BDC Presents: Gradient Comfort

March 28, 2024

Summary:

Dive into the world of cutting-edge HVAC innovation in our upcoming webinar, featuring Gradient's groundbreaking All-Weather 120V window heat pump, slated for release later this year. This session, hosted by Jason Wexler, Gradient's SVP of Policy and Technology, will explore the fusion of mini-split efficiency and window AC convenience embodied in their latest offering. Discover how this pioneering product, designed for 30-minute installation without the need for specialized tools or costly building modifications, connects seamlessly to standard electrical outlets and boasts a pre-charged refrigerant circuit. Learn about the rollout of 10,000 units in partnership with the New York City Housing Authority as part of the Clean Heat for All Challenge, a testament to the product's transformative potential in urban retrofitting. Gain insights into their efforts to adapt heat pump incentives to accommodate this new product type, marking a significant leap forward in building decarbonization efforts.

Resources:

- **Recording**
- **BDC newsletter sign up**

Events

- **California Policy Call:** April 16th, 10am PT / 1pm ET
- **BDC Presents: 120V Heat Pump Water Heater**: April 25th, 10am PT/ 1pm ET

Summary

Why Gradient's 120V Window Heat Pumps?

- Cheaper to install compared to mini-split heat pumps or central/ducted heat pumps for three reasons
    - Do not require refrigerant handling, the installer does not need an EPA-608 license to install it
    - Have plug-in installation, no need for an electrician to install it
    - Avoids building modifications, there is no need for drilling holes or modifying ducts
- The installation process is simple (video)
    - Pioneered inverted- U heat pumps in 2022, currently operating in 36 states
    - Takes approximately 30 minutes compared to a conventional split system that might take days to install and is installable by two laypeople
- Other Benefits of Gradient's All-Weather 120V
        - Designed for cold climates and has low GWP refrigerant (R32)
        - Supports variable window depth (unit slides apart like an accordion to accommodate a range of windows) and fits ~50% of US residential windows
        - Meltwater atomizer, allows the meltwater to drip outside
        - Dual air vents for room mixing that creates a uniform temperature throughout the whole space

Case Studies

- Palo Alto Case Study
  - Located in a two-story building, relatively modern with 1-BR and 2BR apartments
  - Realized 38% overall project savings
    - Reduce time spent installing per apartment from 78 hours to two hours
    - Reduce apartment entries from 6 times to one time
  - More project savings expected in multifamily retrofits (According to Bourbon Green Institute, expect to pay about $24 a square foot in NY a large multi-family building to install heat pumps)
- New York City Housing Authority (NYCHA) Clean Heat for All Challenge
  - Passed in 2019, Local Law 97 included a provision that NYCHA was required to 'make an effort' to meet GhG emissions goals: 40% reduction by 2030 and 80% reduction by 2050
  - NYCHA's Clean Heat for All Challenge
  - To meet climate goals, NYCHA worked with NYSERDA and NYPA to create the Clean Heat for All Challenge. Through this initiative, it found that it was cost-prohibitive for them to electrify large, old, high-rise buildings with conventional technologies
  - Trying to address this, NYCHA selected Gradient to supply 10,000 units and test out the viability of window heat pumps. Gradient was selected because it met all of NYCHA's specific requirements, notably ensuring that there would be no dripping or freezing on other units, which is not a concern with Gradient's atomizer technology.
    - Installed 36 window heat pumps as part of the pilot in December 2023
      - The team that installed it had no prior experience in installing HVAC and was able to trained in less than 2 hours
      - Took an average of one hour per unit to install, including removing the radiator in each room and being let into apartments
      - The actual installation process took about 20 minutes
    - 12 apartments have been heated using their product since December, with positive feedback from all residents
    - Units in the field are seeing a higher coefficient of performance than initially rated but are still being evaluated

