Emerging Technologies

National Approach to CHPWH Deployment

July 28, 2022

Agenda

1. Hello and welcome (5 min)
2. Updates/News (5 min)
3. DOE Update (10 min)
4. Tacoma Power CHPWH Program (Jack Zeiger/Seth McKinney) (15 min)
5. Commercial Water Heater Load Shifting (Connectivity) (20 min)
6. Ascent to Market Transformation (20 min)
7. Subgroup Formation (15 min)

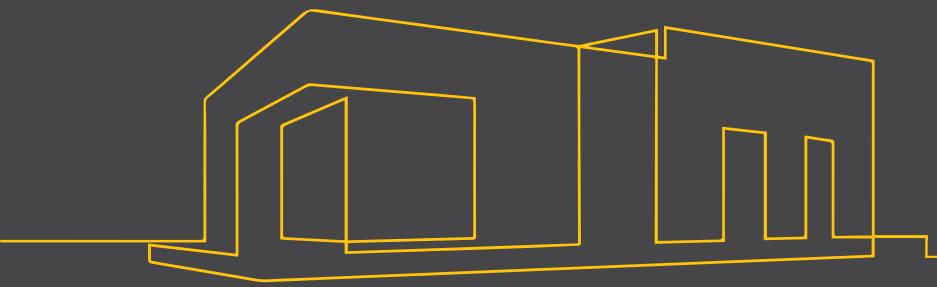
TACOMA POWER CHPWH PROGRAM

9/23/2022

Overview

+APPA Grant

- Support a new, simplified utility prescriptive program for CHPWHs
- Develop/improve tools to deliver reliable savings and high customer value.
- Accelerate the deployment of high-performance CHPWHs in the multifamily sector.



PROBLEM

+ Market currently relies on custom engineered solutions with a wide range of performance around:
  - Cost
  - Efficiency
  - Reliability
  - Savings persistence
+ Variability and specialized knowledge currently limits CHPWH-specific programs
+ Custom projects likely require expensive pre/post M&V and project review and delay project approvals

EXAMPLE

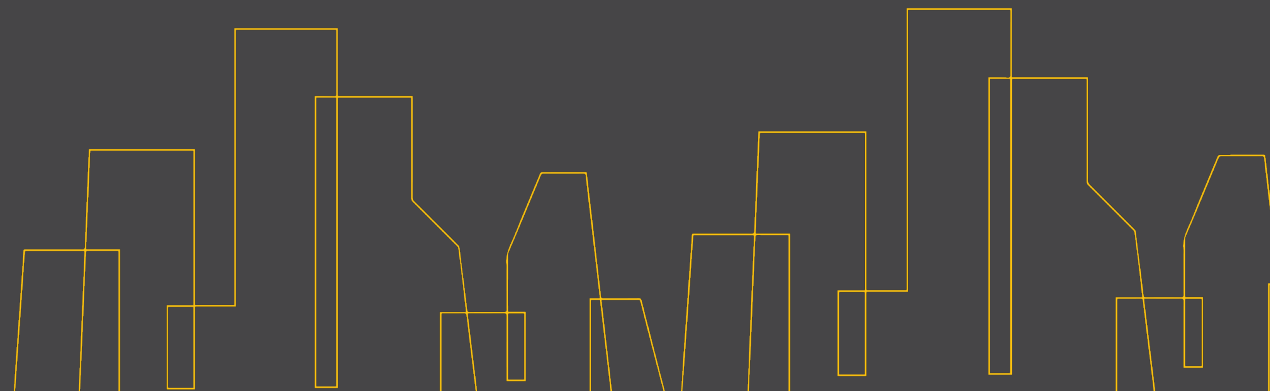
+ **Measure Identifiers for the old Seattle City Light CHPWH program:**
  - $350/apt for ***ANY*** HPWH
  - $500/apt for ***ANY*** CO_2 HPWH
+ **Pros:**
  - No need to worry about a baseline
  - Quick project approval
+ **Cons:**
  - Massive variability in performance (Cost, Efficiency, Reliability, Savings persistence)
  - No design guidance/requirements

UTILITY PROGRAM DEV

+ A new, simplified utility prescriptive program for CHPWHs

- Establish a prescriptive calculator and supporting prescriptive measure and mechanism for custom programs (if needed).

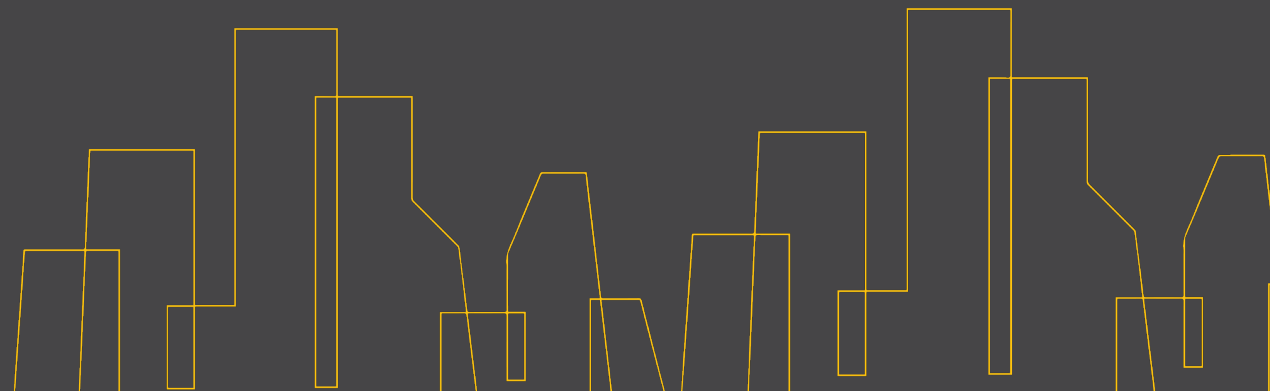
- "Last mile" improvements of the collaborative work to date to deliver an efficient, high impact, high value, light-lift utility program that can be adopted across the nation.



