Proposal for a Heat Pump Transition in Minnesota

Case Studies of Maine, Massachusetts, and New York

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Introduction:

Heating and cooling together comprise a majority (51%) of household energy use and a sizable share of the energy bill (40%) (Patano, Malinowski, Gard-Murray, Adams 2021). In the United States, residential heating and cooling systems have long been dominated by gas and electric resistance furnaces for heating and air conditioners for cooling. Heat pumps are energy efficient all-in-one heating, ventilation, and air conditioning (HVAC) systems that use electricity instead of fossil fuels. Heat pumps are air conditioning units that can cool in hot weather as well as heat the home during cold weather, operating even below negative 14 degrees Fahrenheit (10 degrees Celsius) with efficiency. Heat pumps come in two main types: air-source heat pumps (AHSP) and ground-source heat pumps (GSHP). They work by essentially transferring heat, pulling heat indoors from the outside air for heating or pushing heat from the indoors to the outside for cooling.

While the deployment of heat pumps in Minnesota has been low, I've assessed three northeast states as case studies for examples of what a heat pump rollout can look like for Minnesota. Three states: Maine, Massachusetts, and New York are chosen for their more robust implementation of heat pump programs compared to Minnesota. Furthermore, they are also operating in cold-weather climates that are similar to Minnesota's long and harsh winter, making them suitable comparison studies. Outlining heat pump programs and the policies that are employed in these states, we put forward recommendations that would serve Minnesota in switching to heat pumps as the main HVAC units. This proposal aims to advocate for a clean and equitable energy transition prioritizing heat pumps in residential areas using a policy framework.

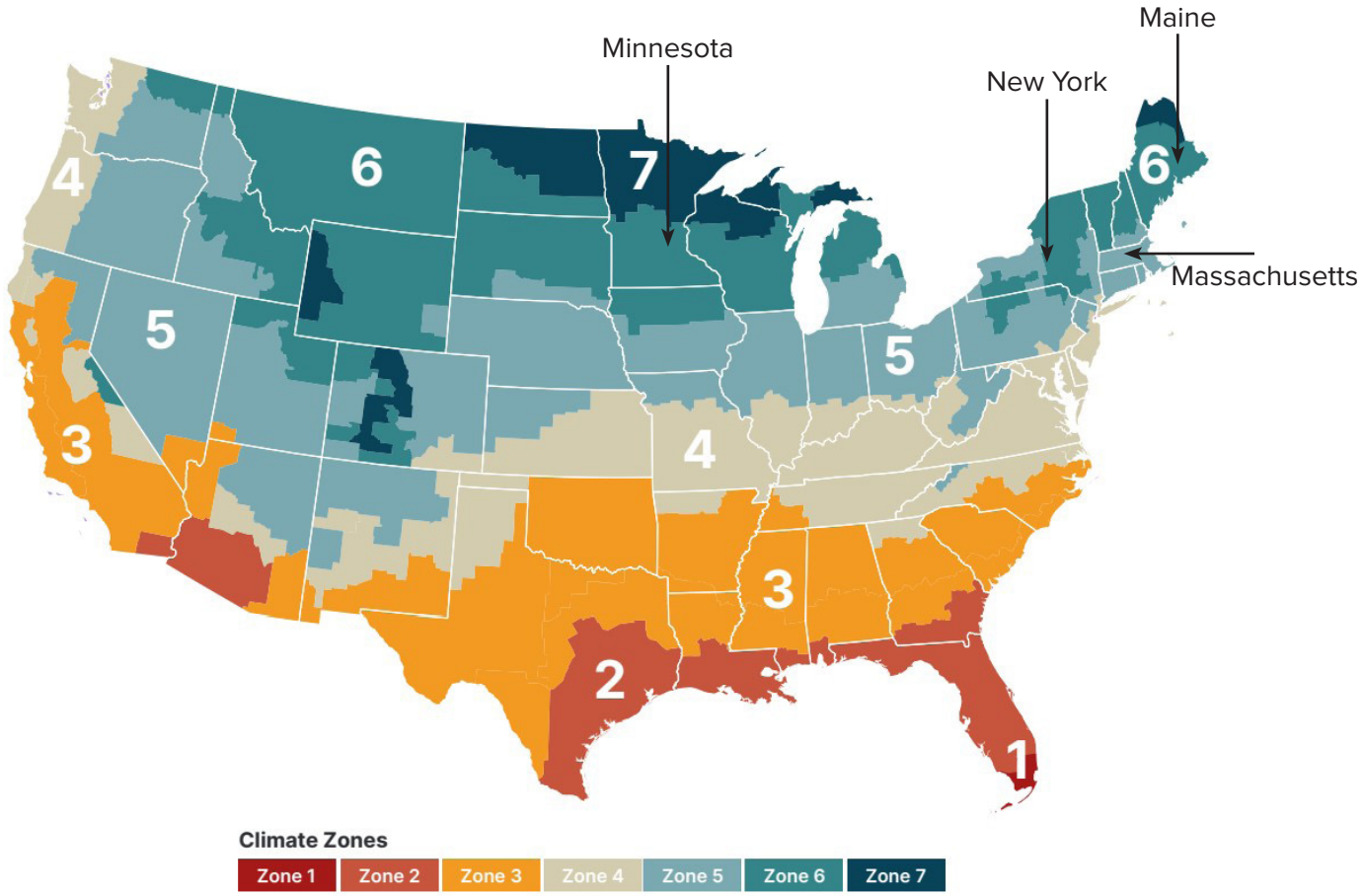
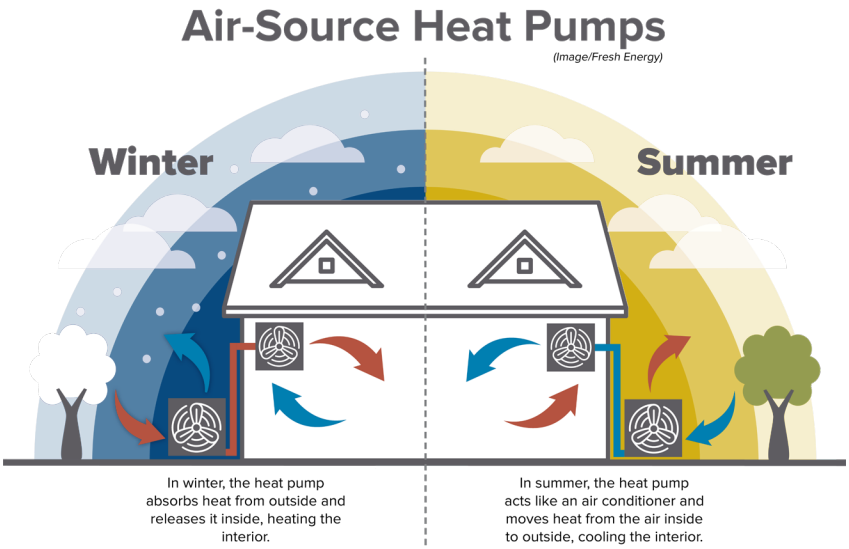


