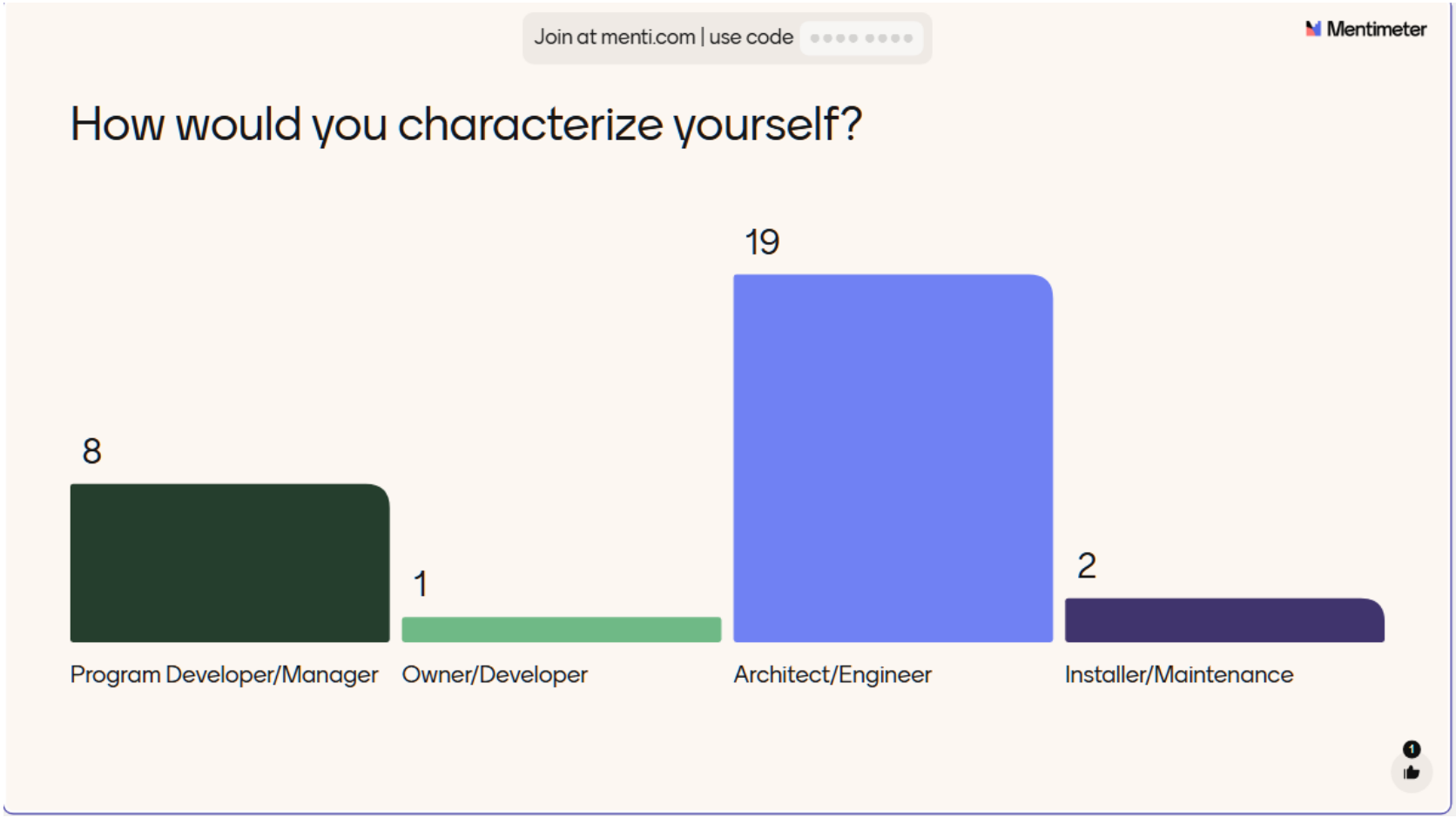
Quick Audience Info Poll
- while you wait -

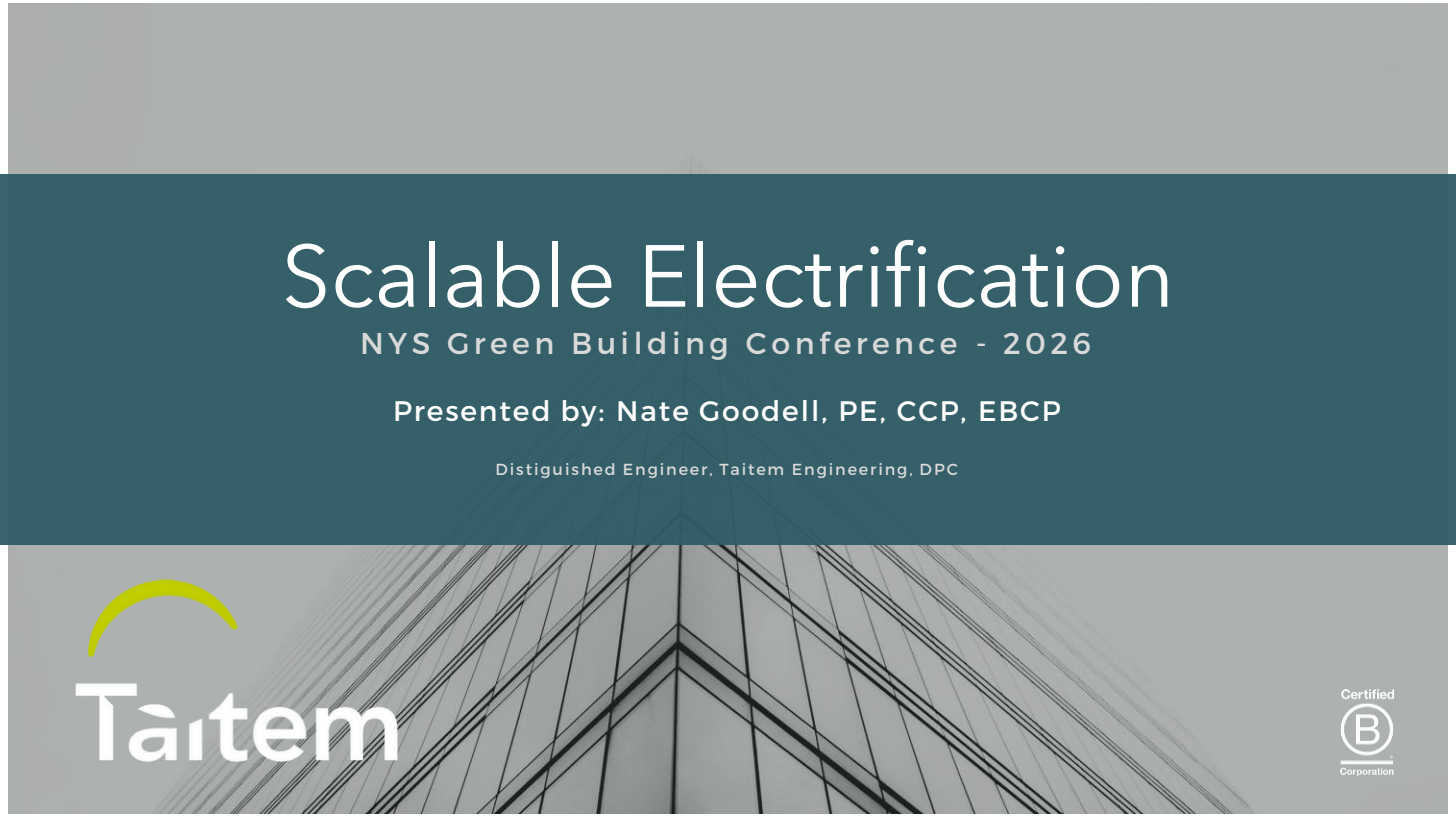


Scalable Electrification

NYS Green Building Conference - 2026

Presented by: Nate Goodell, PE, CCP, EBCP

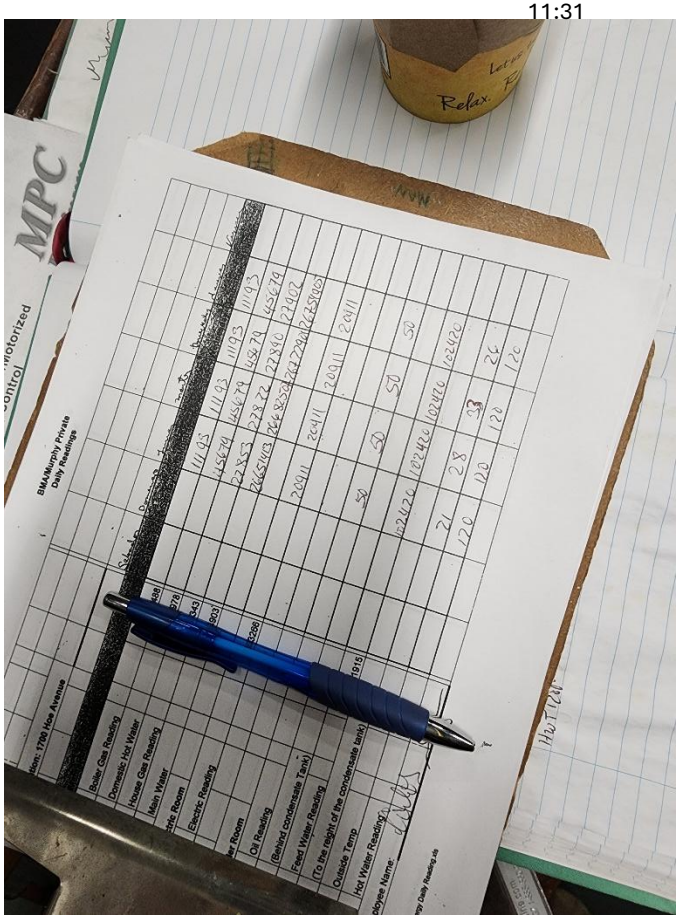
Distiguished Engineer, Taitem Engineering, DPC



Disclaimer:

