Micro HP Field Study

Data Analysis Slides

July 18th, 2023

CLASSIFICATION LEVEL: PUBLIC

Project Overview

What is a Micro Heat Pump?

NEEA's Definition

- Operates on shared 15A 120V circuit.
- Inverter Driven Compressor
- Factory charged, doesn't require evacuation or charging of refrigerants.
- Easy to Install

Form Factors

Window AC

Portable

Saddlebag

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Three General Climate Categories

Window HP Category	Min Temp	Defrost	ER Heat	Notes
AC Climate	40°F	no	R410A only	*Only 30-40% of heating load-hours*
Mild Climate	17°F	yes	none	*what to do with defrost melt water*
Cold Climate	-10°F	Yes	none	*NYCHA/NYPA RFP product*

This study focused on AC climate and mild climate products available in Q3 of 2022

Lots of Potential Uses

- Single Family
- Multifamily
- Low and Moderate Income
- Emergency Cooling
- Decarbonization

*Rough Savings Potential in NW

RBSA 2 - NW Homes with Single or Double Hung Windows

	Marine Climate	Cold Climate	
EFAF	147,924	69,372	
Zonal	375,261	99,302	
ASHP	473,633	93,893	
Gas	992,213	349,645	
Other	81,480	44,447	
Total	2,070,510	656,659	
EFAF, Zonal, Other	604,665	213,121	homes
Savings/home	1000	500	kWh/yr
Technical Potential	69	12	81 aMW
Market Share	25%	25%	
Savings De-rate	50%	50%	
Est. Program Potential	9	2	10 aMW

Research Objectives

1. Understand the customer experience installing, operating and their expectations of what a window heat pump is and does.
2. Understand, installation, noise, and any mechanical limitations that may impact performance or customer experience.
3. Understand how users changed behavior such that the window HP displaced heating and cooling from preexisting sources.
4. Gather data that can be used to determine how effective the window HP is at displacing other heating or cooling sources in the home.

Project Timeline

- Q3 2022 Scoping and procurement of some units
- Q4 2023 Workplan, initial recruitment
- Q1 2023 Phase 1 – Initial Reaction
- Q2 2023 Phase 2 – Home Use Test

Micro VSHP Heat Pump Research: Phase Two

Northwest Energy Efficiency Alliance | C+C Research Report

July 2023

Agenda

[Phase Two Results Presentation]

Introductions, Background + Objectives	15 min
Phase One	20 min
Phase Two	45 min
Questions	10 min

Introductions, Overall Background + Objectives

C+C Team

Rebecca Strott
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Overall Background + Objectives

NEEA conducted a two-phased project that involved: an upfront study to gain insight into the initial reaction consumers had to the Micro VSHP Heat Pump Units that heat as well as cool. The second phase was a home-use test study with three different Micro VSHP Heat Pumps, totaling 12 units.

Overall Research Objectives

Gather general feedback on Micro VSHP Heat Pumps and real-world usage of three different Micro VSHP Heat Pumps, in order to:

- Understand the customer experience installing, operating, and their expectations of what a window heat pump is and does.
- Understand installation, noise, and any mechanical limitations that may impact performance or customer experience.
- Understand how users changed behavior such that the window HP displaced heating and cooling from preexisting sources.

This was conducted to inform NEEA and help them approach utilities with the best recommendation on which Micro VSHP Heat Pump to support.

Overall Desired Outcomes

The two desired outcomes of this project are to:

1. Sufficiently understand the customer experience with Micro VSHP Heat Pumps so that NEEA can guide utility programs and the EPA regarding their value as an energy-saving opportunity.

2. Provide manufacturers of Micro VSHP Heat Pumps with additional recommendations that would improve the product's value proposition and/or customer experience.

Planning

About This Presentation

Objective: To share the pertinent results of the Home Use Test (HUT) in a way that enables NEEA and stakeholders to understand what we learned and discuss the ramifications.

We will review:

- Key Findings (what we learned)
- Conclusions + Implications (ramifications)

Unit Key – Total (n=12)

Saddle (n=5)

Portable (n=4)

Window (n=3)

Phase 1

Phase One Background

Research Approach: Phase 1

Methodology	Phase 1
Length	35-45 minutes
Format	Online Qualitative Discussion & Concept Testing *
Date	Jan 6-22, 2023
n	36
Sample Sources	WA and OR residents from MROC

**Please note that this is meant to be qualitative research, meaning this is more directional than predictive.*

Primary Audiences: Phase 1

Phase 1: People who live in climate zones where Heat Pump Air Conditioners would
sufficiently heat as well as cool in WA and OR. The following characteristics were prioritized:

- Those involved in at least 50% of decision-making for HH maintenance purchases
- A mix of single-family homeowners and those who live in multi-family housing
- A mix of ethnicities, ages, gender, HHI etc.
- A focus to recruit mostly electric heating was added as an additional criteria

Demographics: Phase 1 - Total (n=36)

Gender	
Female	23
Male	11
Gender Variant	2

Household Income	
<$35k	5
$35K-49K	5
$50K-74k	9
$75K-99K	5
$100K-149K	9
>$150k	3

Age	
18-24	0
25-34	7
35-44	9
45-54	8
55-64	9
65+	3

Electric vs. Non-electric Heating	
Electric	27
Non-electric	9

Homeowner vs. Renter	
Homeowner	24
Renter	12

Household Size	
1	8
2	10
3	7
4	7
5	3
6+	1

Phase One
Conclusions + Implications

Overall Perception

Findings

- Most felt saving on energy costs, energy efficiency, and maintaining a comfortable temperature were very important factors when it comes to heating and cooling their home.
- Most participants already used ancillary products to heat and/or cool their homes.
- Their perception of the concept was positive, with many believing it would solve a problem for them.
    - Portability, all-in-one heating and cooling, and compatibility with 120v outlets are primary drivers of interest.

Implications

- The idea of a portable unit to provide a comfortable temperature was already familiar to participants.
- The additional benefits of saving on energy costs and being energy efficient will increase positive perception of the concept.
    - These were not primary benefits perceived by participants and should be promoted as a primary benefit of this product.

Product Concepts

Findings

- The Saddle unit scored highest on most measures of interest but other concepts were also well received.
- The biggest concerns were how well it would really work, size/weight, and compatibility with their windows.
- Most participants did not understand heat pump technology.

Implications

- Although the Saddle unit received the highest scores, its price and size may limit its initial adoption. A smaller, more familiar product like the Window or Portable unit may be an easier initial transition for consumers.
- It is important to ensure these products are more energy efficient than alternative ancillary heating and cooling products and provide enough energy savings to offset the higher initial upfront costs, especially for those with lower incomes.
- Heat pump technology itself may not be an immediate draw, since average consumers were unfamiliar with heat pumps, but the benefits of heat pump technology should be marketed, especially the all-in-one heating and cooling feature, which is unique to this product.

Intended Uses

Findings

- Participants were more likely to use it for cooling than heating, especially in circumstances where they don't have central A/C.
- Some participants who discussed reducing or replacing their use of existing heat sources were people who had baseboard heat.
- Participants primarily would plan to use the product in a central location, such as a living room, or in bedrooms at night.
    - Some expressed desire for the product to be able to heat/cool multiple areas, such as living, kitchen, and dining rooms.

Implications

- While the product is portable, most would keep it in a stationary location.
- It is more likely that people would consider replacing ancillary products than their primary central heating or cooling systems. More research would need to be done to see if cost savings from this alone would yield enough energy and cost savings, or if consumers would also need to reduce their central heating and cooling usage.
    - This product may enable those with baseboard heat to turn off the heat in places heated by the heat pump.

Phase 2

Phase Two Background

Research Approach: Phase 2

Methodology	Phase 2
Length	90 minutes, 6 mini activities
Format	Home Use Test, Online Qualitative Discussion *
Date	March-May 2023
n	12
Sample Sources	WA and OR residents from C+C's MROC (market research online community) Participants were selected from Phase 1 study

**Please note that this is meant to be qualitative research, meaning this is more directional than predictive.*

Primary Audiences: Phase 2

Phase 2: Respondents with a profile that was defined in the workshop meeting after Phase One. The following characteristics were prioritized:

- Lives along the Washington and Oregon I-5 corridor, providing the easiest logistics required to distribute the units. This also ensures that participants will live in a climate zone appropriate for this product.
- Sash or slider window types.
- Diversified household income levels.
- Prioritize those currently using electric heat.
- Interest + willingness to participate – electronic participation agreement.

Demographics: Phase 2 - Total (n=12)

Gender	
Female	9
Male	3

Household Income	
<$35k	1
$35K-49K	3
$50K-74k	3
$75K-99K	1
$100K-149K	3
>$150k	1

Age	
18-24	0
25-34	1
35-44	4
45-54	4
55-64	1
65+	2

Electric vs. Non-electric Heating	
Electric	8
Non-electric	4

Homeowner vs. Renter	
Homeowner	8
Renter	4

Household Size	
1	2
2	2
3	3
4	1
5	3
6+	1

Phase Two
Key Findings

Key Finding #1

Initial responses to the products were favorable

- Participants were **eager, hopeful, optimistic + excited** to use the product.
- A few mentioned various potential benefits such as **visual appeal, space-savings, energy-savings,** and **environmental benefits**.
- **Most participants were at least somewhat satisfied across all measures**. Participants were most satisfied with the **ease of use**, followed by **overall heating performance**, then **noise level**.

Key Finding #2

Participants reported that the units tended to work as expected

- **Window unit** users were **familiar with the design**, and most described they experienced what they expected; however, one participant was confused about whether the unit only works when it is warmer outside.
- **Saddle unit** users generally found their experience to be as expected with the only notable factor being that it **lacked enough insulation to fill air gaps**. Participants appreciated its **performance, design, ease of installation, quietness, temperature control,** and **overall user experience**.
- **Two of the four Portable unit** users mentioned the product **did not shut off once the desired temperature is reached**. **Portable unit** users were also surprised by some aspects of their experience, such as **installation challenges** (instructions and process), **drainage, noise level**, and **inability to seal properly**. Despite these challenges, **two of the four Portable unit** users mentioned they were **impressed by its overall heating performance**.

Key Finding #3

Although installation was considered easy overall, there were some issues

- **Some found installation difficult** in terms of **fitting the unit to their window/getting an airtight seal.**
- The **Portable unit** was reported to be **more difficult to install** than the other units.
- **Some found the directions unclear or lacking**, especially with the **Portable unit**, which caused some frustration.
- **Saddle unit** users had an **easier time with installation**. They considered the **instructions clear** and found the **numbered boxes to be helpful**. However, it may be important to note that they had a pre-research call to let them know that the unit would be heavy and would require two people for installation.
- **Two participants with the Window unit** noted it was **heavier than expected.**
- One participant assigned to a **Window unit** ran into a "deal breaker" because they were **unable to use screws in their window frame due to their rental agreement**.

Key Finding #4

Most found the settings + controls easy to understand + manage

- **Temperature and heat settings** were **most commonly used** by participants.
- Some adjusted the temperature, mode, or setting **throughout the day** while others **set it to their desired temperature and left it**.
- For the most part, participants made adjustments to the settings based on **time of day, personal preference,** and/or **weather**.
- Some reported **issues with trying to use the associated control apps**.

Key Finding #5

Many used the product(s) as the primary source of heat in the room it was installed

- Most participants placed their units in the **living room** or **bedroom**.
- When reflecting on how they used their existing sources of heat in the area where the product is installed during the study, **nearly all respondents (11 out of 12) reported they used their existing source(s) less or not at all**. Only 1 participant reported they used their other source(s) about the same amount.

Key Finding #6

Participants easily adjusted to heating with the product

- Participants set their temperature **between 65 and 75 degrees Fahrenheit**, and participants chose their temperature based on **what they typically set their thermostat to** and/or based on **the weather**.
- A few participants reported having to lower the temperature once it **warmed up quicker than expected.**
- Several mentioned they were **not sure at first whether it was working/producing heat** – some commented that **the air felt cool as it came out, causing some uncertainty**.
- Some commented that the **heat is distributed differently** than what they were familiar with, but it is not a problem. **In fact, they ultimately thought it permeated the space more effectively than other sources of heat.**
- Most participants reported **feeling comfortable with their heat pump thermostat at a higher temperature than their primary heating system** over the 3-day period (in Mini Activity #4).

Key Finding #7

Energy efficiency optimization was not a top priority for participants

- **Participants' top priority was comfort before they were told about energy efficiency tips.**
- After learning tips about the products' energy efficiency, **participants expressed intent to use the products more frequently as a primary source**, especially during moderate outdoor temperatures (above 40 degrees Fahrenheit).
- Considering the data from the temperature and power meters and the common usage of the temperature setting, **it is possible that participants believed setting the temperature to their desired temperature and letting it adjust automatically instead of manually changing it was more energy efficient**.

Key Finding #8

While all units performed well, each product had unique benefits

- According to most participants assigned to the **Saddle unit**, the product was **visually appealing**, **unobtrusive/space-saving**, **quiet**, **provided shelf space,** and **allowed use of windows.**
- The **Portable unit's functionality went beyond just heating and cooling**, it was **also a fan and dehumidifier**, etc. One participant even suggested calling it a **4-in-1**.
- The **Window unit** had a **familiar look and feel**, which made it **more approachable**.

Key Finding #9

Ultimately, participants were pleased with their product experiences

- Their **excitement and optimism** at the start of the study **did not diminish after use.**
- Participants rated the units well on performance measures: **ease of use, heating performance, and noise level** (although for some the noise level was an issue, especially the **Portable and Window units**).
- **10 out of 12** participants *completely agreed* that the product was **appealing**, and **they would recommend purchasing this product to someone they know.**

Key Finding #10

There were some potential "deal-breakers" that need to be addressed

- The **40-degree threshold was the most significant barrier** – there was concern that they **would not be able to use it often enough** or **when they need it most.**
- **External aesthetics and impediments** were a deal breaker for some – one person dropped out because the outside view of the unit on the front of their house was unappealing; another because of concerns over the impact on clearance with their roof.
- **Physical barriers** such as the **need to screw the unit into the window structure presented a problem**, **particularly for renters**, one of whom had to drop out of the study.
- There was some concern that the units **only work for a limited area due to their placement in a particular room.**
- The **noise level was an issue for a few participants**, especially those with **Portable** or **Window** units.

Key Finding #11

Market size and value proposition could present a problem

- **Hard to find homes that qualify** (i.e., restrictions on the physical makeup of the home); and therefore, people to participate in the HUT.
- **Physical barriers** to **product installation** that were discovered.
- Participants were not able to assess the value proposition since they were not given pricing until the end of the study. **The cost could be a barrier for many.**

Phase Two
Conclusions + Implications

Participants needed clearer communications about installation, operations + maintenance

Findings

- Some participants found it hard to assess whether or not their window(s) would be compatible with the unit.
- Installation was difficult for some in terms of fitting the unit to their window/getting an airtight seal.
- Some found the installation instructions to be unclear.
- Operational issues, such as drainage maintenance (Portable), noise level (Portable and Window units), and the app experience across all units were of concern.

Implications

→ Find a way to help customers understand if their windows can accommodate the product, such as a QR code on the packaging or a website tool.

→ Offer a kit and/or a variety of approaches to achieve an airtight seal.

→ Consider visual instructions for installation: YouTube videos, website graphics, infographics, etc. Also, consider using clear labels or numbers if there are various components for installation.

→ Consider FAQs, YouTube videos, detailed troubleshooting tips for maintenance and operational issues, and/or 24/7 access to customer service support.

Overall, participants were excited about the product + had good experiences

Findings

- Of the installation, maintenance and operational challenges, installation was the biggest problem.
- Despite some issues, most participants found the product easy to use once installed.
- Participants found that it provides heat as well as or better than their existing sources – with nearly all participants using their other source(s) of heat less or not at all during this time.
- However, participants were not informed of the cost of these units.

Implications

→ It will be critically important to make sure that installation is truly easy for the end user.

→ Once people purchase the units, they are likely to have a good experience – it is important to find a way to gather reviews for marketing.

→ There is a need to understand the impact that pricing will have on interest/enthusiasm since cost will likely be a barrier for many.

→ The importance of other benefits (overall performance, environment, ease of use, shelf space, noise level, etc.) should be studied to better understand if/how these benefits combined would create a strong value proposition.

Communication materials should include motivation + best practices for driving energy efficiency

Findings

- Prior to being informed of the products' energy efficiency, comfortable room temperature was a higher priority.
- More clarity is needed regarding how to best leverage the unit(s) for energy efficiency – some were misinformed, and some were uninformed.
- When using the term efficiency, it must be clear that it refers to energy efficiency rather than performance efficiency, as some participants used the term efficient in general to describe the product.
- *Anecdotally, those who have gas heat tend to believe anything electric would not save them money by being energy efficient (based on other studies on EE products).*

Implications

→ Focus marketing communications on WHAT benefits the product delivers (i.e., saves money via energy efficiency), not HOW it delivers those benefits (no technical explanation of *how* the heat pump works).

  → This is corroborated by studies done with Energy Star regarding heat pump HVAC and water heaters.

→ Provide testimonials and/or reviews that demonstrate comfort is not sacrificed for energy savings.

→ Provide easy-to-understand communications about what the end user needs to do in order to achieve maximum energy efficiency.

The market size is impacted by building specifications + product limitations

Findings

- The required window/building specifications were difficult to find, making recruitment a challenge.
- Renters are not likely to be able to or may think they are not allowed to make structural changes to their windows for installation.
- Some participants expressed concerns about effectiveness due to the 40-degree + temperature restriction.
- Some participants were not satisfied with the aesthetics and noise levels.

Implications

→ Based on the physical requirements of the building/window, a strategy for identifying the "right" building/window types should be a priority for assessing potential energy savings.

→ It may be prudent to create a persona for marketing based on current users.

→ There is a need to assess market size for energy savings (NEEA) based on assumptions that address building and human specifications.

→ For multi-unit buildings, consider targeting new construction or buildings being remodeled.

→ Understand the impact of effective use at 40 degrees on energy savings potential.

Thank You.

C+C Market Intelligence

Data Loggers

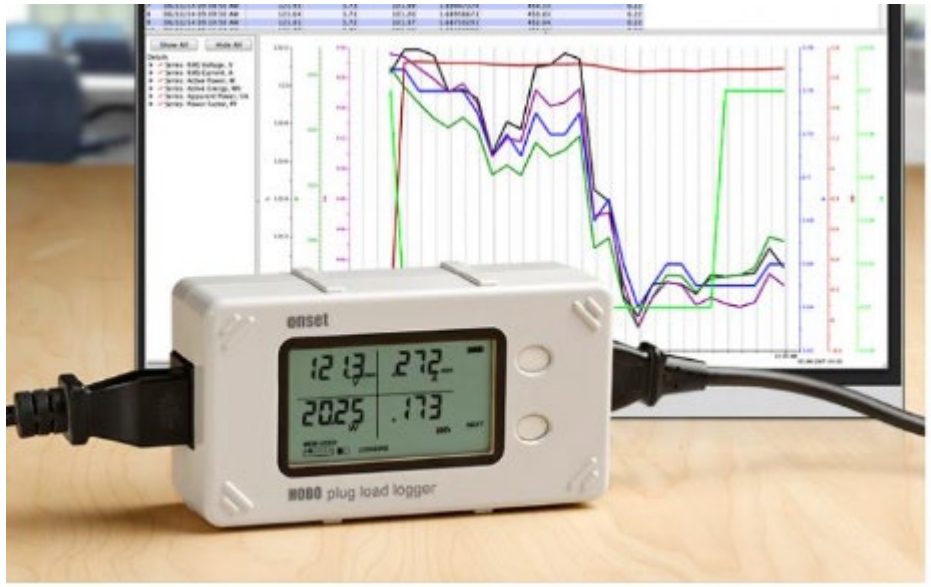
Observations

Take-Aways

Notes

What Was Installed

- 5 Gradient window HPs
- 3 Midea window AC/HPs
- 4 Midea portable HPs

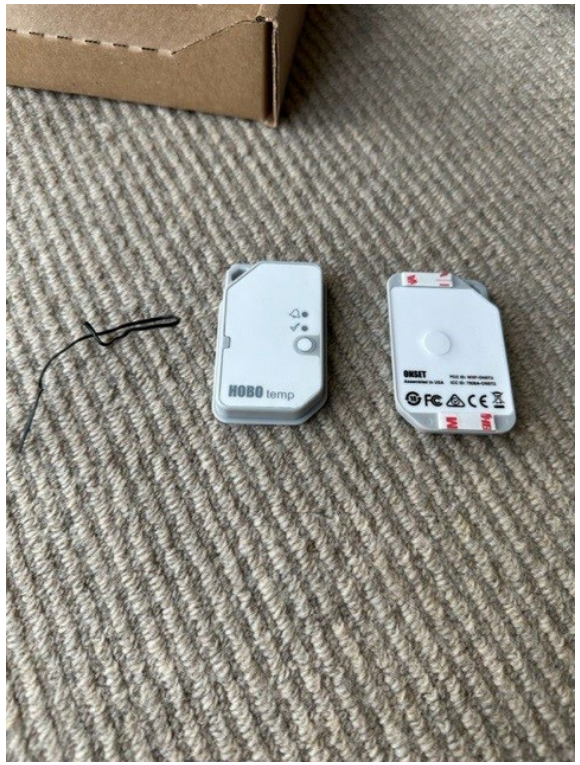


- Each participant was responsible for installing
  - Heat pump
  - Power data logger (energy, runtime, power factor)
  - Temperature data logger (supply air temp)

Data Logger Installation

Power logger

Temperature Logger

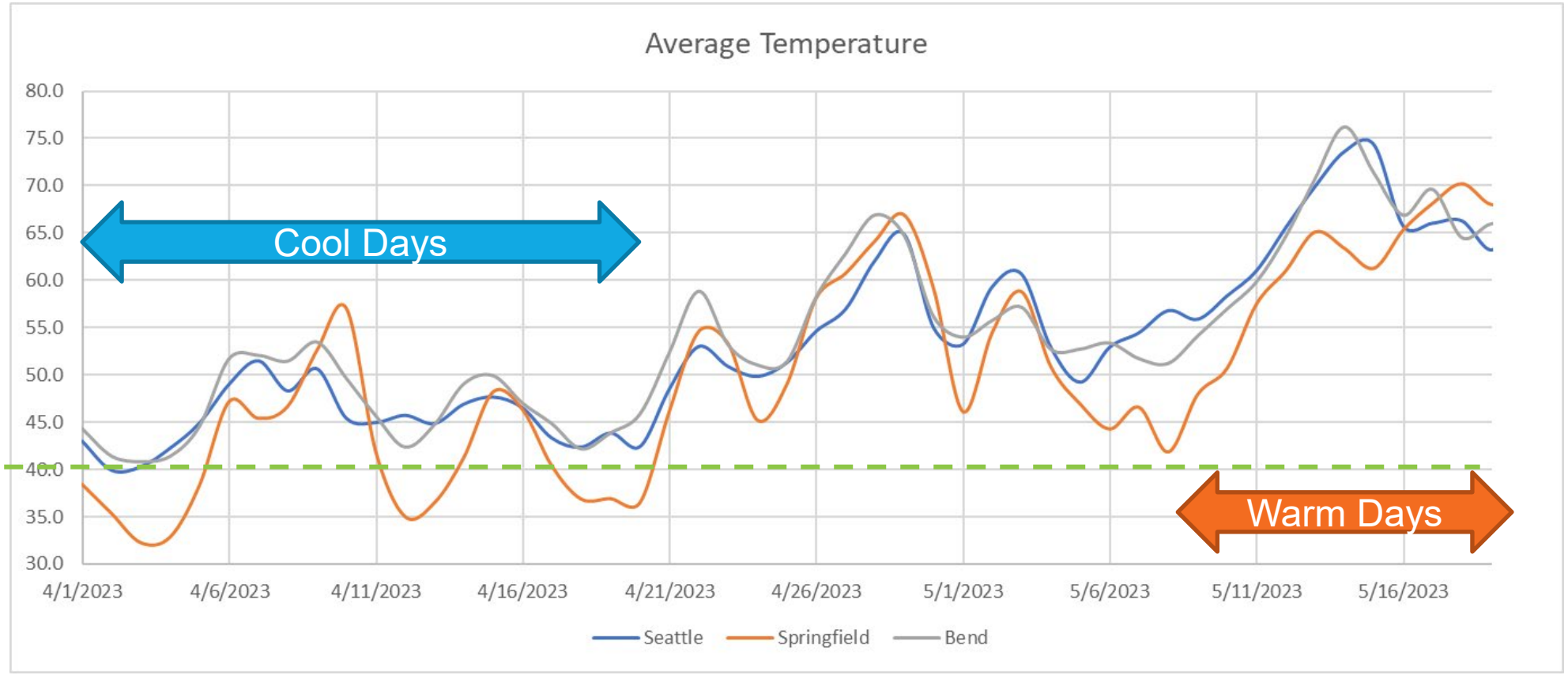


Participants were provided with video of logger installation

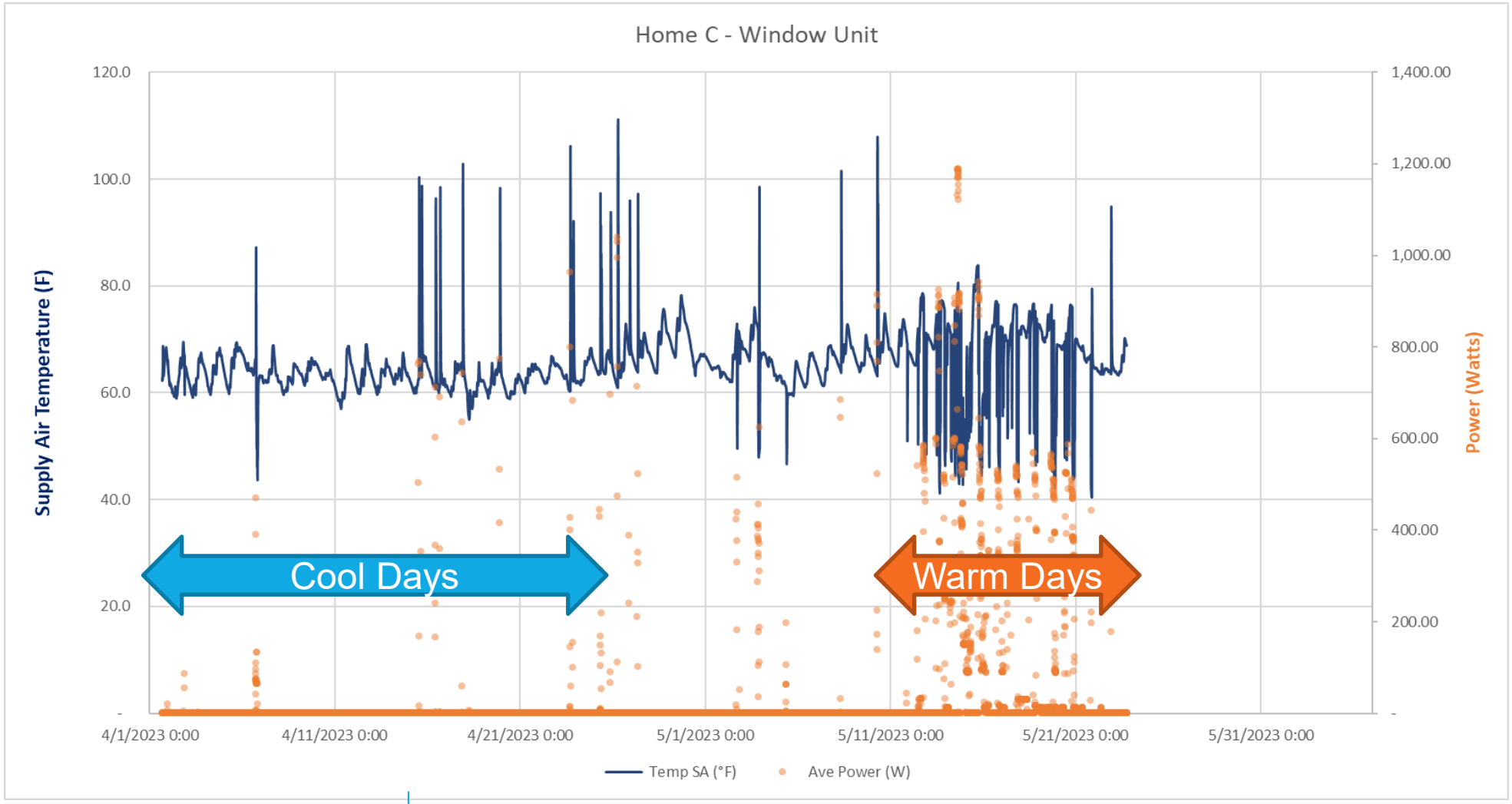
Observations and Take Aways

1. The window and portable units were not used for heating very much. This may be because the they are able to operate below 41°F or because of participant expectations.
2. All units displayed inverter driven system behavior with with multiple stages.
3. Gradient units appeared to have good part load operation control, but with lower delivered air temperature.
4. One unit was installed on a circuit that appeared to trip the breaker nearly every day.
5. Quite a few showed heating and cooling on the same day, even same hour. Probable reasons include:
   - They were set to “Auto” mode
   - Fighting existing heating system