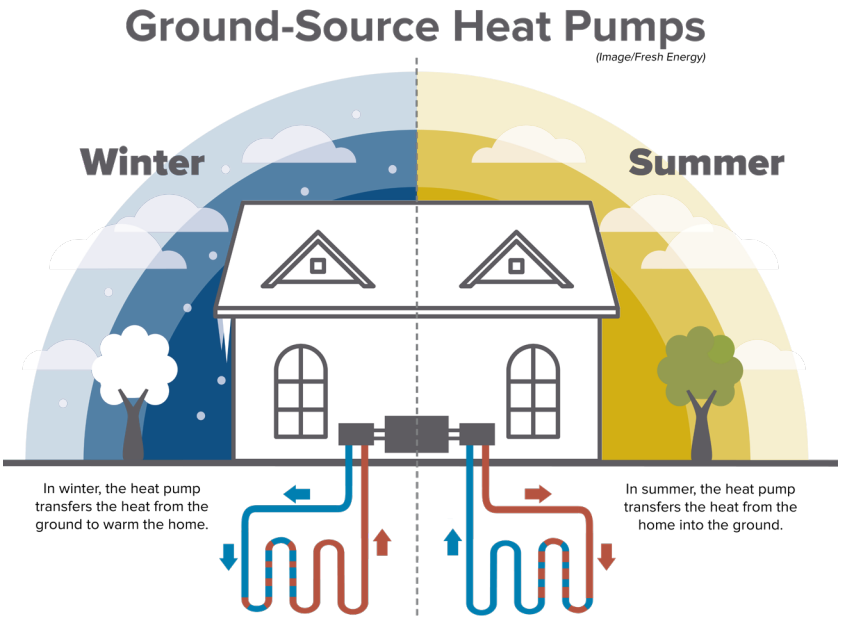
Figure 1: International Energy Conservation Code (IECC) Climate Regions. Minnesota has the coldest climate zones containing zones 6 and 7 throughout its regions. Maine, Massachusetts, and New York experience similar climate zones in the northeast regions of the U.S. Source: Collaborative Labeling and Appliance Standards Program

What is a Heat Pump?

