



Regional Technical Forum

**December 5, 2023
Meeting Minutes**

Welcome, Agenda Review and Meeting Minutes

Jennifer Light, RTF Chair, began the meeting at 9:00 am by calling for introductions. She counted 22 voting members in the room and the webinar. Philip Kelsven, BPA, moved to approve the minutes from the November 7, 2023 meeting. Brian Owens, CLEAResult, seconded. The minutes were approved unanimously.

Eric Miller, independent, moved to approve the day's agenda. Mitt Jones, Cadmus Group, seconded. The agenda was approved unanimously.

Management Update

Laura Thomas, RTF Manager [Presentation](#)

Staff provided an update on upcoming RTF meeting topics and addressed planning for 2024 including reviews for current upcoming RFPs and changes to the Contract Analyst Team.

There was no discussion.

Planning UES Update: Circulator Pumps

Ryan Firestone, RTF Contract Analyst (CAT) [Presentation](#)

Staff presented updates to the Circulator Pumps UES measure. The RTF discussed the costs, details around how the systems operate, and hours of use. The RTF approved the updates as presented.

Mark Lenssen, Puget Sound Energy, asked if the circulation loop in Multi-family buildings can be turned off or just slowed down [Slide 10].

- Ryan Firestone, RTF Contract Analyst: We only considered on/off for this application, not speed control. A Multi-family building could use a temperature control strategy, but only by using on/off.
- Lenssen: I just worry that on/off controls may be of limited use in Multi-family as residents expect hot water on demand.
- Sarah Widder, Cadeo Group: In my experience, you don't want to let the loop cool down, but you can turn the pump off for a period of time while the loop is hot. I have observed speed controls in practice, and you do see significant savings.

Dave Baylon, independent, voiced surprise at some of the hours of use numbers, asking where they came from.

- Firestone: We'll get into the sources later.
- Baylon: You can do things with the circulation pump, but the developer often doesn't allow it.

Kelsven asked if the controls are near the water heater.

- Firestone: They are usually near the end of the loop. The sensor isn't integrated with the pump so it can be put anywhere else on the loop.

Jackie Goss, Energy Trust of Oregon, asked how hydronic heating without controls works [Slide 14].

- Firestone: It's without speed controls. There is still an on/off control.

Baylon asked if the savings for ECMs was adjusted [Slide 21].

- Firestone: We didn't, but that is addressed in the Research Strategy.

Baylon was perplexed that ECMs are not cost-effective, noting that they have been in the code for 20 years [Slide 25].

- Firestone: This is what the numbers are showing.
- Light: Remember that our avoided costs changed a lot in the 2021 Plan. There are factors outside of our analysis that impact cost-effectiveness. These numbers are based on the RTF's cost-effectiveness calculations, but not all utilities use these.
- Widder: I think maintaining these measures is important. A utility might choose to offer a domestic hot water program and it's good to have hydronic heating available as well for comprehensiveness.

Kelsven asked how much of the cost is due to labor.

- Firestone: None because this is a current practice measure. The controls are integrated.

Baylon was struck by the numbers below the temperature controls on [Slide 28], saying they looked strikingly low.

- Firestone: Yes, NEEA found that too.
- Widder: These hours make sense for an application with combined temperature and timer controls. There aren't many commercial buildings where it would be applicable, but there are some where it would be possible.

Goss asked if XMP is always integrated into controls, wondering if that isn't the definition of the program [Slide 32].

- Firestone: I don't think so. The data included sales without controls.
- Widder: As a program XMP focuses on pumps with integrated controls, largely ECM. But the program does collect data on all sales from all participating distributors.

Baylon expressed amazement that the current practice baseline is 75% induction motors. He said the larger sizes have been WA and OR code since 2003, calling it surprising that ECMs haven't integrated more than 25% in that time frame.

- Firestone: This is the actual sales data from the program.
- Widder: This is real sales data. Code does not apply to all buildings and situations.

Goss asked if the numbers on [Slide 39] are incremental or total costs.

- Firestone: Total costs.
- Goss: Are the baseline costs anywhere?
- Firestone: No.

Kevin Geraghty, independent, asked about the difference between small Multi-family and central Multi-family [Slide 44.]

- Firestone: Small Multi-family looks more like small, individual units. Central Multi-family is a larger Multi-family building with a central water heater system.

Kelsven asked about the potential.

- Firestone: We have more potential in commercial, and it's primarily in recirculation.

MOTION

I, Eric Miller, move the RTF Approve updates to Circulator Pumps UES measure as presented and Keep the Category at Planning, Keep the Status at Active, Set the sunset date to December 31, 2026.