Daily Average Temperatures During Field Test



Example: Limited Heating Use



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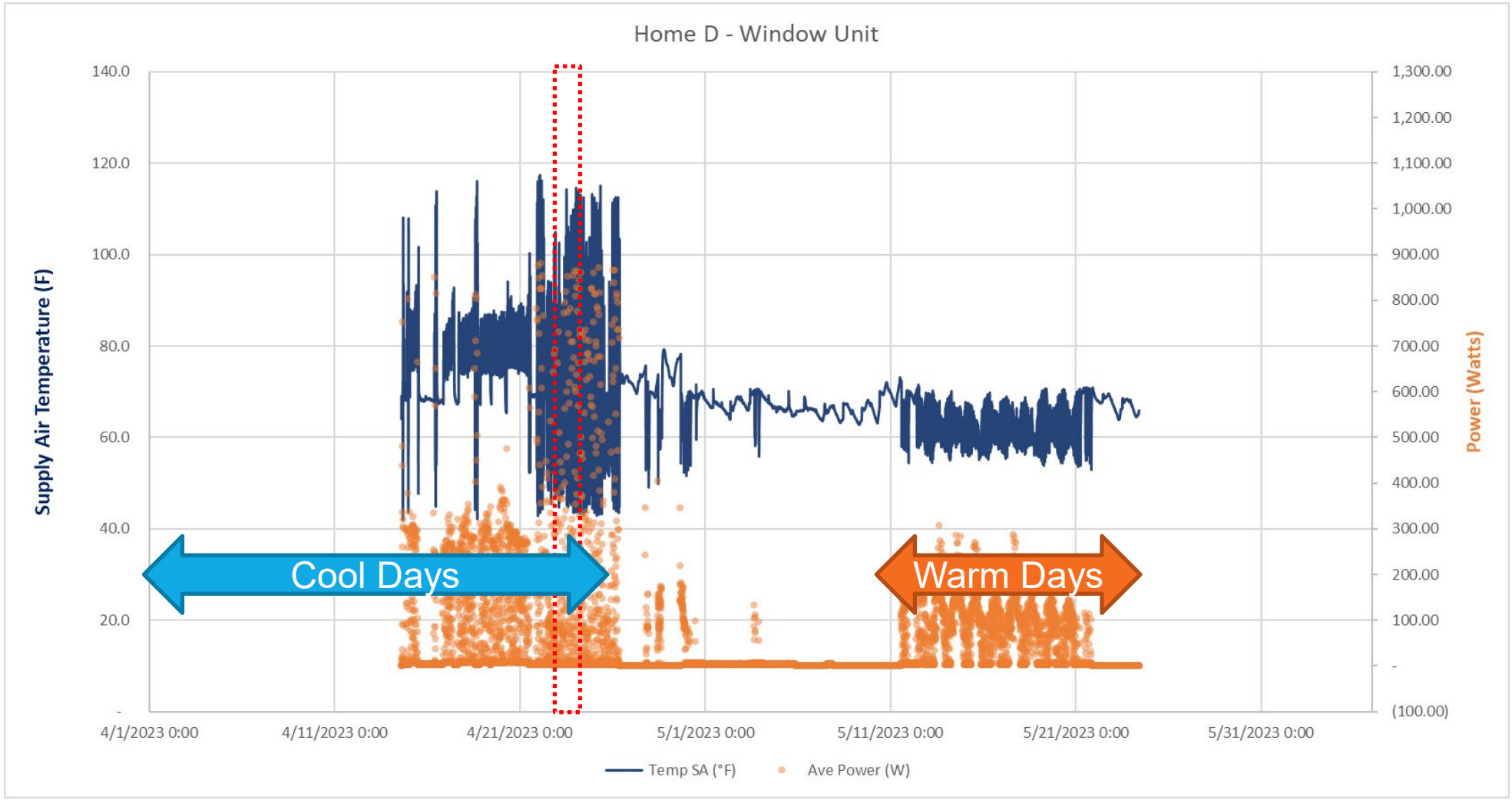
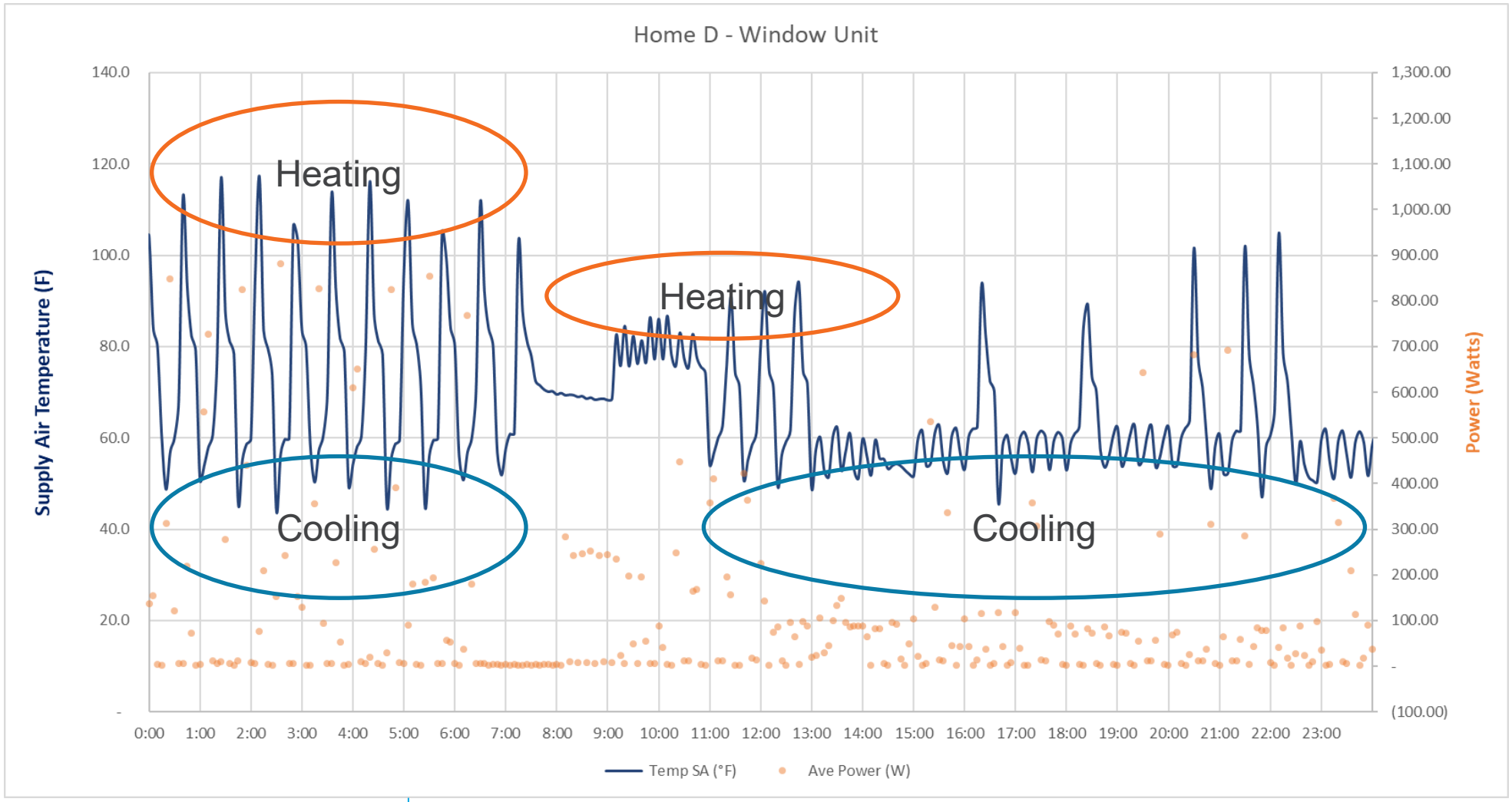
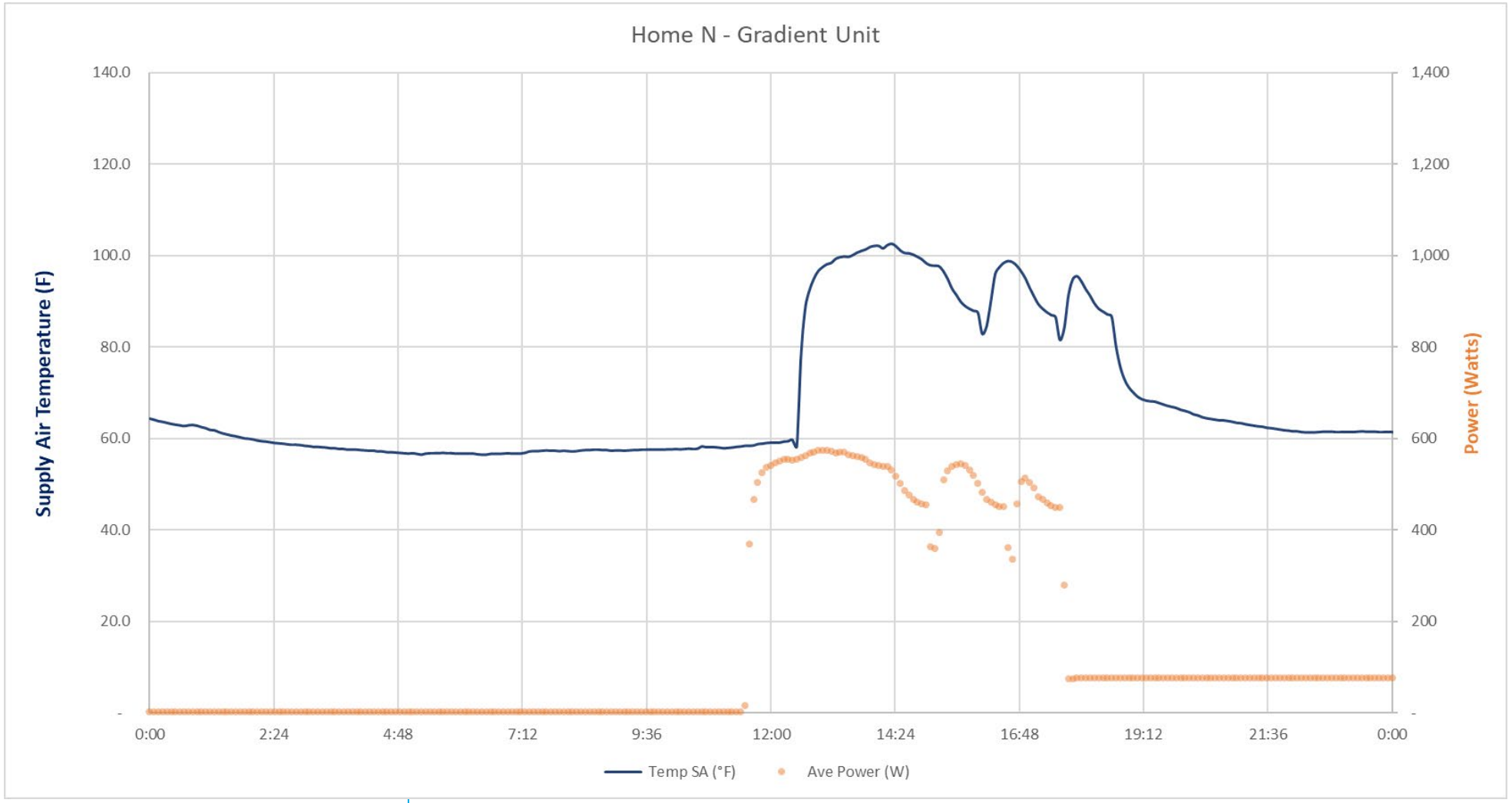
Example: Heating and Cooling



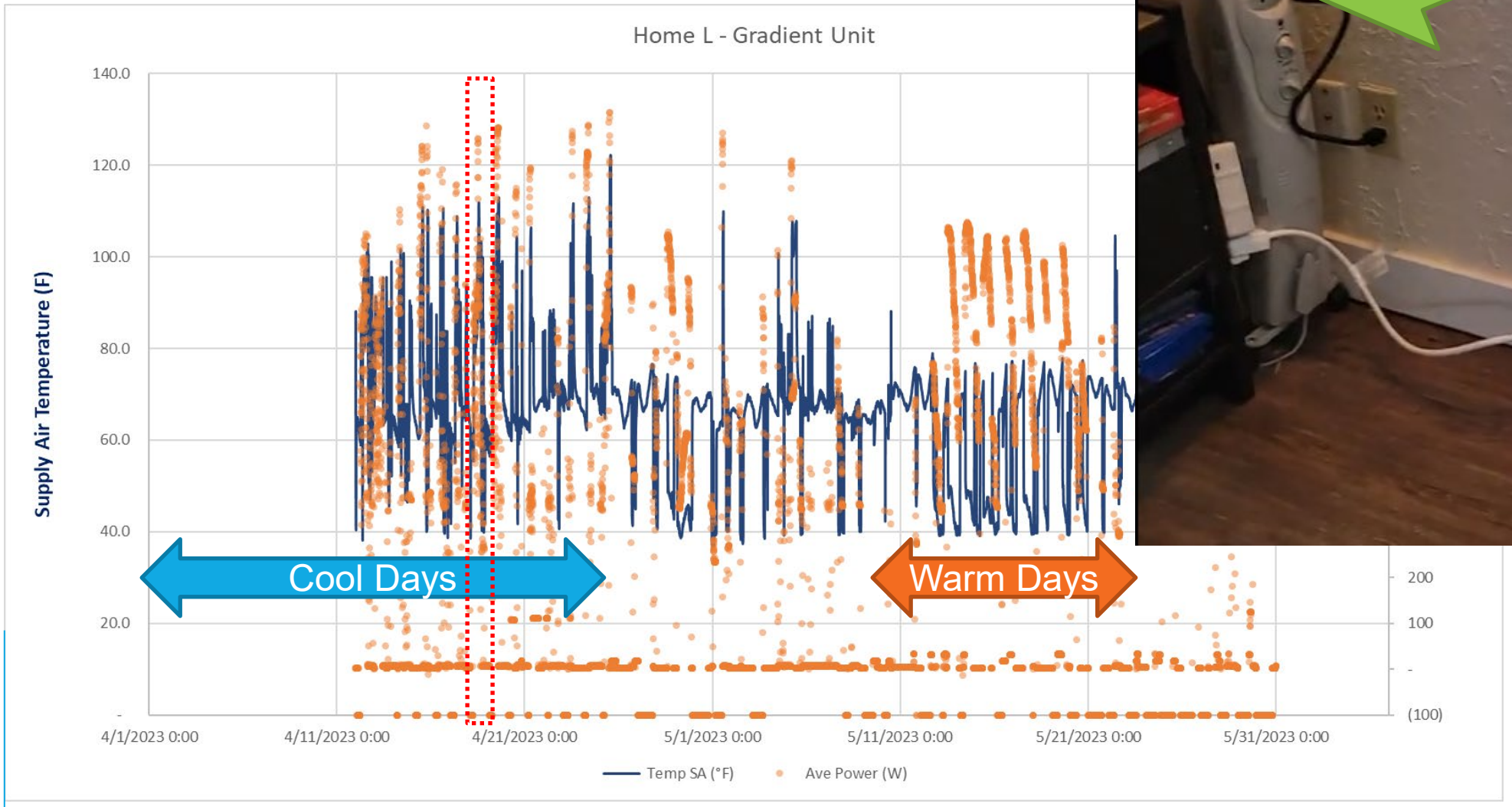
Heating and Cooling Detail



Variable Speed Behavior



Fighting Systems?



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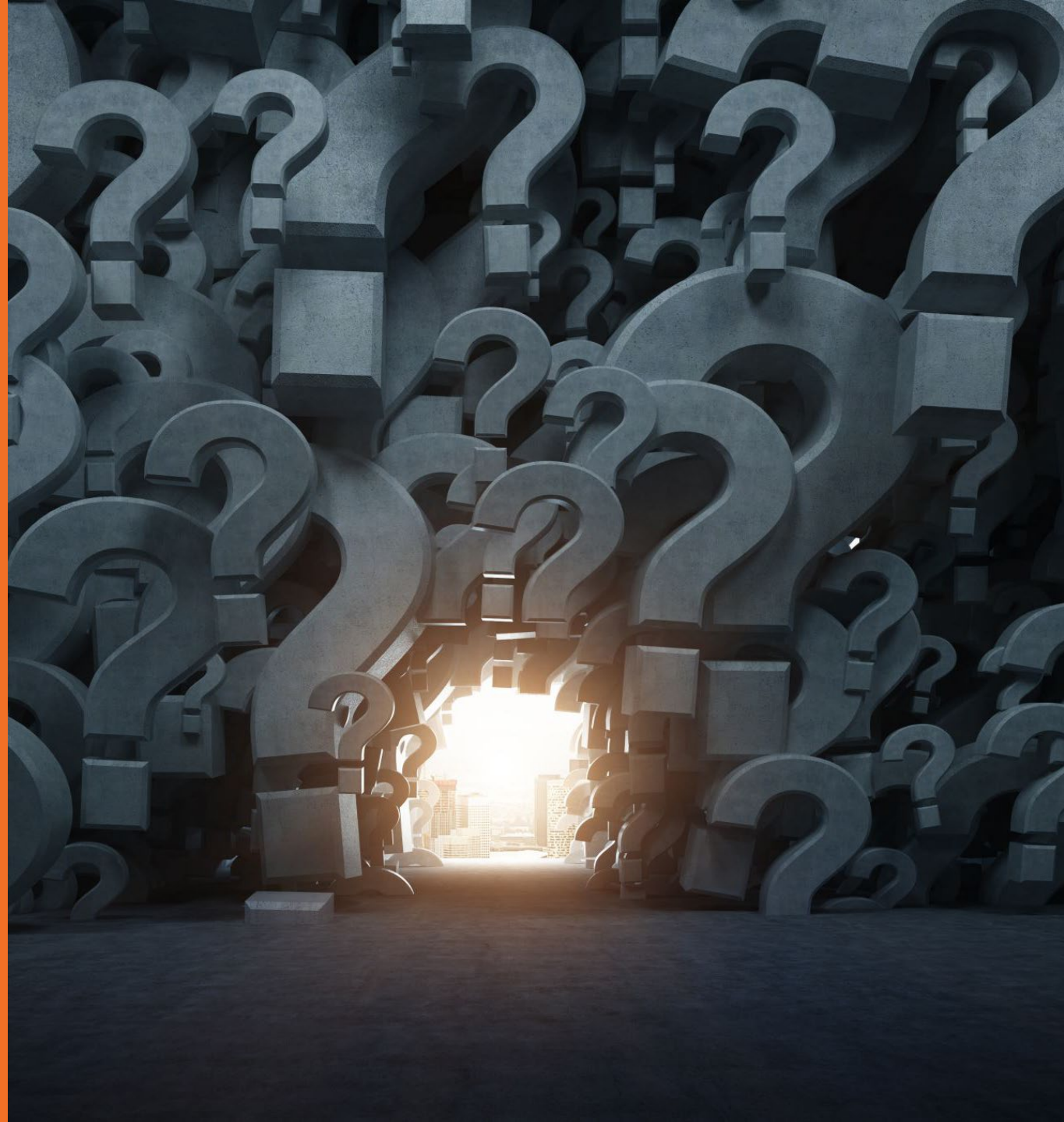
Notes

- Deployment into the field was 4-6 weeks late, resulting in limited days with heating loads. This resulted in not being able to evaluate behavior change from Activity #4 in which participants were to change the way the unit and existing heating system was operated.
- User installed loggers worked well, but we recommend future verification of temperature sensor locations.
- One power logger failed – no idea why.

Questions and Discussion



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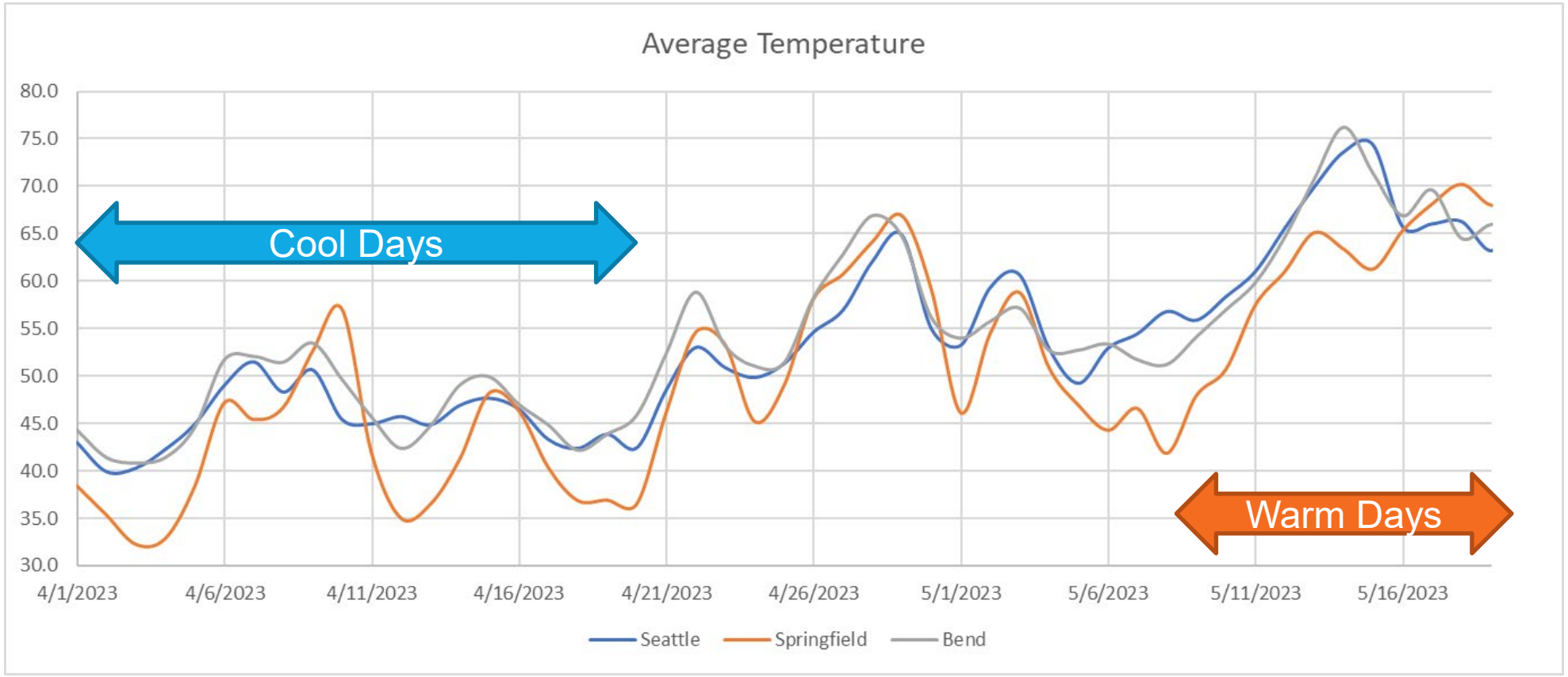
Field Data Slides

Installations

Home	City	Type	Start	Days	Notes
A	Lynnwood WA	Window	-	-	*Participant Returned Unit*
B	Fife WA	Window	4/4	60	
C	Seattle WA	Window	4/2	58	
D	Portland OR	Window	4/15	38	
E	King City OR	Window	-	-	*Participant Returned Unit*
F	Salem OR	Portable	4/1	69	
G	Renton WA	Portable	4/4	60	
H	Bend OR	Portable	4/16	44	*Power Logger Fail*
I	Springfield OR	Portable	4/8	53	
J	-	Portable	-	-	*Whytner Unit – held back for testing*
K	Everette WA	Gradient	4/17	38	
L	Salem OR	Gradient	4/12	48	*Unplugged or breaker tripped almost every day*
M	Tacoma WA	Gradient	4/6	47	*Temp sensor appears to be placed incorrectly*
N	Brownsville OR	Gradient	4/15	53	
O	Seattle WA	Gradient	4/16	52	
P	-	Gradient	-	-	*Unit kept at NEEA for future Testing*

Hide Participants Names

Average Temperatures During Field Test



Six Activities

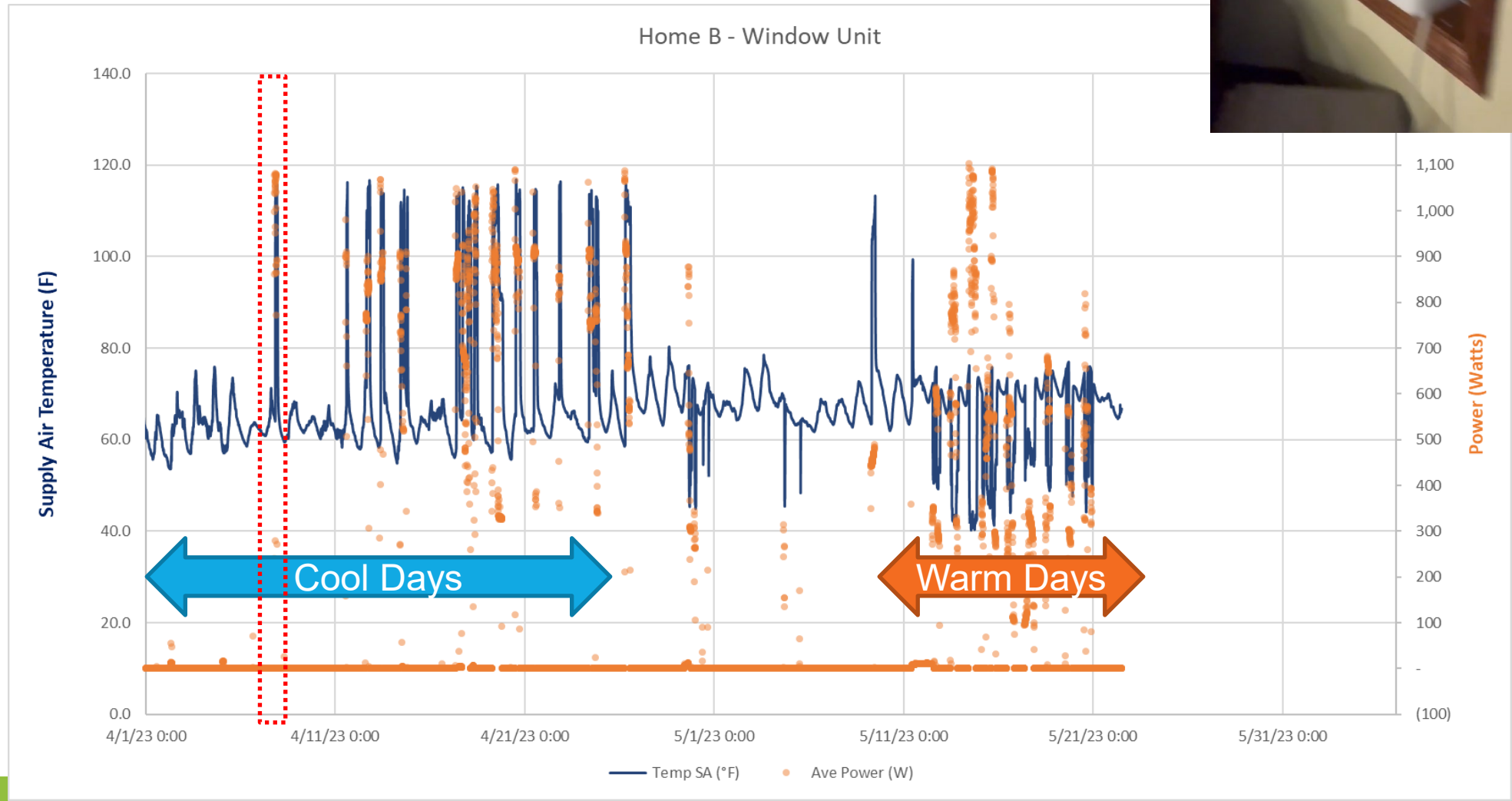
1. Activity #1: **Introduction + Video**
   - (Gather initial feedback on installation process, first impressions of heat pump)
   - 4/3 – 4/17
2. Activity #2: **Experience Journal**
   - (Gather general information on early heat pump usage/behaviors and share heat pump tips)
   - 4/12 – 4/19
3. Activity #3: **Occasions**
   - (Gather insights on usage of the heat pump as a primary source of heat)
   - 4/19 – 5/2 *(Raquel completed late on 5/31)
4. Activity #4: **Temperature Tip**
   - (See if participants willing to adjust temperatures of heat pump & other heating sources to test efficiency)
   - May 4 – May 15
   - (Rebeka completed late on 5/21 and Raquel completed late on 5/31)
5. Activity #5: **Imagine + Describe**
   - (How they'd describe the product/tech to someone they know)
   - 5/15 – 5/23 (Raquel completed late on 5/31)
6. Activity #6: **Overall Experience + Final Thoughts**
   - (Gather feedback on overall experience using the heat pump and expected future usage)
   - 5/23 – 5/29