Challenges to Overcome

- Comparability issue
  - There are different DOE cooling metrics and cooling test procedures for the Gradient heat pump, Combined Energy Efficiency Ratio (CEER), and split system or package central AC/HP solutions, (Seasonal Energy Efficiency Ratio SEER2)
  - Energy Star is attempting to fix this with the Heating Energy Efficiency Ratio (HEER)
- Updating incentives
  - Comparing heating efficiency is more difficult because there wasn't really a need for a heating metric for this product type, but Energy Star is attempting to fix this with the Heating Energy Efficiency Ratio (HEER)
  - The challenge with this new standard is organizations that provide incentives will need to update them to recognize this new product category

Q & A

1. **What is the approximate cost per unit, the life of the unit, and how many amps does it draw?**

- MSRP is $3,800. We do plan on offering to individuals, potentially in a retail setting, but don't have a timeline for this available.
- The estimated life of a unit is 15 years.
- The rated value is 12 A.

2. **How long is the power cord, does it require a grounded outlet, and can an extension cord be used if necessary?**

- The power cord is 6', requires grounding, and we do not recommend using an extension cord.

3. **Does the 120V window heat pump need a dedicated circuit?**

- Yes, so it has a nameplate rating is 12 amps which based on the electrical code indicates that it should be on a dedicated circuit.

4. **Would mold be a concern in the unit itself?** I find that to be somewhat of an issue with window unit AC that are used sporadically

- We use antimicrobial plastics and design geometries for thorough draining in order to minimize mold.

5. Earlier in your presentation, we saw that some people had put stuff onto the gradient. **How many pounds can the gradient handle?**

- The product is UL certified and as part of the UL standard for a product like this, there's a test that involves putting 200 pounds on the indoor side and separately 400 pounds on the outdoor side. The requirement in that case is that the unit does not break in a dangerous way. So I can tell you that the unit is not breaking in dangerous ways if you put 200 pounds on it, howeverI do not recommend putting 200 pounds on it, but it can hold a significant amount of weight.

6. **Can you discuss the price point of a product since it is an important consideration for actual implementation?**

- Analysis shared in the presentation shows typically 30-50% savings on installed cost compared to conventional heat pumps in multifamily buildings.

7. On one of your slides, you talk about BACnet. **How do you control the window heat pumps?**

- Great question! So we have a couple of different ways to control the products. Each product has an interface on it so you can control it if you're in the room. They also connect to an app so you can use your app to control multiple units and you can set a schedule. And then lastly, we're in the process of developing BACnet functionality that will be ready by the time the product launches that'll allow the system to connect to a building management system for a large commercial building to allow building owners to do things like control a whole fleet of units at once and set operating bounds.

8. **What is the filtering system like on this and is there a secondary air-quality benefit doing some of your gradients?**

- I can't get into the details too much on that, but I'll say keep an eye on our website later this year for some announcements.

9. **Would it be possible to make a unit that was 12,000 or 15,000 BTU?**
- It is possible, but higher capacity is challenging because you start to run into the current limit for a standard 15 amp outlet. However, if we consider lower capacity, there is a lot of potential there.

10. If it's very hot outside, **how does the efficiency of this unit compare to a window AC unit?**
- Based on the Department of Energy (DOE) estimate, window AC units, on average, have an efficiency of 10.8 CEER and for the gradient we are targeting at least 30% higher efficiency.

11. **Is there any protocol that you use to evaluate the effects of the window heat pump on the max load of the panel?**
- Though the nameplate rating is 12 amps, we have never seen it get close to that in practice and one anecdote is that NYCHA has told us that they have barely been able to see the impact on the building electrical load of these systems operated. So for the most part, we haven't needed to worry about reaching max load, but we are potentially looking at creative ways to make sure that people don't need to upgrade their panels.

12. **Based on your slides, what constitutes cold climate? What's the lowest operating temperature that the heat pump can operate at?**
- Yeah, that's a great question. So if you look at CEE, NEAP, Northeast Energy Efficiency Partnership, and also ENERGY STAR, they've all kind of converged around this idea that for a cold climate heat pump needs to have a capacity at 5 degrees Fahrenheit, that's at least 70% of the capacity 47 degrees Fahrenheit. And we're definitely able to meet that. We're still dialing in how high exactly the capacity is going to be at 5 degrees Fahrenheit, but we know we'll be able to meet that 70 percent. And then in terms of how low of a temperature it could go, we're still dialing that in as well. We know what we will at least be able to go down to minus 7 and potentially much lower.