UTILITY PROGRAM

Technical Resources

+ **QPL**
  - Format, populate with multiple manufacturer
  - Protocol for updating QPL/program over time
+ **AWHS**
  - Provide additional formatting, data collection to support program deployment
+ **Savings Methodology/Load Calculator:**
  - Develop tool to calculate and demonstrate savings vs. baseline.
  - Input spreadsheet with output form.
  - M&V Baseline assumption
+ **Ecosizer**
  - Tool is complete with a manual interface
  - Need to fund user-friendly web version

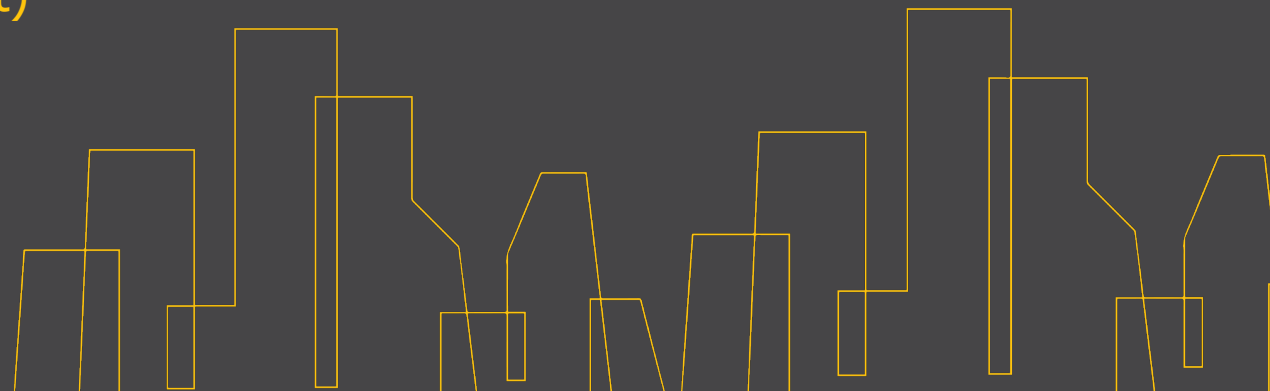


UTILITY PROGRAM

Implementation Tools

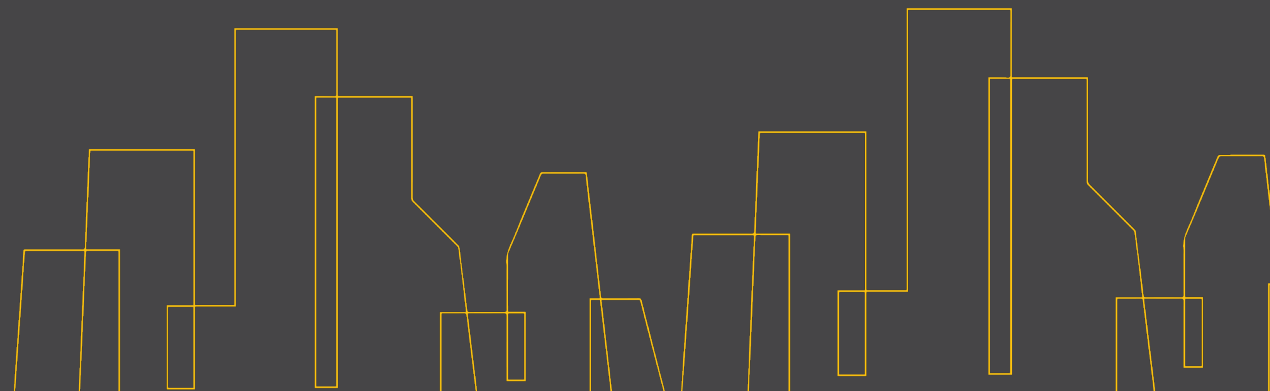
+ **Screening Criteria (Target Building Guidance)**
  - Worksheet for program staff to help identify existing building characteristics that support straightforward deployment
  - Format, populate with multiple manufacturers / configurations
  - Protocol for updating over time

+ **Specification Sheet**
  - Develop form identifying system requirements and documentation (checklist of configuration and components, savings tool output, Ecosizer output)



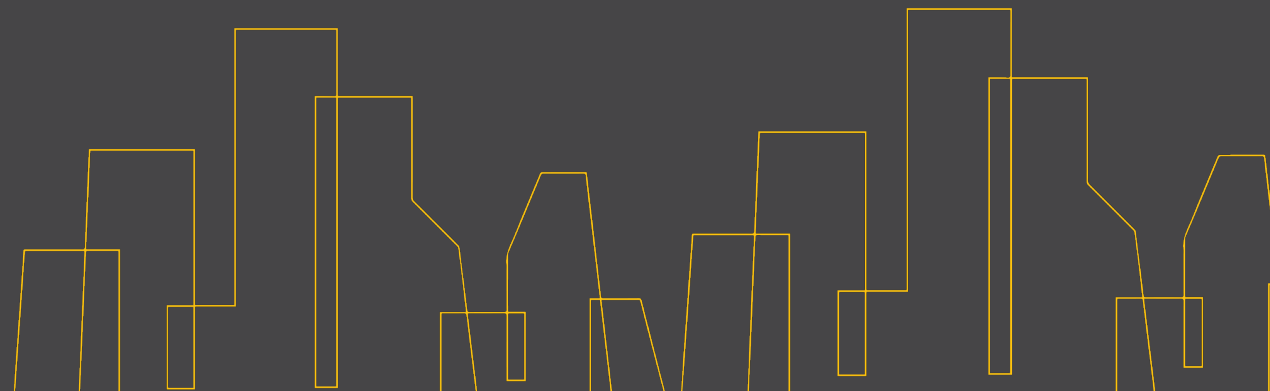
UTILITY PROGRAM

+ **Questions we're asking:** to establish a prescriptive calculator and supporting prescriptive measures
  - What are the measure identifiers?
  - How do we manage variability in cost, efficiency, reliability, and savings persistence?
  - How might we include Load Shift?
  - What's the baseline?