**Note some of these timeframes vary and/or had to be extended to ensure that all participants completed each activity.*

Home B - Window

Good T_{SA} sensor location

- Heating 3% of the time during cool days



Heating means
T_{SA} > 70°F

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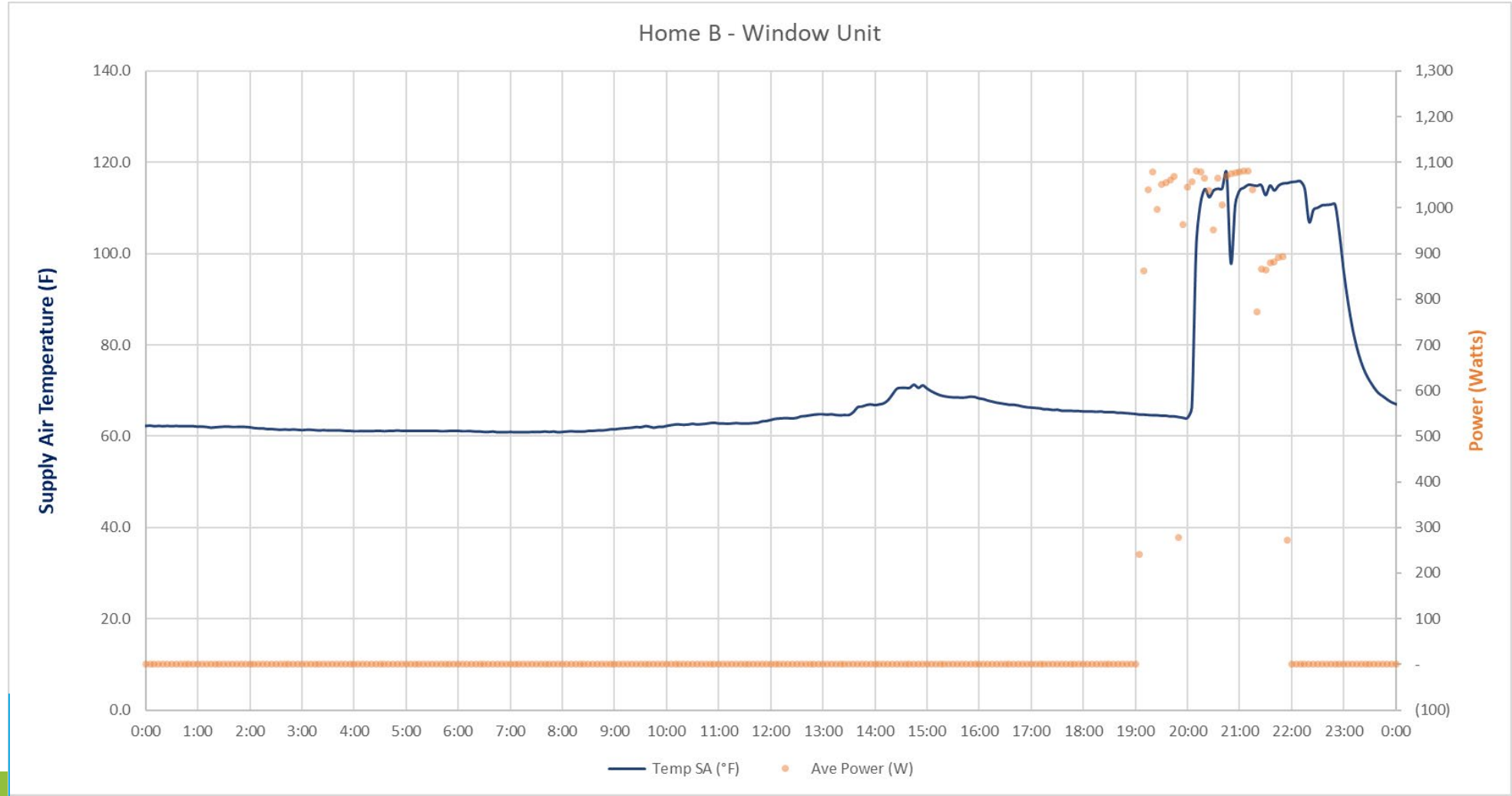
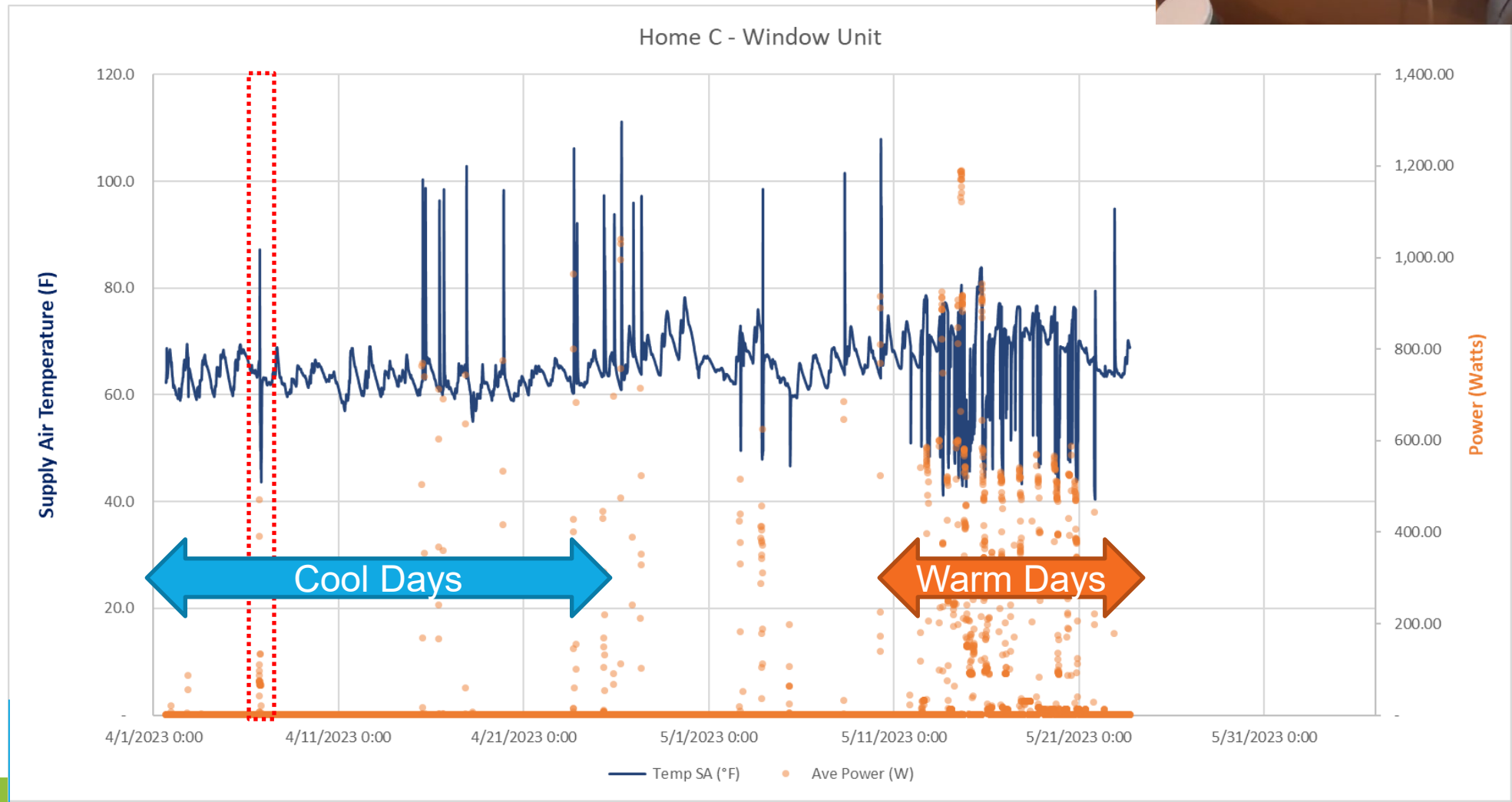
Home B - Window

- April 7



Home C - Window

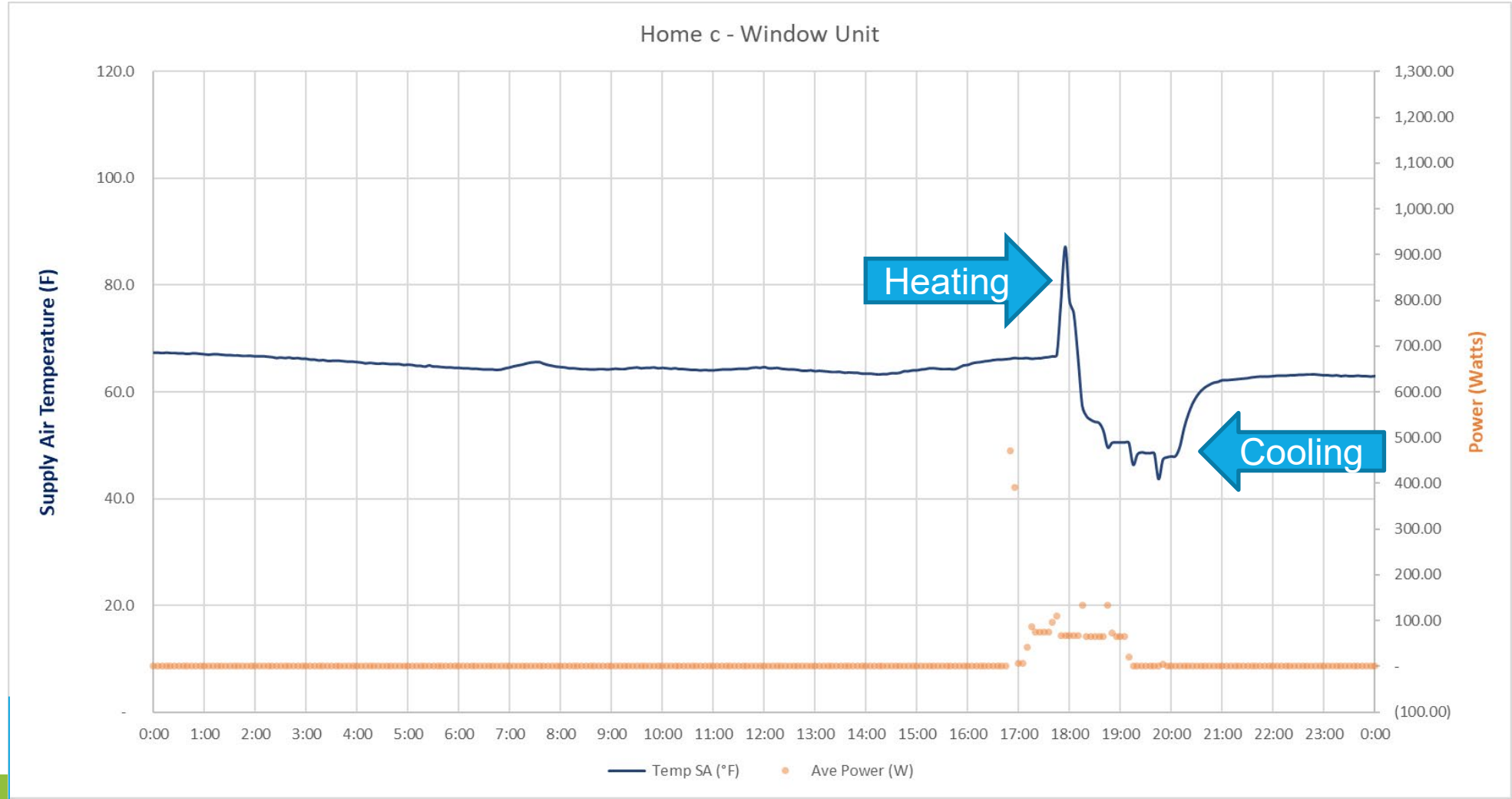
- Heating <1% of the time during cool days



Heating means
T_{SA} > 70°F

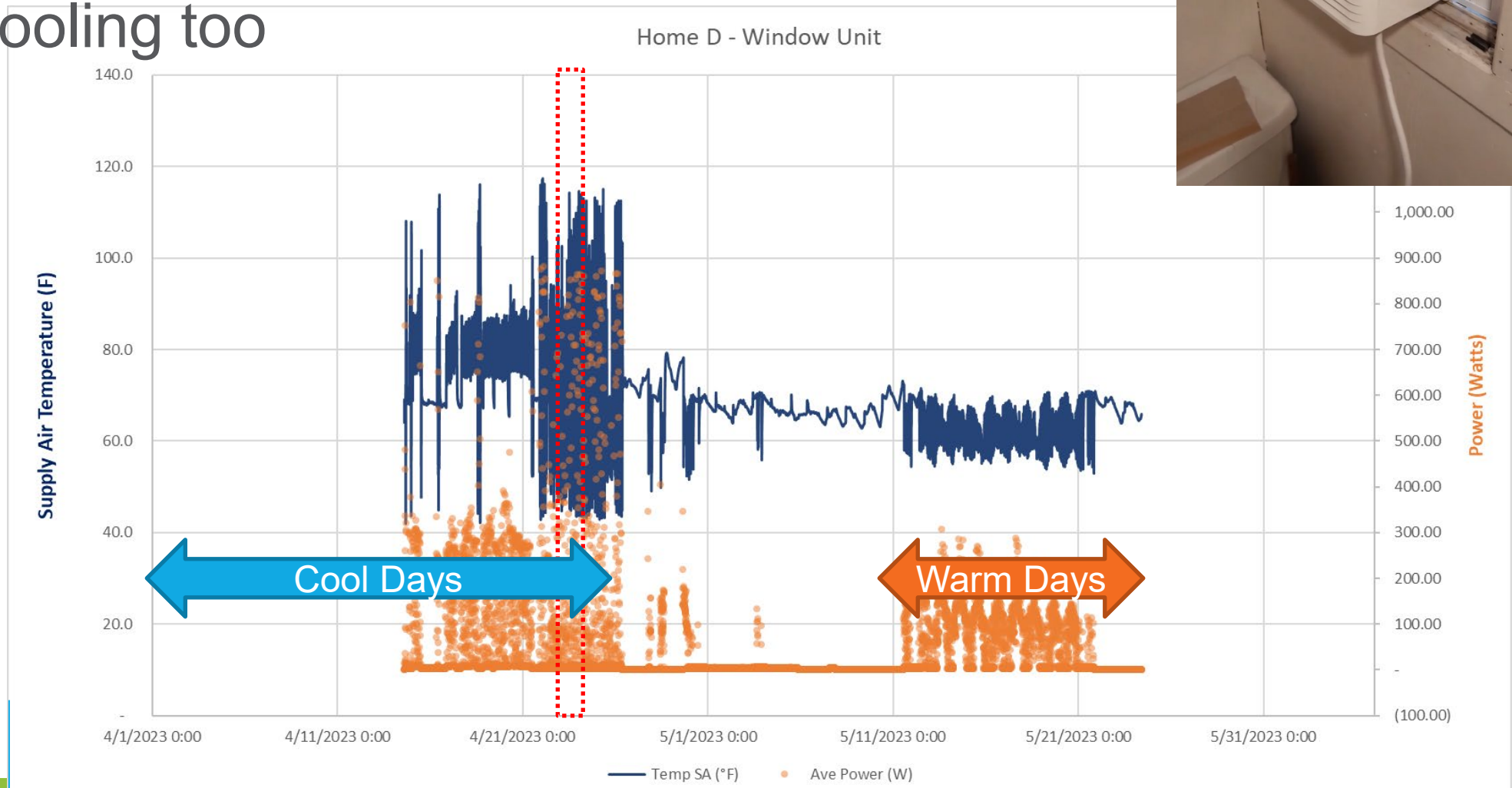
Home C - Window

- April 6th



Home D - Window

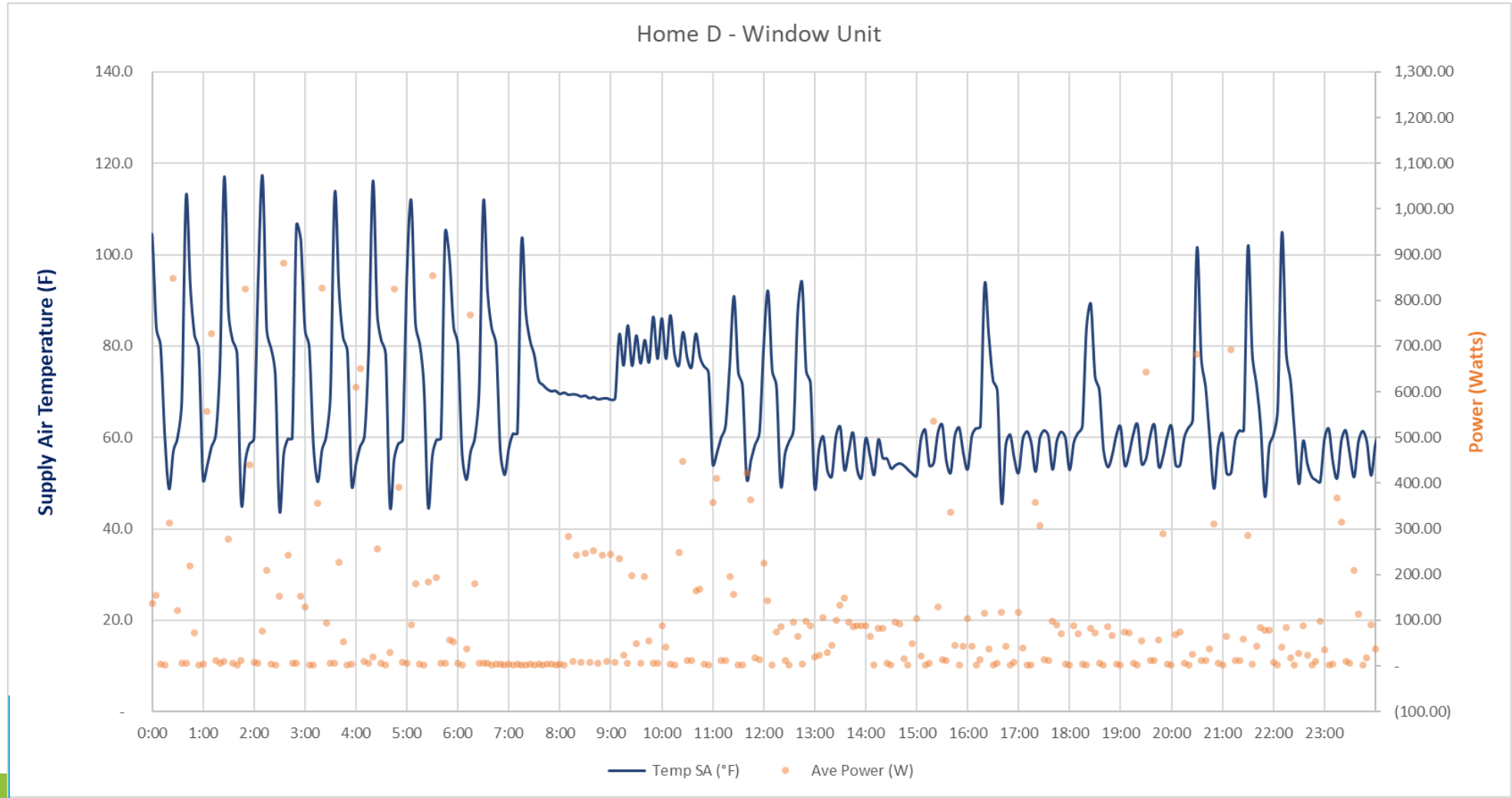
- Heating 52% of the time during cool days
- Lots of Cooling too



Heating means
$T_{SA} > 70°F$

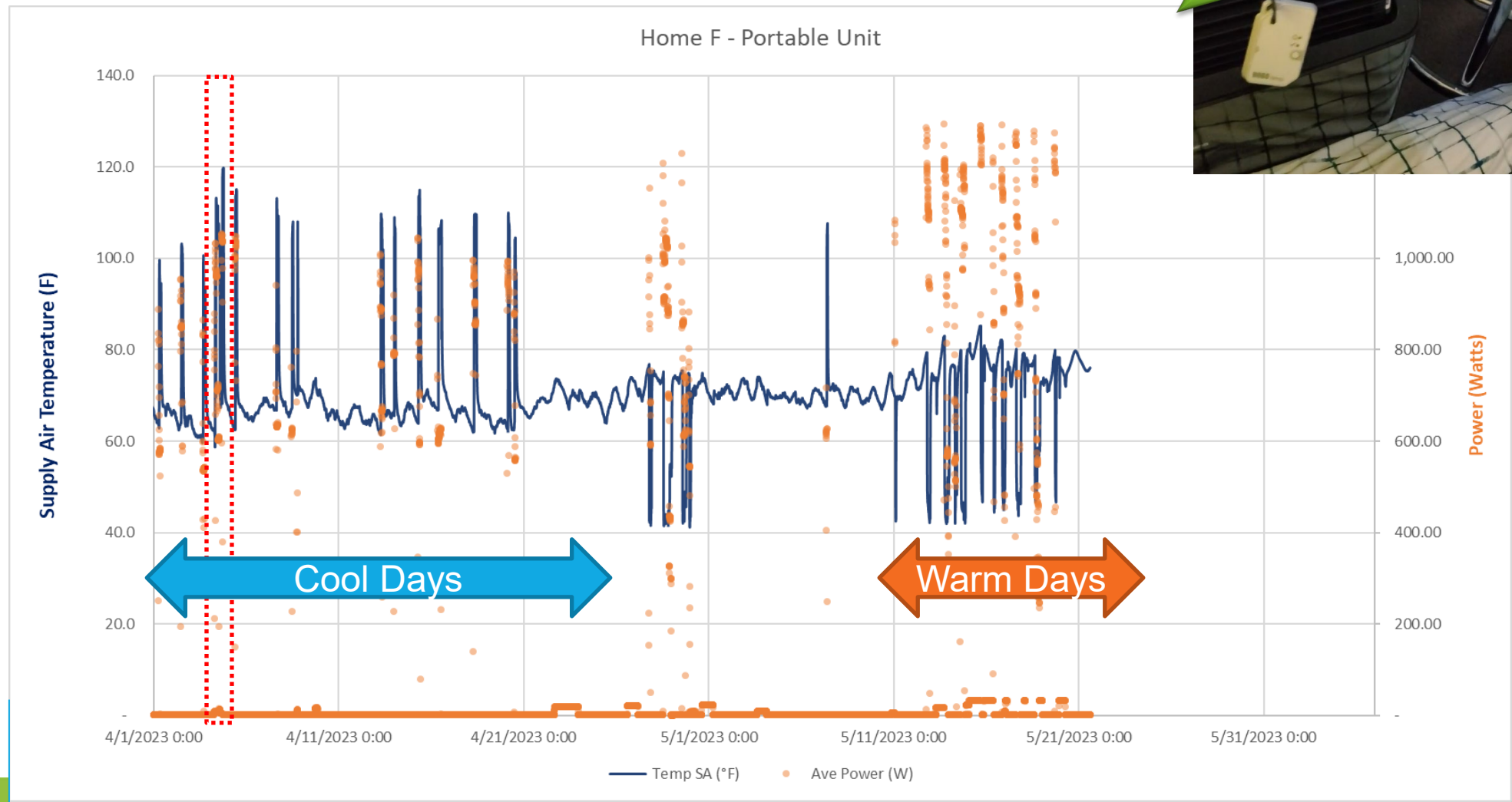
Home D - Window

- April 22nd



Home F - Portable

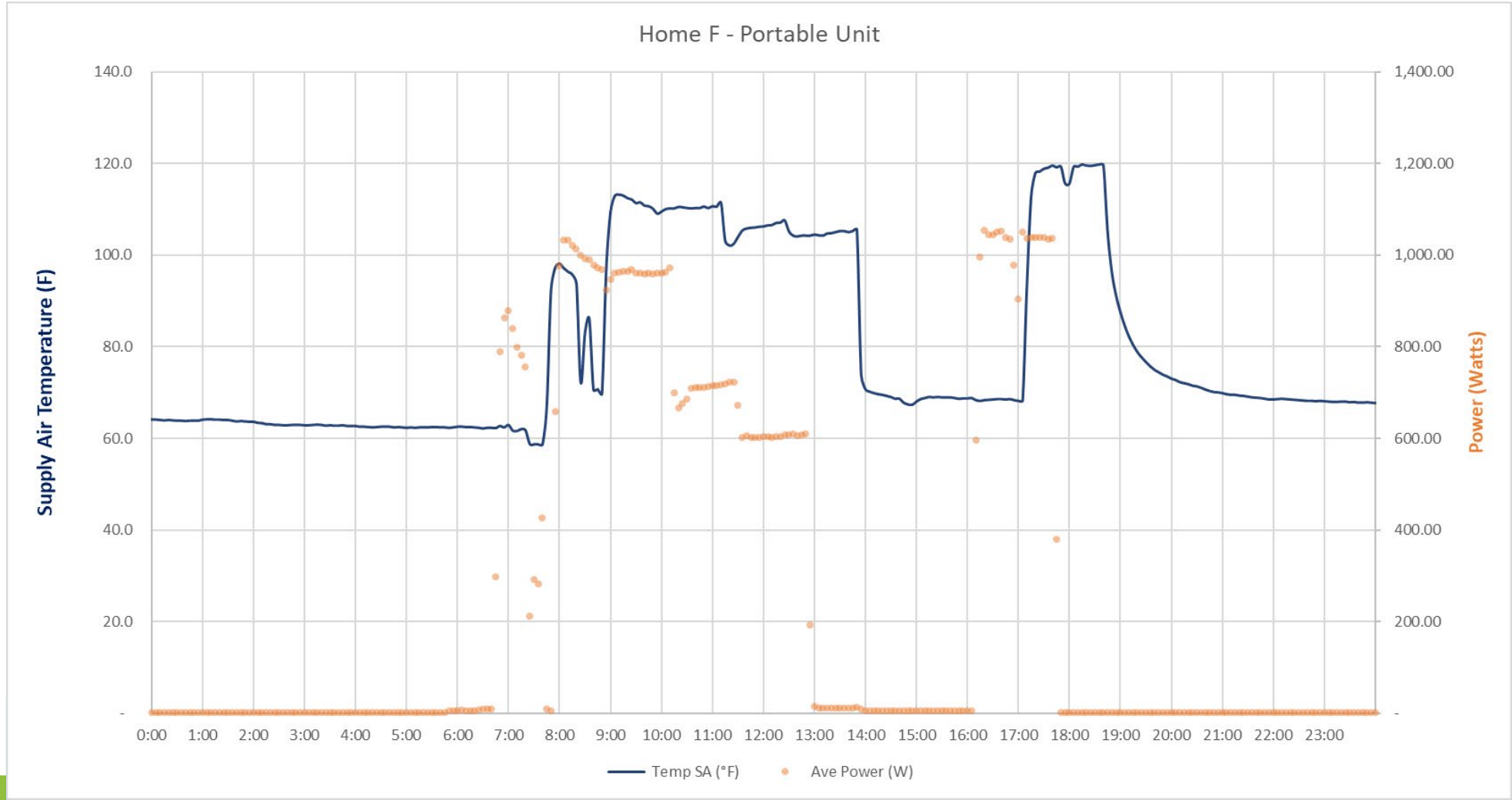
- Heating 9% of the time during cool days