A heat pump is a system that transfers heat from inside to outside and vice versa, as desired for homes, multifamily residential units, and even commercial buildings. Functioning as a heater, heat pumps take heat from the outside air and distribute it inside the home or building. This is possible even on cold winter days with great efficiency. In cooling mode, heat pumps remove heat from inside the house and take it outside, cooling the indoors in the process. Heat pumps use energy to deliver heat or remove heat instead of generating heat. Heat pumps can be split into two distinct types of installation: Ground-Source Heat Pumps (GSHP) and Air-Source Heat Pumps (ASHP). Both function similarly by transferring heat: taking heat from the outside and distributing it inside the house during the winter months. For warmer months, the system reverses and cools the home by taking hot air from the inside and pumping it outside, cooling the interior. To learn more about heat pumps and their effectiveness, check out Fresh Energy's blog on heat pumps.



Graphic 1: Air-source heat pumps pulls in heat from the outside to heat the home (winter) and pulls out inside heat to cool the home (summer)



Graphic 2: Ground-source heat pump takes heat from the ground during cold months through the pipe system and distributes it throughout the home. During warmer weather, the process is reversed.

Ductless heat pump installed outside of a home in Maine. Photo//Efficiency Maine

Case Study: Maine

According to the U.S. Energy Information Agency, Maine is the most heating-oil dependent state in the country (Maine.gov, 2021). Moreover, as the third coldest in the United States throughout the year (Minnesota is the fourth coldest), transitioning to cleaner heating and cooling systems is among one of the highest priorities for Maine's new Climate Action Plan (Maine.gov, 2021). This effort has been propelled by Maine's Governor Janet Mills (D) signing LD 1766 "An Act To Transform Maine's Heat Pump Market To Advance Economic Security and Climate Objectives" in June, 2019. In this plan, Maine has called for installation of 100,000 heat pumps by 2025. By 2030, the goal is for 130,000 homes to have one to two heat pumps installed and 115,000 more homes to be using a whole-home heat pump system. Since Maine has 550,000 total households, this adoption of heat pumps would represent the most decisive step towards an electrification of space heating thus far in the state.

The independent implementer for the state's efficiency programs, Efficiency Maine. has been rolling out heat pumps at a rapid rate compared to other states. Heat pumps have shown to be effective and efficient in heating this northeast state, helping residents of Maine save $812 a year on energy spending compared to when using a fossil gas furnace and up to $2,930 when switching from propane (Long, 2021). Adding 100,000 new heat pumps in Maine by 2025 is also forecasted to reduce heating bills as much as $300-$600 a year per home. Efficiency Maine aims to expand its heat pump installations to small businesses, municipal and public school buildings, other buildings and to the rest of the state.

Additionally, Efficiency Maine has partnered with MaineHousing to provide a heat pump program for under-resourced households. MaineHousing is an independent agency created by the Maine State Legislature to address unaffordable housing and provide other services pertaining to housing for under-resourced communities. This heat pumps program will pay for the cost of purchasing and installation if qualified for the program. Eligibility for assistance includes:

- Eligible for the Home Energy Assistance Program (HEAP) and the Central Heating Improvement Program (CHIP), and
- You are a homeowner, and
- Your home is a good candidate for a heat pump as a secondary heating source. (This can be decided at an inspection – you do not need to know the answer to this question right now.)
  - mainehousing.org

According to Efficiency Maine, installation data have shown the most installation per capita in rural and northern Maine. In addition to programs for under-resourced households, Efficiency Maine has also provided funding opportunities to help smaller municipalities accelerate transition to efficient heating and lighting systems, such as funds to offset the cost of heat pump installations. From December 29, 2020 to March 31, 2021, Maine municipalities with 4,000 residents or fewer were eligible to apply for additional incentives from Efficiency Maine for high-performance heat pumps in municipal buildings. Buildings such as community centers, fire and police stations, public safety buildings, public works, town halls, and libraries were eligible for this enhanced incentive. However, outbuildings such as sports, range, playground buildings, schools, pumps stations, and modular non-permanent structures were not eligible. Accepted projects were completed by June 1, 2021. This limited-time offer supported the installation of 189 heat pumps across 60 municipalities.