- I went into this with too much content – Not going to be able to cover everything I wanted.
- Going to have to make some tough choices

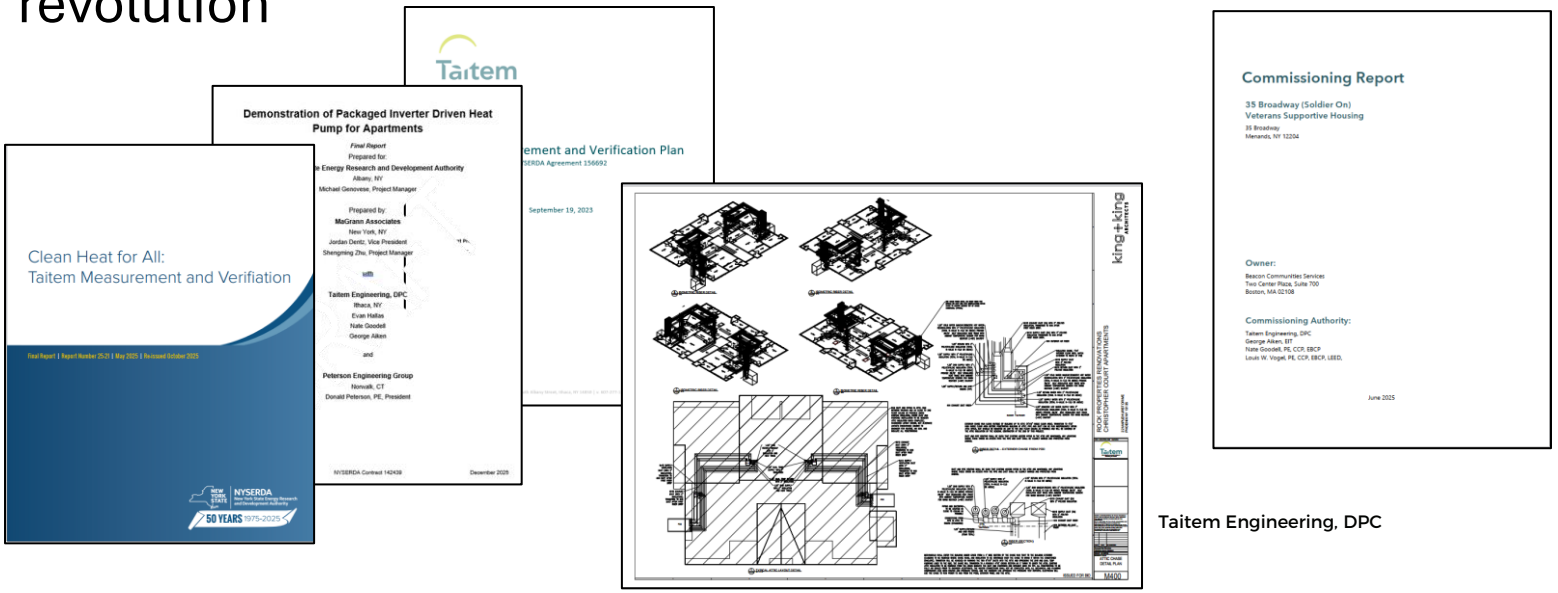
- Tried to ensure there was more material in slides so attendees can revisit and dig further into areas of interest



Background

11:32

- Taitem has been involved in a series of projects monitoring and demonstrating new electrification technologies
- Many of these share similar goals or attempt to address similar market gaps, which seem like universal challenges
- Several of these technologies appear to be successfully addressing their targeted issues, and we appear to be at the early stages of a practical, scalable, electrification revolution



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Objectives

11:33

- Define the problem
- Share knowledge about these solutions
- Gain knowledge about new solutions and approaches

Structure

11:33

- Introduction
  - Background/Goals
  - Structure (you are here!)
  - Establish common basis of understanding
    - What is scalable electrification?
- Define the Problem
    - Define the problem
    - What does a solution(s) look like?
- Solutions
  - VRF, PWHP, Pod DHW, Room HPs, Central HP hot water, Other HP DHW Solutions
- Review
  - What did we miss?
  - Do these systems meet the needs?
- Closing Thoughts

What is Scalable Electrification

Lets make this interactive

11:34

Lets make this interactive

11:34

How do you define Electrification?

Lets make this interactive

11:34

How do you define Scalable?

Lets make this interactive

11:34

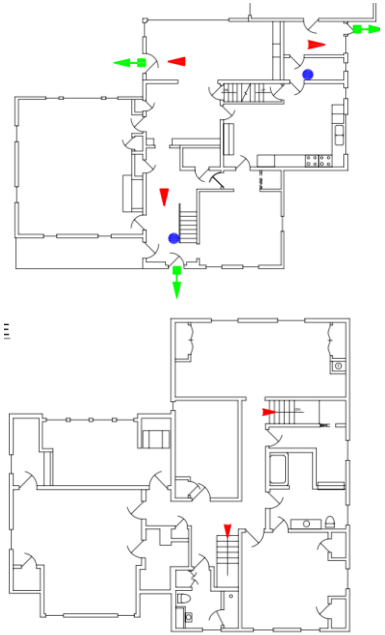
To Me: Scalable Electrification

11:37

- Solutions that:
  - Effectively reduce or eliminate non-electric energy loads (focus on HVAC)
  - Applicable to New Construction and Existing Buildings
  - Can be implemented on:
    - Entire portfolios
    - Whole buildings
    - Parts of buildings
    - Individual apartments
- Competitive with non-electric alternatives! Some combination of:
  - Cost effective (first cost and lifetime)
  - Minimally disruptive installation
  - No or minimal infrastructure upgrades
  - Reliable with minimal (if any) additional maintenance needs
  - Occupants like them

Define The Problem

Why does this matter?



Your turn: What are our challenges?

11:39

Can we group these challenges?

11:41

Time

Money

Impact on Occupants

Reliability

Can we group these challenges?

11:42

- Time
  - Buildings need a new system when their existing system fails - path of least resistance is 1-for-1 replacement.
  - New elect. systems not always locally available
- Cost
  - Electrification is hard, often requires infrastructure upgrades to complete
  - Existing building infrastructure can usually be repaired at lower first cost than a comprehensive upgrade
- Impact on Occupants
  - Getting into apartments to work (especially for infrastructure upgrades) is difficult and disruptive
  - At best new systems different, worst will have some initial install/design issues to uncover and resolve.
- Reliability
  - Building maintenance/service staff are not familiar with new electric solutions
  - New systems have relatively unproven/unknown performance, longevity, limitations and design needs

Challenges: Time

11:42

Programs	Owners	Designers	Contractors
Time: • Short window of opportunity • Need broad public awareness • Programs must be streamlined enough to be worth participation • Rapidly evolving market – some sort of standard needed with continuous maintenance?	Time • Short window of opportunity • Damage to reputation, relationships, building from any delays • Infrastructure or need to rely on other parties adds significant risk • Rapidly evolving market – can't just stick with 'big name'	Time • Owners need solutions ASAP • Limited time to vet complex new products • Rapidly evolving market – how to keep current and also suitably vet products that look great on paper?	Time • Construction delays due to limited availability of novel products • New systems with limited time to gain experience.

Challenges: Money

11:42

Programs	Owners	Designers	Contractors
Money • Program solutions must be broadly cost effective	Money • Feasible first costs – how do you finance or spread out initial cost • Long term at least as cost-effective as existing systems were • Include hidden costs of staff training, different maintenance needs, stocking alternate replacement items, etc.	Money • Design costs for new and potentially complex systems higher than 1-for-1 alternatives	Money • Installation costs for novel systems higher (staff training, higher contingency) • Different systems, different skills, tools, parts needed for maintenance

Challenges: Occupants

11:42

Programs	Owners	Designers	Contractors
Impact on Occupants • Ensure systems are meeting claimed performance metrics • Discourage systems that trigger common complaints (noise, uneven or uncomfortable air temperatures, hard to use controls, etc.)	Impact on Occupants • Minimize disruption to building and occupants during install • Ensure occupants are at least as satisfied with system operation and performance as with previous • Avoid un-aesthetic options that will negatively impact property value	Impact on Occupants • Provide implementable design with minimal in-apartment activities (ideally avoid needing to temporarily displace any occupants for install) • Avoid potential concerns with cold weather operation or undersized systems	Impact on Occupants • Avoid in-apartment work as much as possible • Condense construction schedule to avoid multiple trips to apartments (1-day in and out) • No customer complaints

Challenges: Reliability

11:42

Programs	Owners	Designers	Contractors
Reliability • Need to know effective life for ROI • Can't be incentivizing products that get a reputation for not working • Need to know there will be manufacturer support for products	Reliability • Need to know what to expect for financial and maintenance planning • Need to have a reasonably reliable system to avoid costs and reputation damage • Need to have plan for shift in training/approach for planned maintenance	Reliability • Need to ensure proposed systems meet minimum level of reliability as professional responsibility (and potential legal liability in the event of major or frequent failures the prevent system from achieving design needs)	Reliability • Staff can quickly learn basic maintenance • Can't increase demands (time/ resources) on maintenance staff • Can be serviced by local partners • Any failures must be quickly repairable/ recoverable with limited onsite spares and locally available parts

Solutions

VRF Heat Pump: Current ‘typical’ electrification solution

11:43

- Chosen because
  - You can put in long refrigerant runs,
  - It’s a relatively known technology,
  - Engineers can farm out the specific design needs
  - Reputation as efficient electrification solution