Heating means
$T_{SA} > 70°F$

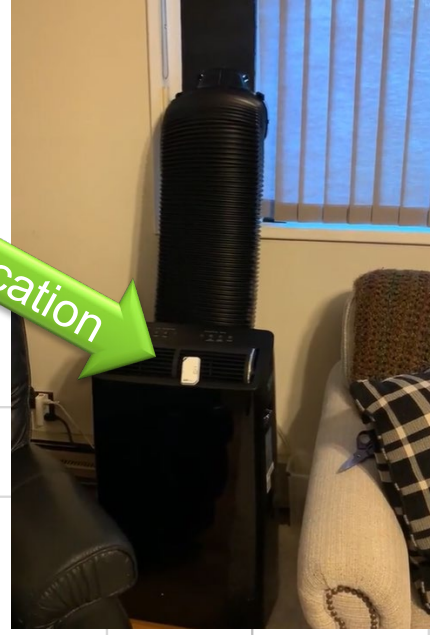
Home F - Portable

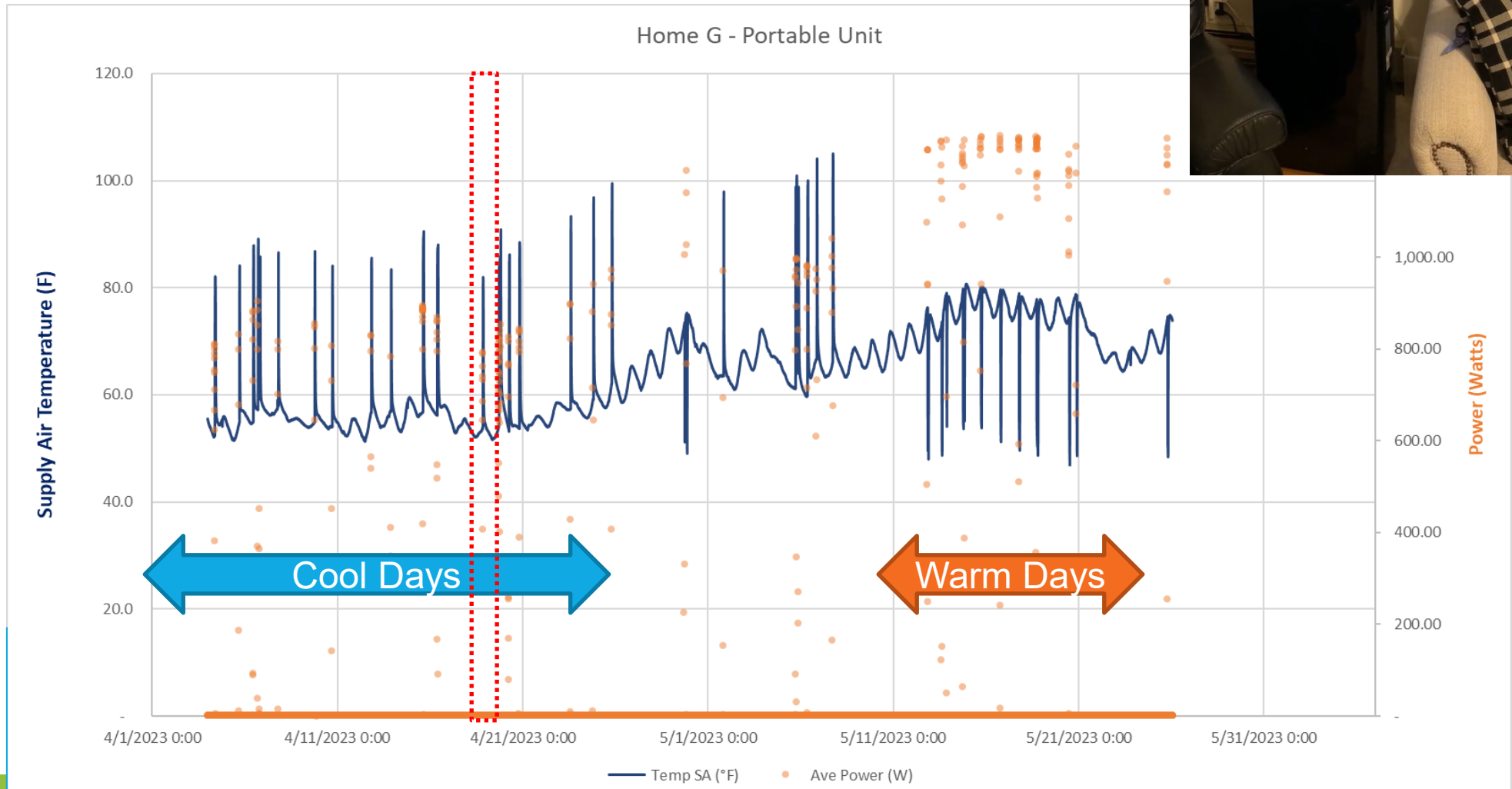
- April 4th



Home G - Portable

- Heating 1% of the time during cool days

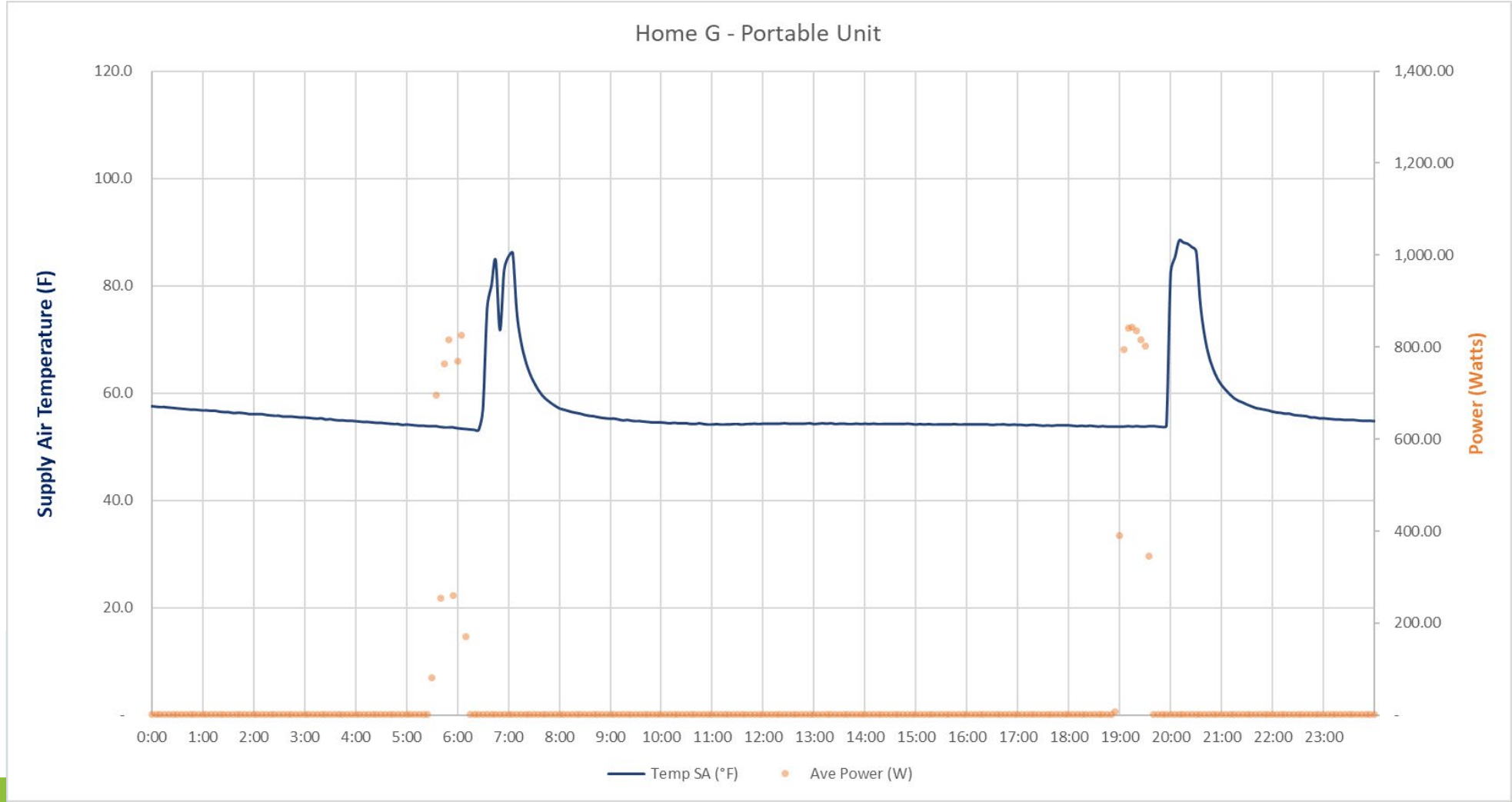




Heating means
T_{SA} > 70°F

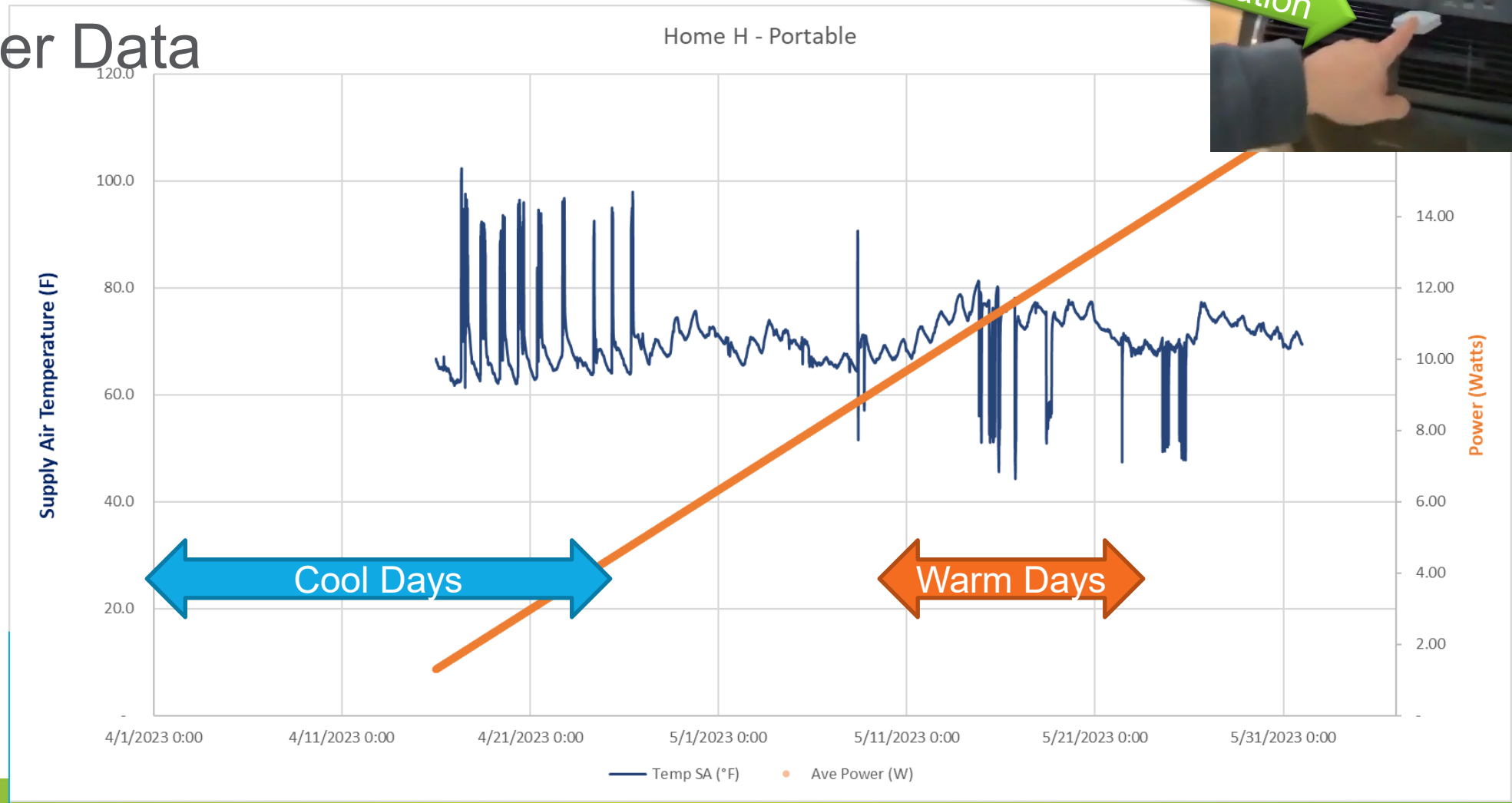
Home G - Portable

- April 20th



Home H - Portable

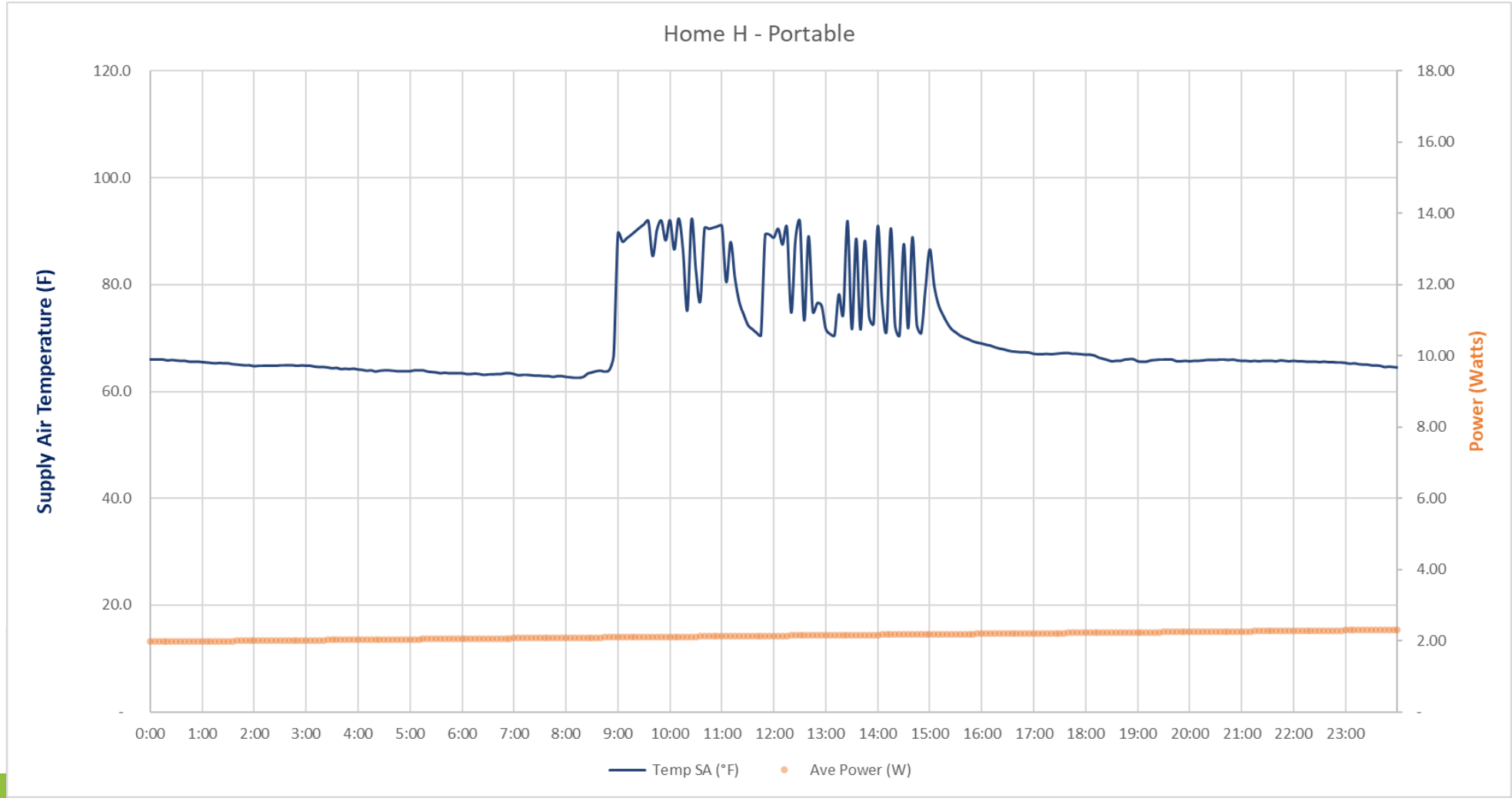
- Heating 23% of the time during cool days
- Bad Power Data



Heating means
$T_{SA} > 70°F$

Home H - Portable

- April 18th



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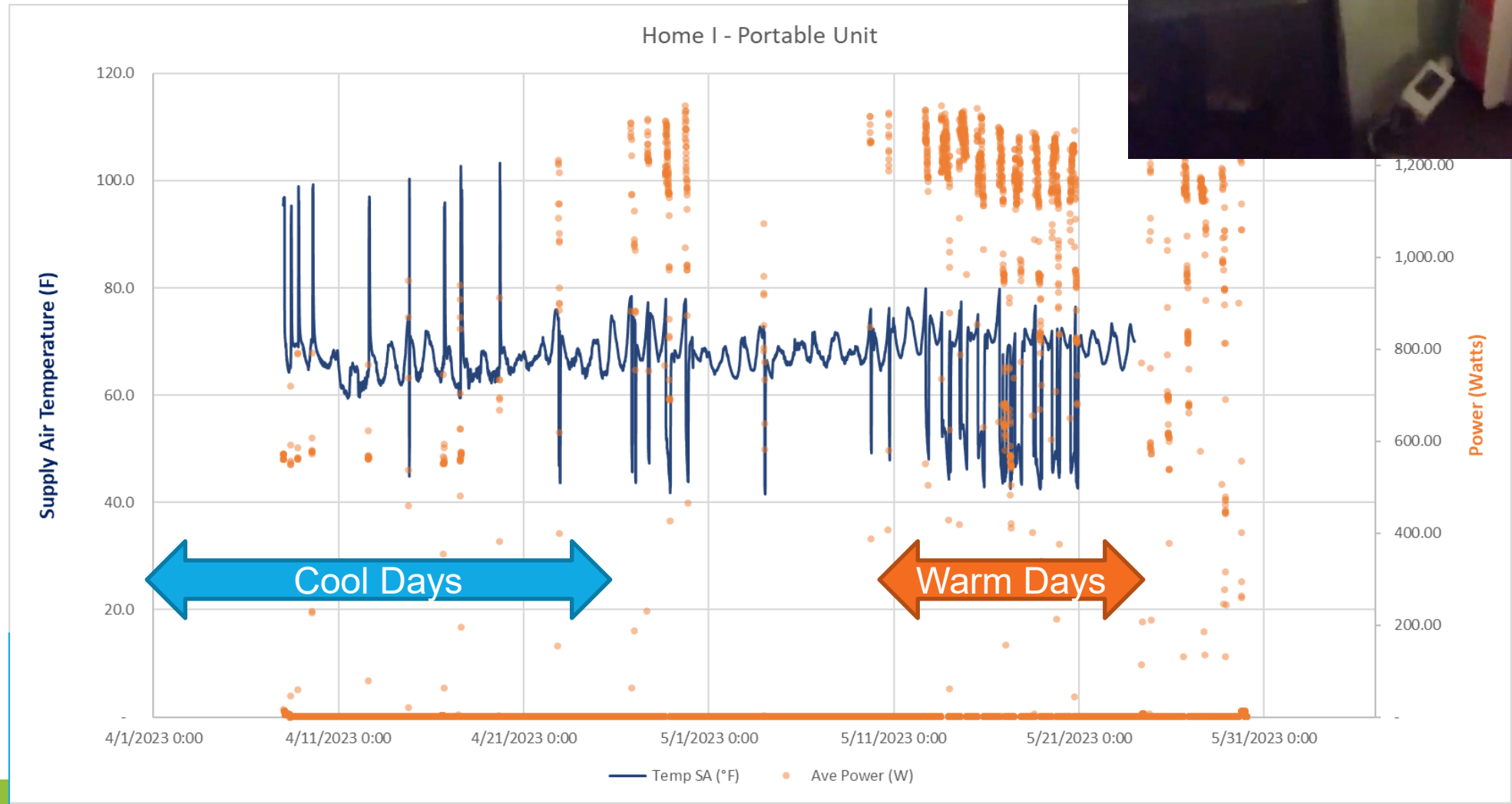
Home I - Portable

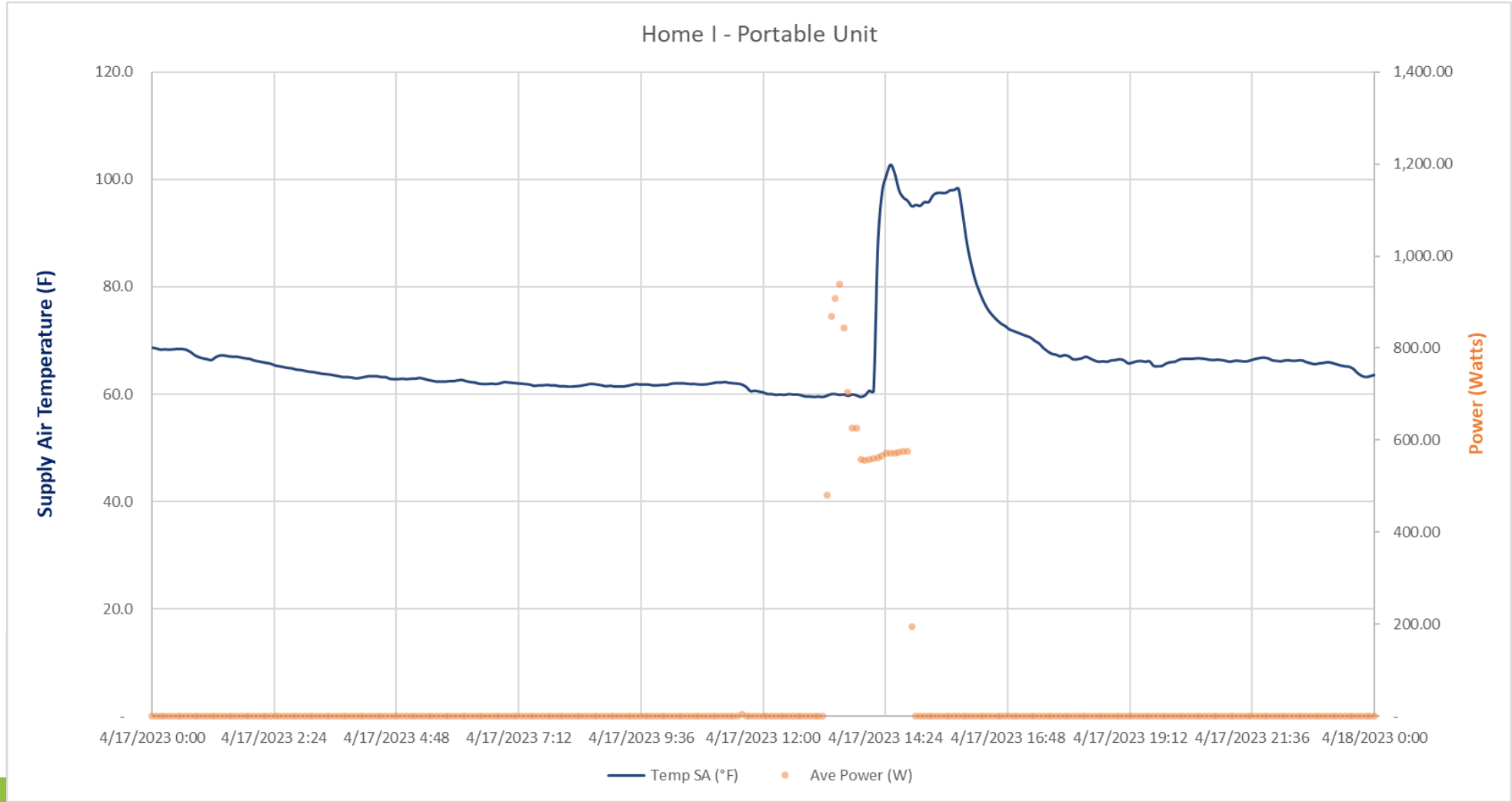
- Heating 7% of the time during cool days



Heating means
T_{SA} > 70°F

Home I - Portable

- April 17th



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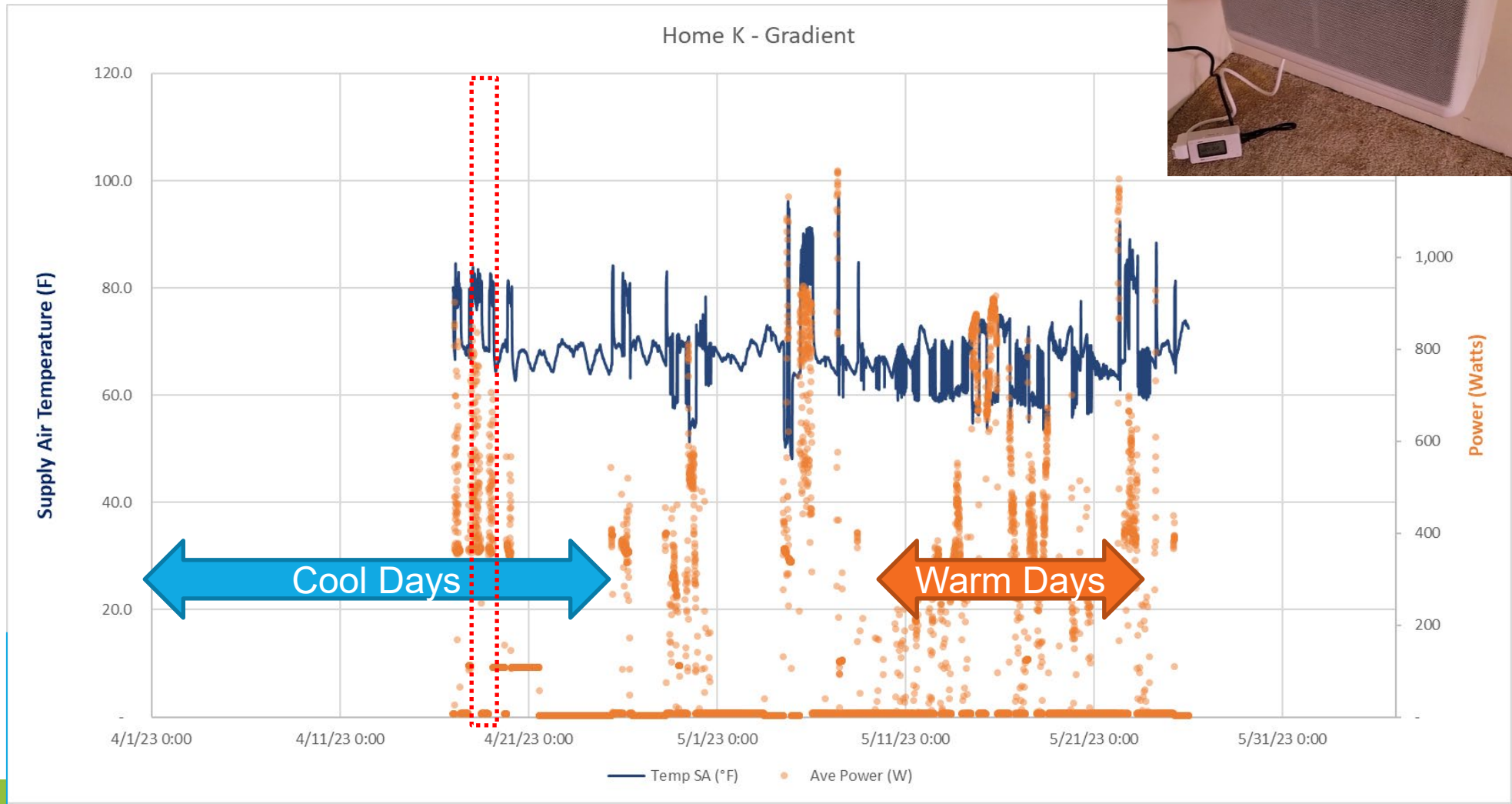
Home K - Gradient