13. There are a lot of questions about this condensate innovation. **Could you elaborate on how it works and if it would work less efficiently if it was very humid outside? Would it freeze in lower temperatures?**
- We've put a ton of R&D effort into this particular part of the product because it's brand new. No one has ever done anything like it before. In terms of working less efficiently in a humid environment, no because we are atomizing it and generating very tiny droplets. This droplet generation process doesn't depend on the humidity but it does bring up the concern of clogging. We recognized this concern, so we were intentional with how we built this and through a series of tests such as putting dirt into the meltwater tray and regulation soot into the condensate tray, and out of all of these tests, we were unable to clog it. In terms of it freezing, no. There's a resistive heater in the grain pan that heats as it needs to. There is a question about reliability since no one has deployed anything like this before. We have ongoing reliability tests that take time, but so far we have yet to see any failures.

14. For the NYCHA installations, **how big were the apartments? How many units are required for that size?**

- About 700 square feet, two-bedroom apartments. NYCHA had a firm look at the whole NYCHA portfolio and decided that 9,000 BTUs per hour was the capacity they needed. If I recall, one heat pump per bedroom and then one per living room would be able to cover nearly all of the NYCHA portfolio.

15. In the example that you shared, the field test showed a higher efficiency than the lab would have predicted. **Can you share why you think that was the case?**

- The reason that it's a higher efficiency is that when you do these rating tests, you're often operating at the maximum capacity that the system can deliver. Whereas when it's out in the field, you know, depending on how many square feet you're trying to heat or cool with the product, you may not necessarily need that full capacity

16. Would this be an economically and logistically realistic alternative to installing a new natural gas boiler for a large co-op or other type of large apartment building in NY? Would it be cost-competitive? Could the building heat and cool common areas without windows, etc?

- Our analysis predicts cost savings versus boilers. In some difficult-to-retrofit buildings such as NYCHA those cost savings are realized upfront based on capital expenditure difference alone, whereas with simpler boiler replacements the cost savings are realized over time, in the form of operating cost savings due to the low efficiency of boilers (typically ~60% for steam).

17. I had a lot of questions regarding the Woodside installation to see if this would work in a high-rise. **(1) How big were the apt units that needed the 3 pumps? (2) Are there any issues with the electrical riser capacity (e.g. could all three run at the same time)? we are sub-metered. (3) Is there a way to monitor draw so we can charge residents for cooling but not heating? (4) Our windows are quite wide. How would the sides be sealed if they are wider than the unit?**

- (1) 700 sq ft, though field data indicates that the systems are significantly oversized (i.e. potentially could get by with only 2)
- (2) It depends on many factors including building electrical capacity and building thermal load, but we can say that at NYCHA our backend data indicates that the units rarely operate near their rated amperage, even on the coldest days.
- (3) We are aware of this issue, stay tuned for future updates.
- (4) The units come with materials to seal windows that are up to 40" wide (materials are cuttable down to length). Additional materials are available if needed.

18. Has it been submitted for EnergyStar certification? What's the likelihood of it becoming IRA rebate eligible under the heat pump heating and cooling product category for HEAR?

- All-Weather product is not yet publicly available so has not yet been submitted to ENERGY STAR certification. The HEAR rules from DOE specify a pathway for this new product category to qualify for those rebates, and we are working with the various stakeholders involved to execute this pathway.

19. **Do you have any projection on the cost coming down with scaled-up manufacturing? Especially for use in individually owned homes (e.g. in the Bay Area where no A/C now around the Bay)?**

- As we continue to innovate and expand, we're always looking for ways to make our technology more accessible. Scaling up manufacturing is one avenue for achieving that. While it's a bit early to share specifics, we're optimistic that as we grow, we'll find efficiencies that will positively affect cost.