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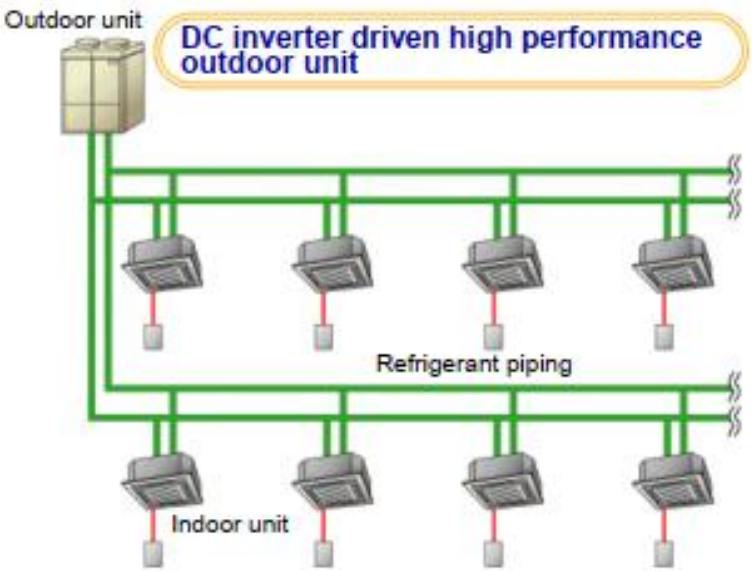
What does it look like

11:43



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Assessment

11:43

- Lots of systems installed, experienced techs and installers pretty available
- Need apartment access to install, maintain
- Typically need infrastructure upgrades to the electrical (loads shifted from gas to electric, typically on the house meter)
- Large scale one-and-done type project, can't roll out in stages
- Some known performance issue with incorrect sizing of systems
- Still a shocking number of issues with VRF systems, for what we now consider an 'established' technology
- Some comfort concerns when done without envelope measures

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Cost: NYCHA report and Cadmus study: $33,000-$38,000/apartment (may include new electrical, etc.)(https://be-exchange.org/wp-content/uploads/2025/01/20250116_CleanHeat_Slides-UPDATED.pdf)
Comparable cost: NREL Assessment by Cycle: ~$26,000/apartment for boiler replacement

VRF System – Interesting Findings:

11:44

Low Load Performance (SWA Study)

That's COP!

Never even getting to 50% design capacity

Source: NESEA BuildEnergy Boston 3/20/2024, Monitored VRF Performance in New Multifamily Buildings – Dylan Martello, Shari Rauls (Steven Winter Associates)

Common Issues – VRF Systems

11:44

Most prevalent Issues?

- REFRIGERANT LEAKS
- System Sizing
- Controls and thermostat issues

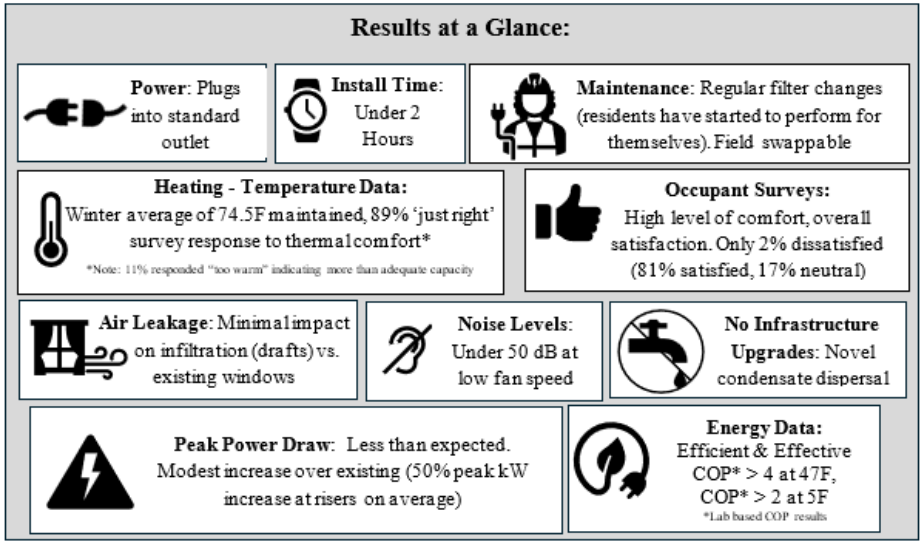
PWHP: New Type of Room Heat Pump

11:45

Genisis story:

- NYCHA was looking for a product to meet a specific set of needs.
- Couldn't find product that met those needs, so – leveraged buying power to drive the market to make what they needed

- AND IT WORKED!!!
- Results so far are super promising:



What does it look like?

11:45

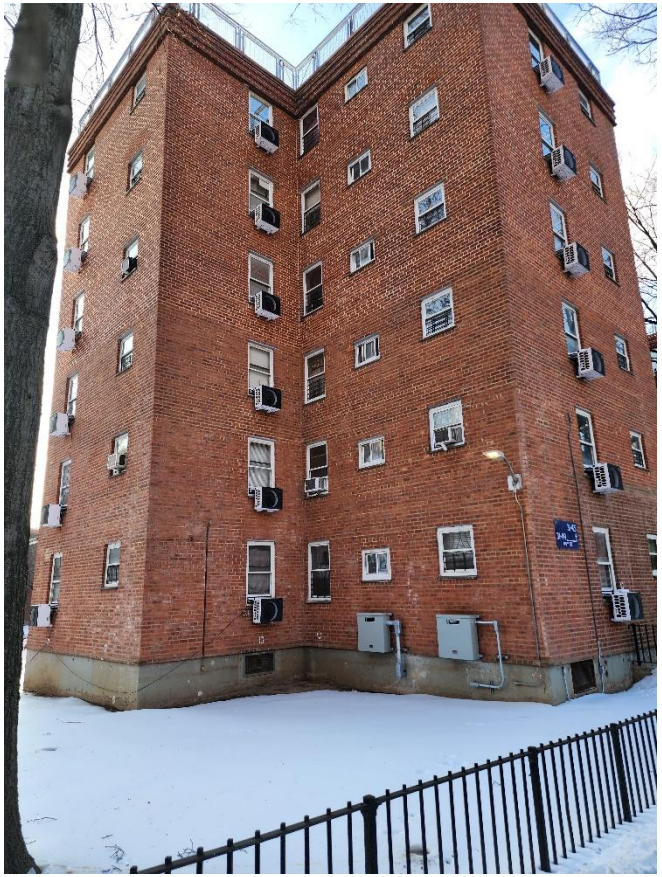
Also referred to as saddle bag style HPs, outdoor unit sites on a cradle outside the window, a thin bridge runs through a gap at the bottom of the window and connects to the indoor portion of the system, which hangs down under the window.




Example installation images from CH4A demonstration of Gradient and Midea systems

PWHP: Additional details

11:46



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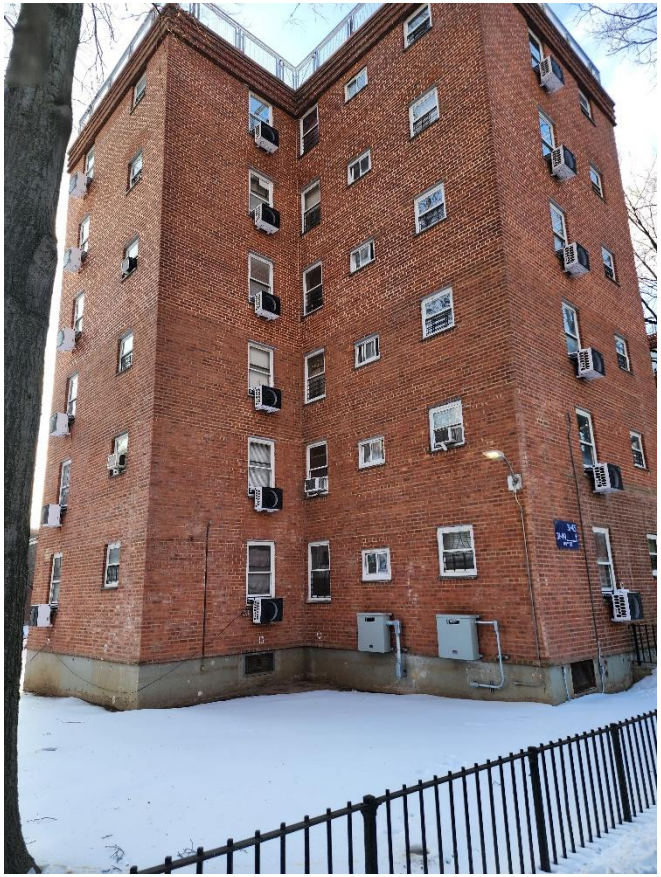
PWHP: Additional details

11:46

- Can retrofit on an apartment-by-apartment basis, installed in hours
- Often build on existing AC outlets -existing electric infrastructure has a good chance of supporting them (especially if watching the peak loads during phased roll-out)
  - Potential solutions if peak loads exceed existing capacity (battery storage, software based limiting)
- If phased, upgrade costs can be spread out. If locally stocked, plug and play, so systems can be purchased and installed on short notice to address partial failures of existing systems, etc.
- Very positive feedback on improved zone level controls, comfort, ease of use for PWHPs,
- Swappable units – Faulting units can be hot swapped, resulting in more repair/service options.