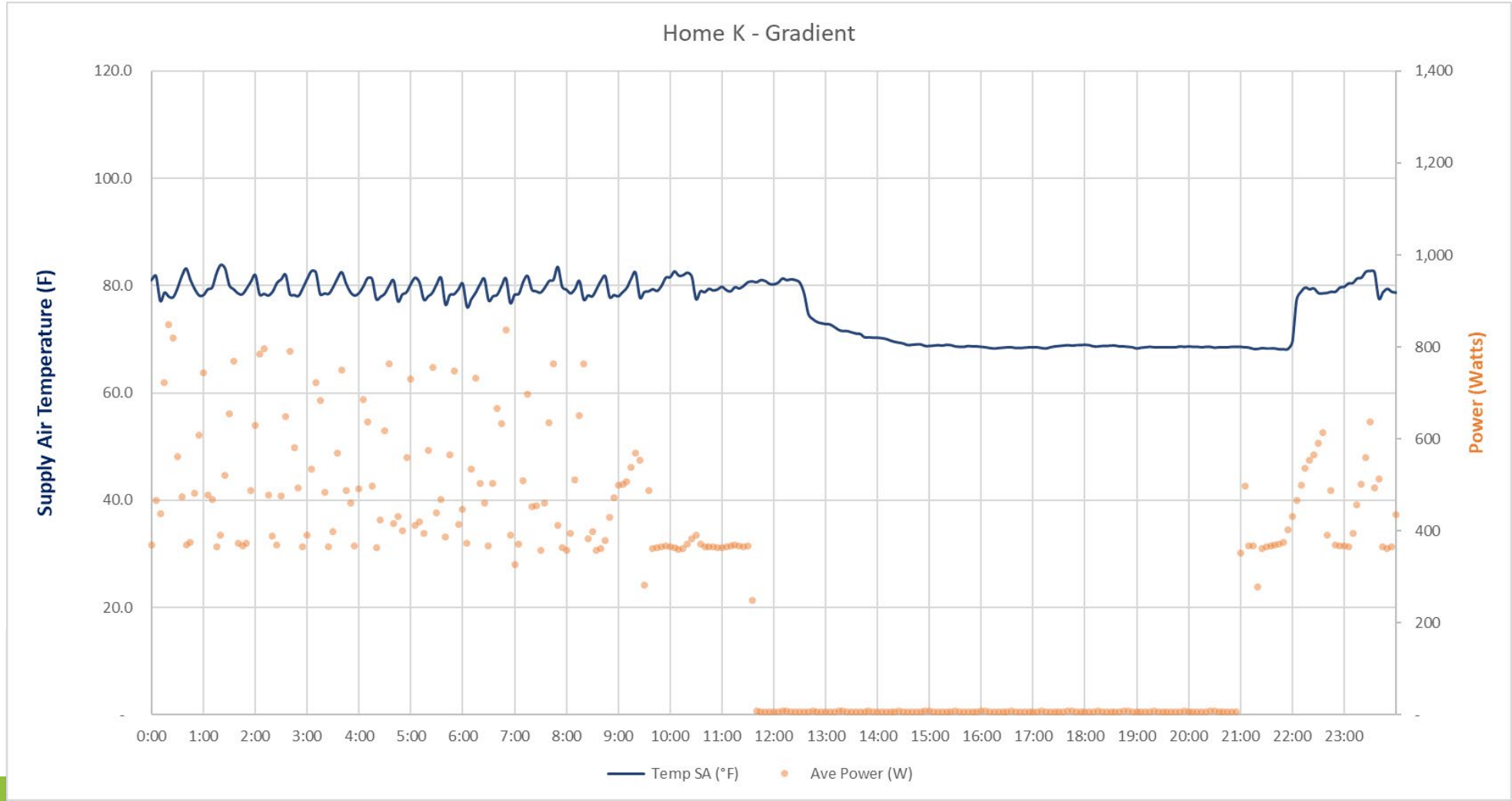
- Heating 6% of the time during cool days



