

Helping DHCD Evaluate the Installation of Heat-Pumps in Local Housing Authorities

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Massachusetts and Boston are attempting to integrate energy efficiency and climate resilience into state and local policy, leading to intersections with public housing and renewable energy to encourage sustainability. Heat pumps have become a rising star in renewable energy since the air source heat pump units pull air from the outdoors and adjust the temperature to the resident's preference. This system transfers heat instead of burning fuel and diminishes the need for separate heating and cooling systems, thus making energy more sustainable and efficient. Beyond sustainability, current oil and gas dependent utilities are losing their efficiency and reliability in the future as systems erode and resources for non-renewable fuels are depleting. To address this, the city of Boston is investing in housing retrofit programs to modernize the city's buildings: "The city's estimated 10,000 [heat pump] units in public housing, which the mayor also pledged will be entirely free of fossil fuels — new and older buildings — by 2030"¹ mandating that heat pumps will be a primary utility for residents.

With less than a decade of time to install these heat pumps, I was curious to examine the efficiency of heat pumps and the advantages and disadvantages of installing them in public housing. To learn from professionals in the field, I was privileged enough to connect with the Department of Housing and Community Development (DHCD), a department of the state of Massachusetts which has a goal of energy use reduction and sustainable sources of energy for public housing. To accomplish these goals, the department works closely with Massachusetts's Local Housing Authorities (LHAs) who are housing officials that manage several towns and thousands of constituents across the state. The DHCD has been a program called the Local Income Energy Affordability Network (LEAN) which is a program that subsidizes energy

¹ Noor, D. (2023, January 26). Boston's public housing is getting a green makeover. *The Boston Globe*.

<https://www.bostonglobe.com/2023/01/26/science/bostons-public-housing-is-getting-green-makeover/>

efficient systems across the United States to reduce the installation costs of air source heat pump units from what used to be \$6K-18K in installation to \$0 cost for the system. Through other programs such as Mass Save: “people can borrow up to \$25,000 at 0 percent interest to cover the cost of the installation.”² Which are both useful programs to make heat pumps seem more appealing and accessible than reinstalling and updating fossil fuel-dependent utilities. This system is useful because tenants that are renting or have complicated leases are not involved in splitting costs; however, this leaves LHAs responsible for the maintenance costs of the unit they incur.

When meeting with various members of the DHCD, I learned about their process for subsidies, their priorities of sustainable energy, and climate resilience. As a third-party researcher, I wanted to focus on what the DHCD hopes to learn from LHAs and what questions they have for the DHCD to learn how to maximize the utility of heat pumps. Our goals narrowed down to the topics of understanding the needs of the DHCD in relation to maintenance costs, their outlook on the future of heat pumps expanding in public housing, and the LHA’s thoughts on climate resilience and sustainability. Concerning maintenance costs, the DHCD told me that through their own internal reports, they evaluated that installation of the free heat pump units was done poorly in some homes, leading to escalated maintenance costs. But heat pumps do not differ very greatly from modern heating and cooling systems, and require regular upkeep to make sure the unit is running smoothly. The DHCD hoped to learn how to help LHAs with handling service visits and incurring the cost of the units. The future of heat pumps is also a

² Gorey, J. (2021, November 3). *Everything you need to know about adding heat pumps to your home*. Boston.Com.

<https://www.boston.com/real-estate/real-estate-news/2021/11/03/everything-you-need-to-know-about-adding-heat-pumpsto-your-home/>

priority for the DHCD because they hope to install more across the state and the city of Boston with Mayor Wu's new retrofitting policy. A concern for local LHAs is that heat pumps lack the efficiency to warm houses in extreme cold weather, which often occurs in Massachusetts through snowstorms, nor'easters, and heavy rain. This adds to the reluctance of LHA's to substitute existing systems, however the DHCD provided me with several examples of successes of heat pumps in colder climate. They cited localities in Maine, Eastern Europe, and beyond which have been using heat pumps regularly when they have similar or more extreme weather than Massachusetts. There are also heat pumps that come in "Arctic series" and are prepared for cold weather, so the DHCD was curious how LHAs perceive the quality of heat pumps. Finally, the DHCD clearly prioritizes climate readiness and energy efficiency with renewables, but they were wondering if LHAs share this need for sustainability and are willing to try alternatives to fossil fuels. Since the DHCD is competing against the priorities of fossil fuel companies advocating for oil, natural gas, and propane, which have dominated utilities for the past century. These firms often intervene when the DHCD tried to put together capital improvement plans for LHAs which prioritize heat pump substitutions. The DHCD also argued that existing nonrenewable systems are out of date for maximum utility due to depleting fuel sources and the lifespan of said systems. However, what is worth noting is that the payback period, or time that a system generates energy equivalent to the cost of installation for the system is 10 years for gas systems, but around 45 years for heat pumps, making them less economical in hindsight. Although the department understand that people can be set in their ways, they want to learn how to make climate readiness more appealing to people past the rebates and subsidies they apply for sustainable units.