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Assessment

11:47

Cost: NREL Assessment by Cycle: $8,000-$33,000/apartment (may include new electrical circuits, demo of existing, etc.)
Comparable cost: ~$26,000/apartment for boiler replacement

Assessment

11:47

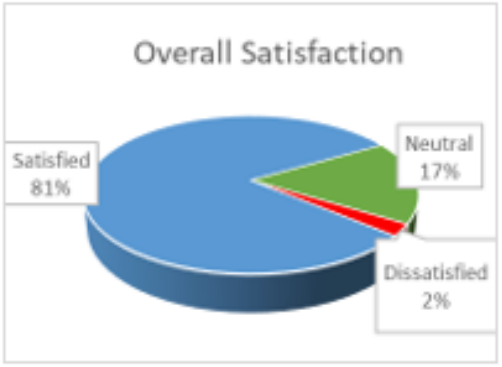
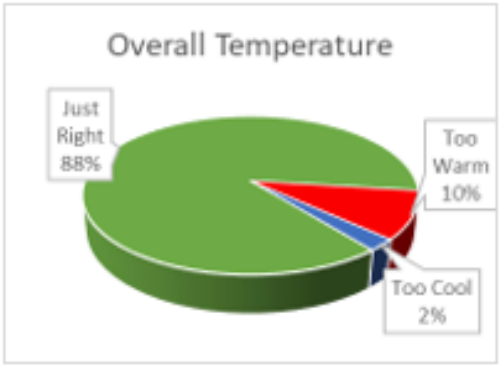
- Still need apartment access (but not much)
- May not work in all buildings - only installable in rooms with exterior access, may need certain size windows or PTAC openings.
- Some projects will still need infrastructure upgrades to the electrical
- Concerns about shifting heating costs from building to apartment
- Still relatively new technology, so limited longevity and real-world experience in non-standard applications
- Code and design standards still catching up with this type of system – some ambiguity over permanent vs. plug-in device, appliance vs. HVAC equipment, etc.
- May only be addressing part of the problem - no ventilation fix, no integrated DHW solution, no envelope upgrades…

Cost: NREL Assessment by Cycle: $8,000-$33,000/apartment (may include new electrical circuits, demo of existing, etc.)
Comparable cost: ~$26,000/apartment for boiler replacement

PWHP – Interesting Findings? 11:48

Very high satisfaction ratings from occupants

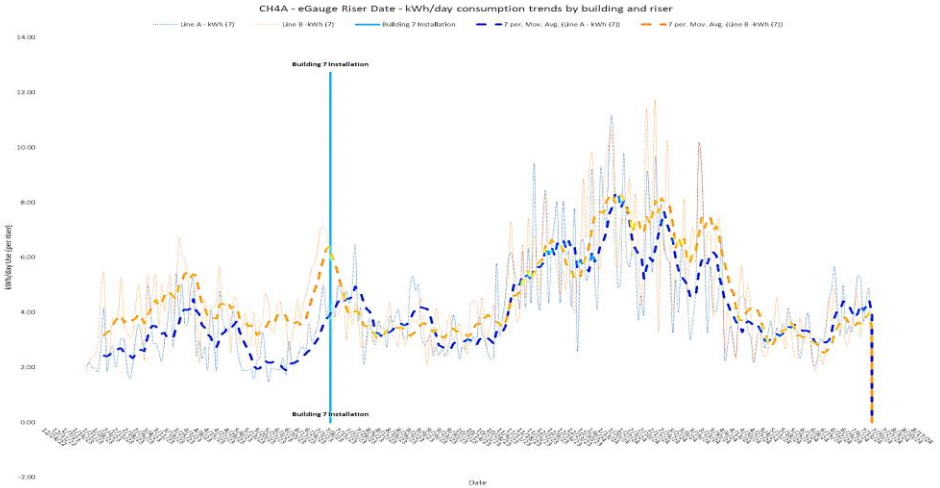
Figure 14: CH4A Overall Survey Summary

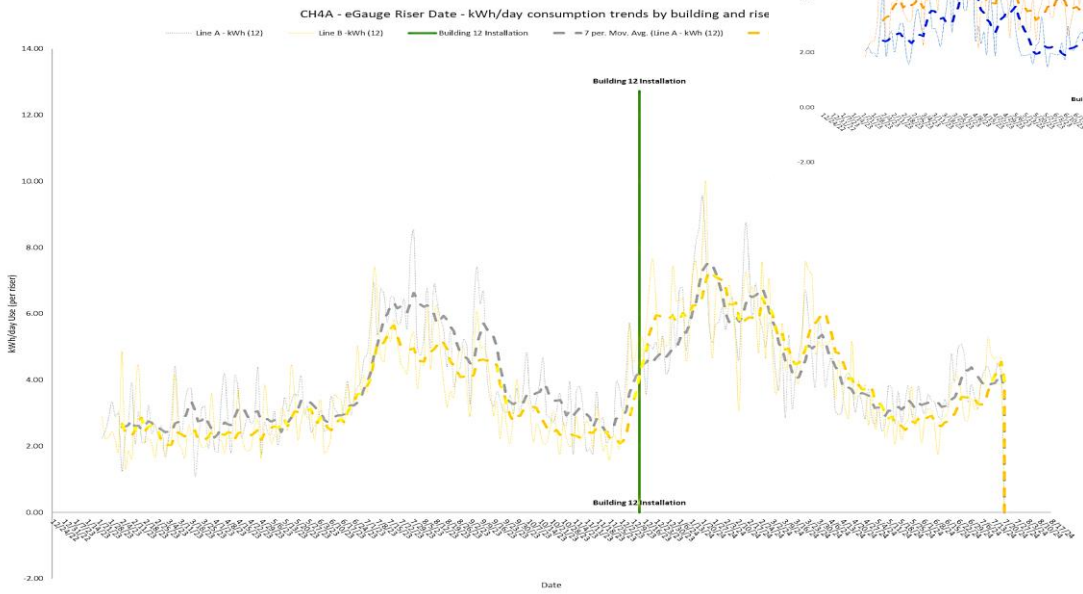
	Overall satisfaction responses were extremely high. The one dissatisfied response was received during the cooling season and was a result of equipment issues that were identified and corrected in the production models.
	Temperature responses are similarly favorable. It is worth noting that only one of the four "too warm" responses was received during cooling, and that the other 3 were received during the heating season. Similarly the one too cool response that was received was collected for the cooling season – indicating that if anything the main issue with these systems is oversizing.

PWHP – Interesting Findings

11:49

Difficult to identify installation date from electrical data (impressive!)





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Common Issues – PWHP

11:50

Common Issues – PWHP

11:50

- Some maintenance needed on filters (air and water side)
- Concerns noted for systems that might be installed at a tilt or not level (water leaking from condensate pans)
- Some reports of sounds when the condensate pump cycles.

Most prevalent Issues?

- Installation! If reasonable care is not taken when sealing the window opening that the HP goes through, water can enter through this opening.

Pod HP DHW Systems

11:51

- Made up Genesis story:
  - Why cant we just replace our old water heater with a HP system?
    - Thermal Storage Tanks – bigger
    - Part of the system needs to be outdoors…
  - Lets just put the whole thing outdoors…
  - And then we can pre-build it and make it just like a swap-out unit too!
    - Ok, now how are we going to transport it.
  - You know whats good for transport – Shipping containers!

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Pod HP DHW Systems

11:52

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Pod HP DHW Systems

11:52

- Pre-packaged POD HP DHW Solutions
- Built, configured and tested off site. Can be transported and connected to the existing infrastructure with <1 day of disruption to residents. One system was fully installed without interrupting cold water flow to residents at all.
- New technology, but so far seeing fewer issues than designs based on custom integration into an existing system and mechanical space, and significantly fewer installation issues (systems very thoroughly pre-checked)
- Not pulling heat from inside the building, no apartment access needed for maintenance or installation
- Some current issues
  - Freeze protection for outdoor system components with potable water (recommend auto-drain back system).
  - Some HP faults - still need/recommend full backup resistance system

Assessment

11:53

Cost: NYCHA/NYPA CPC document: ~$43,402,000 – financed amount($~26,000,000 base bid, ~$31,500,000 with add/alts)
Comparable cost: ~$21,200,000 for boiler plant (heating and DHW) replacement – 4 boilers (Cycle NREL study metrics)