Widder seconded.

Vote on the motion. The motion carries (23 yes, 0 no, 1 abstain)

Prestigious Awards: Outstanding Achievements in the Field of Excellence

Josh Rushton, RTF CAT

Staff presented recognitions for Contract Analyst Team Members who are moving on to new endeavors. The recognitions, known as the David Baylon Awards (AKA the Daveys), were presented to:

- Greg Brown for "Outstanding achievement in the field of fantasy savings."
- Christian Douglass for "Outstanding achievement in providing possibly helpful reassurance."

Both Brown and Douglass express gratitude for receiving this high honor and for their time at the RTF. Thomas invited the body to a celebration after the meeting.

BREAK

Planning/Proven UES Update: Air Source Heat Pumps Upgrades and Conversions for Single Family and Manufactured Homes

David Bopp, RTF CAT [Presentation](#)

Staff requested a Single family and Manufactured Housing Air Source Heat Pump Measure and proposed next steps toward updating the RTF's heat pump measure suite. The RTF provided initial reactions and discussion around the following topics occupancy hours, setbacks, commissioning, controls, and sizing. The RTF approved the sunset date extension

Tom Eckhart, UCONS, asked about the audience for this measure, wondering why the end-user or customer was not included [Slide 13.]

- David Bopp, RTF CAT: They are the audience for a program, our measures are focused on the program administrator not the end-user.

Baylon noted that since 1989 all HSPF and Federal Standard testing require fairly good control of electric resistance use [Slide 16]. He then pointed to an additional set of controls available to installers that can completely erode this. Baylon suggested that taking away those additional controls will give you the functionality.

- Adam Hadley, Hadley Energy Engineering: For clarification, the Federal Standard assumes this but does not require it.
- Baylon: That's correct, but testing does require it. Or does it?

Widder thought that the numbers on [Slide 24] were probably due to controls and not evidence of supplemental fuels, based on the kWh/month measurement.

Widder then asked if [Slide 23] could be evidence of the unit losing charge, or not being properly charged from the start.

- Bopp: It could be, but I don't think that's the case based on the installer having both positive and negative savings.
- Widder: Got it. But it is something to keep in mind.
- Bopp: Higher occupancy could have been an impact of COVID.
- Rushton: We have tended not to worry much about charge too much because people fix their AC if it doesn't work.
- Widder: [Slide 24] has no cooling load. So maybe they never noticed.

Mark Rehley, NEEA, asked if there are temperature control settings.

- Bopp: No. These numbers are from billing.

Baylon noted climate differences across this service territory's climate. He pointed to Lake Wenatchee, which is 1,000-2,000 feet higher, and filled with high-end and vacation homes. He said these properties change hands often which might trigger a new vacation schedule or a significant change in occupancy. Baylon admitted that this information wasn't collected but stressed its importance for a resort community. He concluded by calling Lake Wenatchee a good market for heat pumps, but not necessarily for heat pump results.

Jim White, Chelan PUD, noted that the temperature setting can be found by looking for when the loads go close to zero, saying the house on the slide shows a setpoint at around 70°F. He

noted that a lot of people in Lake Wenatchee turn their heat pumps off because there's so much snow.

- Bopp: We've heard anecdotes of contractors telling people to turn off heat pumps in winter to avoid wearing them out.

Goss asked if the units on [Slide 28] may run electric resistance during the defrost cycle.

- Bopp: I assume so, but I don't know if they have that data.
- Baylon: Defrost would be right below 40°F.
- Douglass: If there was resistance during defrost, you'd see it at around 40°F. I think this data gives us a pretty good idea of what's happening. The vast majority of HEMS sights look like [Slide 28].

Bob Davis, Ecotope, stated HEMS has a sensor on the suction vapor line that can show defrost because the suction line gets cold in the winter. He said you typically have resistance during defrost adding that this usually does not lead to a big penalty, but there is a big range. Davis stated that some of the newer units don't use resistance during defrost, adding that there's finally some movement on the defrost in the ratings. He concluded by saying resistance during defrost can be 10-15% of annual consumption.

- Thomas: There's a lot more we can learn from HEMS, and we will.
- Baylon: As long as we learn it. Twenty years ago, we had well-set lockouts and balance points. We don't today.

Anna Hilbruner, Elise Solutions, asked if a differentiation between new and existing homes has been seen.

- Douglass: I doubt HEMS has newly constructed homes. Most equipment are single speed HPs, some are newer single speed HP (HSPF 9), some older (HSPF 7 to 7.5).

Josh Keeling, Utility API, used personal experience to confirm the behavior outlined on [Slide 29].

