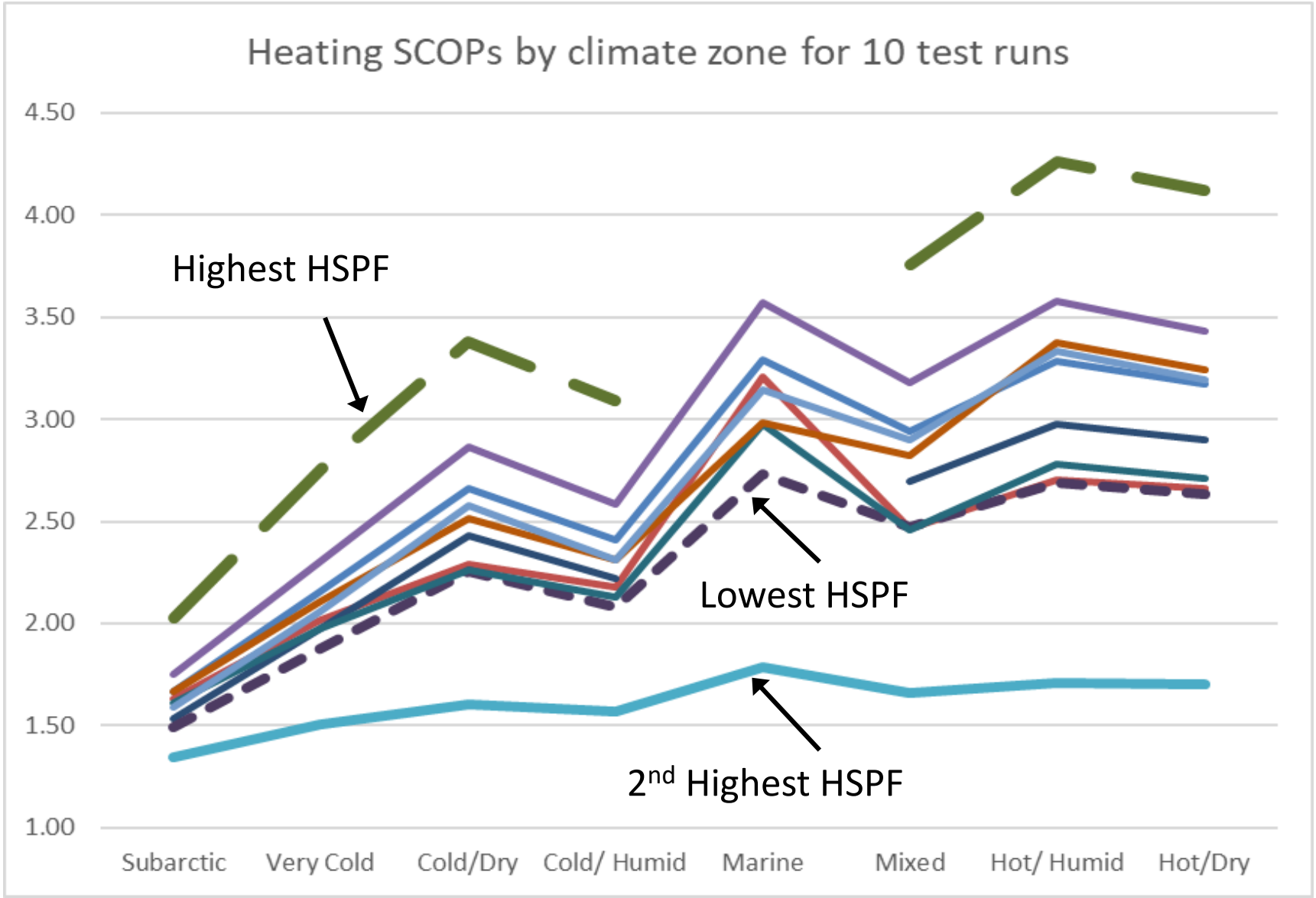
EXP07 Results – NEEA 5 - Cooling



EXP07 Results – NEEA 2 - Cooling

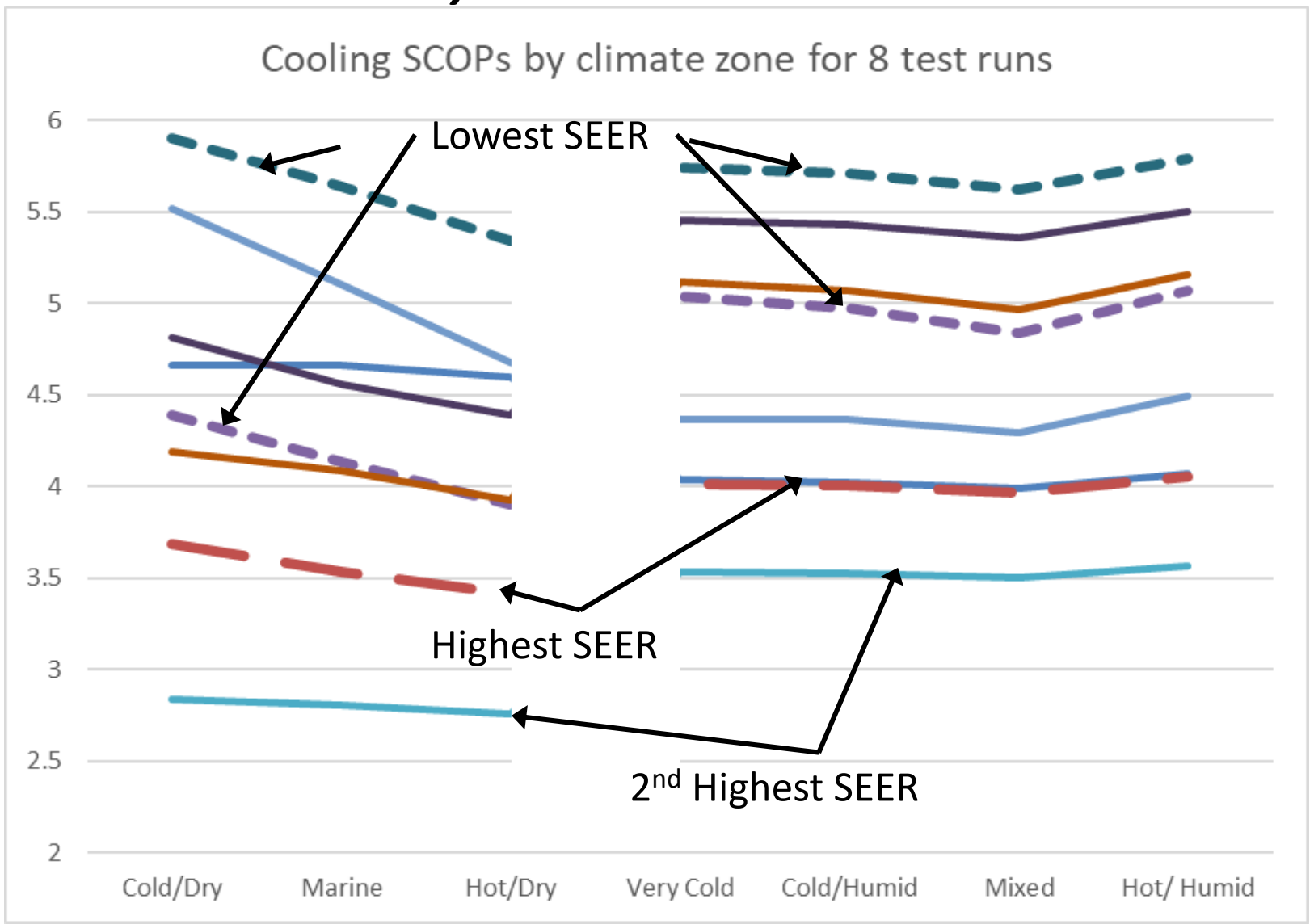


Heating SCOPs – Grouped by climate



Cooling SCOPs - Grouped

Dry - Humid



Next Steps

- Plain Language Guide
- Preliminary Findings
- 3R's evaluation
  - Repeatability
  - Reproducibility
  - Representativeness
- Qualified Product List(s)
  - California – title 24
  - NEEP – Cold Climate HP ---- version 4? Or 5?