Assessment

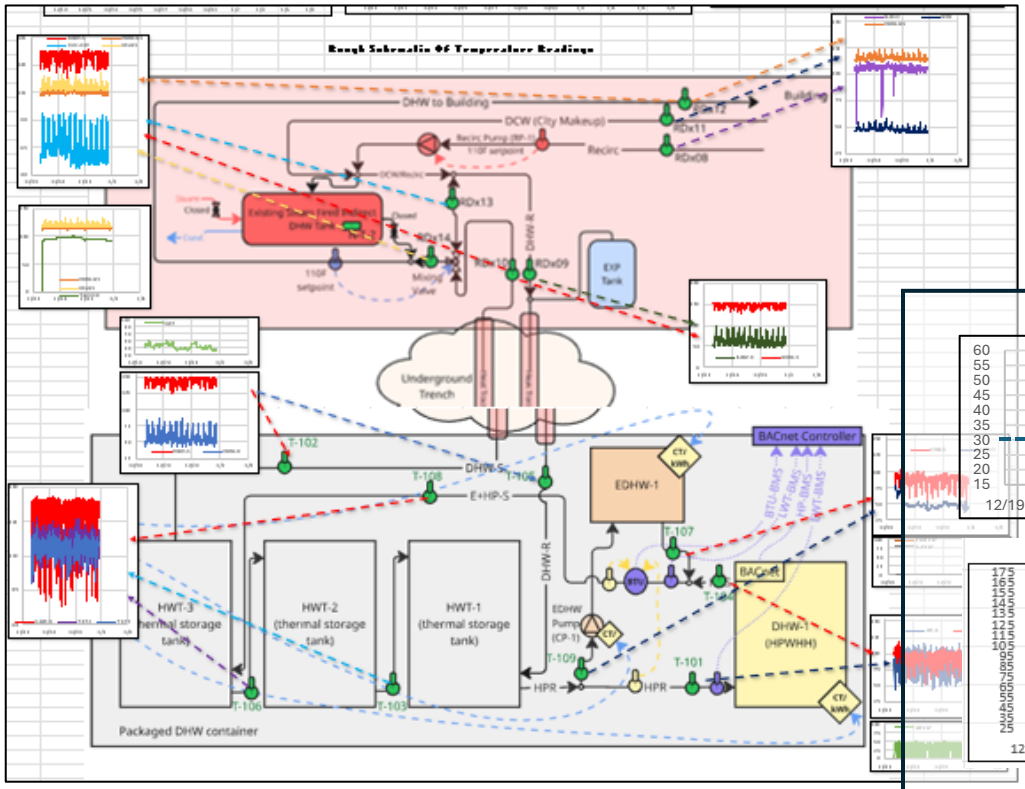
11:53

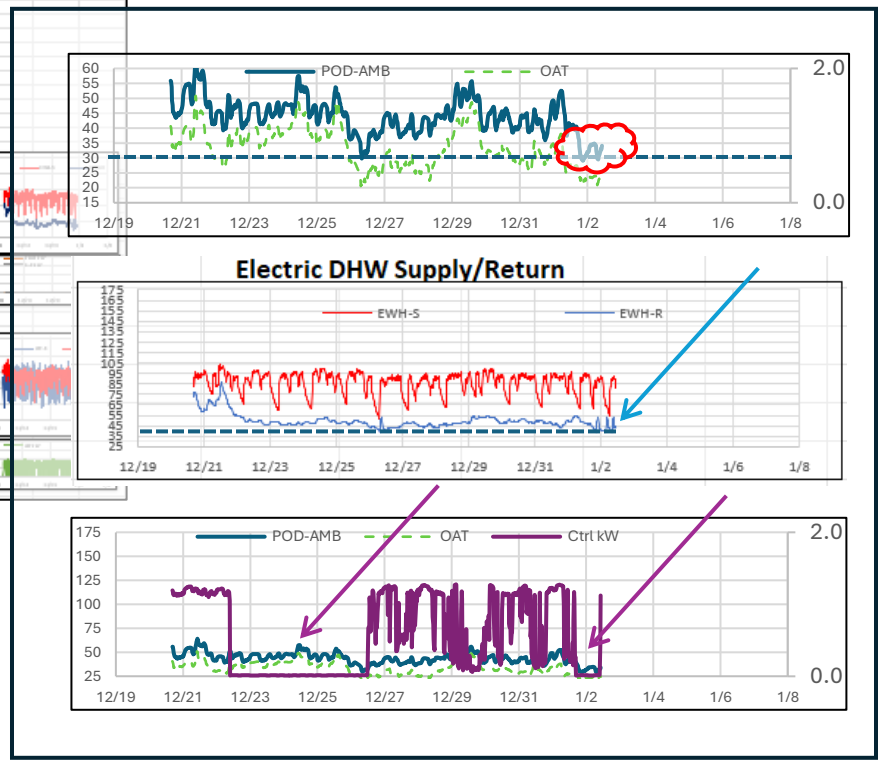
- Installations for buildings with central DHW Plants pretty practical, harder (but doable) to replace in-apartment systems
- Some projects will still need infrastructure upgrades to the electrical
- Still relatively new technology, so limited longevity and real-world experience in non-standard applications. At least comparable to central DHW plants
- Storage tanks are located outside the building - this leads to better and more consistent design, but also greater heat loss (which is also not contributing to heating the building)
- Freeze protection a must, for components, in the event of power failure, and for spaces that used to house the existing DHW systems.
- Noting some issues with defrost and HP failure conditions - until proven further, or fully redundant, recommend resistance backup.

Cost: NYCHA/NYPA CPC document: ~$43,402,000 – financed amount($~26,000,000 base bid, ~$31,500,000 with add/alts)
Comparable cost: ~$21,200,000 for boiler plant (heating and DHW) replacement – 4 boilers (Cycle NREL study metrics)

Interesting Findings

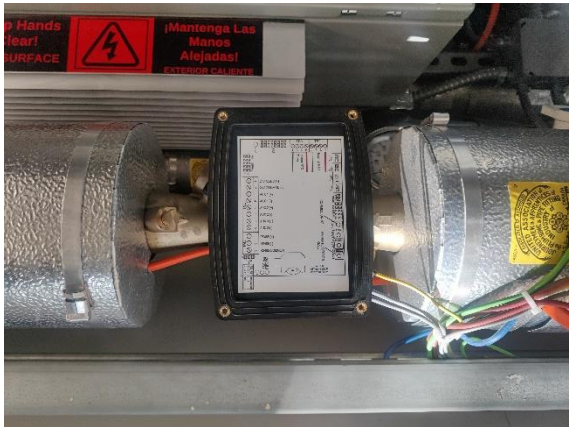
11:54





Common Issues – POD and Central HP DHW

11:55

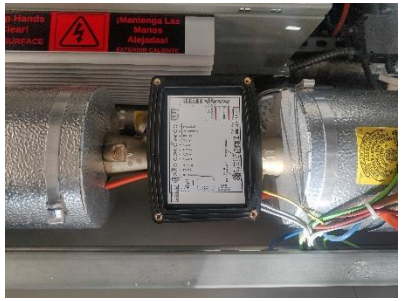


Common Issues – POD and Central HP DHW

11:55

HP Specific Issues:

- High recirculation rates leading to storage tank destratification
- Inappropriate control over backup heating systems
- Failure to plan for defrost cycles
- Freeze Protection (during normal operation, and in event of power failure)



Common Issues

- Unbalanced returns, excessive home-runs (large pipe, low flow)
- Lack of insulation (really!)
- Mixing valve and recirculation pump incompatibilities and issues
- General lack of quality/QC – swapped hot/cold, incorrect PRVs, no tuning of setpoints, etc.

Note –Pod solutions beyond DHW

11:57

Example installation: Student housing at Syracuse University

Note –Pod solutions beyond DHW

11:57

- TKF HydroPod
  - Same approach, but serves:
    - DHW
    - Ventilation
    - Hydronic Heating and Cooling
  - Smaller scale – typically* serving groups of ~4 apartments

Example installation: Student housing at Syracuse University

Common Issues – HydroPod

11:58

Common Issues – HydroPod

11:58

Common Issues:

- Connections to existing infrastructure.
- Failures with the ‘conventional’ systems used to deliver the hydronic heating/cooling.

Notes:

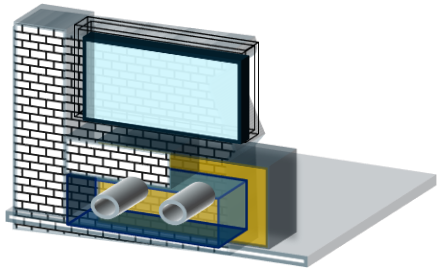
- Works best with envelope improvements, low temperature hydronic heat emitters
- Fairly invasive for HP solution (ventilation, DHW and Htg/Clg infrastructure needs to be run)

PRHP: Packaged Room HP

12:00

- Imagined Genesis Story:
  - Manufacturers saw the huge market for PTACs,
  - No single PTHP solution rising to the top
  - Lets re-imagine it
    - What if we re-use an existing opening? → windows, wall sleeves?
    - What if we don't need the same size wall sleeve?
    - What if we don't even need a wall sleeve?

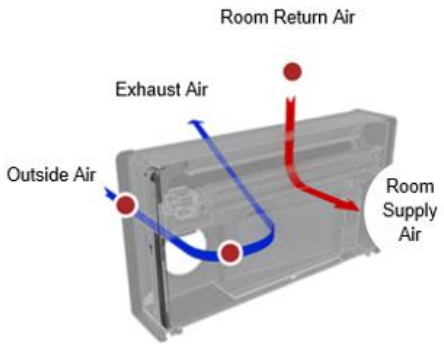
- Includes systems like:
  - Ephoca
  - Fujitsu
  - Midea
  - Gradient



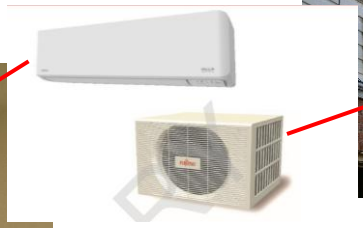
Packaged Room HP – Broad Category

- Ephoca (PTHP-ish)





- Fujitsu (split system)



EFFICIENCIES			
SEER			21.3
EER			12.5
HSPF			11.1
COP	kW/KW		4.04
	BTU/hW		13.80
OUTDOOR TEMPERATURE OPERATION RANGE			
Cooling	°F(°C)		14 - 115(-10 - 46)
Heating			5 - 75(-15 - 24)
CAPACITIES			
Cooling	Rated	BTU/hW	9,000
	Min.–Max.		3,070 - 9900
Heating	Rated		10,900
	Min.–Max.		3070 - 13000

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Plus the PWHPs we already discussed

PRHP: Additional details

PRHP: Additional details

- Can retrofit on an apartment-by-apartment basis, installed in a day
- Often build on existing AC outlets -existing electric infrastructure has a good chance of supporting them (especially if watching the peak loads during phased roll-out)
    - Potential solutions if peak loads exceed existing capacity (battery storage, software based limiting)
- If phased, upgrade costs can be spread out. If locally stocked, plug and play, so systems can be purchased and installed on short notice to address partial failures of existing systems, etc.
- Mixed feedback - Appreciate zone level controls, concerns about complexity, reliability
- Swappable units – Faulting units can be hot swapped, resulting in more repair/service options.

Assessment

12:03

Ephoca Cost: NREL Assessment by Cycle: ~$37,000/apartment (includes new electrical circuits, demo of existing, etc.)
Comparable cost: ~$26,000/apartment for boiler replacement

Assessment

- Still need apartment access (but day/days not weeks)
- May not work in all buildings - only installable in rooms with exterior access, may need certain size PTAC openings/wall space.
- Some projects will still need infrastructure upgrades to the electrical
- Concerns about shifting heating costs from building to apartment
- Still relatively new technology, so limited longevity and real-world experience in non-standard applications
- Code and design standards still catching up with this type of system – some ambiguity over permanent vs. plug-in device, appliance vs. HVAC equipment, etc.
- May only be addressing part of the problem - no ventilation fix, no integrated DHW solution, no envelope upgrades…

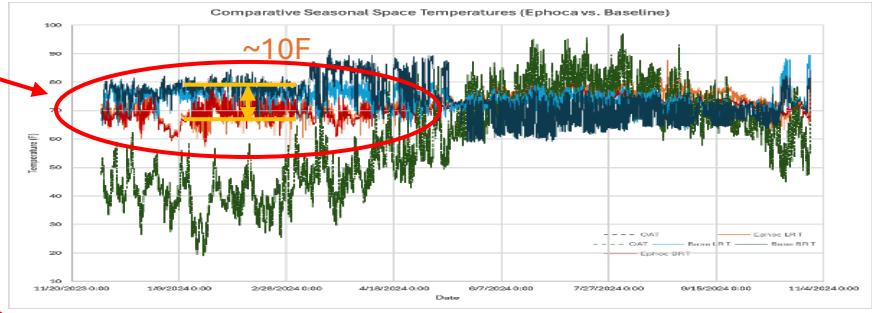
Ephoca Cost: NREL Assessment by Cycle: ~$37,000/apartment (includes new electrical circuits, demo of existing, etc.)
Comparable cost: ~$26,000/apartment for boiler replacement

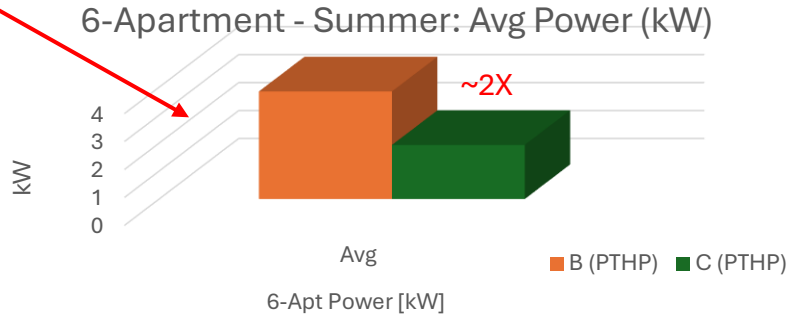
Interesting Findings

12:04

- Different use patterns between apartments, systems, rooms! –
  - Study 1 – Ephoca vs. HW baseboard: ~10F lower avg. space temp.
  - Study 2 - ~2x energy use from site with more vacant apts. In sample (identical Ephoca units in each)
  - Study 3 - ~10x difference in annual apartment HVAC energy use between lowest and highest using apartment (in 12 apt sample – PWHP)
- Hard to compare!