Funding for Maine small town rebates was provided by Efficiency Maines's Commercial and Industrial Prescriptive Program in partnership with The Nature Conservancy in Maine. Heat pump incentives were capped at $2,600 per single-zone system with a maximum of three systems (or $7,800). Efficiency Maine contributed $1,600 of the $2,600 and The Nature Conservancy will contribute $1,000.

Heat pumps installed on the exterior of a Massachusetts house. A Mass Save proposal offers incentives for buildings using natural gas to purchase heat pumps. Photo// Erin Clark, The Boston Globe

Case Study: Massachusetts

For more than a decade, Massachusetts' energy efficiency programs have been considered one of the most robust and effective in the country (Coakley 2021, Mass.gov 2021). Integral to this has been the Mass Save program - a consortium of electric and gas utility companies that manage and deliver energy efficiency services to regions in Massachusetts, funded by small fees on consumers' utility bills. It works closely with the Massachusetts Department of Energy Resources to offer incentive rebates for homeowners to make the switch to more efficient heat systems that emit less carbon, such as qualifying heat pump models.

The consortium has to set emissions reduction goals for every three-year efficiency plan, and programming follows these plans for the next three years, a system set in place by Massachusetts' 2008 Global Warming Solution Act. The efficiency plan for 2022-2024 made electrification a core tenet. Mass Save is currently in the process of being aligned to the state's new law requiring that gas emissions in 2030 be at least 50% percent lower than 1990 emissions and for Massachusetts to achieve net-zero carbon emission by 2050 (Young 2021).

In the last three-year program cycle (2016-2018), Mass Save has given out more than 26,100 heat pump rebates across its residential and business customers. Mass Save's rebates can go up to $15,000 for installation of ground-source (geothermal) heat pumps. Air-source heat pumps (mini splits) can rebate for $250 per ton of thermal units based on cooling and heating capacity. Mass Save offers an "Energy Optimization Rebate" to customers switching from pre-existing heating sources of fuel, like oil, propane, or electric resistance and planning to use their air-source heat pumps for winter heating:

- "If displacing oil or propane heat: Integrated Controls are required unless pre-existing, central heating system has been removed
- If displacing electric heat: electric bill must show 900 kWh difference between sum of three winter-usage and three lowest-usage months" - Mass Save

Since Mass Save is run by local electric and fossil gas utilities and energy efficiency service providers, to qualify for heat pump rebates, account holders must be Massachusetts residential electric customers of Massachusetts including Berkshire Gas, Cape Light Compact, Ever source, Liberty Utilities, National Grid and Unitil. Additionally, heat pumps must be listed on Mass Save Heat Pumps and/or Integrated Controls Qualified Products List at the time of purchase. Equipment installation must also be done by a licensed heating contractor and subject to a verification inspection.

Despite its robust programming, a 2020 study for Massachusetts Program Administrators (PAs) and Energy Efficiency Advisory Council (EEAC) showed that residential communities with more people of color, non-English speakers, renters, and lower household incomes receive Mass Save's services at significantly lower rates than communities that are more affluent and white. The results prompted the new three-year plan to include investments in expansion of work with community groups and municipalities to better serve historically underserved communities. Initiatives will increase participation via incentives for utilities to offer benefits for customers living in environmental justice areas in the state, and through the development of a workforce of energy efficient workers to address the shortage of workers (Shemkus, 2021).

Case Study: New York

New York has already launched several pilot projects to ramp up deployment of electrification technologies, especially for affordable housing which need additional investments for these capital intensive projects to actualize (Wilt 2021).
Heat pump incentives are run by the New York State Energy Research and Development Authority (NYSERDA). Its heat pump incentives are divided into five programs across the state aiming to advance the state's clean energy goals. New York has committed to carbon neutrality by 2040 (Parsons 2021), laying out a model for clean energy initiatives. Through NYSERDA, New York State will be investing over $450 million in heat pump incentives through utilities and over $200 million in market enabling, the process of utilizing education, marketing, and research to help to drive market take up of heat pumps (Parsons 2021).