Baylon noted that WA code says that you can't use first stage electric above 40°F [Slide 32].

- Bopp: Does anyone check that?
- Light: Our specs have said that too. The challenge is the space between what people say and what people do.

Baylon asked how far Chelan PUD is in this process [Slide 37].

- White: The journey of 1,000 miles begins with a single step.
- Davis: This utility own two dams on the Columbia River. They sell excess power. They see the economic benefit of reducing demand.
- Bopp: Yes, and they have run into capacity issues in the winter.

Goss voiced concern about the setback issue [Slide 38]. She understood the issue around using resistance to ramp up but was concerned about uncomfortably warm houses making it hard sleep well at night.

- Bopp: There is an option for that.
- Geraghty: Setbacks only present an issue if you have resistance heat. You could start ramping up earlier in the morning with just the compressor. It's a controls issue.
- Keeling: You could also start earlier in the morning.
- Mark Jerome, CLEAResult and RTF Vice Chair: Controls can do all kinds of things without intervention. But there may be a better way. In 2017, I saw a system with no thermostat but could be controlled with "warmer" or "cooler" buttons. Removing the thermostat could achieve some of this.
- Baylon: I recall Jimmy Carter fireside chats in the late 1970s where the entire action plan was "do setbacks at night." That's been the federal education plan ever since. Maybe we can undo it.

Rehley noted that the conversation was veering into commentary. He said the technology to deliver comfort and efficiency exists but will involve some product change. Rehley stated that Christopher Dymond, NEEA, is talking to manufacturers to affect that change. He was confident that we can have both comfort and efficiency, but not with the systems on the market today.

Keeling called first party thermostats a problem as well as commissioning, specifically on the setback issue [Slide 39].

Eckhart asked about the presumed life of a Manufactured Home duct or a duct repair. He acknowledged that the majority of this work is for Single Family but pointed to his work with Manufactured Homes and the CalTF. Eckhart noted big differences in assumptions around duct life for Single Family versus Manufactured Home before asking about RTF assumptions.

- Light: We don't have that.
- Baylon: We use same numbers as a house. Maybe 40 years.
- Eckhart: It wasn't that long ago that the duct life in Northwest was between eight and 20 years with seven years in CA. We had to advocate for longer duct life in CA to make AC measures cost-effective.

Light called it disappointing that [Slide 42] is the path we're going down as it looks like we're giving up on programs trying to do the right thing. She thought the strategy would probably be okay for Heating Zone 1 but would present comfort issues in Heating Zone 2/3 that might lead to people plugging in space heaters.

- Davis: You said the P word: Program. But whose job is it? The problem with getting anything done is that it has to be someone's job. It should take about a day for someone to look at load and ducts and then determine the cost to fix ducts. But why take the day if you don't get paid for it? Who pays for that day? Who does that work? Is there anyone at the utility that can oversee this? Unfortunately, this is where we are. 60-70% of houses in the region still use gas. It's a lot easier to use a dual fuel HP. The installer pockets more profit. Gas kicks in if it's too cold. Problem solved! Except for decarbonization goals. It's not 1978 or 2003 when PTCS was invented and there was money spent on QC. It's 2023, we're going the wrong direction because we don't have or want to spend the money to do it.

- Kelsven: I agree with a lot of what Davis said. We've thrown in the towel on working with contractors. It's been very difficult, and NEEA is also reluctant to go there. If we can get the equipment right, through NEEA, then our job is to go to utilities and tie incentives to sizing. This will take a lot of behavior change. We need to pay someone to do the sizing.
- Bopp: But you also need to avoid incentive to oversize.
- Kelsven: Don't pay for the size, pay for the process of sizing.

Goss partially agreed, saying they were afraid to oversize single speed units, but upsizing isn't an efficiency problem for variable speed equipment. She said removing electric resistance heat without oversizing will lead to cold houses, calling that a problem.

Keeling disagreed with Light's assessment of this as a failure. He called the narrative in the EE community about the behavior of people and contractors the problem. Keeling recognized the difficulty in changing/unchanging behavior but pointed to the technology that removes the need electric resistance.

- Light: We need to look at the temperatures across the region and be smart.
- Widder: We have the technology to remove electric resistance heat in all NW climates.
- Keeling: Yes. It's expensive, but we can work with manufactures to bring cost down. The process is not expensive because there are more materials, it's expensive because people don't do it. Now is the time to do it, rather than hoping contractors get it together. I just had six bids from good contractors, and no one checked my ducts until I asked. Their incentive is for people to be comfortable and happy. Let's meet the market where it is. From a measure perspective, you could have a retrofit. Clip some coils to remove resistance and change the settings.