Heating means
T_{SA} > 70°F

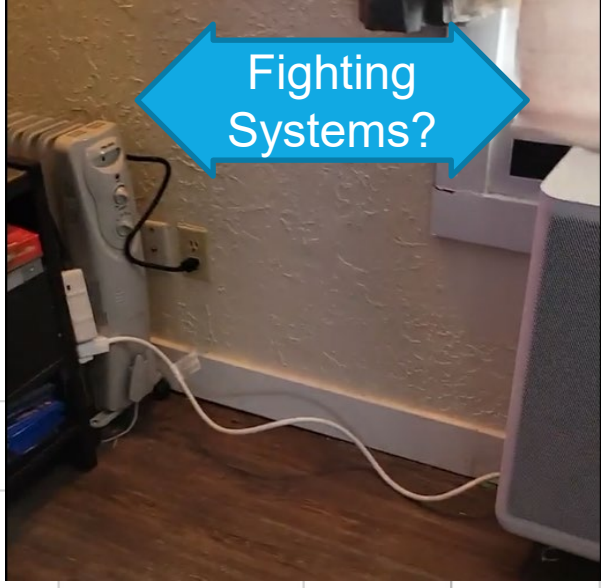
Home K - Gradient

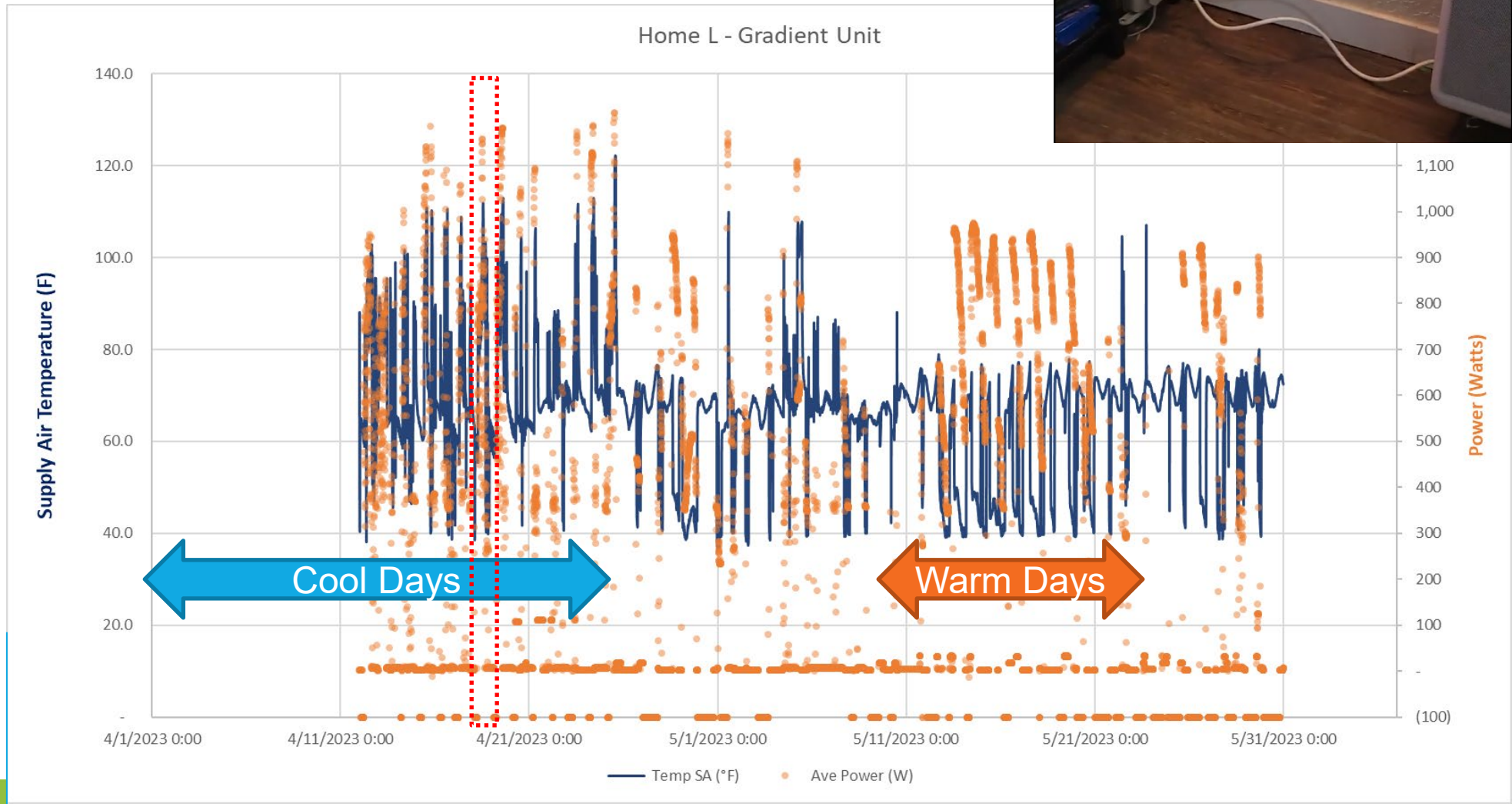
- April 18



Home L - Gradient

- Heating 31% of the time during cool days

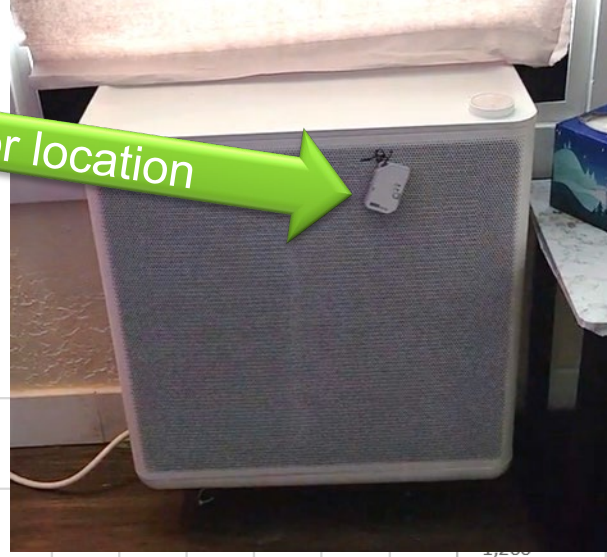


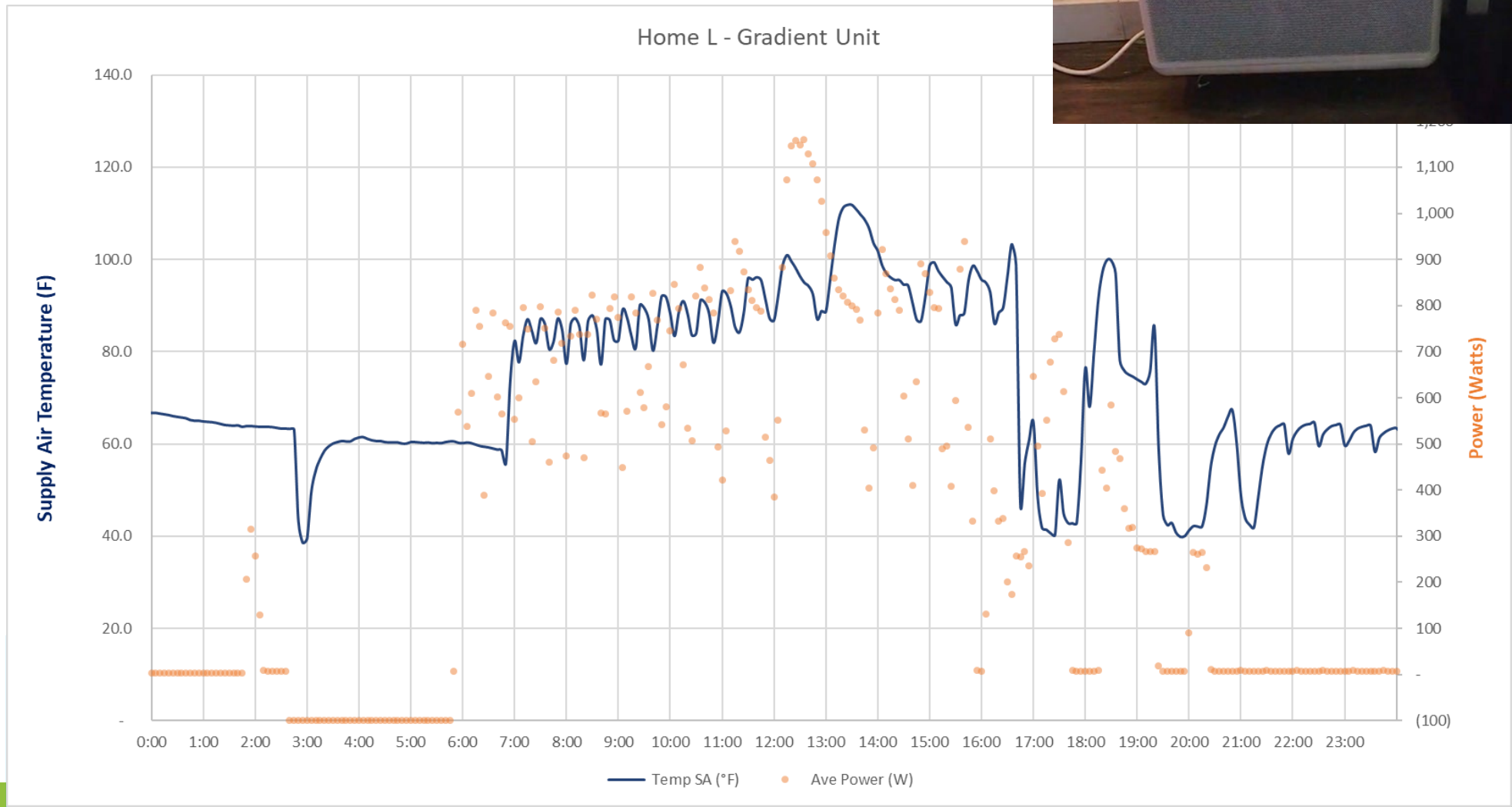


Heating means $T_{SA} > 70°F$

Home L - Gradient

- April 18th

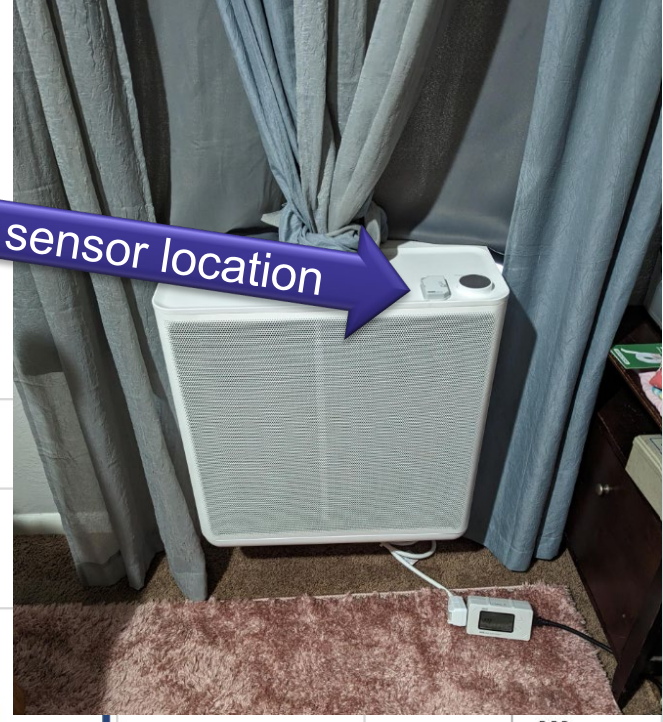


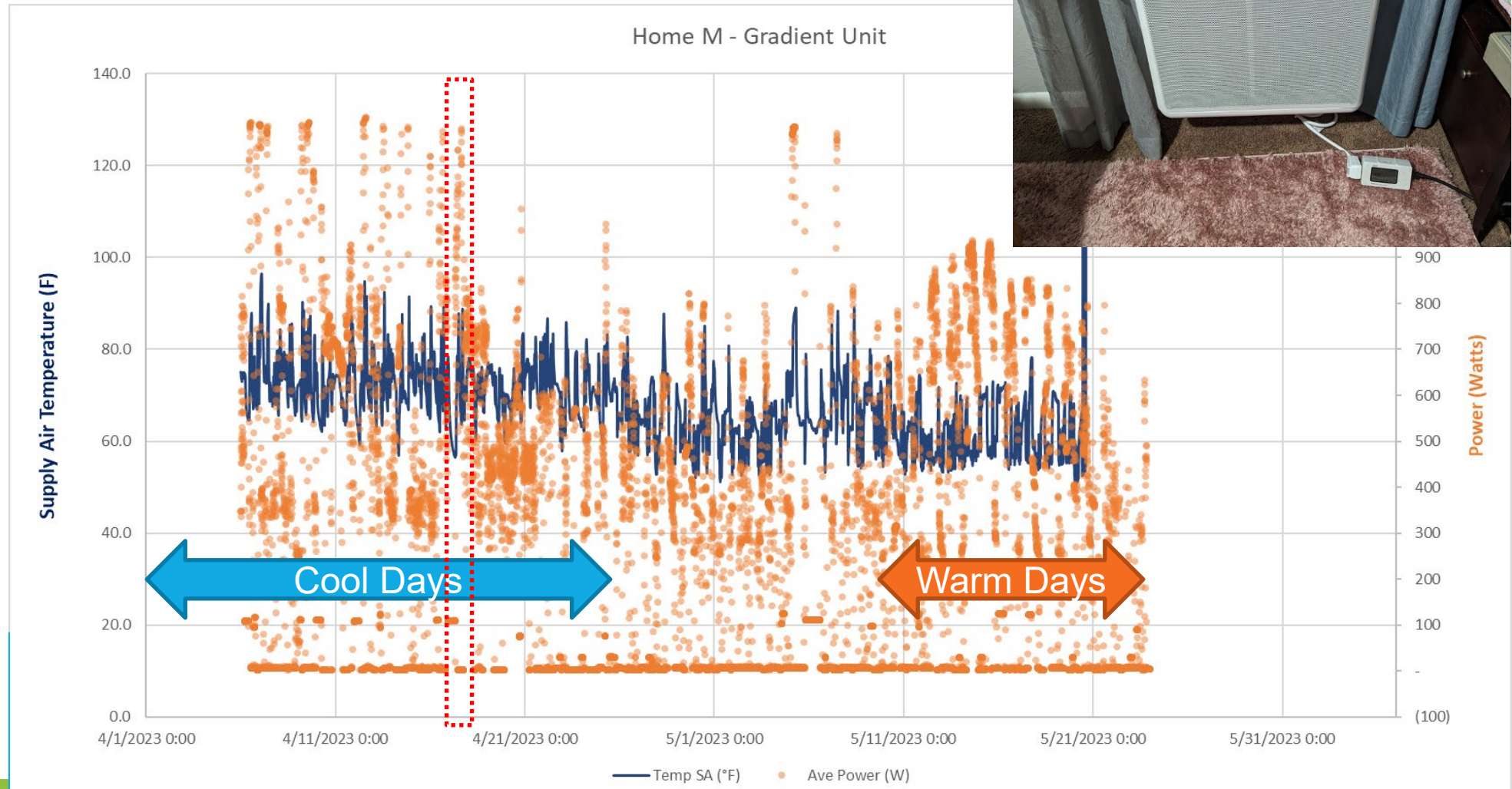


Heating means
T_{SA} > 70°F

Home M - Gradient

- Heating 7% of the time during cool days

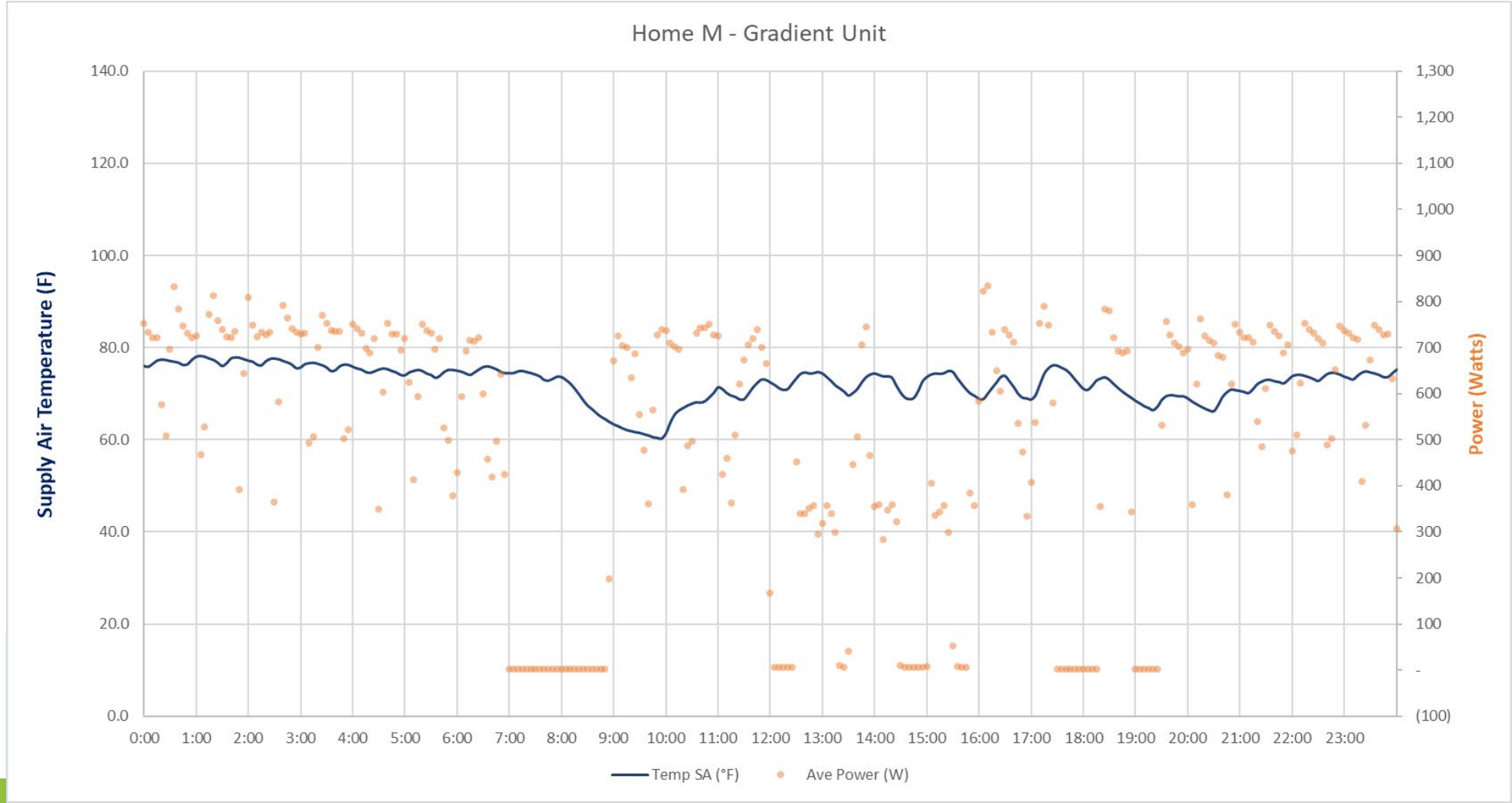




Heating means $T_{SA} > 70°F$

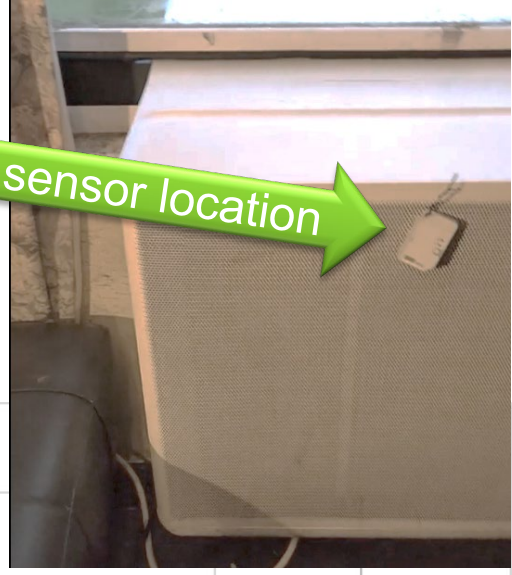
Home M - Gradient

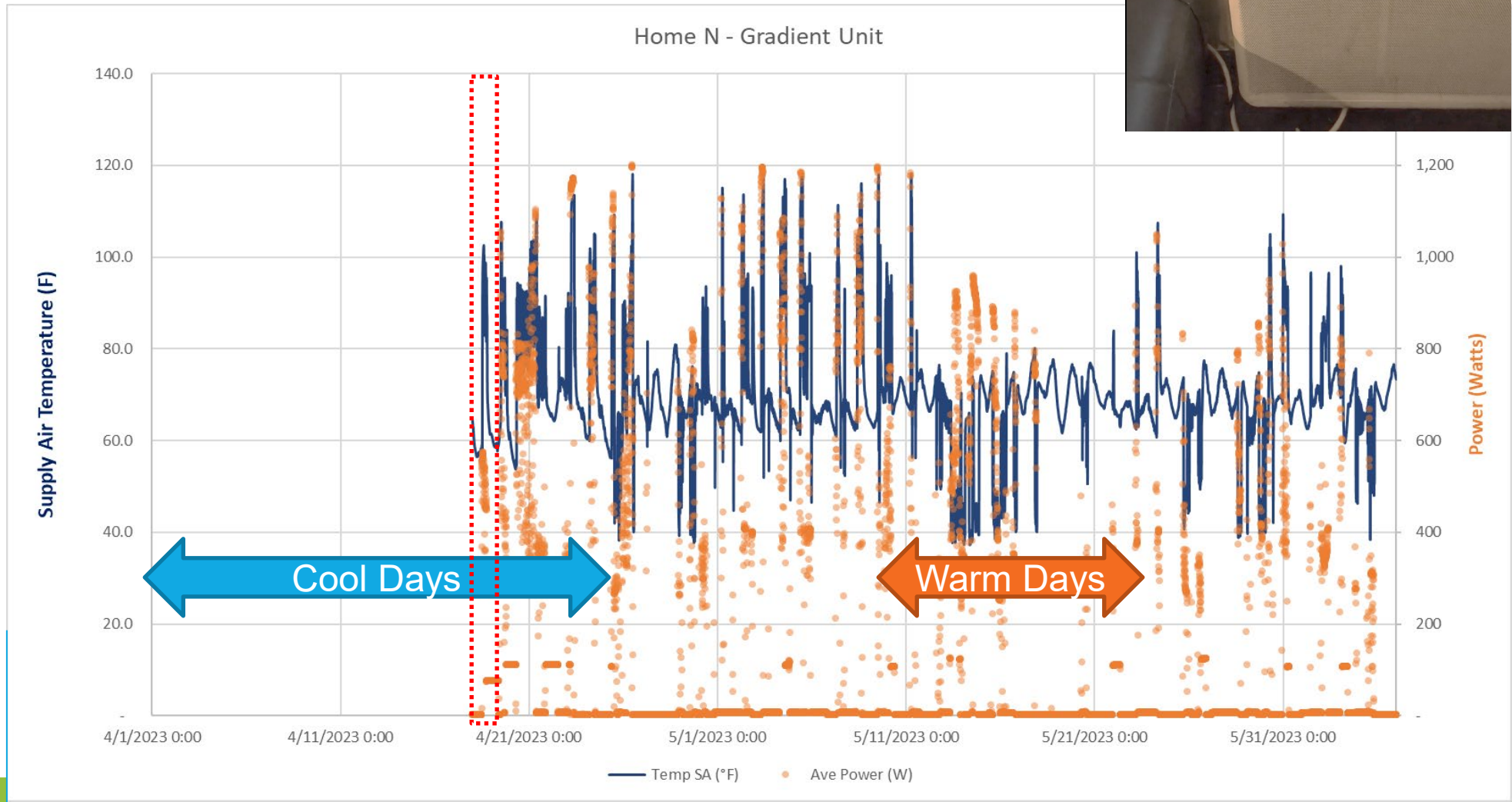
- April 18th



Home N - Gradient

- Heating 37% of the time during cool days

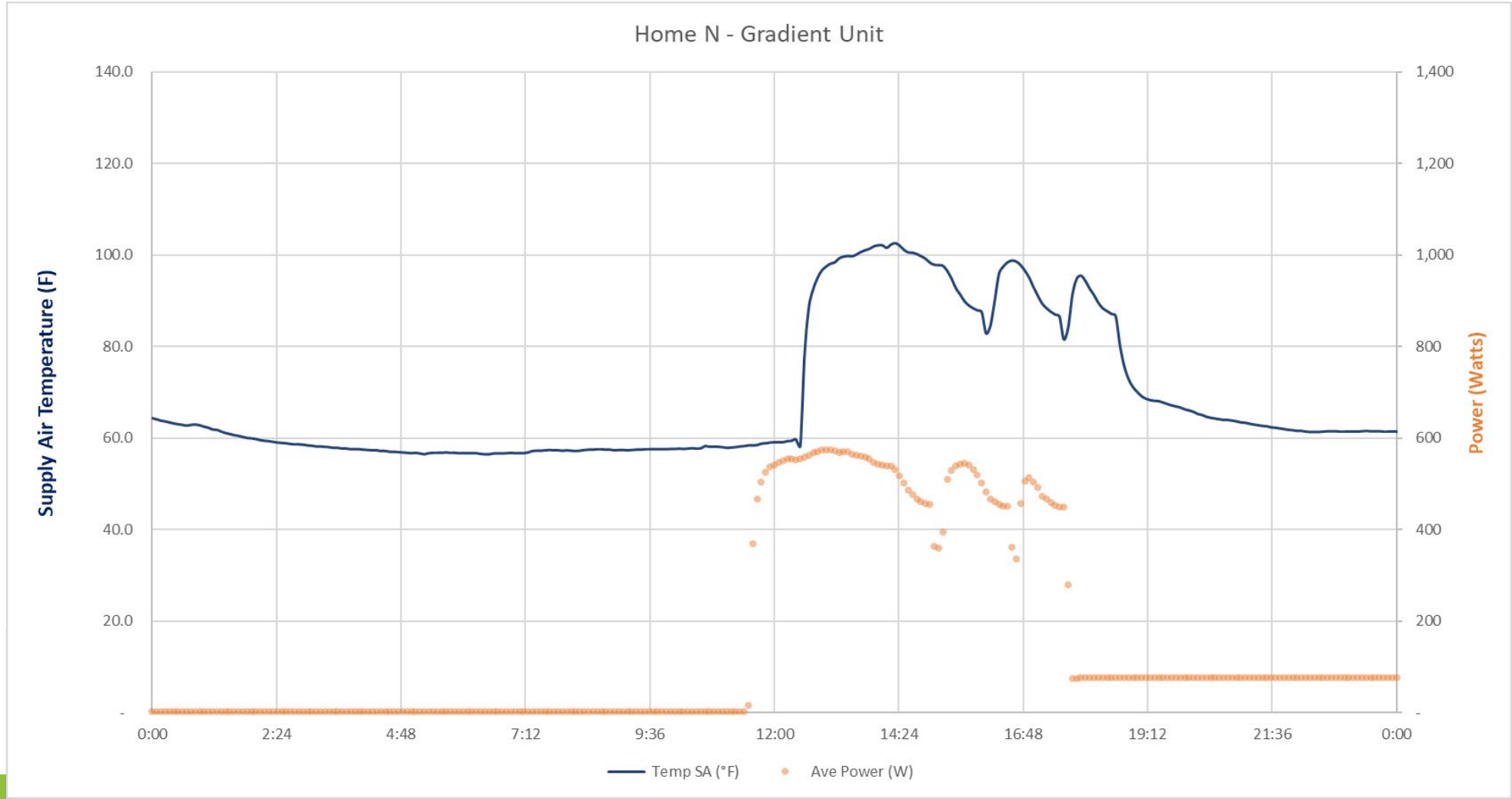




Heating means
$T_{SA} > 70°F$

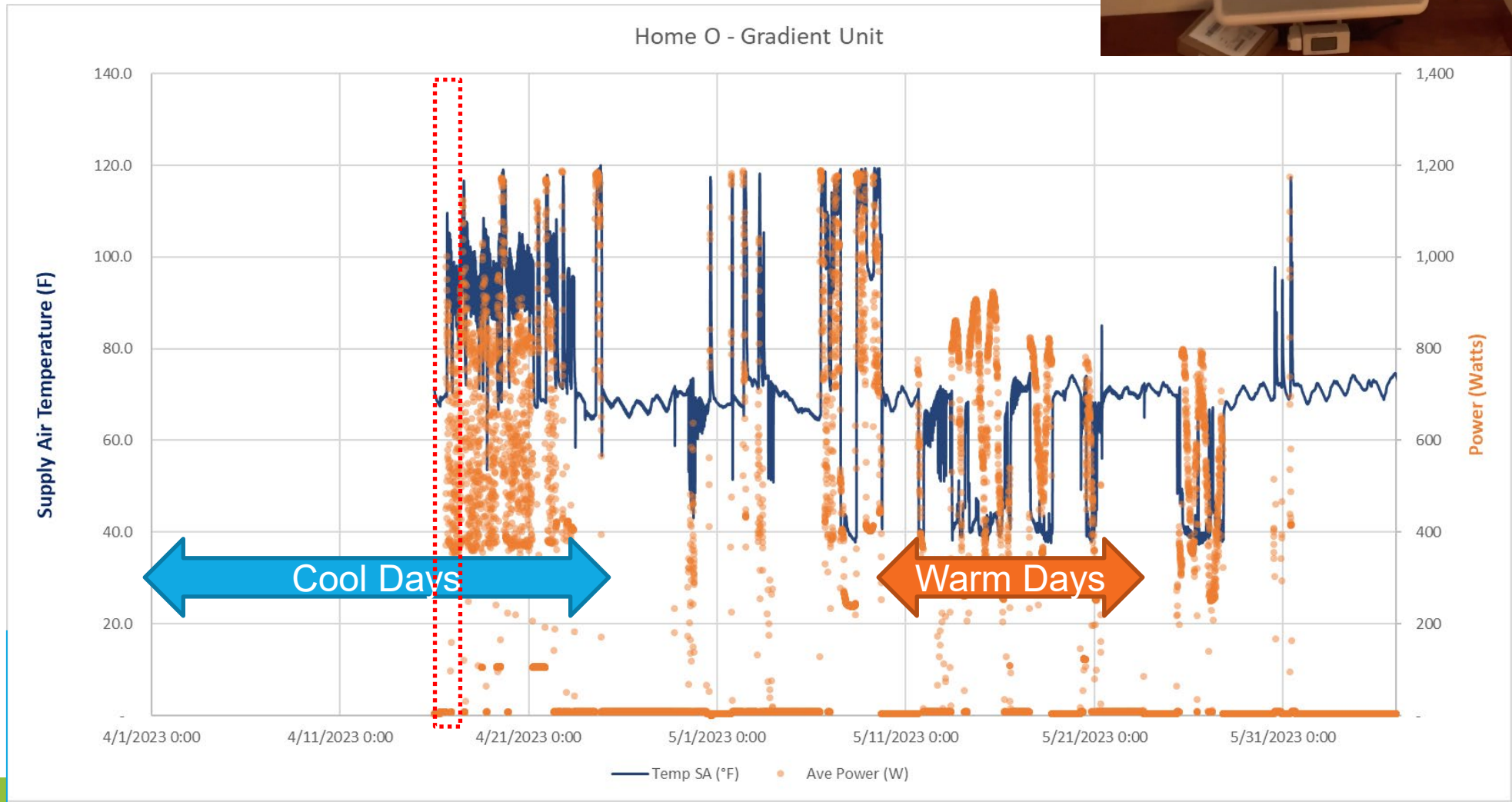
Home N - Gradient

- April 18th



Home O - Gradient

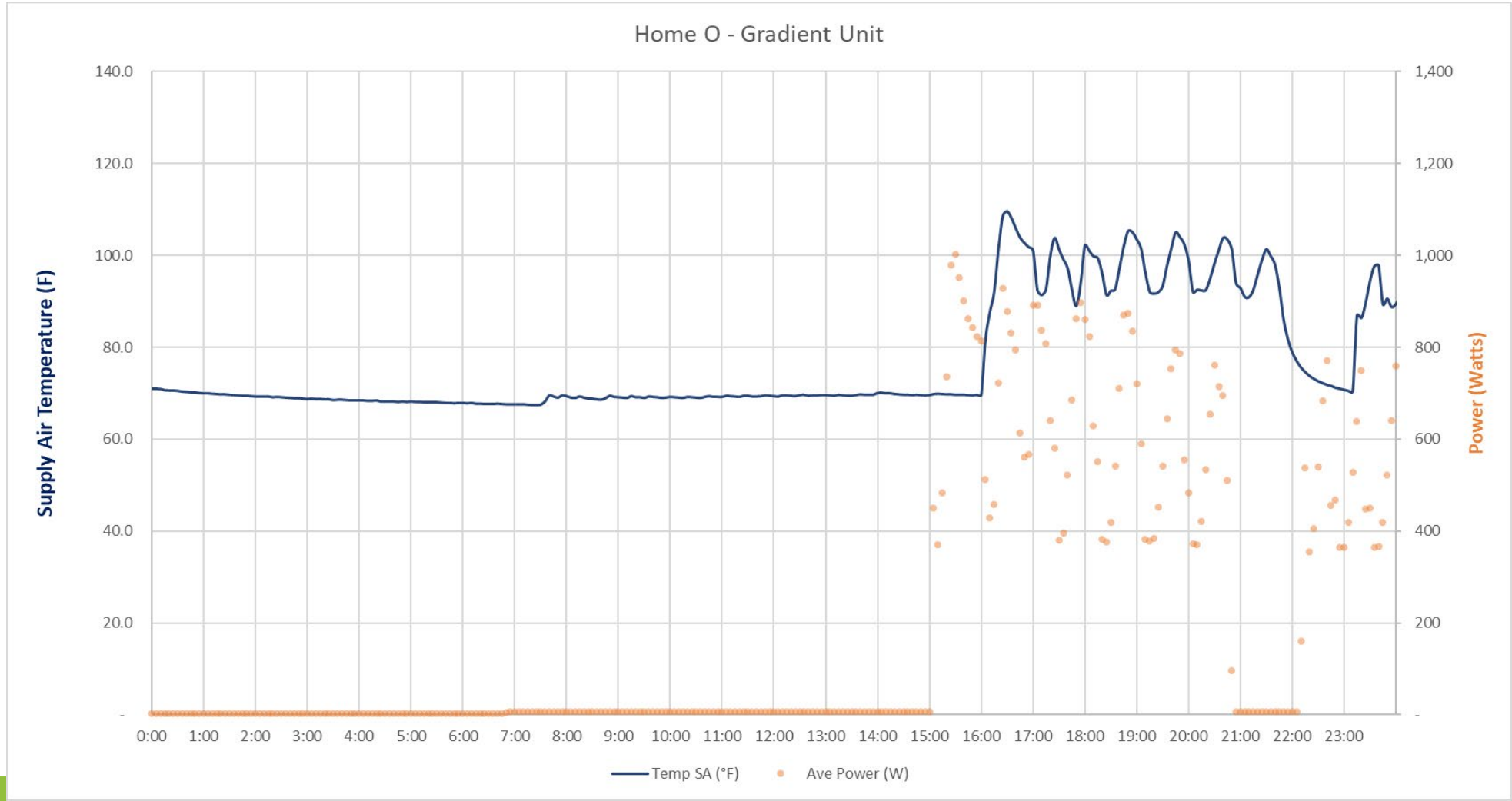
- Heating 46% of the time during cool days



Heating means
$T_{SA} > 70°F$

Home O - Gradient

- April 16



Supplemental Research

Micro VSHP Heat Pump Research

Northwest Energy Efficiency Alliance | C+C Research Report

February 2023

Agenda

[Phase One Results Presentation]

Background + Objectives	5 min
Detailed Findings	45 min
Key Findings + Implications	30 min
Next Steps	10 min

Background

Background

NEEA is conducting a two-phased project involving: an upfront study to gain insight into the initial reaction consumers have about Micro VSHP Heat Pump Units that heat as well as cool. The second phase will be a home-use test study with three different Micro VSHP Heat Pumps, totaling 16 units.

Research Objectives

Gather general feedback on Micro VSHP Heat Pumps and real-world usage of three different Micro VSHP Heat Pumps, in order to:

- Understand the customer experience installing, operating, and their expectations of what a window heat pump is and does.
- Understand installation, noise, and any mechanical limitations that may impact performance or customer experience.
- Understand how users changed behavior such that the window HP displaced heating and cooling from preexisting sources.
- Gather and organize data that can be used to determine how effective the window HP is at displacing other heating or cooling sources in the home.
- This will be conducted in a way that can inform NEEA and help them approach utilities with the best recommendation on which Micro VSHP Heat Pump to support.

Desired Outcomes

The two desired outcomes of this project are to:

1. Sufficiently understand the customer experience with Micro VSHP Heat Pumps so that NEEA can guide utility programs and the EPA regarding their value as an energy-saving opportunity.

2. Provide manufacturers of Micro VSHP Heat Pumps with additional recommendations that would improve the product's value proposition and/or customer experience.

Research Approach: Phase 1

Methodology	Phase 1
Length	35-45 minutes
Format	Online qualitative discussion & concept testing
Date	Jan 6-22, 2023
n	36
Sample Sources	WA and OR residents from MROC

Primary Audiences

Phase 1: People who live in climate zones where Heat Pump Air Conditioners would sufficiently heat as well as cool in WA and OR. We recommend that this audience includes:

- Those who are involved at least 50% in decision-making for HH maintenance
- purchases
- A mix of single-family homeowners and those who live in multi-family housing
- A mix of ethnicities, ages, gender, etc.
- A focus to recruit mostly electric heating was added as an additional criteria

Demographics - Total (n=36)

Gender	
Female	23
Male	11
Gender Variant	2

Household Income	
<$35k	5
$35K-49K	5
$50K-74k	9
$75K-99K	5
$100K-149K	9
>$150k	3

Age	
18-24	0
25-34	7
35-44	9
45-54	8
55-64	9
65+	3

Electric vs. Non-electric Heating	
Electric	27
Non-electric	9

Homeowner vs. Renter	
Homeowner	24
Renter	12

Household Size	
1	8
2	10
3	7
4	7
5	3
6+	1

Detailed Findings

Heating + Cooling Behaviors

Detailed Finding 1:

Saving on energy costs, energy efficiency, and comfort are important factors considered when heating/cooling homes

- More than half of the participants also consider ease of use, low/no cost installation, and centralized systems to be very important.
- Having remote controlled (app) access to heating and cooling is the least important factor.

Saving on energy costs (89%), being more energy efficient (78%), and comfortable temperatures (75%) are considered very important factors when heating and cooling homes

- Those with non-electric heating consider how heating and cooling their home impacts climate change more important than those with electric heating. **Please note, these are very small sample sizes: electric heating (n=27), non-electric heating (n=9)*

Factors Total (n=36)	Not at all important	Somewhat important	Very important
Saving on energy costs	0% (0)	11% (4)	**89% (32)**
Being more energy efficient	0% (0)	22% (8)	**78% (28)**
Having my home at a temperature that is comfortable	0% (0)	25% (9)	**75% (27)**
How easy it is to heat or cool my home to my liking	6% (2)	28% (10)	67% (24)
Low or no cost installation of a heating or cooling system	6% (2)	33% (12)	61% (22)
Heating or cooling my entire home	8% (3)	33% (12)	58% (21)
How heating and cooling my home impacts climate change	25% (9)	33% (12)	42% (15)
Having the ability to program the heating or cooling temperatures at specific times of day	28% (10)	31% (11)	42% (15)
Heating or cooling only the rooms I spend the most time in	11% (4)	50% (18)	39% (14)
How much noise the heating or cooling system/device(s) make	11% (4)	64% (23)	25% (9)
Having the ability to heat and/or cool my home remotely with an app	58% (21)	36% (13)	6% (2)

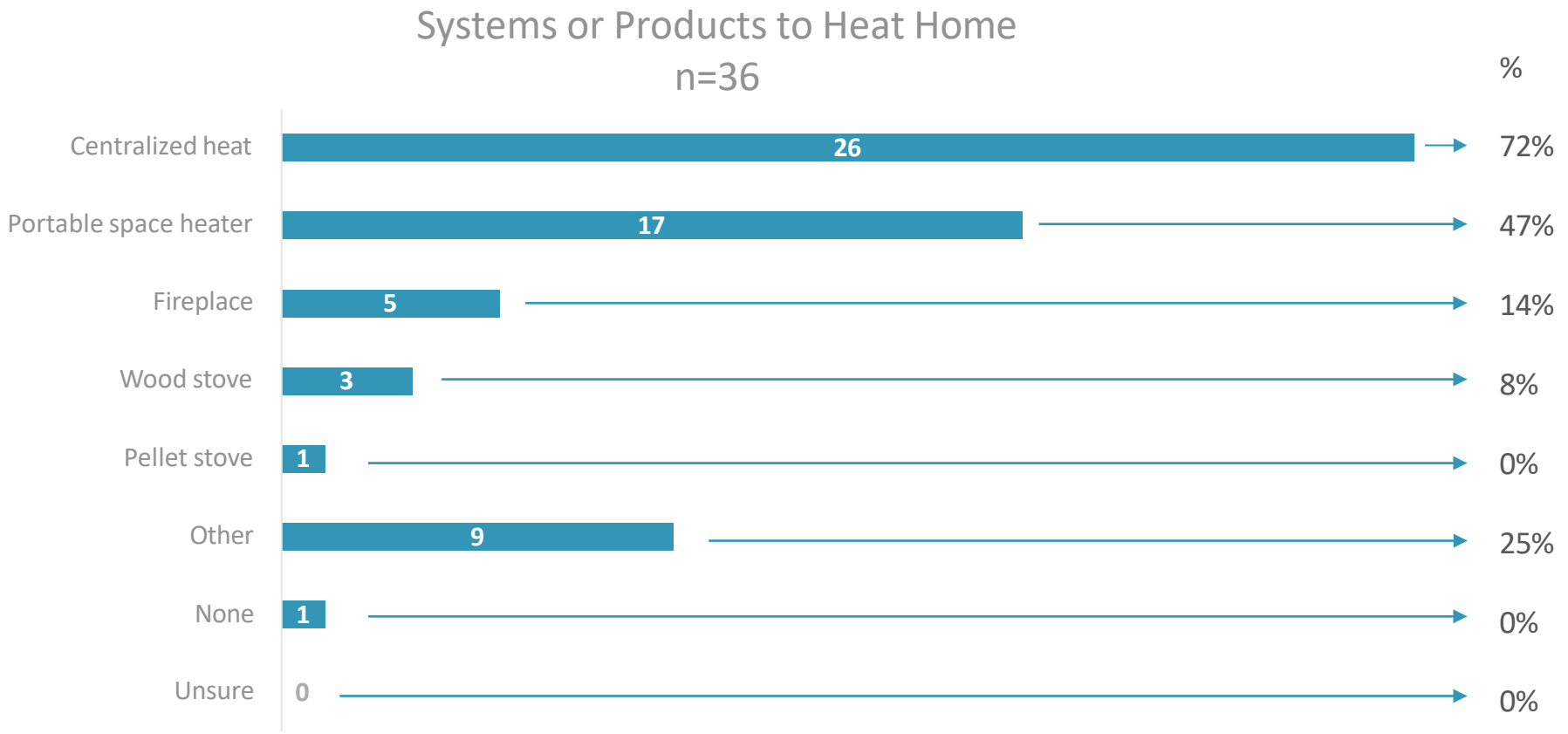
n=36 Q: How important are the below factors to you when it comes to heating and cooling your home? Please mark the following as either *"Not at all important," "Somewhat important," or "Very important."*

Detailed Finding 2:
Participants are accustomed to using multiple products and methods to heat + cool their homes

- The ancillary heating products currently being used enable them to be energy efficient/save money by turning their heaters down in the winter.
- Along with centralized heat, many participants are using portable space heaters and fireplaces to heat their homes.
- Ancillary cooling products are most often used when there is no central A/C.
- Portable fans and portable A/C units are used most often to cool their homes.

Participants most commonly use centralized heat to heat their homes during colder weather

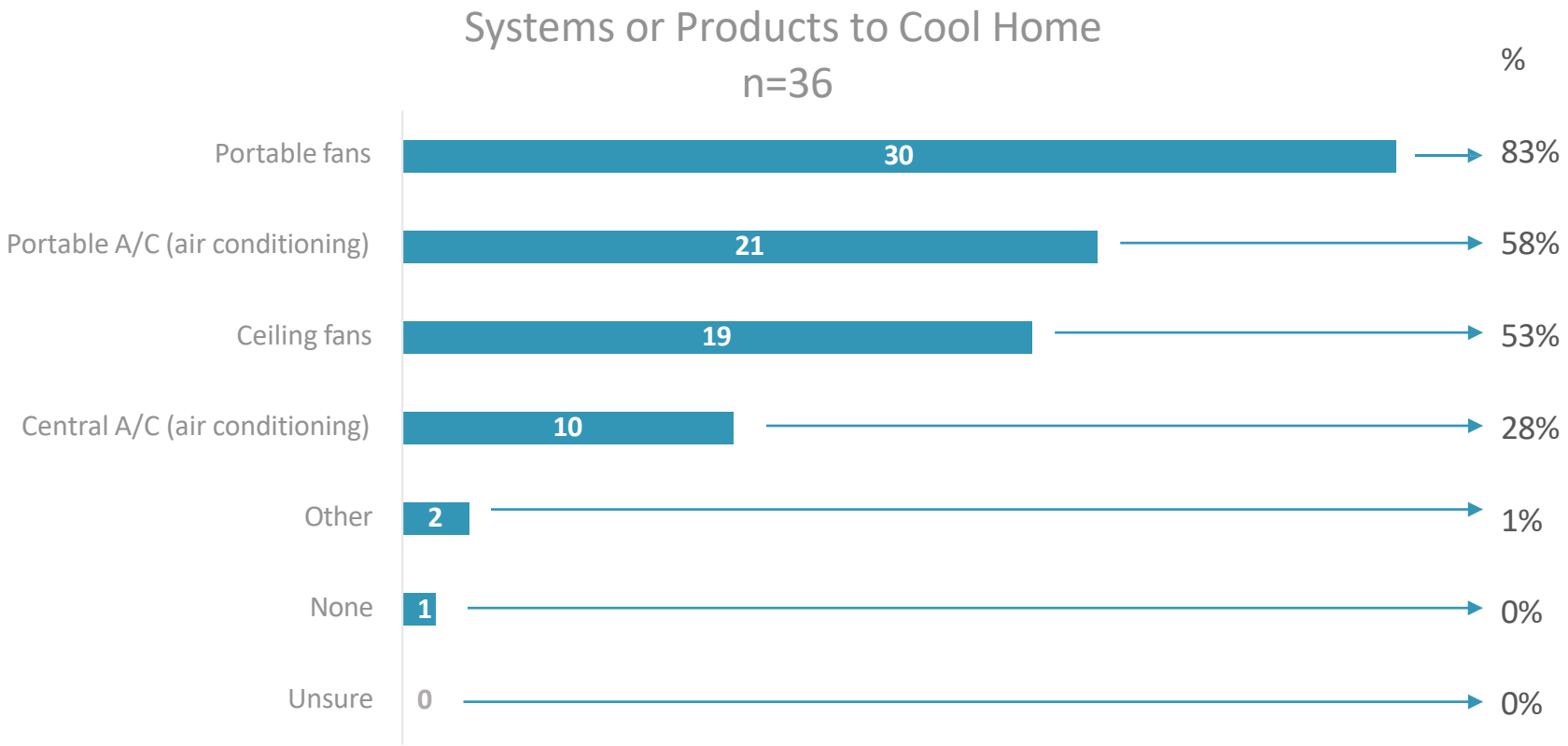
- The participants who indicate 'other' mention baseboard heaters, cadet heating, forced air, and indoor propane heaters.
- Many use more than one heating method.



n=36 Q: Which of the below systems or products do you use to **heat your home** during colder weather? *Please select all that apply*.
*This is a multi-select question.

Most participants use portable fans to cool their homes during warmer weather

- Most participants use portable fans to cool their homes, while fewer participants use central A/C.
- The participants who indicate 'other' mention A/C window units.
- Many use more than one cooling method.



n=36 Q: Which of the below systems or products do you use to **cool your home** during warmer weather? *Please select all that apply.*
*This is a multi-select question.

Detailed Finding 3:

Participants often use portable products to focus on specific areas of the home and/or to supplement primary methods

- This is true for both heating and cooling.
- Portable and ceiling fans are often used in conjunction with portable A/C units in homes without central A/C.
- Most homes with central A/C also use fans to cool their homes.

Heating: Most participants supplement their heat with portable products

- This is true for electric and non-electric heating sources.

- *"I use electric baseboard heaters in the bedrooms and there is a fan-forced Cadet-type electric heater in the central part of the main living/dining/kitchen area. They are each operated with a thermostat that is located in the room they are in. I also have a fireplace in the living room that I use for extra warmth on days when the temperature drops to below freezing."*
- *"I use a lot of different methods in my home depending on the room and area of the house. We use electric and gas heating. We also have small portable heaters. Our house does not have good insulation it is an older house..."*
- *"To heat our home we primarily use a gas furnace that blows warm air. We also use a couple of space heaters…"*
- *"To heat my home, I have baseboard heat in the living room that I'll use as needed (and then turn off as soon as I can, because it's expensive) and a couple of radiator heater things I use in bedrooms…"*
- *"We have a gas heater and an electric air conditioner. we also use radiator-style space heaters in the rooms we frequent to keep overall costs low and not dry out the air in the house. we work from home so this only affects two rooms."*

n=36, Q: Think about **how you heat and cool** your home. What do you use to heat and cool your home? Is this the same across all areas in your home, or does it vary depending on the room or area?