NYSERDA partners with certified contractors to carry out heat pump installation and services for customers. Approved heat pump contracts can assess which type of heat pump is appropriate for a house model, conduct quality installation, and provide routine maintenance on the heat pump system as needed. If customers are eligible, they can apply for a rebate, incentive, or federal tax credit on their installation cost.

Heat pumps installed outside of an apartment building in New York.
Photo//RYCOR HVAC

New York has also launched several pilot initiatives geared toward increased electrification for affordable housing. NYSERDA's Low Carbon Pathways for Multifamily Buildings program is allocating $7.8 million for owners or managers of multifamily buildings to implement low carbon solutions as components of planned upgrades.

NYSERDA is one component of New York's Green New Deal strategy to reduce the state's greenhouse gas emissions by 85% by 2050 (Kovaleski 2020). NYS Clean Heat Program is a collaboration between New York Electric Utilities and NYSERDA to provide customers, contractors, and other heat pump providers a consistent experience and business environment throughout New York State.

Construction workers help install a heat pump.
Photo// Marcela Gara, Resource Media, Creative Commons

Recommendations

Comparisons of northeast states provide key similarities and constitute a framework that Minnesota can create for itself in the effort to progress the transition to heat pumps in the state. Pulling from each model, Minnesota can craft its own direction for a heat pump transition that is applicable to the state. Combining various strong points from Maine, Massachusetts, and New York, the following should be kept in mind when ramping up the Minnesota heat pump market:

Heat pump initiatives should support cost reductions strategies through the forms of incentives, rebates, and financing plans for customers. Offers such as rebates are available to reduce the upfront cost when purchasing a heat pump. One of the biggest barriers to wider heat pump adoption is that the system itself has high upfront costs with low immediate returns on investment compared to fossil fuel alternatives. Implementing incentives to reduce the cost of purchase and installation should be a priority, similar to existing utility efficiency rebates. Massachusetts, Maine, and New York offer rebates only through qualified heat pumps and heat pump contractors to ensure quality and longevity of the system. Minnesota should work closely with contractors to provide a good range of options that are up to standard and customer satisfaction.

There must be a clear and achievable goal to drive the heat pump market. Maine has an ambitious goal for heat pump installations that fits into its larger plan to decarbonize and move away from gas-dependent heating. Maine's Climate Action Plan has specific goals for 100,000 heat pump installations by 2025. The passing of LD 1766 provides policy support for the move toward electrification, making heat pumps a key player in decarbonization and the state's Climate Action Plan. With the passing of the Energy Conservation and Optimization (ECO) Act, Minnesota now has the momentum for fuel-switching incentives for households and commercial buildings to make the transition from fossil fuels heat source to electric systems, such as heat pumps. The passing of the ECO Act allows utility companies to count allocations toward their Conservation Improvement Program (CIP) Spending. Minnesota's Climate Action Plan already aims to achieve a "clean energy economy;" now we must re-examine where heat pumps can fit

into this effort with specific goals and benchmarks.

We must address uncertainty and lack of awareness around heat pumps. Despite the growing momentum for heat pumps in Minnesota, many customers and contractors are still unaware of the heat pump options for their homes and businesses across the state. Solutions should focus on building customer demand while presenting incentives to reduce costs. Campaigns to target and engage customers should help address this barrier. Developing a central website/online landing page, linking customers to resources, rebates, and qualified contractors would help to drive access and facilitate heat pump acquisition processes run through the Minnesota Department of Commerce that oversees the utility conservation programs in the state. Additional marketing and promotional campaigns should prioritize clusters of businesses and residential areas. Promotions should also prioritize under-resourced communities and opportunities for rebates and incentives. Customers should also be aware of the economic savings from switching to heat pumps from fossil fuel alternatives, including the environmental and health benefits from switching.

Train more clean energy workers. Increase the workforce of the energy efficiency field to meet the rising demand of electric systems. Workforce development will be key in heat pump deployment, especially as an advocacy point in creating new job opportunities for the state. Preparing people for a career in energy efficiency will help to advance the state's clean energy goals.

Government agencies should develop long-lasting partnerships with contractors and utilities. The Department of Commerce oversees utility conservation programs for investor-owned utilities Minnesota like Xcel Energy that provide electricity for the majority of the Twin Cities metro. Unlike the northeastern states I analyzed investor-owned utilities design and implement their own programs, rather than a third party implementer (like Mass Save, Efficiency Maine and NYSERDA). Xcel Energy and other utilities can implement their own heat pump utility programs through close guidance from the Department of Commerce. This ensures funding for rebates and incentives along with regulations.