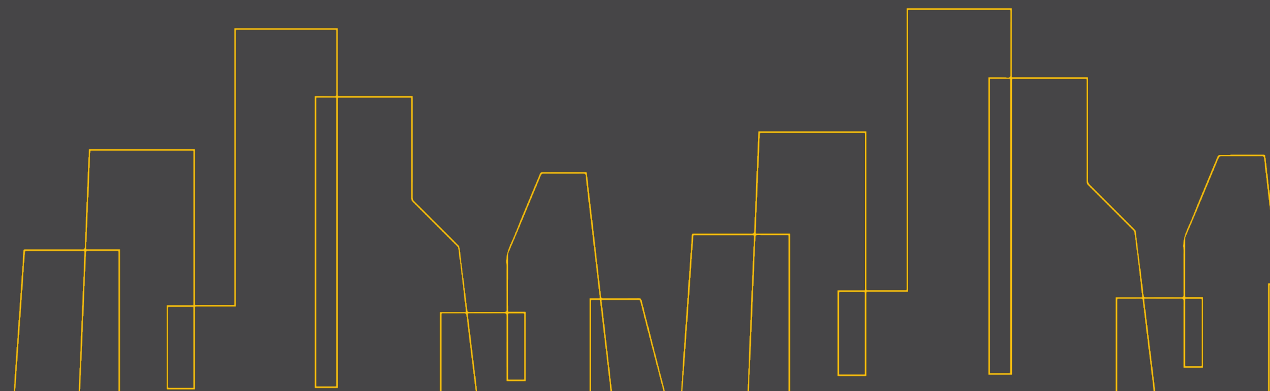
UTILITY PROGRAM

- **Questions we're asking** to fulfil the "Last mile" improvements to deliver a utility program that can be adopted across the nation:
  - How can we support the RTF Process?
  - How can we add other commercial building types?
  - How might we incentivize load shift capability?
  - What is needed for measure validation?



MARKET MOVERS

+ What other program work is under way?
+ What haven't we considered?
+ Other insights?



COMMERCIAL WATER HEATER LOAD SHIFTING

July 2022

Draft Test Plan and Proposed Metric for Quantifying Load Shift Capability for Utility Incentives

GOAL

Provide a commercial Heat Pump Water Heating System laboratory test plan for utility programs

CRITICAL NOTE

Air source water heaters have **excess capacity 99% of the time** so there is a low risk of grid signals causing problems.

Most days year, there is LOTS of excess capacity; therefore, the design day **deploys with high confidence.**

OBJECTIVES

1. M is a single metric used to develop appropriate program incentives
2. Larger the system, larger the incentive
3. Greater the sensors, greater the value
4. Tanks that are same size, with more useable capacity*, should be worth more
5. Encourage system designers to use flexibility and discretion in designs, but have M reflect value of system to grid.
6. M be usable enough that it encourages widespread use and adoption.

* a common tank characteristic in marketing materials

PROPOSED REQUIREMENTS

1. A Mixing valve is mandated
2. System must be able to deliver instantaneous power measurement (can be estimated) of the total system to within +/- 20%...better accuracy is encouraged.
3. System must be “Connected at Install” to be able to receive grid signals or grid schedules.
4. System must be able to turn off any resistance element in the system (whether internal to the primary tank, or legacy tanks previously existing, or recirc and backup tanks) during any SHED level.

UTILITY PROGRAM CONSIDERATIONS

M is designed to be conservative.

Encourage a 2-Step Incentive Approach.

1. Install Incentive.

2. Performance Incentive.

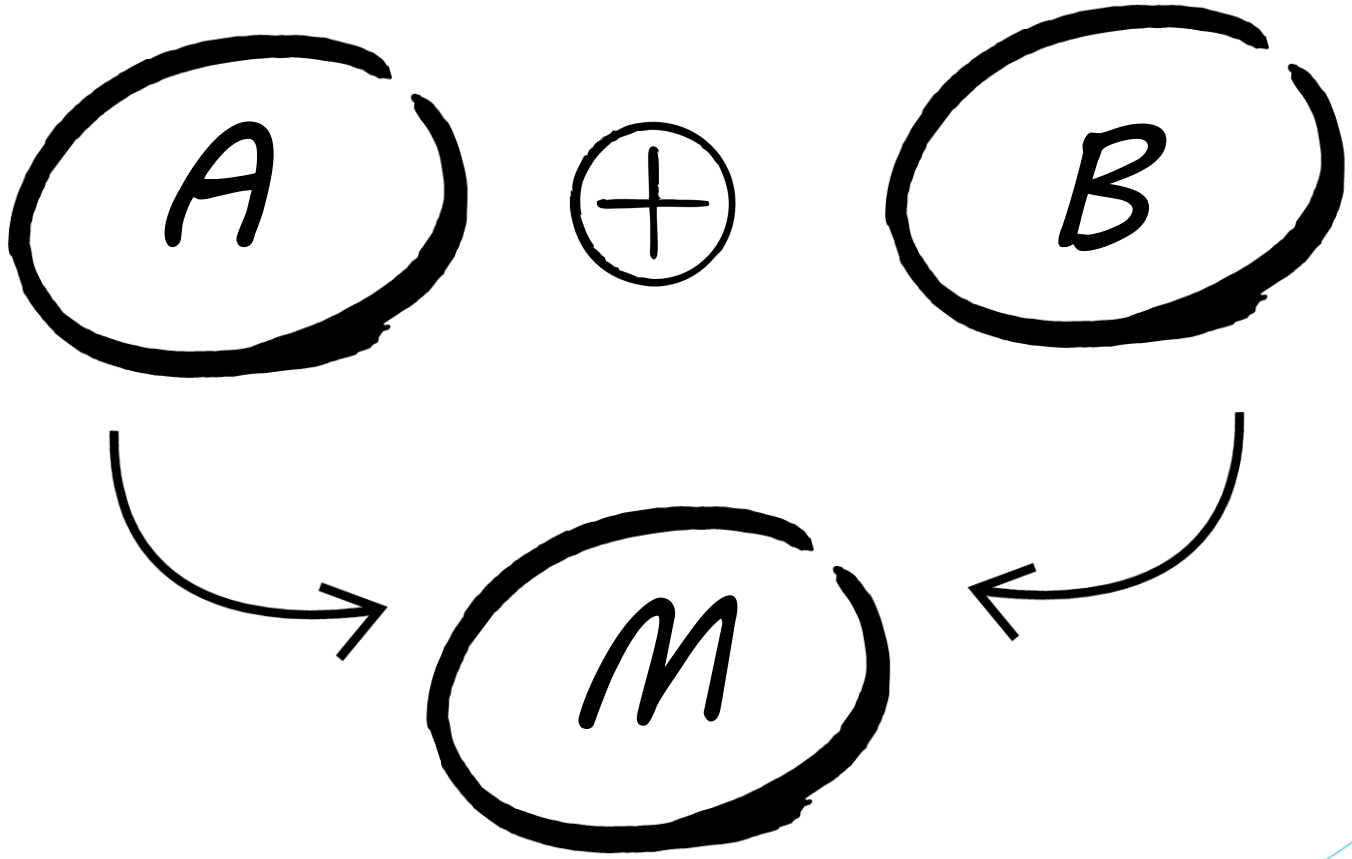
3. Potential additional short-term incentives for tanks with at least 3 temperature sensors during at least the first 2 years. (Greater Sensors = Greater Incentives)