Cooling: Nearly all use fans, some as a primary cooling method, while others use fans in combination with portable and window A/C units

- Most utilize fans in combination with portable or window air conditioning units, while a few use fans as their primary cooling method.
- Less than a third use central A/C and most who do also use fans.

- *"For heating I have electric baseboard heating in my apartment. I do not have A/C (almost unnecessary in the Pacific NW) but use fans to keep air moving when it gets around 80 degrees…"*
- *"…Portable air conditioning units to cool specific rooms, plus strategic use of fans."*
- *"…To cool, I mostly use fans, but I also have a portable AC unit I use in the living room a couple of times a year, just to take the edge off."*
- *"For cooling, I only have a portable air conditioner that I put in my bedroom when summer gets too hot."*
- *"To cool our home, we use a combo of fans and open windows and portable AC unit that we keep in our bedroom."*
- *"To cool the home we have 2 window A/C units in 2 bedrooms, and additionally will use fans to either expel or add cooler outside weather inside the home. Where I live fans can keep the house cool for the most part except a couple of months in the summertime."*

n=36, Q: Think about **how you heat and cool** your home. What do you use to heat and cool your home? Is this the same across all areas in your home, or does it vary depending on the room or area?

Response to Product Idea

Concept

This new product is like a window air conditioner and portable space heater all-in-one. It can provide both cooling during warm weather and heating during cool weather because it uses heat pump technology. It is portable and is plugged into a typical 120v outlet.

Detailed Finding 4:

Most participants consider the product concept (description) appealing and more than half believe it is innovative and has the potential to solve existing heating/cooling problems in their home

- Over a third of participants indicate they would be interested in purchasing the product when it is available.
- The product concept elicits positive feelings: excitement, optimism, and eagerness.

Most participants *completely agree* that the product concept is appealing (72%)

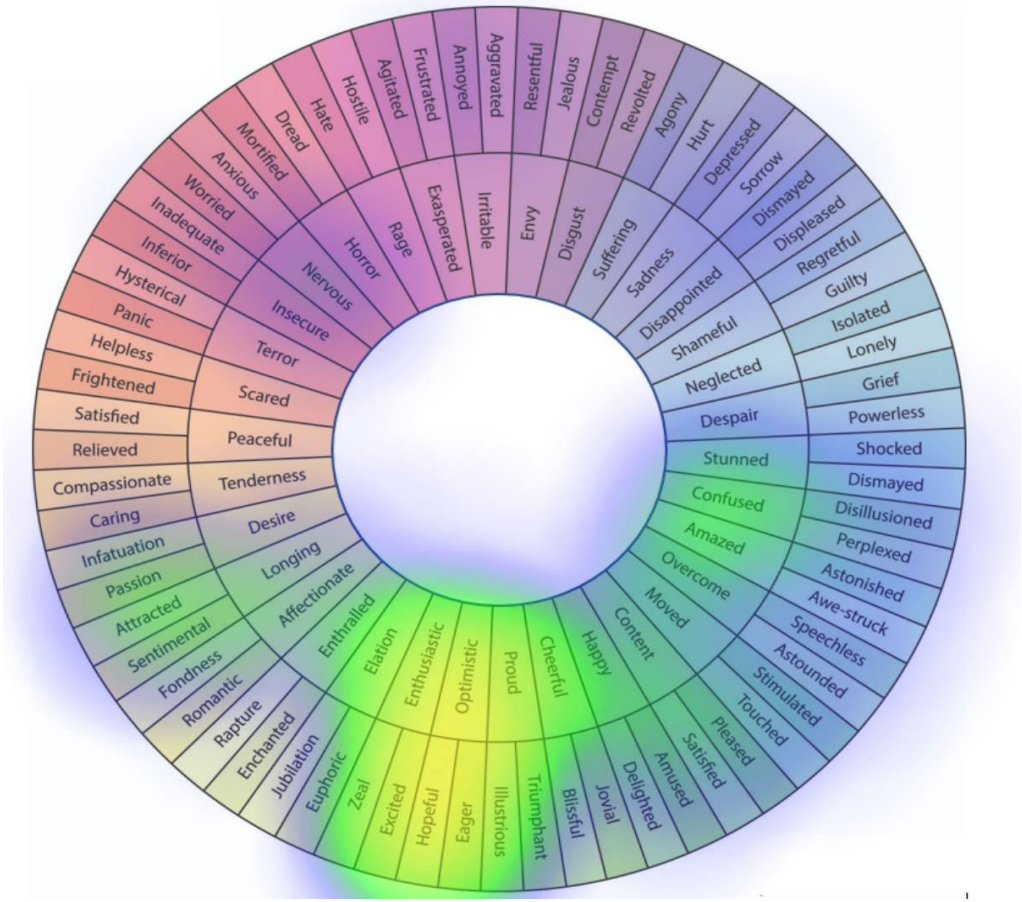
- More than half believe the product concept is unique or innovative (58%) and has the potential to address some issues they currently have with heating and/or cooling their home (56%), while a over a third (39%) would be interested in purchasing .
- A higher percentage of homeowners *completely agree* that this product could address some issues they currently have with heating or cooling in their home compared to renters (63% vs. 42%). **Note, sample size is very small:* homeowners n=24, renters n=12

Statements Total (n=36)	I completely disagree	I somewhat disagree	I somewhat agree	I completely agree	N/A
This product is appealing	3% (1)	8% (3)	17% (6)	**72% (26)**	0% (0)
This product is unique or innovative	3% (1)	8% (3)	28% (10)	58% (21)	3% (1)
This product could address some issues I currently have with the heating and/or cooling in my home	8% (3)	0% (0)	36% (13)	56% (20)	0% (0)
I am interested in purchasing this product when it becomes available	8% (3)	3% (1)	50% (18)	39% (14)	0% (0)

n=36 Q: Continuing to keep the new product description in mind, how much do you agree or disagree with the below statements? Please mark the following as either "I completely disagree," "I somewhat disagree," "I somewhat agree," "I completely agree," or "N/A."

Participants feel excited and optimistic about the new heating and cooling product

- There is a lot of excitement about this product and many participants would like to try it, often noting the convenience of having all-in-one heating and cooling.
- Several mention optimism about potential savings or efficiency improvements.
- A few who expressed confusion mention they feel curious and want to learn more about the product.



"I'm intrigued by the new technology and hope it can solve my cooling issues in an economical fashion." – **Attracted**

"I like the idea of a product that might accomplish heating and cooling better and more efficiently than options I currently have." – **Optimistic**

"I feel eager because I am eager to use such a product. It will be more convenient than buying separate heating and cooling products." – **Eager**

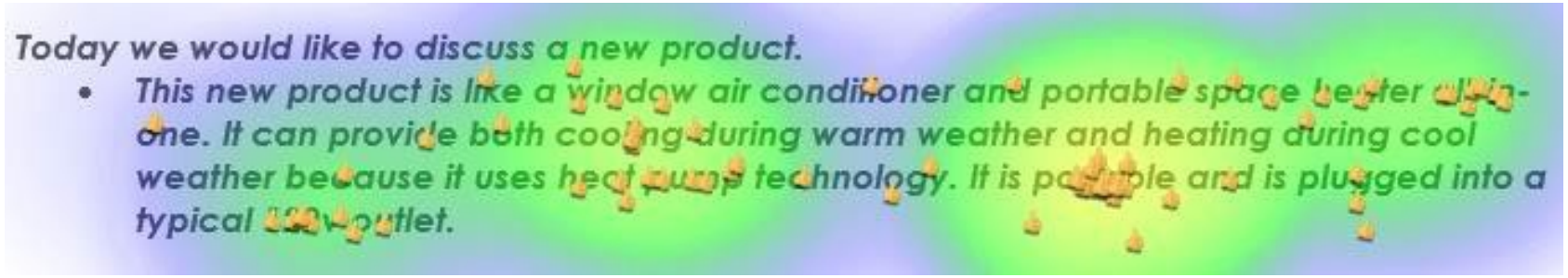
n=36 Markups=76 Q: After reading the description about the new heating and cooling product, how does it make you feel? In other words, what emotions come to mind? *Please select up to three emotions from the below wheel and explain why you feel this way.*

Detailed Finding 5:

- Portability, all-in-one heating and cooling, and compatibility with 120v outlet drive interest in the product concept
  - The few participants who expressed dislike cited concerns over how well it works, and lack of need.
  - While most participants were confused or disinterested in the use of "heat pump technology," there were some who thought it was a positive feature.

Features that drive likeability include portability, all-in-one heating/cooling, + compatibility with 120 v

- A few are also intrigued by the use of heat pump technology.



Total "Like" Markups = 75

Likes

- The **portability** stands out – many feel this would allow them to **conveniently and easily move the product** around their home based on their needs.
- Many like the fact that the product provides **all-in-one** heating and cooling abilities due to its **convenience, needing fewer heating and cooling products** and **saving space**.
- Participants like the convenience of being able to use a **standard 120v outlet** for this product.
- Some participants like the **idea of heat pump technology** and the potential for energy and cost efficiency.

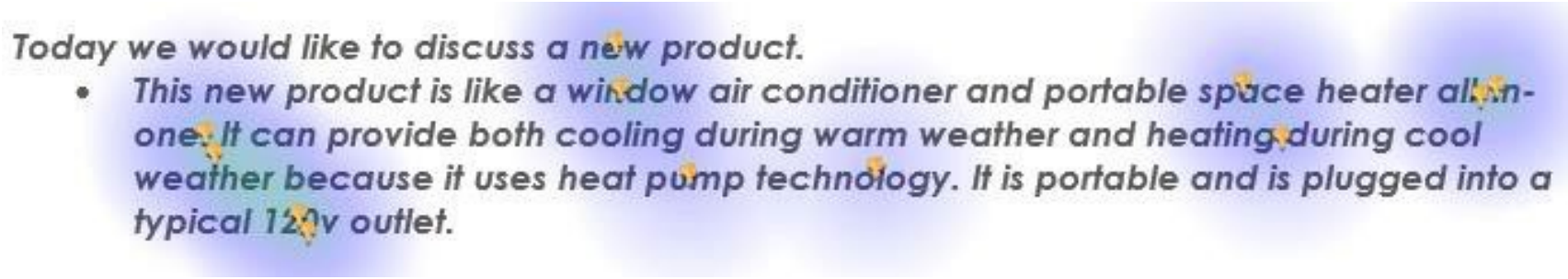
Verbatims

- *"I like that it's **portable** so I **can move it from one room to another**, based on where I am sitting at the time."*
- *"I like the **all-in-one** feature because it will **save space**. I **won't need separate heating and cooling products** like what I have now."*
- *"I like this because it **plugs into a 120v outlet** and it sounds easy to use."*
- *"I like this because it **uses technology** and hopefully is **energy efficient** and **costs less.**"*

n=36 Q: Next, take another look at the description of the new product. Please select at least three markers on the image of the description to capture what you like, dislike, or find confusing and explain why you feel this way.

Concerns over how well the product works were mentioned by a few participants

- A few participants mention they do not need it or it would not solve a problem.



Total "Dislike" Markups = 12

Dislikes

- Several participants are **unsure about the technology or how it will perform**.
- A few are not interested because they **do not have a need** for it or it **doesn't solve a problem** for them.

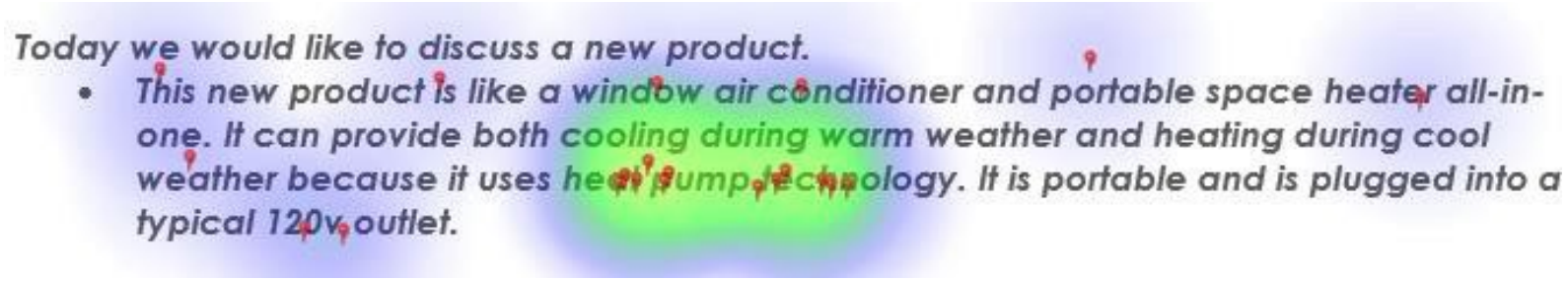
Verbatims

- *"I'm under the impression that heat pumps **don't work well** in super cold weather."*
- *"I dislike this because it is not fully proven yet and **don't know how well it works**."*
- *"I dislike this because **I personally do not need this** for my home. We have central heating."*
- *"This **does not solve a problem** that I have."*

n=36 Q: Next, take another look at the description of the new product. Please select at least three markers on the image of the description to capture what you like, dislike, or find confusing and explain why you feel this way.

There is confusion about "heat pump technology"

- A few participants are also confused about how it can heat and cool.



Total "Confusing" Markups = 21

Confusing

- Some express confusion because **they don't know much about heat pump technology**, **how it works**, or **what the potential benefits** are.
- A few are unsure whether **how it is *like a window air conditioner*** and wonder what the similarities and differences are.
- A couple mention confusion over the product's ability to provide **both heating and cooling**.
- A couple are **not sure what a 120v outlet is**.

Verbatims

- *"I find this confusing since I'm **not really sure what heat pump technology is**, or what the **added benefit** it can provide is."*
- *"I've always been confused about **how heat pumps cool** the air."*
- *"**What exactly is heat pump technology** I mean what is the difference between this and an actual window cooling unit other than the fact that I guess it can blow in warm air?"*
- *"**Does it go into your window** because it says it is like a window air conditioner but **I've never heard of a heating system that is also a window unit.**"*

n=36 Q: Next, take another look at the description of the new product. Please select at least three markers on the image of the description to capture what you like, dislike, or find confusing and explain why you feel this way.

Response to Actual Product

Product M

***Product M Description**: This product is a unit that rests on your window and provides both heat and cool air, while still allowing you to open and close your window.*

Product C

***Product C Description**: This product is a portable heating and cooling unit that uses a dual-hose (duct) that connects from the unit to your window.*

Product T

***Product T Description**: This product is a window A/C (air conditioning) unit that also provides heat.*

Product M

Product M Description:
This product is a unit that rests on your window and provides both heat and cool air, while still allowing you to open and close your window.

Detailed Finding 6:

- Many participants *completely agree* that Product M is unique or innovative (72%)and appealing (69%)

- Over half of participants (58%) *completely agree* that this would address a heating and/or cooling problem in their home.
- Over a third (39%) *completely agree* that they would be interested in purchasing this product.
- The design, the window-sill shelf, and the ability to open and close the window drive the positive response .
- Some indicated that it seems easy to install, which could create a problem, as this is very heavy, comes in multiple boxes, and will require more than one person to install.

Many participants *completely agree* that Product M is *unique or innovative (72%) and appealing (69%)*

- More than half of participants (58%) *completely agree* this product has the potential to address some issues they currently have with heating and/or cooling their home and over a third (39%) *completely agree* that they are interested in purchasing this product.

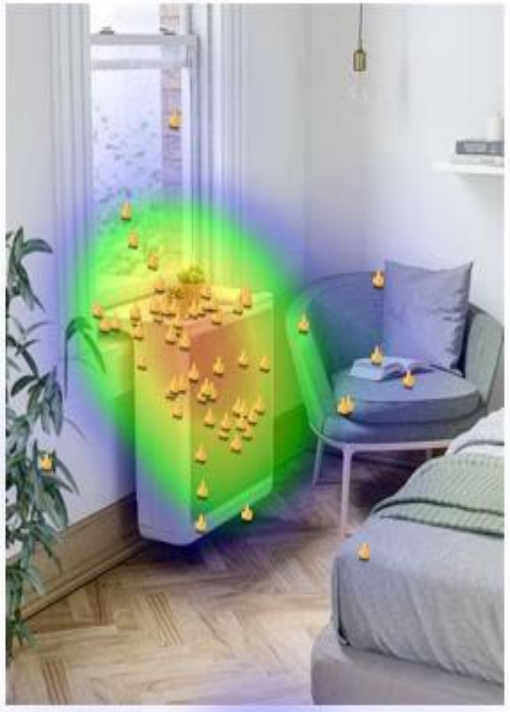
Statements Total (n=36)	I completely disagree	I somewhat disagree	I somewhat agree	I completely agree	N/A
This product is appealing	0% (0)	6% (2)	25% (9)	**69% (25)**	0% (0)
This product is unique or innovative	0% (0)	0% (0)	25% (9)	**72% (26)**	3% (1)
This product could address some issues I currently have with the heating and/or cooling in my home	8% (3)	3% (1)	28% (10)	58% (21)	3% (1)
I am interested in purchasing this product when it becomes available	11% (4)	14% (5)	31% (11)	39% (14)	6% (2)

n=36 Q: Continuing to keep the below product image and a brief description in mind, how much do you agree or disagree with the below statements? Please mark the following as either *"I completely disagree," "I somewhat disagree," "I somewhat agree," "I completely agree," or "N/A."*

Overall design, the shelf, and the ability to open/close the window drive the positive response

- Some also specify space-saving benefits and the ability to safely secure the window shut.
- A few like how it sits in the window and that it seems easy to install.

To Product M



Product M Description: This product is a unit that rests on your window and provides both heat and cool air, while still allowing you to open and close your window.

Total "Likes" Markups = 78

Verbatims

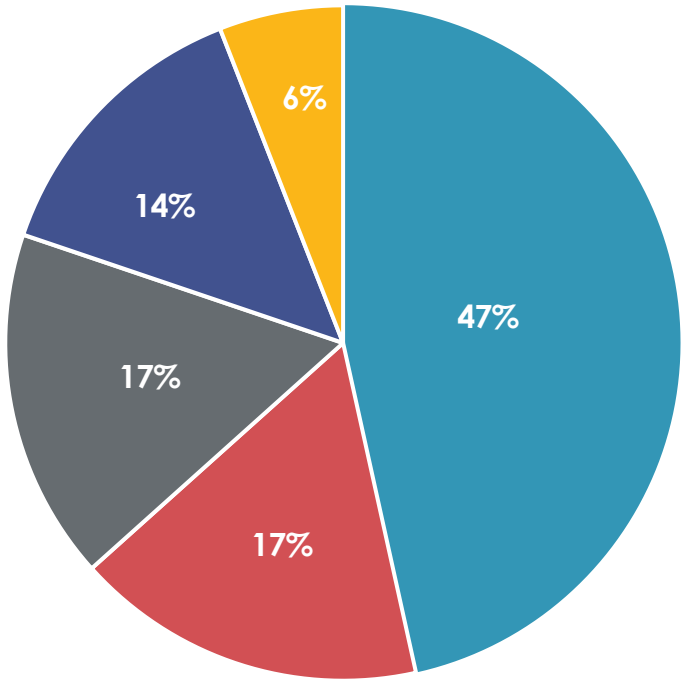
- *"It's very **sleek looking** and it **doesn't look like it takes up a whole lot of room**."*
- *"Awesome design! It **doesn't block the window** and provides **extra shelf space**."*
- *"I like that the top is also **functional for placing things** on like a window sill would be."*
- *"I like that it does not take up the whole window, it **allows the use of the window** even with it there."*
- *"I like the module of the unit for the **safety aspect** as well. I can **secure my window** at almost completely shut."*
- *"I love **how it is situated** sitting in the window."*

n=36 Markup=78 Q: Please view the following product image and brief description. Please select at least three markers on the image to capture what you **like, dislike, or find confusing** and explain why you feel this way.

47% of participants would be *very likely* to use Product M in their homes

Those with electric heating tend to be very or somewhat likely to use this product in their home more than those with non-electric heat.

- Electric heat: 67% - somewhat or very likely
- Non-Electric heat: 56%- somewhat or very likely
- Note: Sample size is very small
  - *Electric heat, n=27;*
  - *Non-electric heat n=9*



n=36 Q: Next, take another look at the product image and brief description. You can click on the image & description to get a better view. How likely would you be to use it in your home?

Detailed Finding 7:
Some perceived issues with Product M are size and potential instability

- Points of confusion include window compatibility, and appearance from the outside.

The biggest issues with Product M are that it seems to take up too much space, and could potentially be unstable

- The design and fit also raised a few concerns about its safety/security.

Product M Description: This product is a unit that rests on your window and provides both heat and cool air, while still allowing you to open and close your window.

Total "Dislikes" Markups = 13

Verbatims

- *"Takes up **a lot of space**."*
- *"Seems like a **large area is taken up** from the inside of the window sill down to the floor."*
- *"I don't like **how big it is** because I wouldn't have room for this in my small home. Every window in my home has furniture already in front of it."*
- *"Not sure I like the **gap**. Makes me think it could be **unstable**."*
- ***"Wonder if it would make it any easier to break into our house."***

n=36 Markups=13 Q: Please view the following product image and brief description. Please select at least three markers on the image to capture what you **like, dislike, or find confusing** and explain why you feel this way.

Some uncertainties about Product M include window compatibility, and how it looks from the outside

- A few also wonder how much space it can heat/cool and whether the design/fit is stable.

Product M Description: This product is a unit that rests on your window and provides both heat and cool air, while still allowing you to open and close your window.

Total "Confusing" Markups = 17

Verbatims

- *"It is unclear if this would be **compatible** with all types of windows."*
- *"Do your **windowsills have to be a certain way** for this product to work?"*
- *"What does it **look like on the outside**, is it ugly?"*
- *"Would it only be able to heat and cool down **one room**?"*
- *"Will the unit be **stable** when the window is open?"*

n=36 Markups: 17 Q: Please view the following product image and brief description. Please select at least three markers on the image to capture what you **like, dislike, or find confusing** and explain why you feel this way.

Product C

Product C Description:
This product is a portable heating and cooling unit that uses a dual-hose (duct) that connects from the unit to your window.

Detailed Finding 8:
Many participants *completely agree* that Product C is unique or innovative (42%) and appealing (39%)

- A third (33%) of participants *completely agree* that this product would address a heating or cooling issue in their home.
- 19% *completely agree* that they would be interested in purchasing this product.
- The design/look, portability, and the perception that it doesn't take up too much space drive the positive response.
- Less important drivers include: familiarity of the design, the control screen, it seems easy to install, and it doesn't block the window.

Many participants completely *agree* Product C is *unique or innovative (42%) and appealing (39%)*

- A third of participants (33%) *completely agree* this product could address some issues they currently have with the heating and/or cooling in their home.
- A higher percentage or renters *somewhat* or *completely* agree that this product could address some issues they currently have heating or cooling their home compared to homeowners (100% vs. 75%). **Please note these are very small sample sizes: renters n=12, homeowners n=24*

Statements Total (n=36)	I completely disagree	I somewhat disagree	I somewhat agree	I completely agree	N/A
This product is appealing	11% (4)	25% (9)	22% (8)	**39% (14)**	3% (1)
This product is unique or innovative	6% (2)	17% (6)	33% (12)	**42% (15)**	3% (1)
This product could address some issues I currently have with the heating and/or cooling in my home	8% (3)	6% (2)	50% (18)	33% (12)	3% (1)
I am interested in purchasing this product when it becomes available	17% (6)	22% (8)	42% (15)	19% (7)	0% (0)

n=36 Q: Continuing to keep the below product image and brief description in mind, how much do you agree or disagree with the below statements? Please mark the following as either *"I completely disagree," "I somewhat disagree," "I somewhat agree," "I completely agree," or "N/A."*

Design/look, portability, and the perception that it doesn't take up too much space drive the positive responses

- Product C also received a positive remarks for its control screen, that it does not block the window, its familiar appearance, and perceived ease of installation.

Product C Description: This product is a portable heating and cooling unit that uses a dual-hose (duct) that connects from the unit to your window.

Total "Likes" Markups = 51

Verbatims

- *"I like the **design**, it is simple and still functional."*
- *"The **style looks appealing**. I like that it **isn't too big**."*
- *"I like that it's **portable** because I could move it from one room to another instead of buying one unit for each room."*
- *"Portable and **doesn't take up too much space** or **block the window**."*
- *"This is also **familiar to me** – it looks very much like the portable air conditioner we have now."*
- *"Clean interface – the **digital screen** is nice."*
- *"I like that this setup is **easy to install** and **use**."*

n=36 Markups=51 Q: Please view the following product image and brief description. Please select at least three markers on the image to capture what you **like, dislike, or find confusing** and explain why you feel this way.

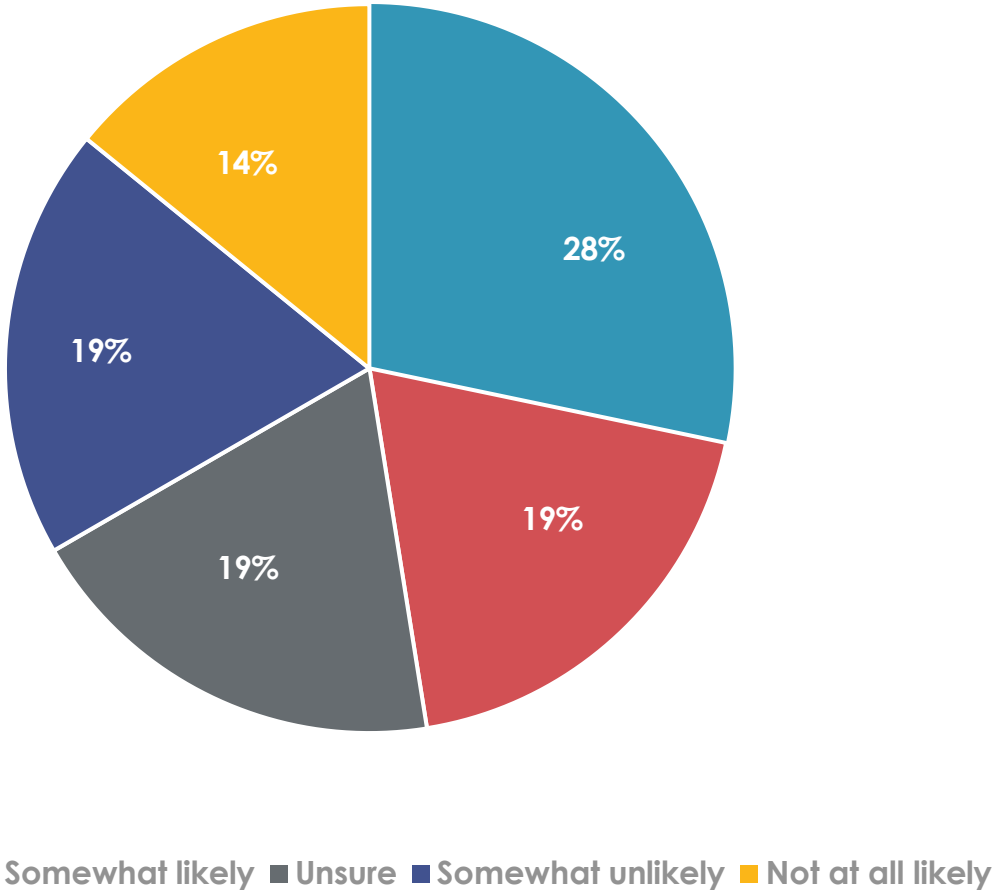
28% of participants would be *very likely* to use Product C in their homes

Those who have non-electric heating are slightly more likely to use Product C in their homes compared to those with electric heating.

- Non-electric heat: 56% - somewhat or very likely
- Electric heat: 44% - somewhat or very likely
- Note small sample size
  - *Electric heat, n=27*
  - *Non-electric heat n=9*

Homeowners are slightly more likely to use Product C in their homes compared to renters.