Baylon voiced agreement with Widder, noting that NEEA and Ecotope reviewed cold climate Heat Pumps in Idaho Falls, ID and Great Falls, MT and found about 7,500 to 8,000 HDD. He noted that these units were DHPs with COPs in 1.5 to 2 range when it was -20°F out. Baylon called that about as cold as we get in this region.

- Light: MT hit -40°F last year. It's rare, but it happens.
- Baylon: -40°F is pushing it, but heat pumps work just fine in -20°F. Minnesota has cold snaps from -30 to -35°F, and it's OK.

Douglass encouraged the body to continue looking at the data and the real performance HEMS. He pointed to an eye-opening regional study that looked at systems with appropriate lockouts. Douglass said HEMS shows a very different story with less lockouts, again stressing the need to look at real data.

Eckhart referenced the strategy of telling customers to keep their hands off the thermostat. He said WA state's new construction policy puts a high priority on HPs, noting that manufacturers of variable speed HPs don't want users playing with setback.

Rehley called behavior change tough—unless it aligns with making money. He said there's no reason we can't have comfort and efficiency, pointing to layers of policy at play. He speculated

that we could have a HP that works at -40°F, but low GWP requirements will make it very difficult. Rehley said we now know that we've been using the wrong HSPF and SEER metric. He reports that manufacturers are learning and making improvements, stressing that there's lots going on and we need to stay closely connected to this topic.

- Sam Rosenberg, PNNL: I have 50+ active field sites in cold climates. We're don't yet have a HP-only application for under -20°F, including prototype models. It's a sizing/install/QA/QC issue. I'm concerned about moving away from electric resistance as it moves us back to fossil fuels. This is a QA/QC install quality issue. I hope that is the direction we move in.

MOTION

I, Josh Keeling, move that the RTF extend the sunset date to September 30th, 2024, for the SF and MH ASHP Conversions UES.

Baylon seconded.

Kelsven asked if this can be done by September, wondering why it is not pushed out longer.

- Thomas: If we push this out further, programs won't get it in for 2025. I think it's important to get this done early.
- Light: This is more important than some of the other measures in our suite. It makes sense to prioritize it.

Baylon stated that in WA, almost everyone is pushing to either replace gas or supplement it significantly. He said new code is coming, but the Department of Commerce isn't going to do this. He said need to do it, and fast!

- Widder: I agree with considering this sooner rather than later. We need to make progress and keep going. We should do the best we can now and revisit it again in a couple of years.

Kelsven asked about a cold climate measure.

- Bopp: That's part of our considerations.

Nick O'Neil, Energy 350, asked to change this to "under review" because of the uncertainty in the data.

- Light: Half of the measure is already "under review."

AMENDMENT

O'Neil asked to change the full measure to "under review."

- There were no objections.
- [Change the Full Measure to "Under Review"] was added.

Vote on the motion. The motion carries. (25 yes, 0 no, 0 abstain)

LUNCH

Joke of the Day:

Christian Douglass, Northwest Power and Conservation Council presented the following:
I opened my electric bill and water bill at the same time.

- It was a real shock!

Update: REEDR Calibration

Christian Douglass, Northwest Power and Conservation Council, [Presentation](#)

Staff presented results of a project that compared REEDR-created EnergyPlus models to circuit-level meter data from the Home Energy Metering Study. The RTF asked clarifying questions and provided comments about areas to consider in understanding the data or results.

Kelsven asked about the AMY, wondering if weather stations or site outdoor air sensors were used [Slide 14].

- Douglass: We used the nearest NOAA stations for automation purposes. Before that we compared the actual outdoor temps to NOAA data, and they compared very well. Also, there were a lot of challenges with HEMS temperature sensors with lots of data gaps.

Hilbruner asked if the HEMS data includes number of occupants, via chat.

- Douglass: No. We have that in RBSA II, but it's from several years before the homes were metered. It might not be right for some homes.

Baylon stated he is in the HEMS data but cannot access RBSA II [Slide 16]. He noted that the audit was done using the RBSA II protocol, asking if there is access to that data.

- Douglass: Not until RBSA III is released.
- Baylon: That's pretty unfortunate.
- Douglass: At this time, we only have RBSA II homes. At some point, we'll have the opportunity to bring in the RBSA III HEMS homes.
- Light: We'll make sure to look at your heat pump.

Keeling questioned the lack of fit on [Slide 23] asking if the greater source of mismatch is cross sectional or time series. He wondered if the times looked weird.