HOW THE TESTS SHOULD HANDLE WIDE VARIETY OF TANKS IN THE "SYSTEMS"

We would like to model the testing similar to the AEDM concept used by DOE for Minimum Efficiency Ratings:

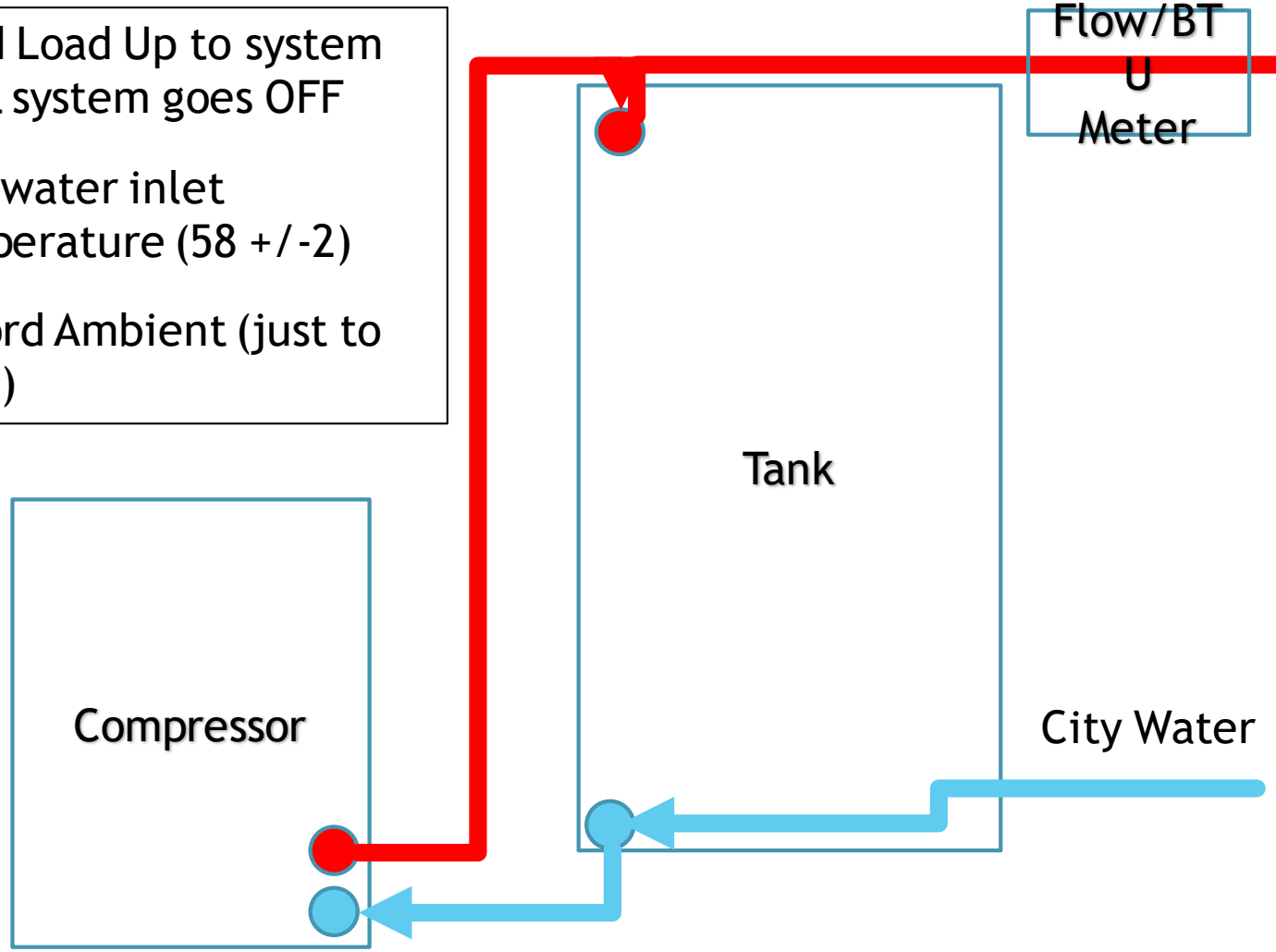
1. Do a little bit of testing and come to broad conclusions.
2. Test one tank size and extrapolate to other tank sizes and similar tank characteristics.