	Time Period	Annual HVAC Energy Use	Annual Heating Only Energy Use	Annual Cooling Only Energy Use
Baseline	12/4/23-12/3/24	7,480 kWh (25,523 kBtu)	6,314 kWh (21,546 kBtu)	960 kWh
Ephoca	10/4/23-10/3/24	1,489 kWh (5,080 kBtu)	1,182 kWh (4,035 kBtu)	91 kWh





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Interesting findings

12:05

- Within the realm of in-room systems, some interesting observations about variability in airflow patterns, and impacts on occupant comfort, heat delivery, etc.

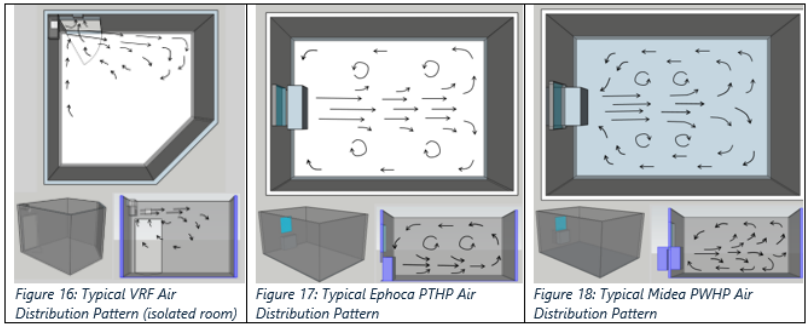
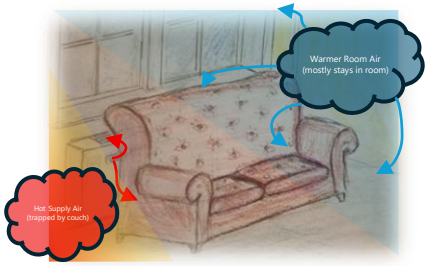


Figure 16: Typical VRF Air Distribution Pattern (isolated room)

Figure 17: Typical Ephoca PTHP Air Distribution Pattern

Figure 18: Typical Midea PWHP Air Distribution Pattern



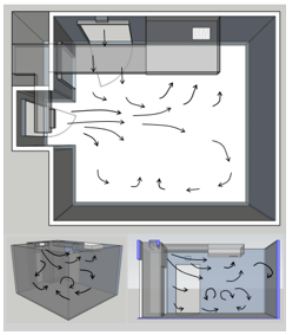


Figure 13: Site A: VRF System – Bedroom Central Return

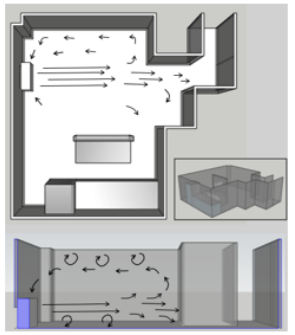


Figure 14: Site B: Living Room Directional Flow

Common Issues

12:05

Common Issues

12:05

- Installation issues – tilt, poor air-sealing, damage while installing, electrical not wired correctly
- Controls – glitches, failure to respond to user input, damage to boards/communication cable to control interface
- Clogged Air Filters
- Water Leaks (potentially due to installation issues and existing conditions)
- ‘Tepid’ supply air

Central Air to Water HP - Heating

12:06

- Genesis?
  - Simply look to the number of existing hydronically heated buildings – easy path to retrofit is a 1:1 replacement with a HP system.

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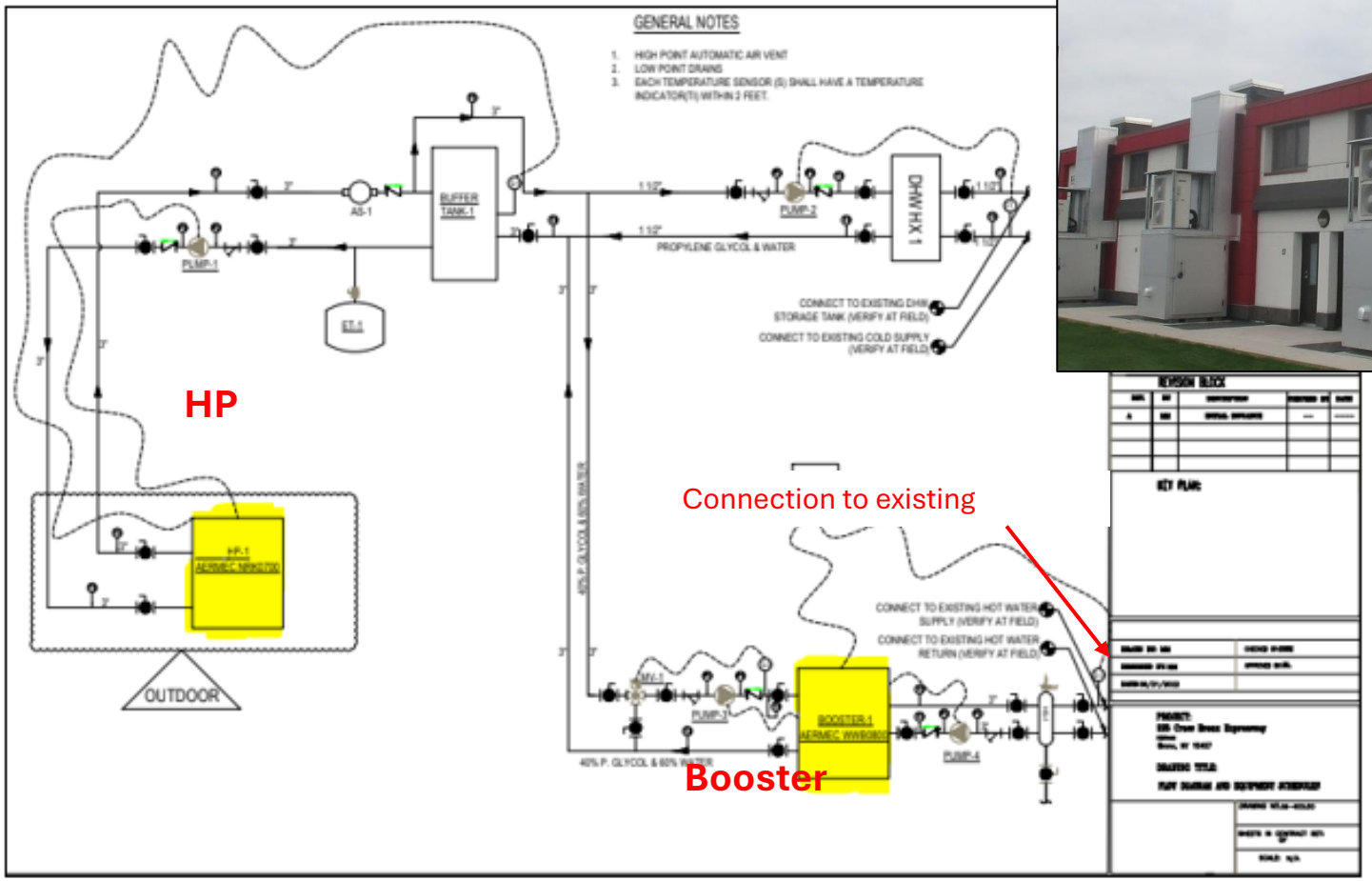
Central HP HW Solutions

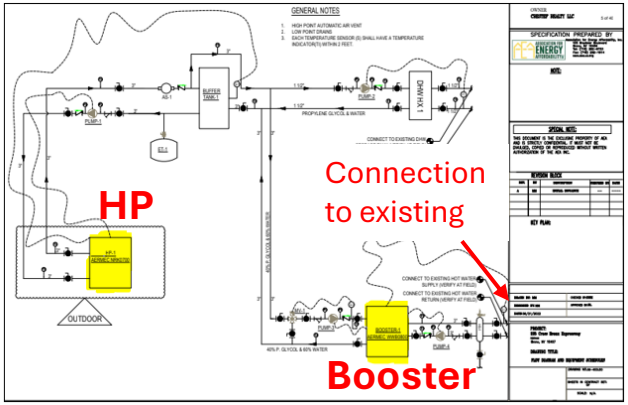
Air to Water HPs serving hydronic systems



Central HP HW Solutions

Air to Water HPs serving hydronic systems

- POD and in-building options
- Some (many?) have potential to provide cooling too, but more involved than simple swap for boiler plant
- Assuming existing central plant no apartment access needed for installation, no increased in-apartment access for maintenance
- Opportunities for heat and DHW solution
- Some considerations-
  - Single stage options have limits on water temperatures, dual stage/cycle designs lose some efficiency
  - Need to consider outdoor system elements and freeze protection - typical to use glycol mix and heat trace
  - Electrical service upgrades almost assured (and can take a long time)
  - Systems typically require some form of buffer tank/thermal storage, and resistance backup best practice