Equipment Roadmap Workgroup

VISION

In 5 Years, programs will broadly promote consistent spec that drives advanced heat pumps (Target audience = manufacturers)

2019 ACTIVITIES

- Define Value Proposition
- Meet Manufactures
  - Understand their GTM strategy
  - Identify Collaboration Opportunities
- Updates for NEEP QPL
- Draft a “Roadmap Specification”

Members

- Northwest Energy Efficiency Alliance
- Northeast Energy Efficiency Partnership
- Natural Resources Canada
- BC Hydro
- Pacific Gas & Electric
- Southern California Edison
- Xcel Energy
- NYSERDA
- ConEdison
- MN Center for Energy and Environment

What is Our Value Proposition?
(to manufacturers)

Utility Incentives are Relatively Tiny

US Market ~ $2,000 Million/yr

Global Market ~ $60,000 Million/yr

What Drives Their Go-to market strategy?

Distribution Relationships

Dealer/Installer Confidence

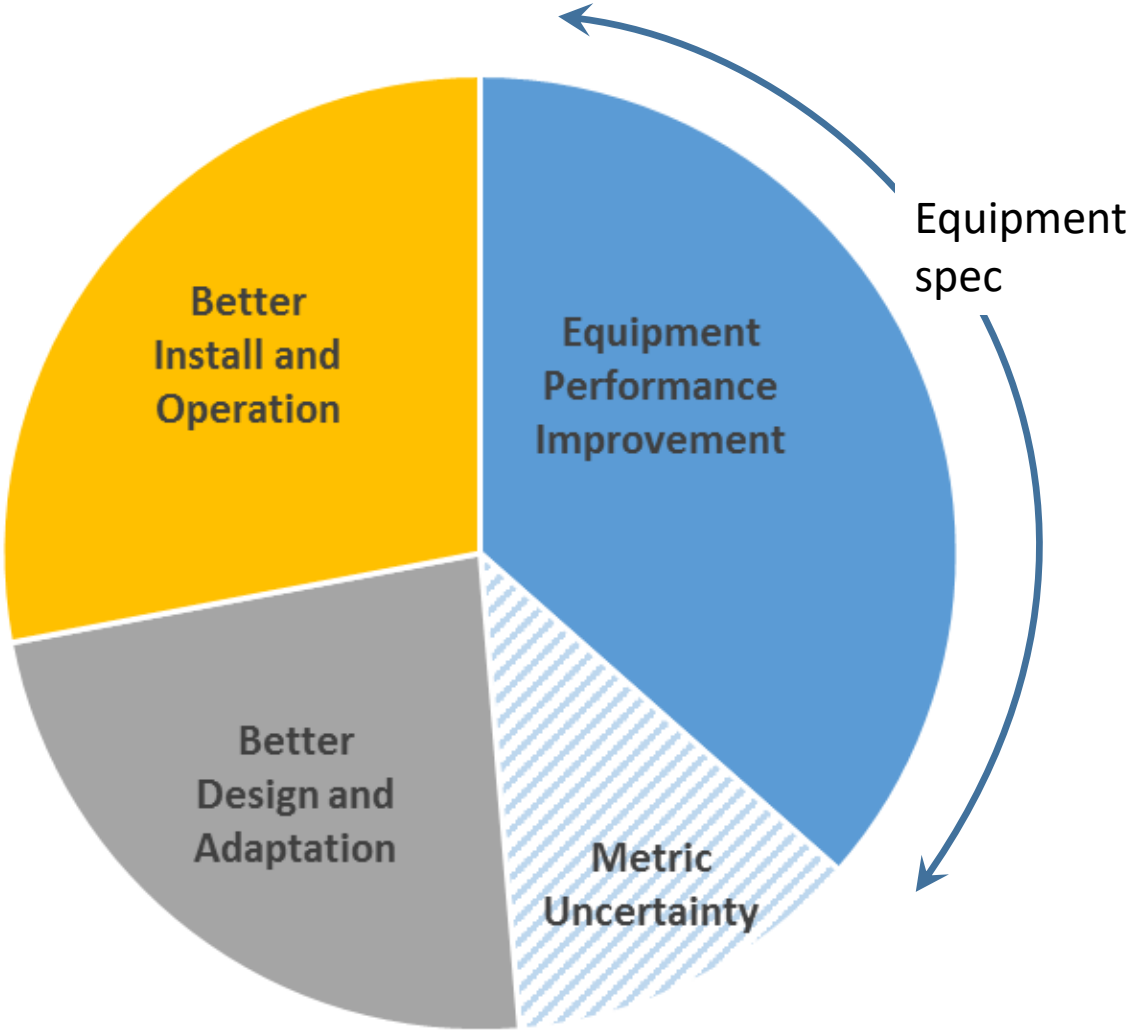
https://www.globenewswire.com/news-release/2019/03/18/1756071/0/en/Heat-Pump-Market-to-surpass-60-billion-by-2025-Global-Market-Insights-Inc.html
https://www.globenewswire.com/news-release/2019/04/17/1805406/0/en/Global-Heat-Pumps-Market-Expected-To-Reach-USD-98-39-Billion-By-2025-Zion-Market-Research.html