My next step was to begin meeting with LHAs from around Massachusetts who have begun installing heat pumps to evaluate the opinion of public housing officials. I met with LHAs that manage systems in Winchendon, Quincy, Hingham, and Marshfield to learn firsthand their experiences with heat pump units. An LHA managing Winchendon told me that the city largely benefitted from the Mass Save program and the installation of 250 air source heat pumps was fully paid for by the program and have been running for seven years. All of the LHAs I spoke to manage over 200 heat pump units. LHAs must report their energy consumption monthly and annually to the DHCD, this then determines their funding. Due to this, LHAs have been prioritizing energy efficiency heavily. To address the research goals I established with the DHCD, I will start by speaking of LHA's experience with the maintenance and upkeep of heat pump units. The LHAs explained that their maintenance costs for incurring heat pump units rose to an average of \$300 when originally it was \$0 or just for sudden repairs. LHAs expressed gratitude that the installation for units came without cost and intervention from LHAs themselves, but that they wished the DHCD was more transparent on what the life cycle costs of heat pump systems would be prior to installation, and that many of these costs are much higher than their previous utility systems that were fossil fuel dependent. When a heat pump system breaks down, the solution is not always the substitution of an element, it is often circuitry or control boards, which require specialized staff to survey the unit themselves. Regular maintenance also required replacement of filters, cleaning of condensation, and ensuring no dust enters the system. Therefore, staff must be trained in how to use the unit itself, manufacturers of heat pump systems have been a great help in this endeavor and have a program to teach staff which LHAs are grateful for. However, the staff themselves are the only ones that are able to do service visits. A contingency plan I suggested when speaking with the DHCD and LHAs was the

possibility of training tenants for how to use their heat pump system to lower the need for LHAs to deploy their staff. But an LHA did their own internal survey of willingness and ability of their tenants to take on this responsibility and evaluated that less than 25% would actually be able to navigate the expansive technological heat pump unit after training and the number of tenants who would regularly upkeep their unit only depletes. This is because many constituents of the LHAs are elderly or disabled communities, as well as families with young children. Thus, the responsibility must be shouldered by LHAs and their trained staff, who are stretched thin across the region and leaves LHAs strapped for resources. The living condition of tenants themselves are at stake if units are inefficient; air filters must be clean, condensate could generate “slime” through inconsistent cleaning which can clog the system, coils could overheat, and fans could spread slime and dander through the air. To prevent these issues, staff repair units every six months and annually and have a service contract they renew based on maintenance demand, which has been increasing. Operation cost of heat pumps could not be answered directly to LHAs in their experience prior to installation, which makes current maintenance all the more difficult. LHAs believe that the DHCD should be more upfront about the continued cost of heat pumps beyond the subsidies that are offered for installation in order to plan proactively for the needs of the unit and their staff. LHAs expressed their need for an expanded staff and more budget from the DHCD to manage these service visits. Through resources like additional training seminars, discretionary spending, and more staff on hand, LHAs would feel better equipped to handle the maintenance of heat pumps.

After addressing maintenance costs, I discussed the quality of heat pumps that currently exist and how they weather in cold environments. An example was given from Winchendon about how during a snowstorm, all of the heating units in the building froze and were unable to

heat constituents during a massive snowstorm in the past year. This residential building had a hybrid system as the main system was run by air source heat pumps, and gas furnaces as a backup. This is because the existing gas system was already at its end of life, but the system was consistent throughout the building. DHCD staff and engineers were both mentioned as approving of this plan and suggested it as a more utilitarian solution. Both systems failed during the winter and the LHA was left to purchase personal heaters for every tenant. This was an example of some of the discrepancies that cannot be solved when heat pump units must be outdoors or in front of a window, external temperature can overwhelm heat pumps and freeze the condensate internally. I questioned if this was a result of splitting the technology systems between heat pumps and nonrenewable or existing systems. But this was soon answered by an LHA who reported near Hingham, a residential building fully fueled by heat pump units also failed during a snowstorm, in this building there were no nonrenewable energy systems that the technology was split between but the heat pumps still failed, it is worth noting that these heat pump systems were not the artic series, meant to be used in colder regions. These were just a few examples LHAs gave about how inefficient heat pumps can be in extreme climate. But LHAs did report that the efficiency of heat pumps is very reliable in warmer months and these issues only occurred during cold events. Otherwise, tenants report they enjoy using their heat pumps and have benefitted from the AC and heat through one system and have reached a great comfort level. The place of concern for LHAs was that the systems are not as reliable as existing systems which have proved successful through all Massachusetts weather. However, this poses more of an issue of heat pumps as a system themselves. To properly tackle the issue of heat pumps in cold weather, more artic series heat pumps should be encouraged in buildings that use heat pumps as the singular energy source, and if hybrid systems are in place, then the backup system should not pose severe

interference with the heat pumps. The DHCD and engineers should work with LHAs for weather resistant heat pump systems and ensure that heat pumps are ready for unexpected weather issues.