Test Plan A and Test Plan B will be averaged to determine M



Test Idea A – geared towards storage

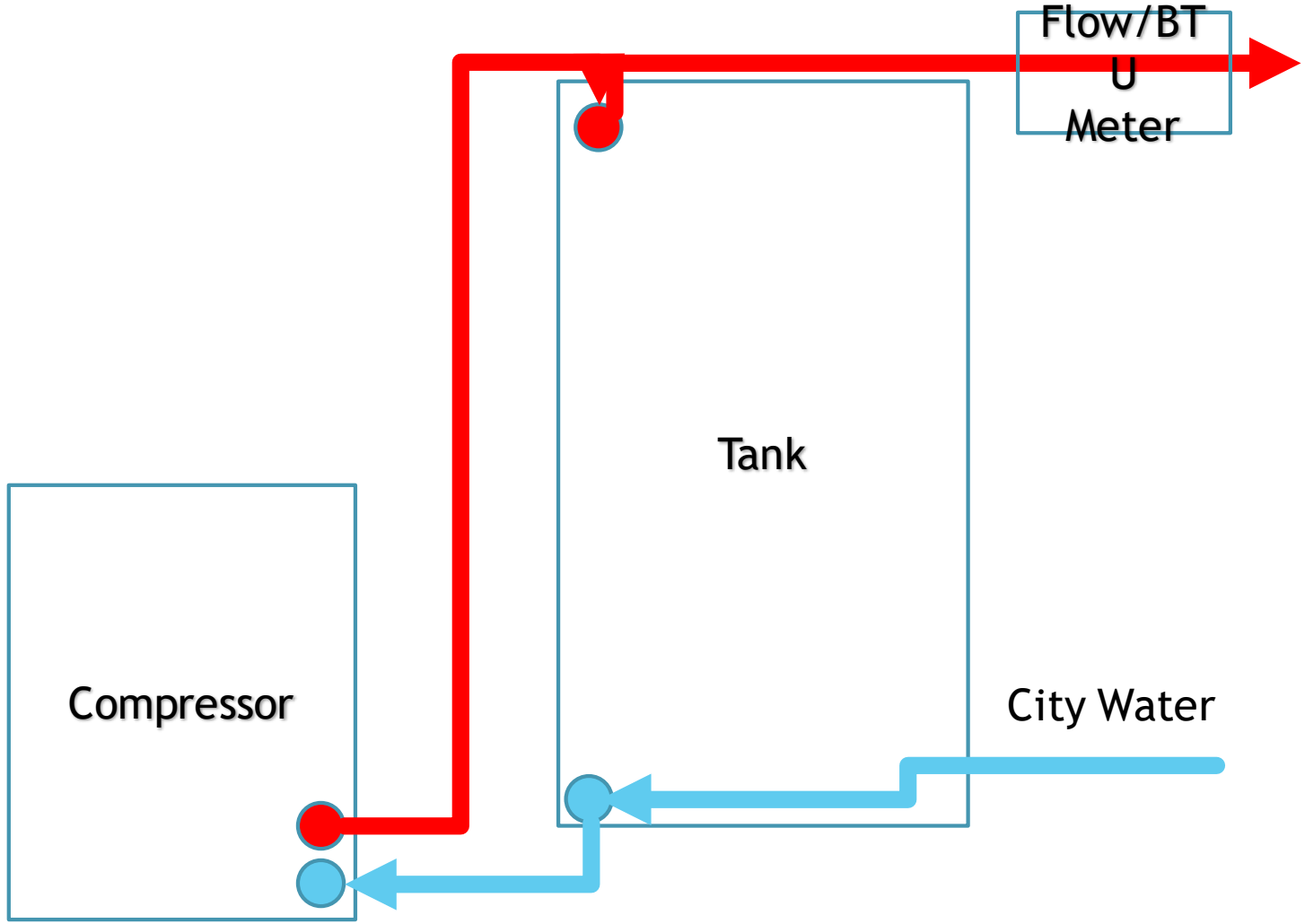
1. Send Load Up to system until system goes OFF
2. City water inlet temperature (58 +/-2)
3. Record Ambient (just to note)



* Draw rate remains TBD. See Appendix A for draw rate ideas

4. SHED temp is mandated to be 110 (heat pump setpoint)
5. Implement an infinite SHED, start a draw at 3 GPM* and turn on the flow/BTU meter
6. When compressor turns on (or ratio of normal power to shed power acceptable), SHED will be over
7. The metric, M, is the BTU/kWh delta between when draw started and when SHED was over (compressor OR other heater came on back to normal)