Assessment

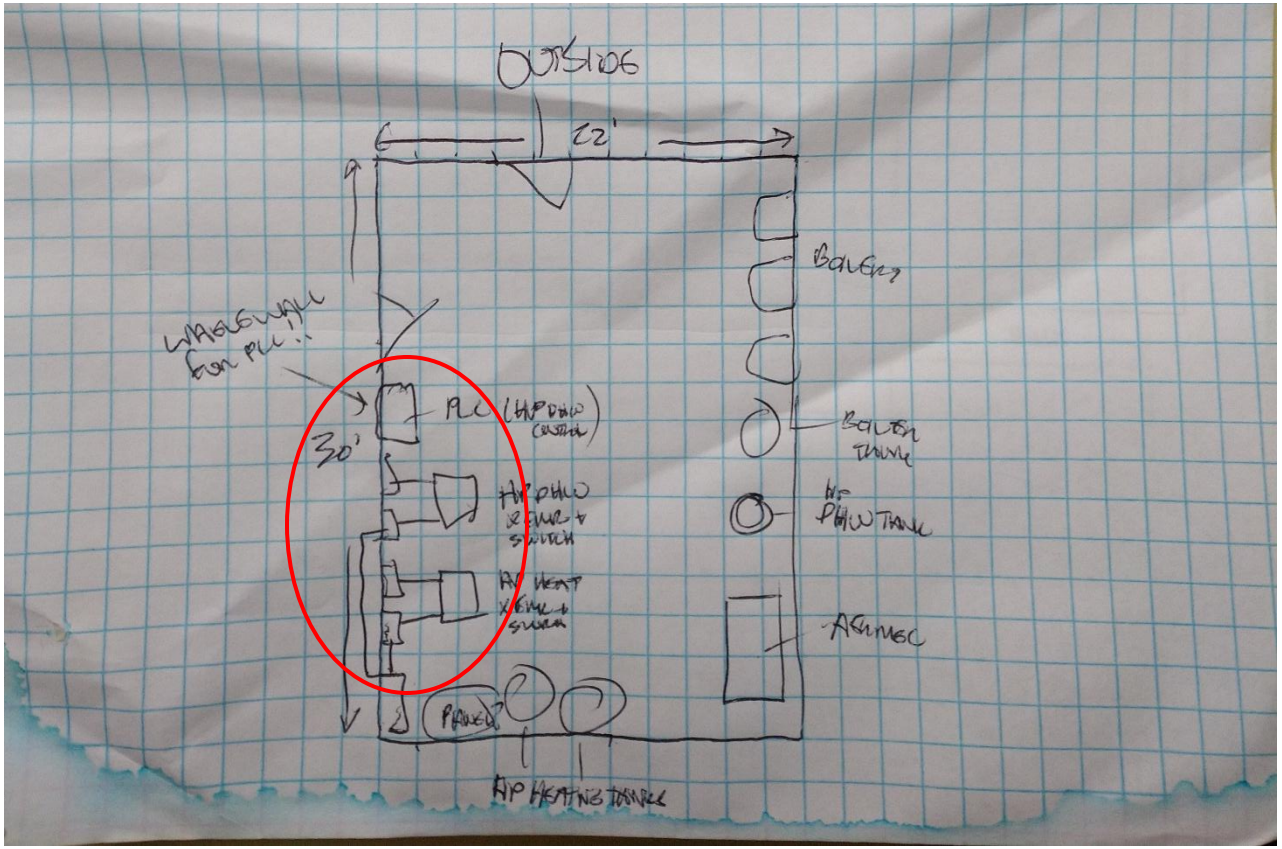
12:08

Assessment

12:08

- No need for apartment access if replacing existing central heating plant (and supplying similar temperatures)
- Most projects will need infrastructure upgrades to the electrical
- Still relatively new technology, so limited longevity and real-world experience in non-standard applications
- Pro and Con of hydronic - some level of future proof, established distribution system, however any existing issues with the hydronic equipment or distribution (lack of insulation, failing valves, etc.) still present
- HP may be capable of cooling, but many existing hydronic systems will not be able to take advantage of that
- No added level of control or zoning - if cooling present, building level htg<>clg switch
- May only be addressing part of the problem - no ventilation fix, no envelope upgrades…

Common Issues – POD and Central HP hot water systems



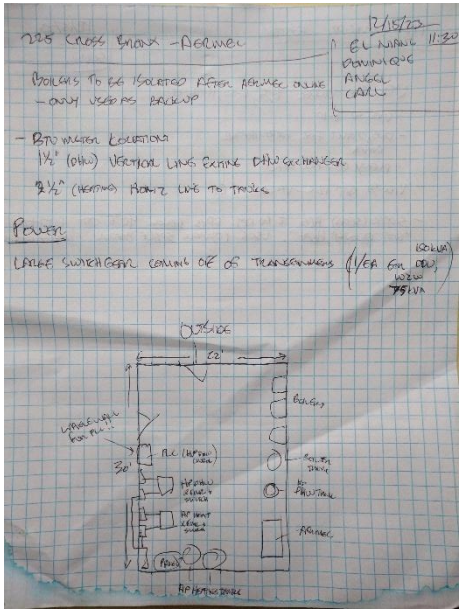
Common Issues – POD and Central HP hot water systems

HP Specific Issues:

- High recirculation rates leading to storage tank destratification
- Inappropriate control over backup heating systems
- Failure to plan for defrost cycles
- Freeze Protection
- Refrigeration Leaks (noted in one unit so far)

Most Common Issues

- Delays and issues resulting from electrical service upgrades!
- General lack of quality/QC – swapped piping, incorrect PRVs, no tuning of setpoints, etc.
- Potentially more sensitive to existing issues with hydronic systems

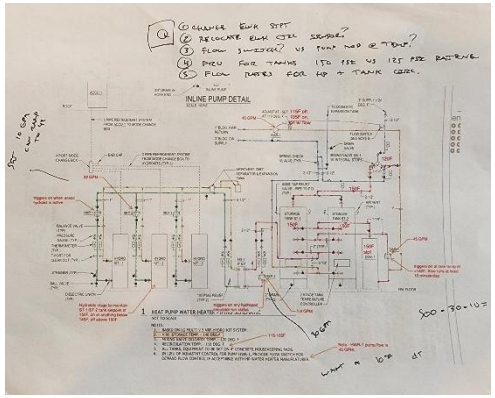


Other Systems to Know?

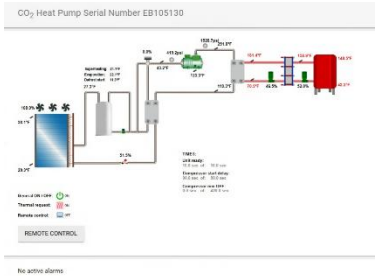
12:10

- SanCO

- LG Hydrokit



- Lync Aegis



Other Systems to Know?

12:10

- SanCO
  - Packaged CO2 based HP. Circulates potable water. Usually deployed as a group of units operated in parallel.
- LG Hydrokit
  - Big name split HP DHW solution. High delivery temperatures possible. System circulates refrigerant to outdoor unit(s)
- Lync Aegis
  - Packaged CO2 based HP. Uses heat exchanger between glycol mix (outdoors) and potable water

- Similar common issues and concerns to central/Pod DHW systems noted previously.
- Worth noting that issues no less frequent with big name systems:

Common Issue Examples?

12:11

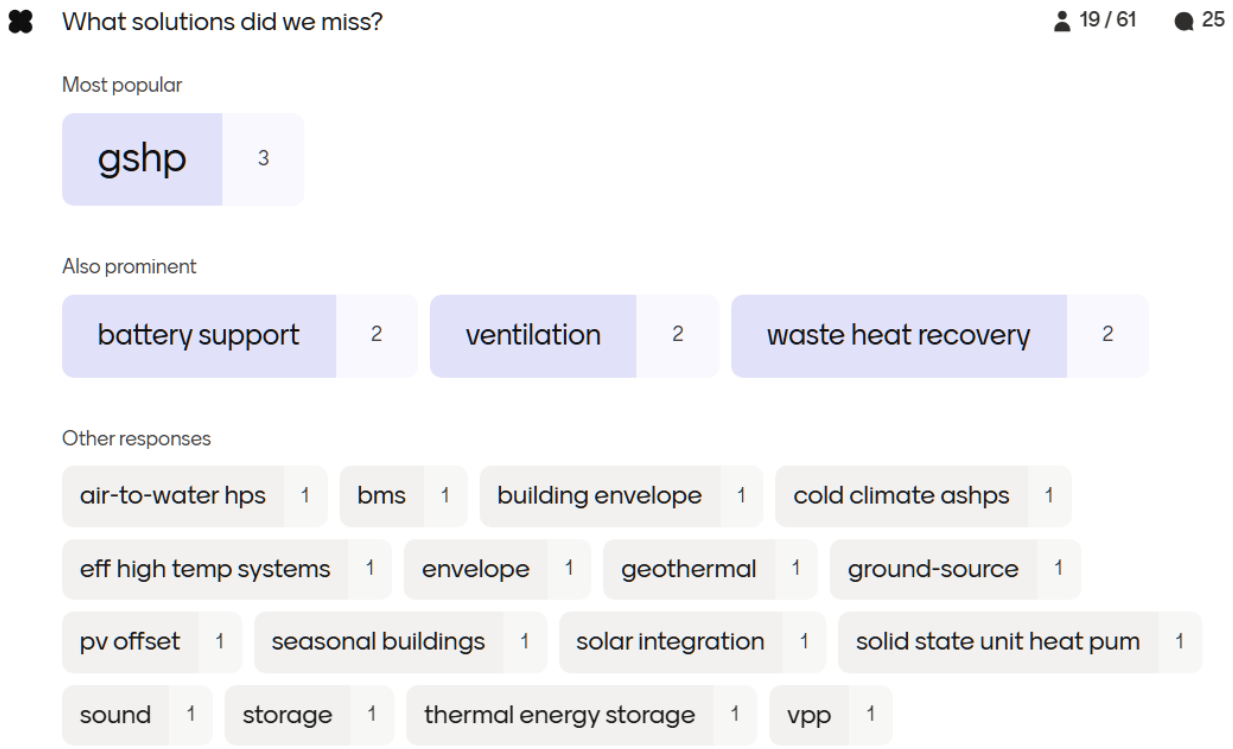
Controls default to ‘Off’ on startup… Found system had been off for over a month…