- Douglass: The timing typically looks good. It's more about magnitude. There are cases of seasonal home use. Most HVAC use looks very weather driven but the magnitude is off.
- Keeling: That's probably very true for central systems. Maybe not for zonal homes. I get nervous about using these results for DR/load shapes because of the weirdness.

Kelsven asked how much HEMS is training the model [Slide 25.]

- Douglass: We use some HEMS data as inputs, but then we compare the EnergyPlus results against HEMS.
- Baylon: This question is what we can get out of EnergyPlus for heat pumps, especially variable speed. The original curves in EnergyPlus are single speed. That won't cut it. Would we have an intervention problem if we start to use a more variable HP?

- Douglass: Most of the HEMS are single speed. Single speed curves are more robust in EnergyPlus, but there are some variable speed curves. They are probably based mostly on lab data. This could be improved over time.
- Baylon: Is that in EnergyPlus?
- Douglass: Yes. They're typically modelled as discrete speeds. But performance curve four is sufficient for modeling variable speed.
- Baylon: The federal standard doesn't handle this.

Keeling suggested looking at a few homes where you suspect the model could be getting it wrong as a test. He called this different than statistical modeling, adding that external validity is really important. He thought focusing on weird conditions and testing how well we get them would be important, calling it a stress test against other extreme conditions that might come up. Keeling called this more important than central tendency for all peak measures.

- Widder: I think this is all really important. To Keeling's point, one of the initial marching orders in developing REEDR was to maintain the HP modeling capabilities. I think we're good there. The discussion now is around how fine to calibrate the models and what amount of diversity we want to represent, based on use cases we're planning for. I kept saying in subcommittee that we got to a place where we could recreate billing data, but you don't know if you're doing right. Depending on what we want to do with the models, we don't need to guess or dig. Stop digging until we know what we're digging for.

Baylon asked the climate zone for the homes on [Slide 26].

- Douglass: I didn't separate by climate zone because the sample size didn't support that.
- Eckhart: This is an excellent slide and much appreciated. It reflects commercial buildings trends I've seen. Do you have data for more than three years to further show the trendline?
- Douglass: No, this is not a trend per se. It's single home data, organized from highest to lowest user.
- Eckhart: The trend is clear. Cooling load is having an impact.

Light asked for confirmation that this is just AC and does not include EVs or anything else.

- Douglass: Yes.
- Geraghty: What is the breakdown of the sites. Is it two thirds Zone 1?
- Douglass: I'm not sure. These are cooling zones. But geographically, I think we know where these sites are.

Keeling asked if [Slide 33] shows all fully occupied homes, wondering if there could be some seasonal occupancy.

- Douglass: Yes, and you can see that in the data. Also, a lot of this was during the pandemic, so you see some odd things. We see seasonal effects. We don't know what caused them, though.

Goss asked if NEEA exclude vacation homes.

- Douglass: I don't know.

Jerome thought it would be difficult to have 6,000 kWh savings with the usage on [Slide 38].

- Douglass: Yes.

Keeling asked if anyone looked at hours outside of the setpoint change to get at actual lockout temperature versus recovery [Slide 39]. He said plotting OAT versus usage shows it coming on earlier, but removing the morning ramp hours might show the actual lockout temperature more clearly.

- Douglass: If there's a lockout, it should be locked out.
- Keeling: I'm trying to separate the two issues. There can be an override on the lockout when there's a big jump in temperature required.
- Douglass: That's probably right. It's not modeled that way.
- Jerome: Most conventional and older thermostats have hard lockouts. Who knows with Nest and others, though.

Davis did not know how reliable lockout is if Honeywell can't make the 3°F per hour. He said we do know that Honeywell's adaptive recovery would cheat by bringing on backup heat. We don't know how the thermostats handle this.

- Keeling: Nest, Ecobee, and Daikin all go into resistance if they can't hit the setpoint fast enough. It would be good to isolate that effect from the lockout temperature.
- Kelsven: Evergreen Economics, our HEMS contractor, is going to do a HP analysis. I'll let them know. Let me know if you have other curiosities about the HEMS data, we can look at.
- Jerome: Thermostats that have that type of algorithm are hard. It's hard to identify if someone opened a window or the home isn't well insulated.
- Rehley: Nest, it's not consistent. It evolves the use of electric resistance over time. That would be tough to model.

Baylon stressed that DHPs have always been a displacement play [Slide 45] adding that there are other heating sources there.

Kelsven asked if you can model the number of heads, or the percentage of load met by the DHP [Slide 49.]

- Douglass: I added a feature to REEDR—called Pseudozonilization—to limit the percent of the load that the DHP can take.