Current Trajectory

The HP market is not currently headed toward total systems performance

The market chases the easiest dollar *they can see*.

The Savings Pie



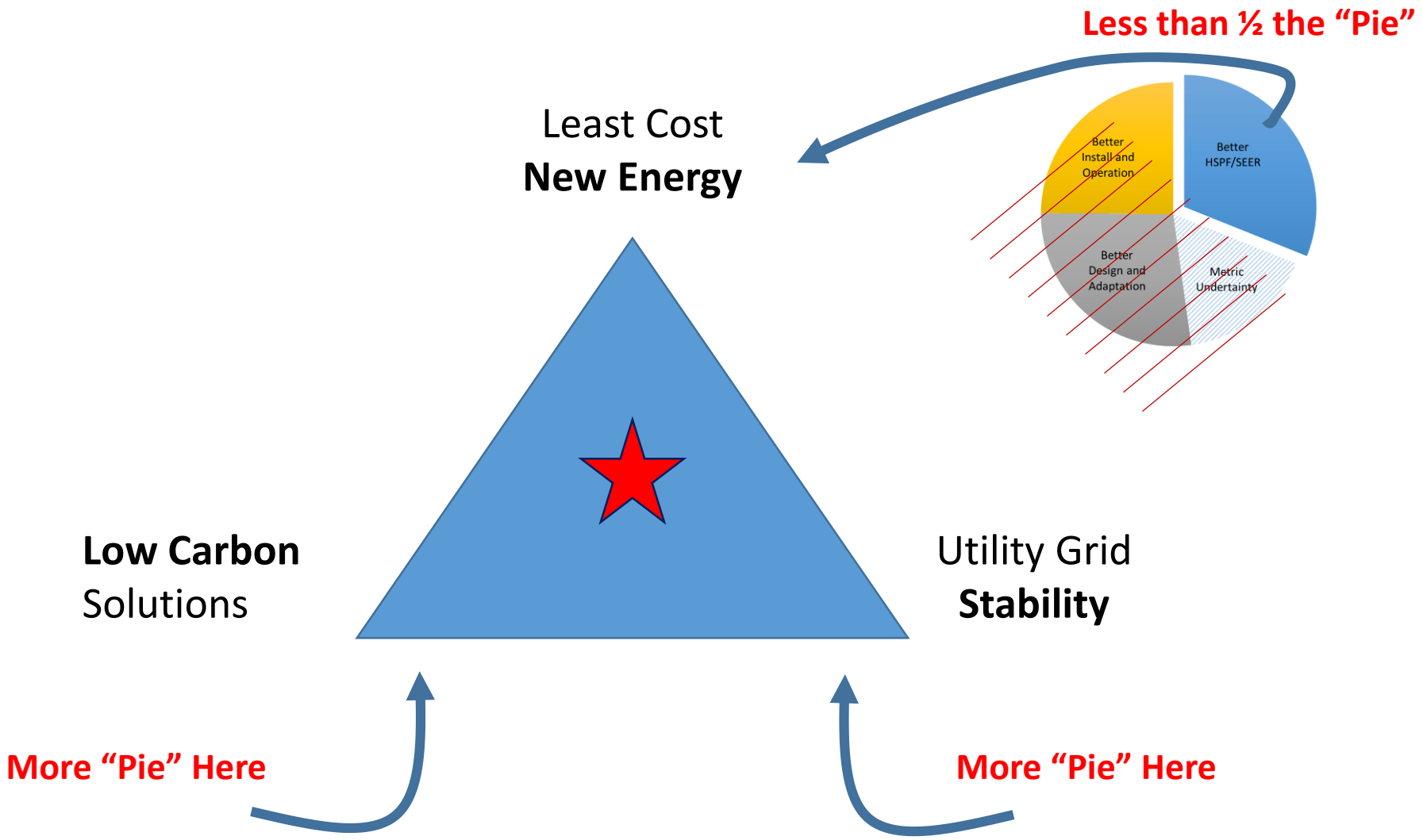
WE

WANT

MORE PIE!