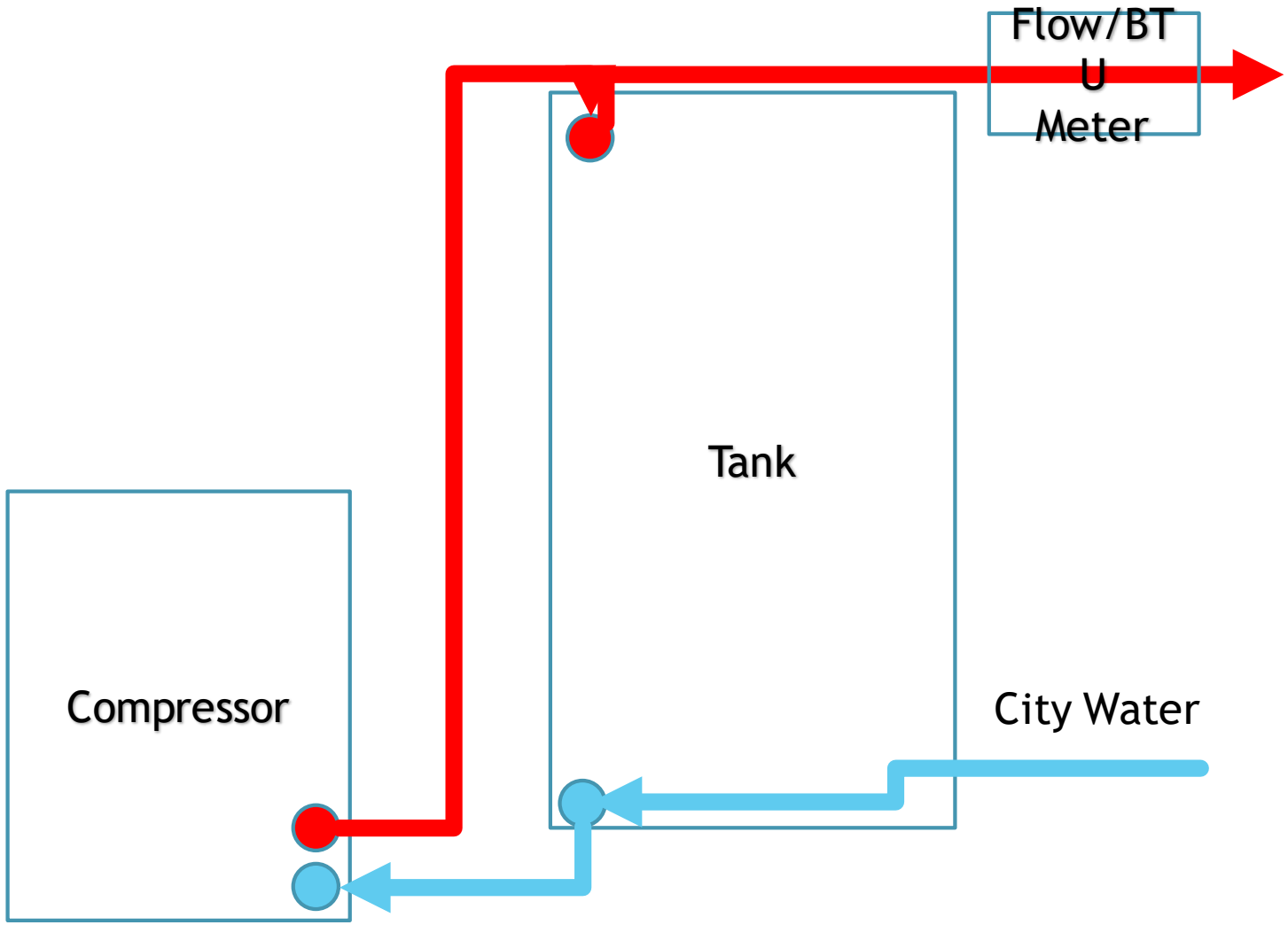
Test Idea B – Similar to Energy Star procedure (8 hr. minimum)



1. Prep step, draw enough water so system will come on
2. Run system for 4 hours under draw profile* and measure energy used
3. Perform a Load Up and then Shed
4. During Shed, measure energy used with same draw profile
5. The M would be the delta in energy use (energy use during normal 4 hours vs energy use during the shed 4 hours)

* Draw rate remains TBD. See Appendix A for draw rate ideas

Test Idea C – Load Up only



1. Prep step, draw enough water so system will come on (probably should have a metric for this, such as outlet temperature = 110)
2. Run Load Up
3. Measure energy used during Load Up until Load Up stops

Notes comparing Test A vs B

- Test A may be better for grid and may allow designs flexibility….but so does Test B
- Test A may be able to give a number for a tank without a heat pump with it.
- Test B measures a ratio of power of what it uses normally and what it uses in a SHED event and that would be a good flexible way to not eliminate system designs. -> ratio: power/event time
- Test B works well for fixed compressor and storage but with central, there is so much mix and match -> need something more flexible for bigger facilities
- The thing we want is NOT only to avoid the shed, but to SHIFT as much energy as possible.
- A Test A2 idea could measure 2 data points instead of 1 by adding the measure of the delta between load up and normal to the Test A load up and shed.

Post – Install Incentive Ideas

1. It may be that because of M&V and data coming out of system post-install, system delivers much more value than quantified in the ‘test’. Therefore, we may want to encourage post-install incentives to systems that deliver better ‘load shift’ than what the test M indicated.

2. One idea: Compare the actual power consumption time profile of the water heater in situ against the average utility power time profile.

   Maybe a simple measure such as % off-peak usage compared to the utility % off-peak supply times some incentive base (could be a varying base based on the pre-sale incentive (proxy for potential value of the shift).

3. Other ideas?

4. Interested in more? Join the load shift work sub team on this commercial heat pump water heater work group

Emerging Technologies

Ascent to Market Transformation

Summer 2022 Ascent to CHPWH Technology Adoption

WHERE WE **STARTED**

PRODUCT

NASCENT INITIATIVE

Few CHPWHs available

Outdated and overly conservative assumptions for hot water usage

MARKET CHANGE

FEW SUPPORTS

No market engagement

No CHPWH system design or workforce training

CODES & STANDARDS

LACK OF GUIDANCE

No robust CHPWH specs, standards, or programs

WHERE WE **WANT TO BE**

PRODUCT	**ROBUST OPTIONS** Large selection of plug-and-play options for all US climate zones; EcoSizer available for wide range of commercial systems
MARKET CHANGE	**MARKET CHOICE** Market knows about CHPWHs and their benefits, and how to design & install them
CODES & STANDARDS	**UTILITY BUY-IN** Utility programs based on QPL and EcoSim

And expanded range of commercial applications (beyond multifamily)