- Homeowners: 50% - somewhat or very likely
- Renters: 42% - somewhat or very likely
- Note small sample size
  - *Homeowners, n=24*
  - *Renters n=12*



n=36 Q: Next, take another look at the product image and brief description. You can click on the image & description to get a better view. How likely would you be to use it in your home?

Detailed Finding 9:

Its size, which impacts the space required and portability, is the primary perceived drawback of Product C

- The duct hose is a barrier for some as they think it is unappealing and/or hard to install – some also don't understand its use.
- Additional concerns include the perception that it would block the window and may not be safe/secure.
- There is confusion regarding the type of window it is compatible with.

Most participants cannot tell how much space it requires

- Some also mention it is not visually appealing, particularly mentioning the appearance of the duct hose.
- Installing the duct hose is perceived by some to be a hassle.
- There are a few concerns about how it will work with different types of windows, that it might block the window, that it is not portable, or that it does not appear to be secure/safe.

Product C Description: This product is a portable heating and cooling unit that uses a dual-hose (duct) that connects from the unit to your window.

Total "Dislikes" Markups = 36

Verbatims

- *"I dislike that it is **so big**, it would **take up a lot of room**."*
- *"It is **unattractive** and **takes up a lot of space** (as does our current portable unit)."*
- *"**Ducts are a hassle**. They don't work great when you have smoke in the area from fires."*
- *"I dislike this because it might be **hard to hook up**."*
- *"I'm not sure I like this because wouldn't it mean I need to have the **type of window that would be compatible** with such a setup."*

n=36 Markups=40 Q: Please view the following product image and brief description. Please select at least three markers on the image to capture what you **like, dislike, or find confusing** and explain why you feel this way.

A few are confused about the purpose and need for a dual hose

- One or two participants wonder about the purpose of the black part on top, whether it creates leakage or condensation, and how to switch from heating to cooling.

Product C Description: This product is a portable heating and cooling unit that uses a dual-hose (duct) that connects from the unit to your window.

Total "Confusing" Markups = 17

Verbatims

- *"Hard to tell how **large or small** this is."*
- *"The photo makes it seem **pretty big to be portable**."*
- *"Why does it seem to have **two hoses**?"*
- *"**How much ducting** do you need/can you have? Is it like a clothes dryer?"*
- *"Usually with portable air conditioning units you have to have a little tray underneath them now for **leakage or drip from condensation**. So I'm wondering it this is actually **condensation free** or?"*

n=36 Markups=17 Q: Please view the following product image and brief description. Please select at least three markers on the image to capture what you **like, dislike, or find confusing** and explain why you feel this way.

Product T

<u>Product T Description</u>:
This product is a window A/C (air conditioning) unit that also provides heat.

Detailed Finding 10:

Over a third of participants (36%)*completely agree* this product is appealing and could address a heating and/or cooling issue they have in their home

- Less than a third (31%) *completely agree* Product T is unique and innovative.
- 19% *completely agree* they would purchase this product.
- Compact size, familiar format, and all-in-one heating + cooling drive interest in this product.
- Some also like that it seems easy to access and use.

Over a third *completely agree* this product is appealing and could solve a heating/cooling problem in their home (36%)

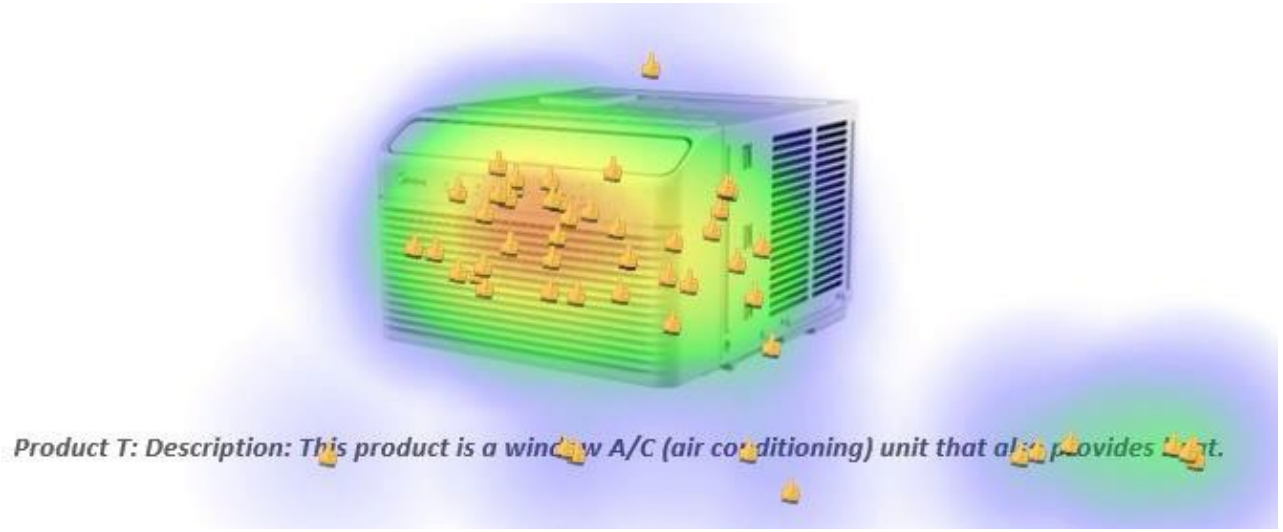
- Nearly a third of participants(31%) *completely agree* that the product is unique or innovative.
- 19% *completely agree* they are interested in purchasing the product when it comes available.

Statements Total (n=36)	I completely disagree	I somewhat disagree	I somewhat agree	I completely agree	N/A
This product is appealing	14% (5)	25% (9)	22% (8)	**36%** (13)	3% (1)
This product is unique or innovative	8% (3)	8% (3)	50% (18)	31% (11)	3% (1)
This product could address some issues I currently have with the heating and/or cooling in my home	8% (3)	11 % (4)	44 % (16)	**36%** (13)	0% (0)
I am interested in purchasing this product when it becomes available	19% (7)	33% (12)	28% (10)	19% (7)	0% (0)

n=36 Q: Continuing to keep the below product image and brief description in mind, how much do you agree or disagree with the below statements? Please mark the following as either *"I completely disagree," "I somewhat disagree," "I somewhat agree," "I completely agree," or "N/A."*

Interest in Product T is driven by its compact size, familiar format, and the fact that it provides both heating + cooling

- Some also mention they like the overall look and design, and think it seems easy to access and use.



Total "Likes" Markups = 53

Verbatims

- *"Seems like a **good size** that will fit easily."*
- *"Has a **familiar look** that I like."*
- *"I like the style it **looks like my old air conditioner** that lasted a good 15 years and was still in good working condition when we got central heating and air conditioning."*
- *"I love the fact that it's **producing heat in cold weather and also cooling** down when in warm weather."*
- *"I like that it is a **dual purpose** product. This feels **convenient**."*
- *"I like the **clean sleek style**."*
- *"I looks **easy to operate**."*

n=36 Markups=53 Q: Please view the following product image and brief description. Please select at least three markers on the image to capture what you **like, dislike, or find confusing** and explain why you feel this way.

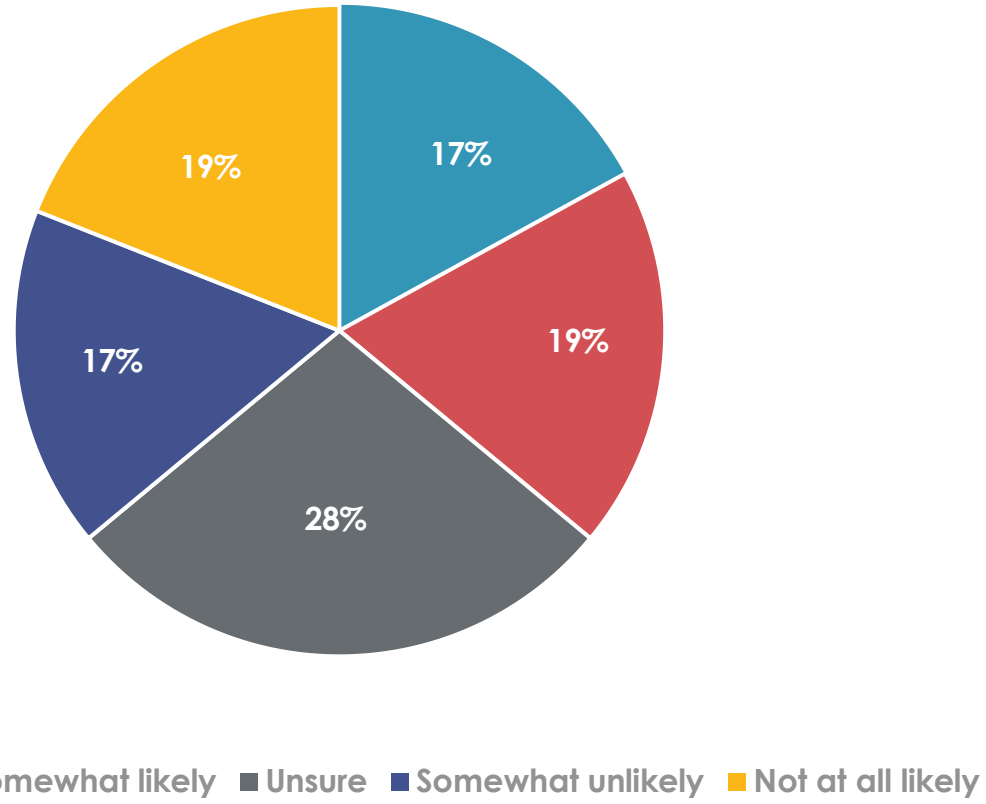
17% of participants would be *very likely* to use Product T in their homes

Those who have non-electric heating are slightly more likely to use Product T in their home compared to those with electric heating.

- Non-electric heat: 44% - somewhat or very likely
- Electric heat: 30% - somewhat or very likely
- Note small sample size:
  - *Electric heat n=27*
  - *Non-electric heat n=9*

Homeowners are slightly more likely to use Product T in their homes compared to renters.

- Homeowners: 42% - somewhat or very likely
- Renters: 25% - somewhat or very likely
- Note small sample size:
  - *Homeowners n=24*
  - *Renters n=12*



n=36 Q: Next, take another look at the product image and brief description. You can click on the image & description to get a better view. How likely would you be to use it in your home?

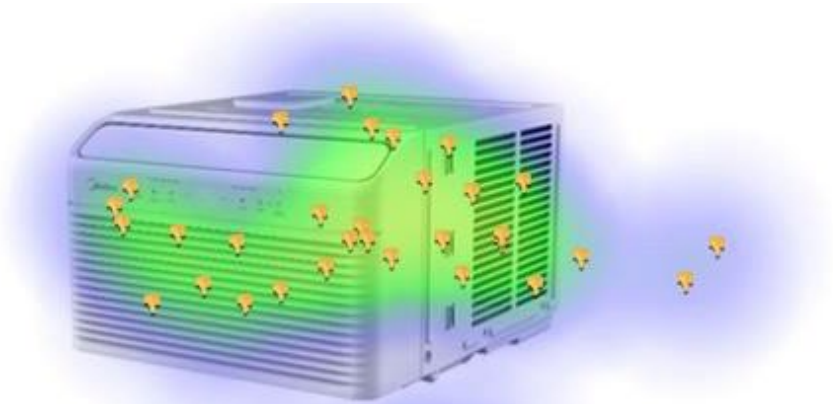
Detailed Finding 11:

Some perceived issues with Product T are that it seems heavy and cumbersome to install, and that it appears to take up the entire window

- Some also worry about how well it seals (concerns over leaking air into the home), its safety + stability, limited window compatibility, and potential lack of portability.

There are concerns about the installation of Product T because it seems heavy, cumbersome, and may block the window

- Some participants mention concerns about how well it seals, safety and security, portability, and limited window compatibility.



Product T: Description: This product is a window A/C (air conditioning) unit that also provides heat.

Total "Dislikes" Markups = 35

Verbatims

- *"Its **big and bulky**… **like a traditional window AC unit**."*
- *"It appears **to fill an entire window** which **would block my view.** It **doesn't appear very portable**."*
- *"The units are usually **heavy and bulky** and would be **hard for me to install myself**."*
- *"It is **limited to the style of window** it can be placed in."*
- *"I find these types of units are **hard to fit into windows** and **have it sealed properly**, so this type of heating and cooling unit to me **seems inefficient** in my home."*

n=36 Markups=35 Q: Please view the following product image and brief description. Please select at least three markers on the image to capture what you **like, dislike, or find confusing** and explain why you feel this way.

There are a wide variety of questions/concerns about Product T

Participant questions and confusions include:

- Design questions, such as what the purpose of the white panel at the top is
- Referring to it as an "A/C unit" that provides heat
- The actual size seems unclear
- Concern over how it stays sealed/insulated
- Window type compatibility
- What, if anything, comes out of the side vent

Total "Confusing" Markups = 21

Verbatims

- *"It's unclear if the window installation would be **difficult to set up**."*
- *"I find it confusing because I am **not sure how easy it is to install and use**."*
- *"**Calling it a window A/C unit** then saying it also provides heat feels counterintuitive to it being an A/C unit."*
- *"I find this confusing because I would sacrifice leaving my home basically unlocked to a thief as well as the cold outdoor weather coming inside **due to lack of being able to seal it off** for the duality it would provide."*

n=36 Markups=21 Q: Please view the following product image and brief description. Please select at least three markers on the image to capture what you **like, dislike, or find confusing** and explain why you feel this way.

Questions + Interests

Participants raise a variety of questions about these products, but most are curious about the product and want to learn more

- Participants have questions about cost/cost efficiency, window compatibility, and how much space the products can heat/cool.
- Many are drawn to the all-in-one heating and cooling capability, portability, and overall look/design.

Questions

- *"My main question is the **compatibility of the window** when it comes to installation, since each product seems to be window-based…"*
- *"The question that's occurring to me now is about **portability**. It seems that unit C is really the only one that's truly portable, as the others need to be fixed in a window somehow. Curious about that."*
- *"Would it **fit** in our house? Would it **save money**? Would it have a **positive climate impact**? Would it be **reliable**?"*
- *"I would like to know **how much of the house** it would heat"*
- *"How much does it **cost**? Is there a **price difference** with the different model types?"*

Interests

- *"I found out that I could get by with **one unit for both heating and cooling** which would simplify my life."*
- *"I'm interested in the **ability to both heat and cool** whilst being **able to open and close our windows** at the same time."*
- *"I think **portability** and the **lack of need for ducts** for the last device is the most important."*
- *"It looks **modern and minimalistic**, which **fits my decoration style**."*
- *"I just like the idea that I **would not need separate heaters and air conditioners**."*
- *"…These approaches appear to combine elements of window unit and house installed, and especially with cooling could **save some money**."*

n=36 Q: Finally, what questions, if any, do you have about the new products you have learned about today? What interests you about these products, if anything?

Anticipated Use

Detailed Finding 12:

While many would expect to use the product for both heating and cooling, slightly more suggest they would use it for cooling purposes

- This is largely because they have more working solutions for heating vs. cooling.
- Most mention that it would only be used in "extreme" weather, especially for cooling in the summer heat.
- It is likely these products would replace existing ancillary products that already enable participants to use less energy/have lower heating bills.

Many envision using the product for cooling purposes, especially on hot summer days or during peak heat hours and in the rooms where they sleep or spend the most time

- Some mention using cooling in their bedrooms to keep a comfortable sleeping temperature, while others mention using it in the rooms they spend the most time in.
- There are a few who mention specific time frames and temperatures when they would be most likely to use it for cooling.

- *"I would use this **during the warmer months** – May through September. I would **only use the cooling feature**…I would be more inclined to use the product during the heat of the day during the summer months. Where I live, the heat of the day is **between 3 & 7 pm…**I would use it **every day in which the high temp is 80 degrees or higher**..."*
- *"I would use the portable air condition in the **summer months**."*
- *"As a portable A/C unit in the **summer**… mainly at night when **we're sleeping or during the day if I'm in the room cleaning or reading.** Most likely to use the A/C during heat waves…"*
- *"**Summertime to cool my home**. I don't think I would use the heating unless my home's heater broke. I would use it around 12pm I like to turn it on before it gets very hot outside otherwise it'll take longer to cool my home…"*

n=36 Q: Imagine you own the new heating and cooling product you selected in the previous question. When and how do you envision yourself using it?

Those who plan to use it for both heating and cooling envision themselves using it year-round, in the areas or rooms they spend the most time in, often replacing their current ancillary products

- It is likely the product would replace existing ancillary products that already enable them to use less energy/have lower heating bills and participants hope that this would do the same.
- Some others mention benefits to replacing their current ancillary products with this product such as overall effectiveness, space savings, and ability to leave it up year-round/not needing to store the product away.

- *"I would basically have it **all year round**. It looks like it can just stay there in my window… we like to use the portable heating and cooling apparatuses and we can get rid of both of those if we got this product."*
- *"I would **use it in place of the current heating and cooling methods** I currently use all year long **in the main living area and the bedrooms**. I feel it would do a better job… and would allow me to free up storage as I would not need the portable fans that I use during the hot weather."*
- *"It would be my **everyday go to option**. As long as it **works** and is **cost effective** it would **replace** my other units."*
- *"I would **use it daily as heating or cooling unit**. I hate having to move my A/C out when the summer is over, so this is great."*

n=36 Q: Imagine you own the new heating and cooling product you selected in the previous question. When and how do you envision yourself using it?

Detailed Finding 13:

These products would be most often used in common rooms, where people spend the majority of their time, often aiming to heat and cool multiple areas of the home with one unit

- Some participants mention using it their bedrooms for comfort at night.
- A few mention moving it from room to room on an as needed basis.
- Products M and T are more likely to be used for both heating and cooling; Product C would be used slightly more for just cooling.

Participants intend to use the product in rooms where they spend most of their time or in central locations in hopes to heat/cool multiple rooms/areas with one product

- Participants most frequently mention using the product in living rooms and bedrooms.
- A few mention using it in a central area to help heat/cool the entire house.
- There is some mention that location might be limited by windows compatibility.

- *"I would place it in our **living room** as it is where **we spend most of our time**."*
- *"My living room is the **main space I inhabit**, and very **central to the rest of the house**, so I would use it there. "*
- *"I would use this heating and cooling product in the most **central** place of my apartment **to set the temperature**."*
- *"I would use it in our bedroom since we could do with **more temperature control** in there and we keep the windows open to varying degrees all year."*
- *"Living room, since that is the only room in my apartment which has the **type of window** (and only one) necessary for the product."*

n=36 Q: Continuing to imagine that you own one of the new heating and cooling products you have learned about today, which room(s) would you use this new heating and cooling product in, and why? As part of your response, please take and then upload pictures of the room(s) you would place the product in, including clear pictures of the type of window(s) you have in the room(s).
Note: Only share pictures from your actual home – do not use images found online.

It is likely Product M would be used for both heating and cooling needs, often in a central/main area or bedroom

There are mixed responses regarding the use of the product as a replacement or supplement for their current heating and cooling methods. Some mention it would be an overall improvement from their current method(s) or would help solve a problem i.e., temperature regulation and/or airflow. A few say they would move it around to different rooms depending on how easy it is to move.

- *"I would use it **in the main living area for heating and cooling** as I think it looks like it would work better than the little heater I have for this area. I would also use one in the bedrooms and I think it would be better at heating and cooling than the baseboard heaters or portable fans I currently use... The hope would be that it would completely **replace** the use of my current options. If it turned out it did not work as well on it's own, I would try to find a **balance using both this and my current options** that is still more cost-effective than my current options alone."*
- *"I would use it in my **office** and/or maybe the **living room** to help **with cooling in the summer and extra heating during the colder months.**"*
- *"I would probably use it in our bedroom since this is where it would be most useful. We have our windows open to some degree all year and our HVAC system often doesn't reach our room very well, especially in the summer. So, this **would help regulate the temperature** of our room and make it more comfortable."*
- *"I would use In each room of the house. **It appears easy to move around**… If it works well it would replace my other heating and cooling options... "*

n=26* Q: Keep thinking about this specific product and the brief description. Assuming you had it in your home, how would you use it?
**Those who indicated they would be very or somewhat likely to use this product were asked this question.*

Product C may be used slightly more for cooling only and moved around based on need

Though many mention they would use it for both heating and cooling, there is a slight tendency for participants to see themselves using the product for cooling purposes only, especially on hot summer days. Further, while some mention a room they have in mind for it, others say they would move it around to different rooms according to need or where they spend time. A few say depending on its power and efficiency they would replace their other heating/cooling methods with this product.

- *"I would use it and **move it around** between a couple of windows depending on **if I have guests**, I could put it to make a preferred temperature where people are hanging out."*
- *"I'd probably **use it in my office during the day** during **both summer and winter** to heat and cool the room that I **spend the most time** in."*
- *"I would definitely use it on **severely hot days and** would usually turn it on in the early morning and would **switch rooms as needed**."*
- *"I would **mainly use it as an air conditioner** in the summer when the heat was unbearable."*
- *"I would **replace the air conditioner** I have now and I would **use it more than my current heater**."*
- *"If it's powerful enough we'd turn our gas furnace off in the winter and **heat the house with this instead**. We'd also **substitute our current portable air conditioners** with it, with the same caveat."*

n=18* Q: Keep thinking about this specific product and the brief description. Assuming you had it in your home, how would you use it?
**Those who indicated they would be very or somewhat likely to use this product were asked this question.*

Most would use Product T in their living room or bedroom, where they spend the most time

A few mention it could replace their current cooling or heating method or use it as a backup if their other heating and/or cooling method did not work.

- *"I would use this **exactly as an air conditioner**. Place it in the **largest area of the home**, assuming it could cool/warm that big of an area. If it couldn't then I'd just use it in my **bedroom** or other **areas that are most used**."*
- *"In the **living room** where most people are or **spend their time**."*
- *"In each room of the house. **Replacing AC-only units**."*
- *"I would use it as a window unit and **hopefully get rid of all of my fans**…"*
- *"Most importantly in the **bedroom** because it **can adapt to weather conditions**."*
- *"I would put it in the **living room**. Sometimes it gets below freezing **when our furnace won't come on**."*

n=16* Q Keep thinking about this specific product and the brief description. Assuming you had it in your home, how would you use it?
*Those who indicated they would be very or somewhat likely to use this product were asked this question.

Product Preference

Detailed Finding 14: Product M is thought to fit participants' lifestyles more than products C + T

- Most participants prefer Product M due to its overall look/design, space-saving features, and ability to open/close their windows.
- Nearly a third prefer Product C since it is similar to what they currently have, it seems compatible with their windows, and it seems portable.
- The few who prefer Product T mention compatibility with their windows/home.

More than half imagine **Product M** best fits their lifestyle

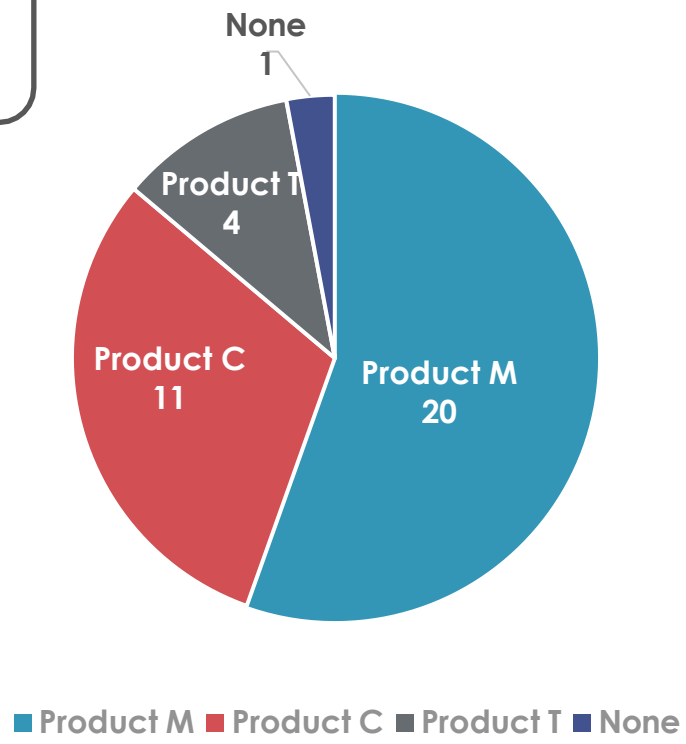
- Most participants prefer Product M due to its overall look/design, space-saving features, and ability to open/close their windows.
- Nearly a third prefer Product C since it is similar to what they currently have, it seems compatible with their windows, and it seems portable.
- The few who prefer Product T mention compatibility with their windows/home.

*"I only have one window in my apartment that this unit would work in, so that's the one I picked. The others are all **impractical for my space**."*

*"I chose this design/concept because it really **works well with the kind of windows I have** in my condominium…"*

*"I chose Product C because it is the **closest to what I already have** so I know it should work."*

*"I chose Product C because of its **portability**. I think it would be convenient to be able to move it around based on my needs."*



*"Product M **takes up the least room**, allowing me to still **use the window** for other things I use my window for. It is also the design I found the **most appealing** to look at."*

*"This would be the best fit for me because it seems the **most compact design** but more importantly it would allow us to **open/close the window** while using the product. I don't feel like any of the other options would suit our lifestyle. in that sense as well.*

*"This seems **least invasive in terms of space** and **visual curb appeal**."*

n=36 Q: Comparing each of the below product images and descriptions you have just seen, which one, if any do you imagine best fits your lifestyle and home?

Product M is preferred overall, but there are reasons this may not be the best option

- Many participants have experience with A/C only products that look similar to Products C + T, so they have experienced frustrations. The look of Product M leads them to believe that it is not bulky and hard to install.

Product Attributes	Product M	Product C	Product T
Overall Interest/Appeal/Purchase Intent			
Unique/Innovative			
Solves a problem in my home			
Fits with my lifestyle			
Size works in my home			
Portability			

Key Findings + Implications

Overall Perception

Findings

- Most feel saving on energy costs, energy efficiency, and a comfortable temperature are very important when it comes to heating and cooling their home.
- Most participants already use ancillary products to heat and/or cool their homes.
- Their perception of the concept was positive, with many believing it would solve a problem for them.
    - Portability, all-in-one heating and cooling, and compatibility with 120v outlets are primary drivers of interest.

Implications

- The idea of a portable unit to provide a comfortable temperature is already familiar to participants.
- The additional benefits of saving on energy costs and being energy efficient will increase positive perception of the concept.
    - These were not primary benefits perceived by participants and should be promoted as a primary benefit of this product.

Product Concepts

Findings

- Product M scores highest on most measures of interest but other concepts were also well received.
- The biggest concerns are how well it would really work, size/weight, and compatibility with their windows.
- Most participants do not understand heat pump technology.

Implications

- Although Concept M received the highest scores, its price and size may limit its initial adoption. A smaller, more familiar product like Concept C or T may be an easier initial transition for consumers.
- It is important to ensure these products are more energy efficient than alternative ancillary heating and cooling products and provide enough energy savings to offset the higher initial upfront costs, especially for those with lower incomes.
- Heat pump technology itself may not be an immediate draw, since average consumers are unfamiliar with heat pumps, but the benefits of heat pump technology should be marketed, especially the all-in-one heating and cooling feature, which is unique to this product.

Intended Uses

Findings

- Participants are more likely to use it for cooling than heating, especially in circumstances where they don't have central A/C.
- Some participants who discussed reducing or replacing their use of existing heat sources were people who had baseboard heat.
- Participants primarily would plan to use in a cental location, such as a living room, or in bedrooms at night.
    - Some expressed desire for the product to be able to heat/cool multiple areas, such as living, kitchen and dining rooms.

Implications

- While the product is portable, most people will keep it in a stationary location.
- It is more likely that people will consider replacing ancillary products than their primary central heating or cooling systems. More research would need to be done to see if cost savings from this alone would be yield enough energy and cost savings, or if consumers would also need to reduce their central heating and cooling usage.
    - This product may enable those with baseboard heat to turn off heat in places heated by the heat pump.

Thank You.

C+C Market Intelligence