Pie is illustrative of the savings potential for a typical single family home ASHP upgrade

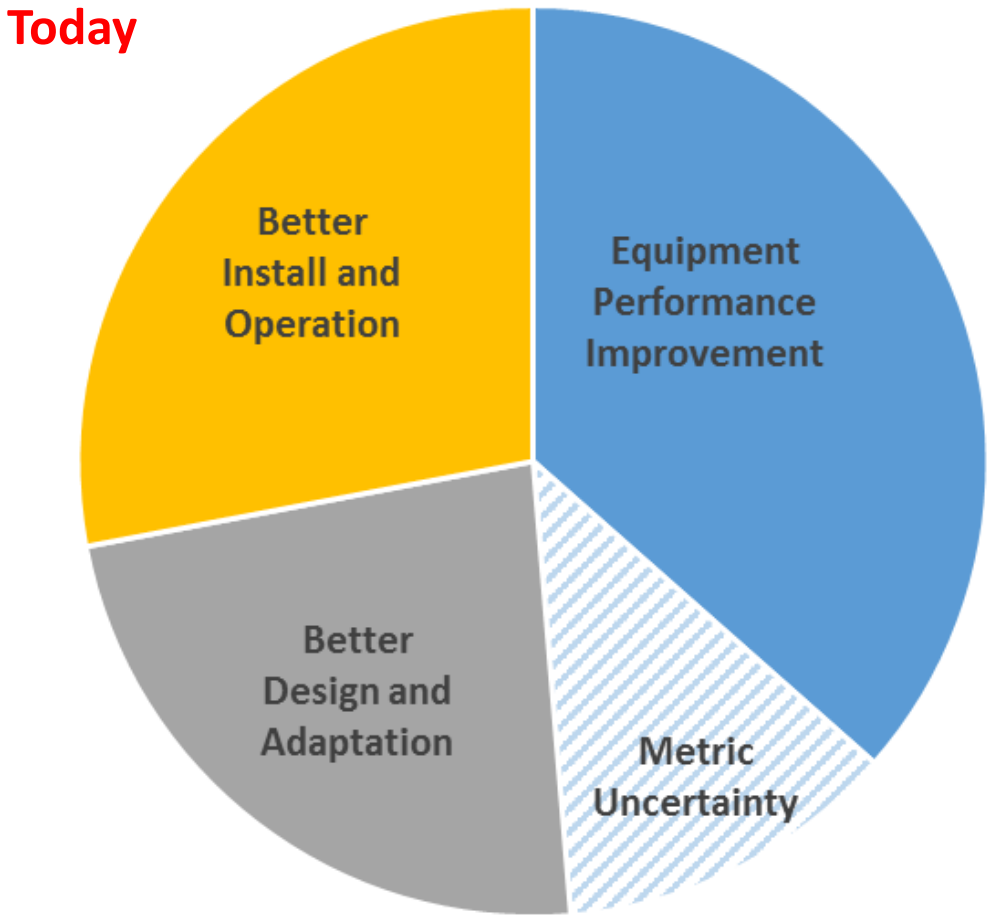
Three Sources of Value



Real World Data Potential

(post installation connected HVAC equipment)

- Dealer Performance Bonus $$
- Dealer Recognition (Awards)
- Performance Based Training
- Brand Loyalty
- Increased Access to Capital
- HVAC as a Service
- DR Confirmation



Manufacturer Feedback

- Current residential systems not technically capable
  - Not hard, Not expensive, but there is no clear reason
  - Need market demand proof
- Current practice doesn’t fully use what data is collected
- Manufacturers driving forces
  - Challenges of global supply chain management
  - Product reliability – reduce callbacks
  - First Cost
- Interest in supporting “top tier” contractor networks