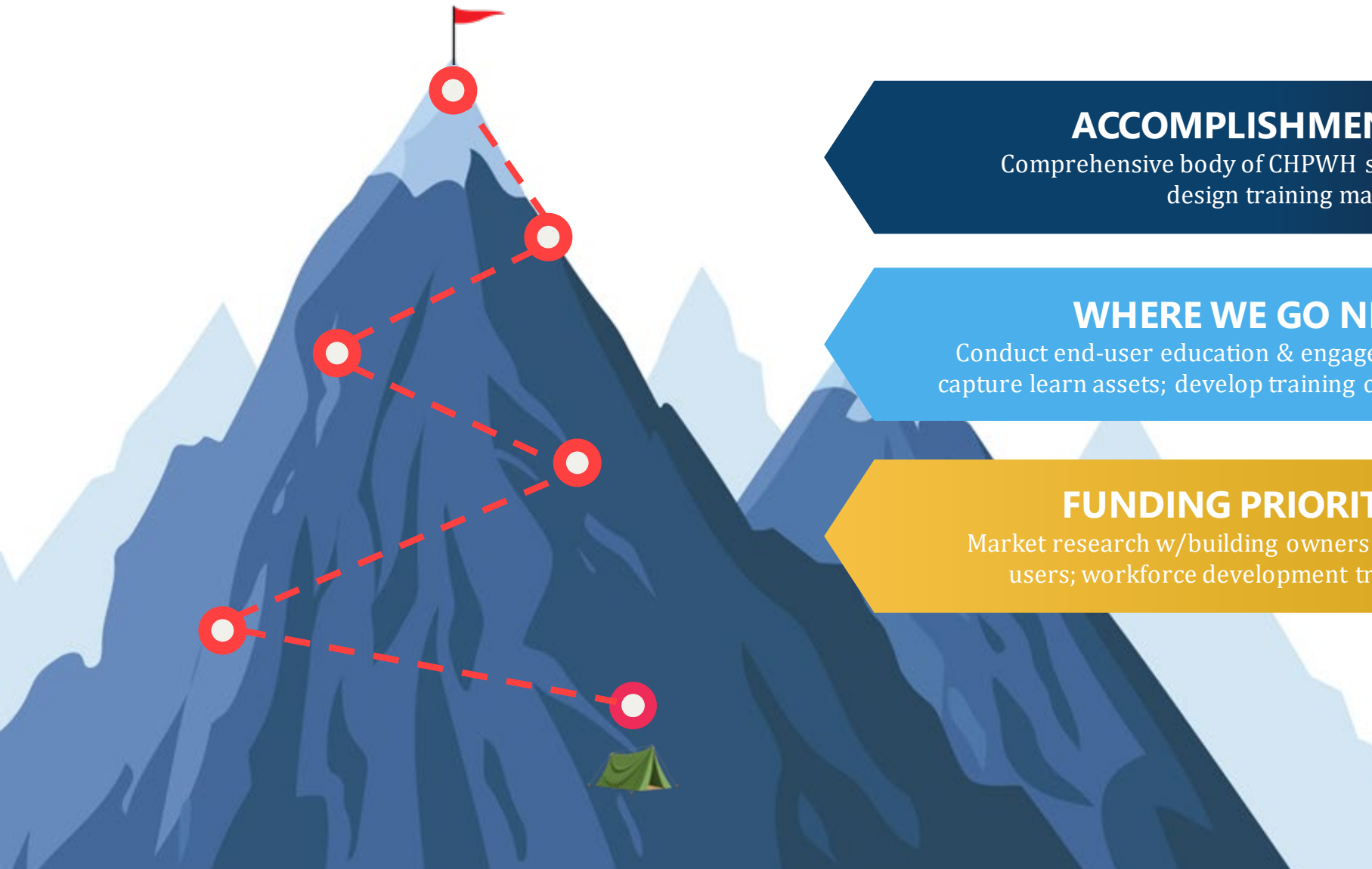
AVAILABLE **PRODUCT**

ACCOMPLISHMENTS:
Shifted market to plug-and-play approach

WHERE WE GO NEXT:
Add functionality to EcoSizer; establish demo projects; develop user-friendly EcoSim interface

FUNDING PRIORITIES:
EcoSizer, TIM, EcoSim

MARKET **CHANGE**



ACCOMPLISHMENTS:
Comprehensive body of CHPWH system design training materials

WHERE WE GO NEXT:
Conduct end-user education & engagement; capture learn assets; develop training catalog

FUNDING PRIORITIES:
Market research w/building owners & end users; workforce development training