Keeling pointed to two issues: Input error as you don't know how big inputs like the wood stove is and Control saying a DHP a remote control is used differently. He thought it would be good to know what the problem is adding that a behavioral problem is different than burning garbage in their living room (i.e., wood stove).

- Goss: Does the model consider the size of the DHP?
- Douglass: Yes, I use the sizing from RBSA. I am modeling these as variable speed HPs. There are about four speeds, each with about six performance curves.

Kelsven cautioned the room to be skeptical of sensors battery life [Slide 51] saying they died sooner than expected. He then asked why sensors were not reliable enough to answer questions about wood stoves.

- Rushton: We didn't know exactly where the sensor was placed in relationship to the stove. Sometimes that data didn't make sense.
- Kelsven: That might help explain the DHP anomalies. We're actually underbudget on end-use metering, so we're going to use the money for analysis. We have an open proposal request.

Goss noticed that the ER baseboard numbers look very low in the latest HEMS report. She wondered if that is all heaters, or maybe interacting with the DHPs?

- Douglass: It could be.
- Kelsven: I don't know how circuits are mapped to baseboards.
- Douglass: Rushton did look at what appears to be heating on miscellaneous circuits.

Keeling thought that a 24 x 365 heat map would be helpful for visualizing a full year data [Slide 52.] He added that load research people are using this.

- Douglass: REEDR is 100% Python. We can generate those pretty easily.
- Bopp: REEDR is open source.
- Douglass: Right. It's on GitHub. It's fully open source.

Light reminded the room that this whole project came from looking at which path to go down for a residential model. She said we were getting ready to move forward on a path and Douglass tried out some things on the side that met a lot of our needs. Light voiced appreciation for the time that Douglass and Logan Douglass, Ptarmigan Research, spent on that. She predicted finding a lot of use for the product and praised the level of detail on the slides, using blue for cooling, red for heating, and purple for both, calling it great.

Light then presented the joke sent in by Rehley: Why did the efficient transformer go to the gym?

- To step up its game.

BREAK

Exploration of Central Heat Pump Water Heaters

Adam Hadley, Hadley Energy Engineering, [Presentation](#)

Hadley Energy Engineering presented a preview of the work toward developing a new Central Heat Pump Water Heaters measure for the RTF. The RTF provided feedback on product configuration, strategies to cut the long ROI period, the need for discussion around what the spec should look like, and an initial look at delivery verification guidance.

Baylon noted that this was first presented to the RTF in 2009 by Jack Callahan, BPA.

- Light: It takes a long time for some of these things.

Baylon said the first bullet on [Slide 4] is incorrect. He said the work was not done by Ecotope and NEEA but Ecotope and BPA. Baylon said that BPA supported this from 2008 through to at least 2016, while NEEA is just now getting to it in the last five years.

- Hadley: Noted. NEEA has the spec being developed.

Jerome stated that the swing tank keeps the primary tank from sending warmer water back to the heat pump, resulting in higher efficiency [Slide 7]. He recalled working with CO2 residential systems and learned very quickly that warm return water ruins efficiency and reduces a big chunk of capacity. Jerome thought that drain water recovery is not a great idea in that situation, but probably OK here.

Baylon pointed to lots of discussion around what swing tank is, agreeing that one is what you have here. He said this also applies to other refrigerants besides CO2 with high temperature output. Baylon noted that electric resistance in the return loop as strip heat is an option on the plumbing. He said this strategy looked pretty good when tested and better than this.

- Hadley: Right. There are lots of configurations and options. I focused on the swing tank because it's the one that's there now.

Eckhart asked if any developers are putting CO2 HPs in new construction.

- Hadley: Yes.
- Eckhart: In the Puget Sound we're finding more inverter units, not CO2.
- Baylon: You get COPs of 4 in this configuration if it's done right.
- Eckhart: I understand. But the cost is very high.

Widder noted that Hadley used a CO2 HP here, adding that it's not specific to NEEA's spec. She said the measure could be refrigerant neutral, but the savings might depend on the technology.

White said he's had a big problem with HPWH including the fact that the fresh water is circulated offsite, and the stratification of the tank is destroyed by having the fluid pulled from inside tank to outside.

- Hadley: Putting primary tanks in a series can help with that.

Jamie Anthony, BPA, mentioned talking to Erik Boyer, BPA, about sizing and working with Ecotope as well [Slide 8]. He called the results a bit too expensive, with a payback period of eight years or so. He asked about sizing a bit smaller, maybe to meet 80% of the load, to capture a lot of the energy savings with a lower payback period.