Finally, we discussed the importance of climate resilience and how heat pumps align with public housing goals. In all of my conversations with LHAs in Massachusetts, I could see a clear passion for the environment and energy efficiency. LHAs fully understand that nonrenewable energy systems are not a viable energy option in the long term and have admitted examples of gas and propane systems losing their maximum efficiency. Since LHAs must report their energy consumption to the state and the DHCD in order to determine their funding, energy efficiency has become a forefront of concern for LHAs in Massachusetts. Heat pumps were reported to reduce energy consumption by half compared to existing nonrenewable utility systems, which largely benefits the LHAs that manage the units. LHAs are more than willing to install heat pumps when comparing their overall energy efficiency, long term energy solutions, and comfort for tenants. The rebates and subsidies made the installation and engineering process much easier. However, the issues that arise with heat pumps which have been discussed throughout this report and adds to the hesitation of LHAs to accept heat pumps as a mainstream energy source is the unexpected maintenance issues and the lack of extreme weather safeguards due to the vulnerable nature of the air-source units which must be outdoors. It comes down to more of a systemic, engineering issue as I discovered in my discussions. The reluctance to install could be diminished greatly if these issues were addressed by the state and provincial organizations like the DHCD. LHAs in Massachusetts see great benefits with heat pumps, but in order to make the systems more accessible and used throughout the state, these organizational issues should be incorporated through the installation and transition process for heat pumps.

My takeaways from my various conversations with members of the DHCD and LHAs across the state were that both bodies have the foundation of climate action and energy efficiency, both see the benefits of heat pumps and are willing to accept change. However, in order for LHAs to fully accept this change and replace existing systems, they require transparency on maintenance costs, contingency plans for staff training and budget expansions, and engineering support against cold weather. I believe these can largely be addressed and incorporated into the DHCD's work. They were undoubtedly a source of support and guidance during the installation phase of heat pump machines, but LHAs reported this decreased when the responsibility fell on LHAs to provide regular maintenance. In order to begin widespread installation of heat pumps, the workforce should be trained adequately and know what to expect with these brand-new technological units. LHAs referred me to the Massachusetts Association of Housing Maintenance Supervisors (MAHAMS) as an administrative body which manages all LHAs across Massachusetts and expressed a desire for additional training services that are accessible to staff across the state. LHAs claimed that if more of their staff was trained and able to do more service visits, they would not feel a strain on their labor force to adapt to heat pumps. Similarly, they explained that the subsidies only were helpful until after the installation process was complete, but to make the payback period for heat pumps more appealing to LHAs still reluctant to install heat pumps, subsidies should extend to the recurring maintenance costs as well. The engineering process could also be more transparent and inclusive of LHAs when expecting cold weather spells, if LHAs had more access to weather resistant heat pumps or the demands of repairs, they could develop more proactive service visits. But these issues also boil down to issues dependent on heat pumps as a technological utility, although these problems cannot be fully addressed by the DHCD or LHAs they are worth discussing. If heat pumps are

expected to be in new and existing homes throughout Boston, the technology should be developed further to avoid such continuous maintenance issues and service visits. This would lessen the monetary and labor commitments which are required for heat pumps. Although these technological issues are expected with newer technology which has not been in use as long as mainstream utility sources, it would hugely benefit both the organizations which advocate for the use of heat pumps such as the DHCD and the managers of the heat pumps through continued use like the LHAs. LHAs fully understand that heat pumps are not the utilitarian solution to sustainable energy efficiency and that new technology takes adjusting and education. But they are waiting for heat pump units without such high life cycle costs as what are available currently to reach the market. The potential of heat pumps is reaching new heights with the LEAN program, Mass Save, the DHCD's continued support, and the flexibility of LHAs. It truly does take a village to make these new systems as adequate as existing utility systems; but through my conversations with authorities in public housing and energy efficiency, I believe heat pumps offer immense opportunities for growth and evolution of the energy sector. Through more proactive planning and transparency, I believe the DHCD can continue to encourage heat pump installation and bring about positive change to make Massachusetts more climate resilient.

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