Assumptions:				
Given the backup system appeared to be struggling to maintain the tank setpoints, we can assume a fairly constant operating schedule – 12-18hrs/day (50-75% of the time)				
Run Time:	12	hrs/day	Electric Rate (guess)	
Duration of operation	30	days	$ 0.15	$/kWh
Backup Electric Hot Water Heater			Backup EWH energy Consumption	
54	kW		19440	kWh
			$ 2,916	Energy Cost
DHW HP efficiency (COP)			DHW HP equivalent energy consumption	
2	COP		9720	kWh
			$ 1,458	Energy Cost
Order of magnatude savings:			**$ 1,458**	(per 30 day period)

Review

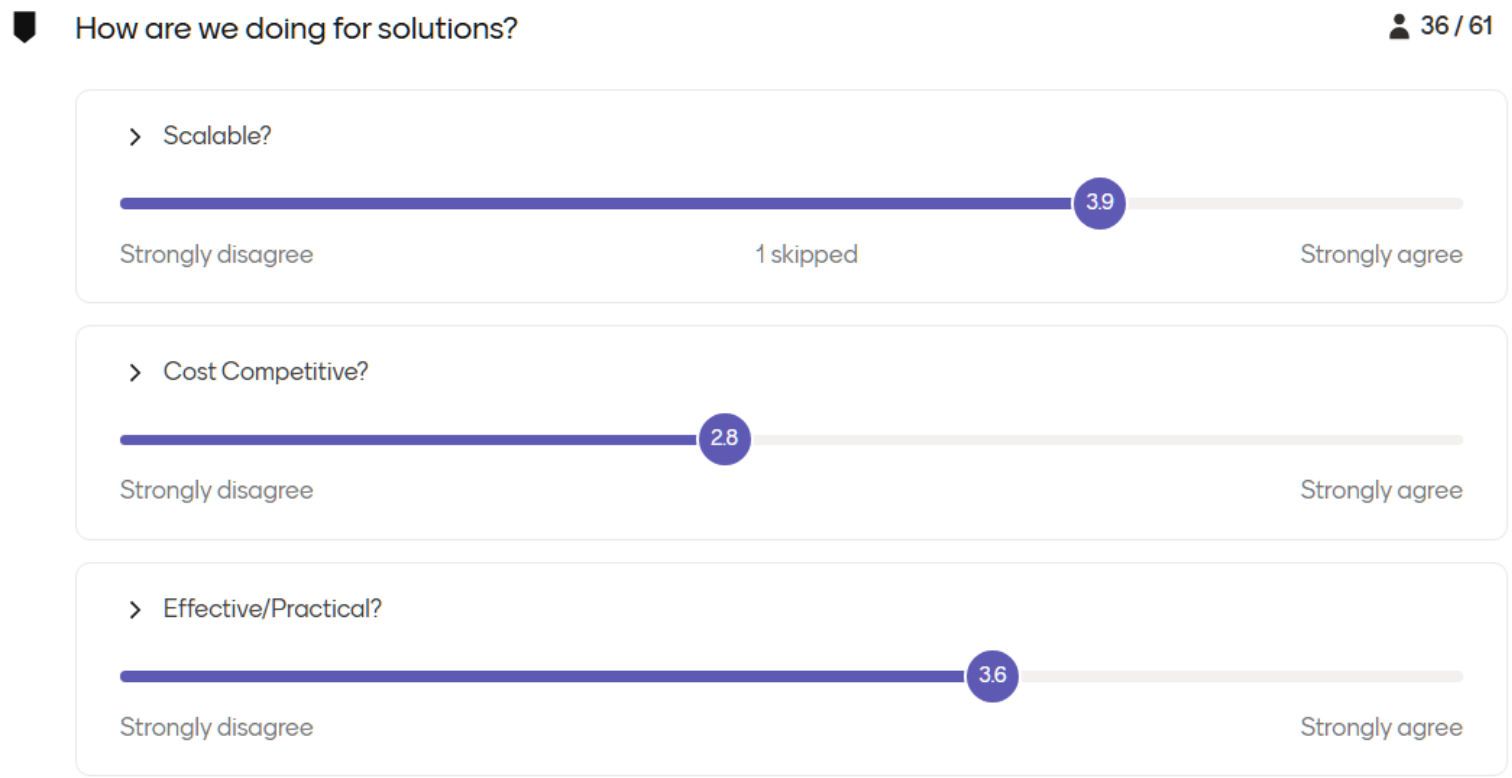
What solutions did we miss?

12:15



How are we doing for solutions?

12:15



Lets summarize

12:20

Many of these share similar goals or attempt to address similar market gaps:

- Low initial cost (including installation)
- Modular and scalable
- Reliable and efficient
- Visually appealing, well functioning and easy to use
- Easily installed in existing infrastructure without disruption to occupants

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No Panacea, but Progress!

Remaining Hurdles

12:21

- Fuel switching – who pays for heat?
- Reliability – new products, how do you know how they will last?
- Service – are these too complex for in-house staff to maintain?

Remaining Hurdles

12:21

Some attempts to address these Hurdles:

- Fuel switching – who pays for heat?
  - **New dedicated HVAC panels in apartments, or internal metering on equipment**
- Reliability – new products, how do you know how they will last?
  - Ongoing stress tests and evaluation of build quality – **NEW ACTIVE NYSERDA PROGRAM TO EVALUATE THIS- LOOKING FOR SITES!**
    - **Reach out to Taitem, Steven Winter Associates or Slip Stream if you would be interested in learning more about this when the program launches.**
- Service – are these too complex for in-house staff to maintain?
  - **Some manufacturers looking at selling systems as a service – with integrated maintenance and service plan bundled with purchase.**

Closing Thoughts

Some Final Thoughts:

12:22

Easy to assume newer products/designs will be less robust than 'conventional' alternatives.

Not what I have experienced, or at least, not in the way you would think:

- Majority of issues with new systems installations --> failures in standard installation approaches:
  - Issues with conventional aspects of an installation, or
  - General craftsmanship (systems installed on a tilt do not drain correctly, etc.)

Current study comparing four public housing sites (VRF, PTHP and PWHP) - similar magnitude and frequency of issues at VRF and PTHP sites, slightly less at PWHP

The Bright Side – A road map!

- I feel like we are starting to get a road map for room based and packaged/Pod based central plant solutions that might work:
  - 120V, <15Amp heat pump systems
  - Mounted on exterior surfaces, or with small diameter/cross sectional ducting/piping to said surfaces
  - Fully modular, packaged systems that can be deployed quickly, hot swapped, and quality control checked pre-deployment
  - Systems that handle multiple needs show some promise, but potentially with limited returns past a certain point – heating and ventilation (for exterior mounted units) seems like an easy overlap. Similarly, hydronic heating and DHW seem to make sense.

Biggest Risks?

- Biggest Potential Hurdle for these new systems?
  - Validate reliability and consistent performance
- Biggest obstacle to that?
  - Low-cost knock-off competition

Key item features

- **Convenient Operation**: Remote control for convenient operation from anywhere in the room
- **Smart Connectivity**: Wi-Fi connectivity allows for smart home integration and remote access
- **Customizable Schedules**: Timer function enables customizable cooling and heating schedules
- **Efficient Performance**: 10,000 BTU capacity provides efficient cooling and heating for rooms up to 475 square feet
- **Easy Maintenance**: Washable filter for easy maintenance
- **Versatile Settings**: Offers 3 heat settings and 3 fan speeds, with a total of 6 settings
- **Simple Installation**: Saddle mount design for easy installation
- **Power Specifications**: Operates on 115V power with 1070W power consumption

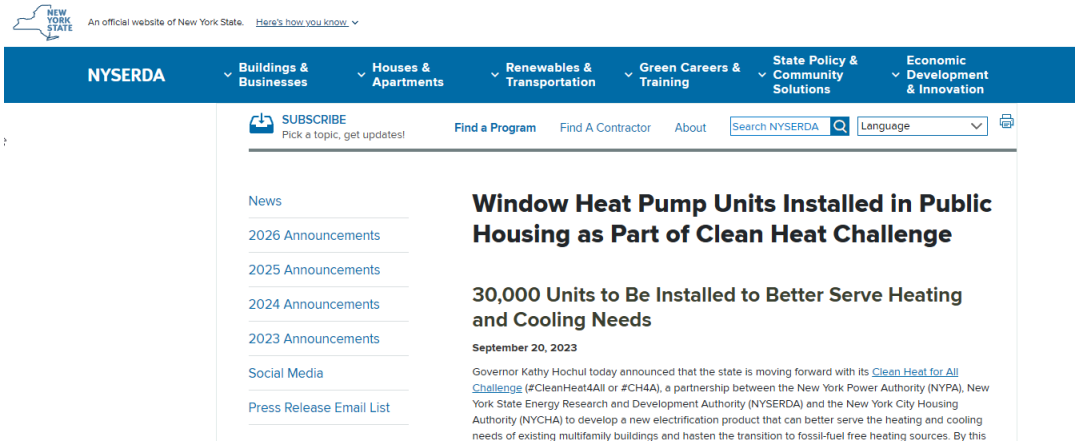
View all item details

Generated by AI

Exciting time to be alive

12:23

- New solutions
- Rapid innovation
- Opportunities to contribute, inform



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What Can you Do?

- Get involved in field testing these systems!
- Learn more about any of these products that interested you or seemed applicable to a project
- Realize that not all systems are equally well developed, do your research

12:25

Questions and discussion

Thank you

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