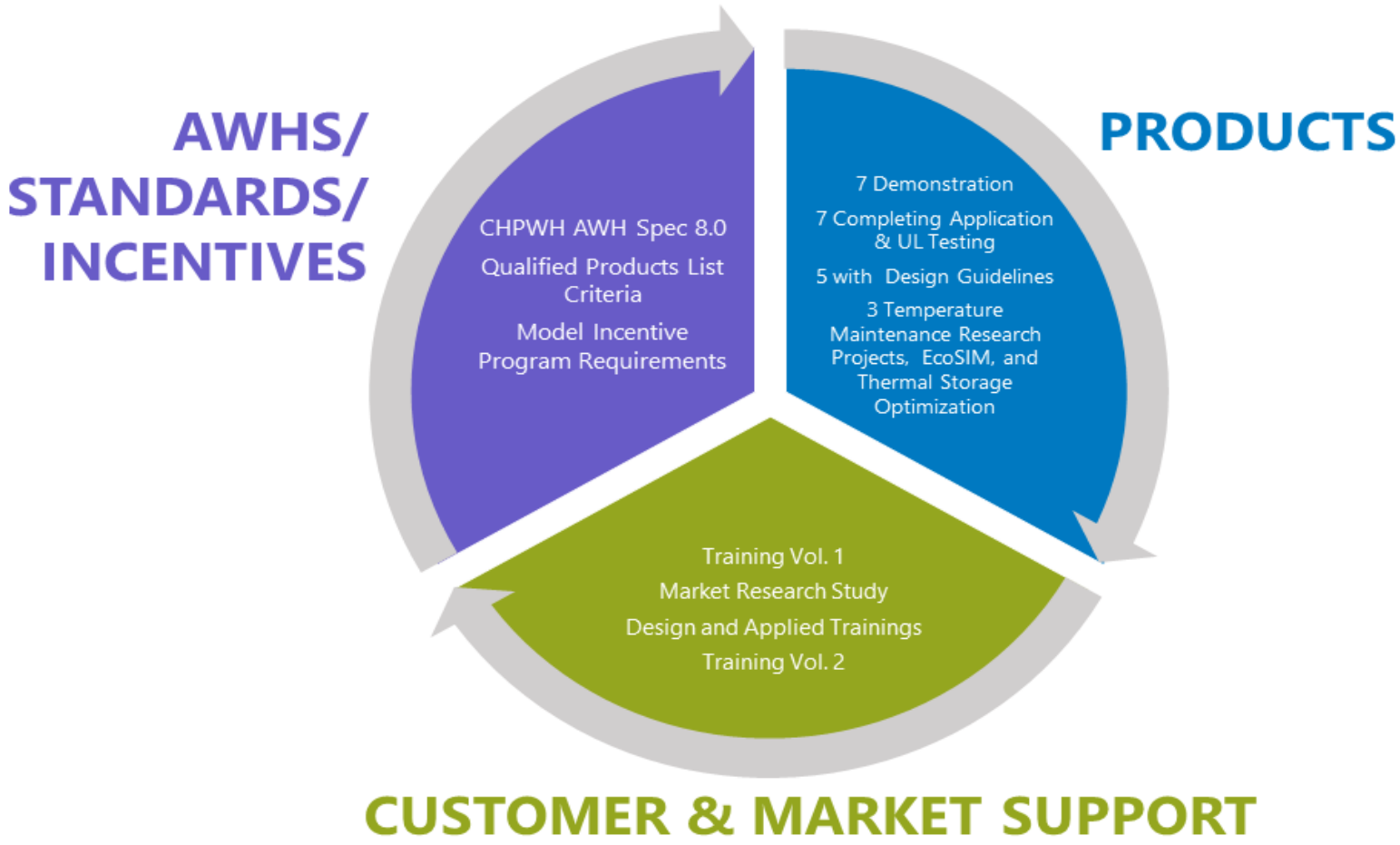
CODES & **STANDARDS**

ACCOMPLISHMENTS:
AWHS published version 8.0 added commercial section

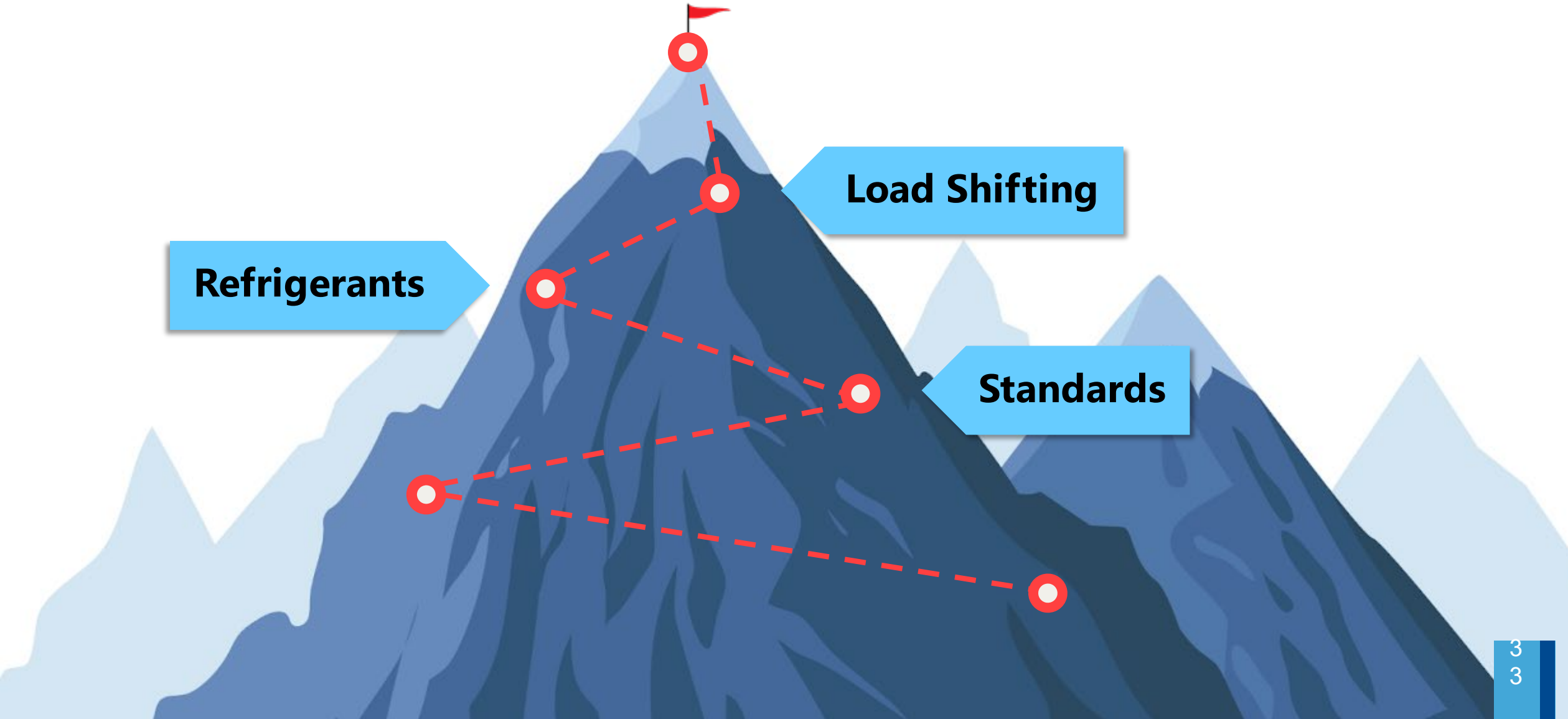
WHERE WE GO NEXT:
Path to QPL; set up CHPWH performance database, create AWHS standards appendix

FUNDING PRIORITIES:
QPL path; establish CHPWH performance data-base; create standards for AWHS & integrate into IECC

CHWPH WORK **GROUP**



SUBGROUPS TO DRIVE **PROGRESS**



Thank You!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