Equity

As Minnesota begins to implement fuel switching heat pumps programs that will be permitted by the passage of the ECO Act, it is imperative that we keep equity at the forefront of this energy transition. Many under-resourced neighborhoods are disproportionately Black, Indigenous, and other communities of color that have been deprived of political and economic wealth due to racist structures in housing and policy that do not invest in these communities. While we recognize that technology is not the only solution to long standing systems of oppression, nor is it the full solution to combating climate change, we want to build a clean energy framework that prioritizes equity and justice in this heat pump transition.

Energy burden, as defined by the U.S. Department of Energy's (DOE), is the percentage of gross household income spent on energy costs. Fifty million households in the U.S. are considered low-income. Low-income households face a disproportionately higher energy burden and face barriers in accessing energy technologies that help make energy more affordable. These barriers include lack of qualifying credits and the inability to finance energy transition. The initial barriers to full adoption of heat pumps across Minnesota include lack of awareness and high cost of heat pumps. Heat pump programs geared specifically toward under-resourced residents should have appropriate outreach. It is often the case that wealthy residents have more access and knowledge to heat pump acquisitions, taking advantage of rebates and benefits offered. Education of heat pumps should prioritize low-income housing establishments and how a transition from fossil fuel systems to heat pumps will save money in the long term for residents. Educational information should also present assistance for low-income households and under-resourced communities. Education is an effective tool in raising awareness and prompting actions, but should be coupled with other energy efficient recommendations. Additionally, campaigns should target customers in the process of deciding whether to make a switch from existing heating and cooling to a more energy efficient system such as heat pumps.

The DOE estimated that 59% of under-resourced households are renters. Energy burden residents are also disproportionately renters, whereas heat pump programs and low-income heat pump programs (see MaineHousing) are aimed toward homeowners. Since residents often pay for their own utility bills, there is a disincentive for landlords and property managers to not install heat pumps. This makes energy savings and cleaner energy technology (i.e. heat pumps) out of reach for under-resourced tenants. Heat pump financial assistance programs should broaden to include renters and rental units for a wider adoption of heat pumps in these areas.

Energy efficiency program implementers should be in relationship with communities and conduct effective community engagement to develop programs that meet the needs of communities while targeting highly burdened households. It is imperative that trust is cultivated among households, heat pump contractors, and program implementers to carry out effective education and outreach. Residents have to trust that the information they are receiving is beneficial to them and not another marketing ploy, and they have to trust that utilities are providing sufficient rebates to renters and homeowners.

The push toward heat pumps in Minnesota will require the cooperation and awareness of all residents in the state, not just those who have the financial capability to afford heat pump technology. While addressing the gap in energy burden and inefficiency, it is imperative to name barriers hindering access to clean energy. Stable and long-lasting approaches should also be integrated linking low-income programs and policies to better impacted households.

Every community deserves access to HVAC systems that are clean, efficient, and affordable, along with receiving all the benefits that come with installing a heat pump in their homes. However, these recommendations are not a substitute for greater economic and social investment in under-resource communities. A rapidly changing energy efficiency adoption is an opportunity to address gaps in energy burden and needs to be inclusive of every household in a clean energy transition.

Conclusion

This proposal aims to create a framework to overcome many of the barriers inhibiting heat pump deployment in Minnesota such as costs, eligibility and lack of awareness, while keeping equity at the center of the deployment. Using Maine, Massachusetts, and New York as case studies due to their heat pump programs and similar climate, we pull forward strong points of each state as recommendations for Minnesota to mirror or build upon. Heat pump programs should be centralized with strong collaboration between utilities and government entities to make it easier for consumers to determine if a heat pump is the right energy efficiency upgrade for their home, business, or building. Recommendations are based on lessons learned from northeast states that seemed beneficial for Minnesota, specifically highlighting community outreach, rebates, workforce development, and legislative support. Regardless, the clean energy transition from fossil fuels to electrification in heating and cooling systems will require policy support at the state level. At its heart, this transition requires policies that are strongly committed to move toward a cleaner energy source for Minnesota homes, with plans that are robust and equitable for all who reside in the state.