- Hadley: Thanks. I've heard that before and it's a clear indication that this isn't ready to be a measure yet. We need to decide on that.
- Baylon: Developers in Seattle are doing this because it changes their LEED rating, which is worth way more than the cost of getting the rating. That's why it's happening in Seattle and nowhere else.

Widder agree that there are lots of options and not all have equal potential in the region [Slide 10]. She thought that at least one or two of these might be addressed by our commercial unitary measure and suggested considering overlap with that measure and the residential HPWH in commercial applications.

- Thomas: Those are both sunseting next year. We'll consider all of them around the same time.
- Widder: Great. Also, it sounds like systems without recirculation would be less complicated with less uncertainty in savings. You're talking through the most complicated situations.
- Baylon: Small apartment buildings, with like 12 units, could get away without recirculation.

Geoff Wickes, NEEA, addressed the spec saying we don't care how you do it, but we need to know the system COP. Wickes stressed that NEEA doesn't care about the layout or the refrigerant, but does care about the methodology of determining the system COP. He called this the important thing at the end of the day.

Baylon said this has been developed for systems of 50 to 500 units because the recirculation loop is key to the design [Slide 16]. He said in smaller buildings, recirculation is not as big of an issue. Baylon said in those cases, you have more flexibility in what kind of heat pump you use.

- Hadley: Yes, that's right. We need more specificity to develop the measure. We can change the five or more units part of the spec.
- Baylon: I think we'd be better off with bigger Multi-family buildings and lodging.
- Hadley: That sounds good. We could use more discussion on what the spec should be.
- Baylon: WA state may no longer require a HPWH. Although it's a relatively low-cost option to meet code.

Widder explored some of interest in using kWh per ton, saying savings scale decently, even if the HP doesn't cover the full load. She said replacing a COP of 1 with a COP of something else scales linearly and called for more exploration of that in research and maybe modeling. Widder thought that having an option to meet less than 100% of load offers more flexibility for the measure.

Widder then mentioned outreach to distributors that confirmed that cost is a big deal. She thought the measure would have more traction if we allowed capital sensitive options, adding that covering a majority of the load or even some of the load is better than none.

- Hadley: My knee jerk reaction to this is our experience with residential HPs. The more we plan to rely on electric resistance, the most likely we are to rely on it too much.
- Widder: All of the products on the market have an electric resistance element. Controlling it is key.

Keeling stressed the importance of how the storage reservoir is used.

- Widder: And an element of sizing for DR.

- Keeling: There are also capacity considerations in new construction. They're paying demand charges. Plus, when you move to central systems in Multi-family, you get weird billing and rate issues. How is that captured from the developer's perspective?
- Widder: This only happens in new construction. No one is retrofitting an existing Multi-family to a central WH.
- Keeling: Right. But who pays for the hot water? Also, the capacity/demand is important.

Baylon agreed that this technology is expensive, risky, and new, but still believed that there are a lot of solutions that would meet 100% of the load. He thought the RTF should probably insist on that. Baylon speculated doing half the load and then wondered what would happen to the other half.

Eckhart discussed "except in WA...part of the load..." on the baseline bullet, saying he's seen this interpreted multiple ways.

- Hadley: We're just talking about central WH plants. The building's entire load doesn't have to be covered by the HPWH.

Light said they will discuss most of [Slide 17] in subcommittee.

- Geraghty: When you say no resistance heat, do you mean not in the primary tank, or not in the swing tank?
- Hadley: Yes.
- Baylon: I think "confirm at least 1" should say "confirm at least 2".
- Hadley: Sure. We can consider that.

Widder said that, even with the scaled capacity, we want savings estimates representative of the system being installed. She said we also want systems that maximize efficiency as much as possible, admitting that this group also needs to balance that against cost and size constraints. She called for simple delivery verification so we can lean more heavily on NEEA's QPL.

- Light: One thing to keep in mind, the RTF spec may include more than the NEEA spec. We might not rely solely on their spec but add in other details for reliability. We'll work through that with the subcommittee.
- Wickes: We would love to know what the spec is missing. That would make it simpler for everyone.
- Hadley: We're planning to rely 100% on the NEEA spec. We have extra things, though, that help define how you get this to a UES. I think we've communicated this to Ecotope.
- Wickes: Yes, that's right.

Baylon stated that the 12% on [Slide 19] is more like 3%.

- Widder: Cost is as uncertain as savings because of configuration variability. We got estimates from many manufacturers with different system types.
- Light: We could have different identifiers for cost drivers.

Douglass stated that the cost requires knowing the base case cost as well [Slide 21.] He admitted that even those are hard to find.