Next Steps

- NEEP QPL
- Technical Validation Studies
  - Integrated controls
  - Extended capacity VRF validation
  - Multi-head mini-split performance
- Whitepaper
  - Voluntary performance metrics
  - Post Install Data
  - Needed proof of concept
- Manufacturer Pilot Project
  - Post install data

Design & Installation Workgroup

VISION

By 2025 a set of criteria and best practice guidelines for HVAC solutions are widely used that ensure 1) energy efficient, 2) grid supportive (alonetic) 3) application appropriate

ACTIVITIES

Create Decision Tree

Design use Cases

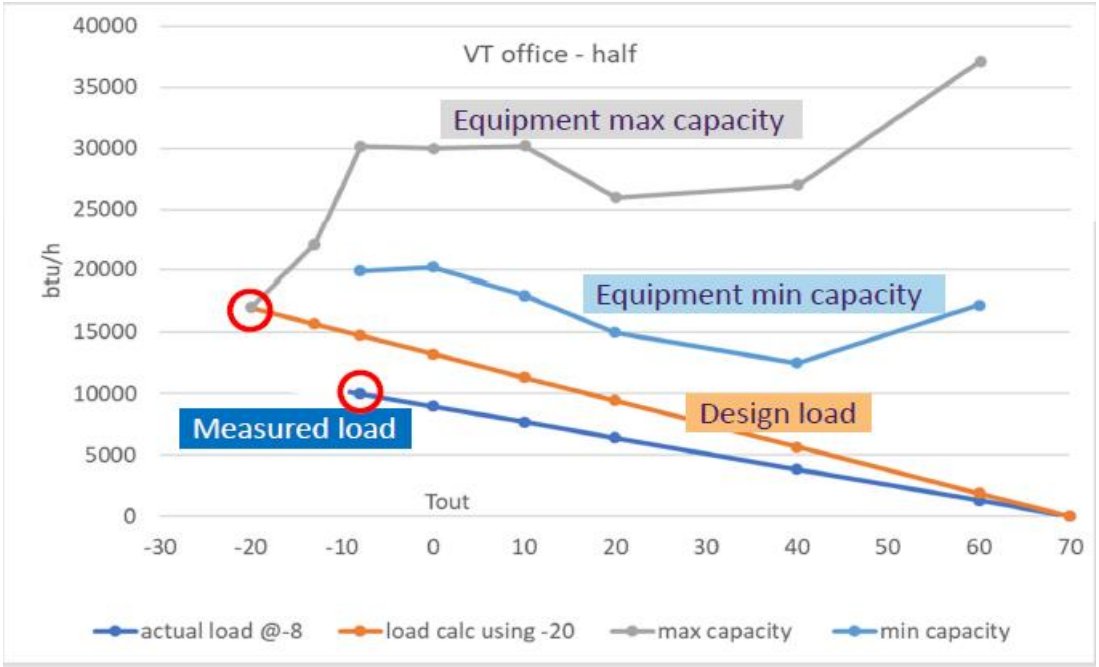
Develop guidance for contractors

Develop Installation Specs

Refine QA Specs

Get Industry Feedback

Conduct Q/A on Program Efforts



Consumer & Installer Understanding

VISION

Customers strongly prefer and desire heat pumps and are actively encouraged by knowledgeable contractors

ACTIVITIES

Market Research – Understand Market Actors

Develop Value proposition for various audiences

Establish Heat Pump Association

Develop Marketing Campaigns

Deploy Marketing Campaign

Follow-up and Feedback

Discussion & Sharing

Upcoming Events

• CEE Industry Partners Meeting	October 1, 2019
• Advanced HP Coalition Workshop	TBD - December
• AHR Expo 2020	February 3, 2020
• IEA Heat Pump Conference (Korea)	Spring 2020

HP Coalition

- 2020 Facilitator
- Active members – fund projects and participate workgroup calls
- Interested members – semi-annual webinars

Questions

- What needs further explanation or is confusing?
- Is there something we are missing?

Sharing

- What research or investigation is your organization doing?

Acknowledgment

We all have lots of **other** work
that needs to get done.

Thank You

Send me an email if you want to be part of the coalition.

cdymond@neea.org