- Widder: That’s an important part of the discussion. One challenge with the theoretical base case of an owner selecting an electric resistance central system is it doesn’t exist. We only have costs for gas central systems.
- Keeling: Wouldn’t the alternative be individual electric resistance water heaters?
- Widder: I don’t think that’s the right baseline for this measure.
- Douglass: If you look at RBSA, you see a lot of Multi-family central resistance water heating. It’s out there.
- Widder: I’ll follow up. I looked at RBSA/CBSA and reached a different conclusion.

Light looked forward to more discussion on this issue. She thanked the room for a good, productive year and hoped for more in-person meetings in 2024. She recognized the CAT and CAT adjacent analysts for their thoughtful, thorough work. Light then acknowledged Thomas’ one-year anniversary as RTF Manager and praised her hard work. Light ended the meeting at 3:45pm.

Voting Record: December 5, 2023

Motion Language	Yea	Nea	Abs	Motion Passes?	Percent of Yea Votes		Number of Voting Members Present
					RTF Voting Members (40% min)	Members Voting (60% min)	
Motion: Approve the minutes from the November 7 meeting (Kelsven/Owens)	26	0	0	Yes	87%	100%	26
Motion: Approve the Agenda for December 5 meeting as posted (Miller/Jones)	26	0	0	Yes	87%	100%	26
Motion: Approve updates to Circulator Pumps UES measure as presented and: -Keep the Category at Planning -Keep the status at Active -Set the sunset date to December 31, 2026 (Miller/Widder)	23	0	1	Yes	77%	100%	24
Motion: Extend the sunset date to September 30, 2024 for Single Family and Manufactured Homes Air Source Heat Pump Conversions and Upgrades UES measures and change the full measure status to "Under Review" (Keeling/Baylon)	25	0	0	Yes	83%	100%	25

December 5, 2023, Meeting Attendance

* Designates Voting Member

Name	Affiliation
Jamie Anthony*	BPA
Rich Arneson	Tacoma Power
Clifford Babson	Energy Solutions
Kathryn Bae	NEEA
David Baylon*	Independent
Rebecca Blanton*	Independent
David Bopp	RTF Contract Analyst
Greg Brown	RTF Contract Analyst
Robert Burns	Pivotal Energy Solutions
Carmen Cejudo	PNNL
Jeff Cropp	Cadmus Group
Bob Davis*	Ecotope
Christian Douglass	Northwest Power and Conservation Council
Logan Douglass	Ptarmigan Consulting
Tom Eckhart	UCONS
Ryan Firestone	RTF Contract Analyst
Trevor Frick	Clark PUD
Kevin Geraghty*	independent
Jackie Goss*	Energy Trust of Oregon
Adam Hadley	Hadley Energy Engineering
Anna Hilbruner	Elise Solutions
Jonathan Heller	Ecotope
Aaron Ingle	NEEA
Mattias Jarvegren	Clallam PUD
Mark Jerome*	CLEAResult
Mitt Jones*	Cadmus Group
Josh Keeling*	Utility API
Phillip Kelsven*	BPA
Steven Klass	Pivotal Energy
Rick Knori*	Lower Valley Electric
Mark Lenssen*	Puget Sound Energy
Jennifer Light*	RTF Chair
Ben Mabee	BPA
Seth McKinney	Ecotope
Eric Miller*	Independent
Eric Mullendore*	BPA
Andi Nix	Energy Trust of Oregon

Alex Novie*	Energy Trust of Oregon
Nick O'Neil*	Energy 350
Brian Owens*	CLEAResult
Andrew Paul*	Avista Corp
Joe Prijyanonda	Applied Energy Group
Laney Ralph*	NW Natural
Mark Rehley*	NEEA
Samuel Rosenberg*	PNNL
Tim Runyan	NEEA
Josh Rushton	RTF Contract Analyst
Aven Satre-Meloy	Lawrence Berkeley National Laboratory
Peter Schaffer*	PacifiCorp
Justin Sharp	Sharply Focused
Blake Shelide*	ODOE
Andrew Shepard	Energy Trust of Oregon
Steve Simmons	NWPCC
Paul Sklar	RTF Contract Analyst
Kevin Smit	NWPCC
Kenji Spielman	Energy Trust of Oregon
Scott Spielman	Ecotope
Christina Steinhoff	NEEA
Laura Thomas	RTF Manager
Michelle Wildie	Puget Sound Energy
Jim White*	Chelan County PUD
Geoff Wickes	NEEA
Sarah Widder*	Cadeo Group
Jake Wise	PGE
Kathy Yi*	Idaho Power