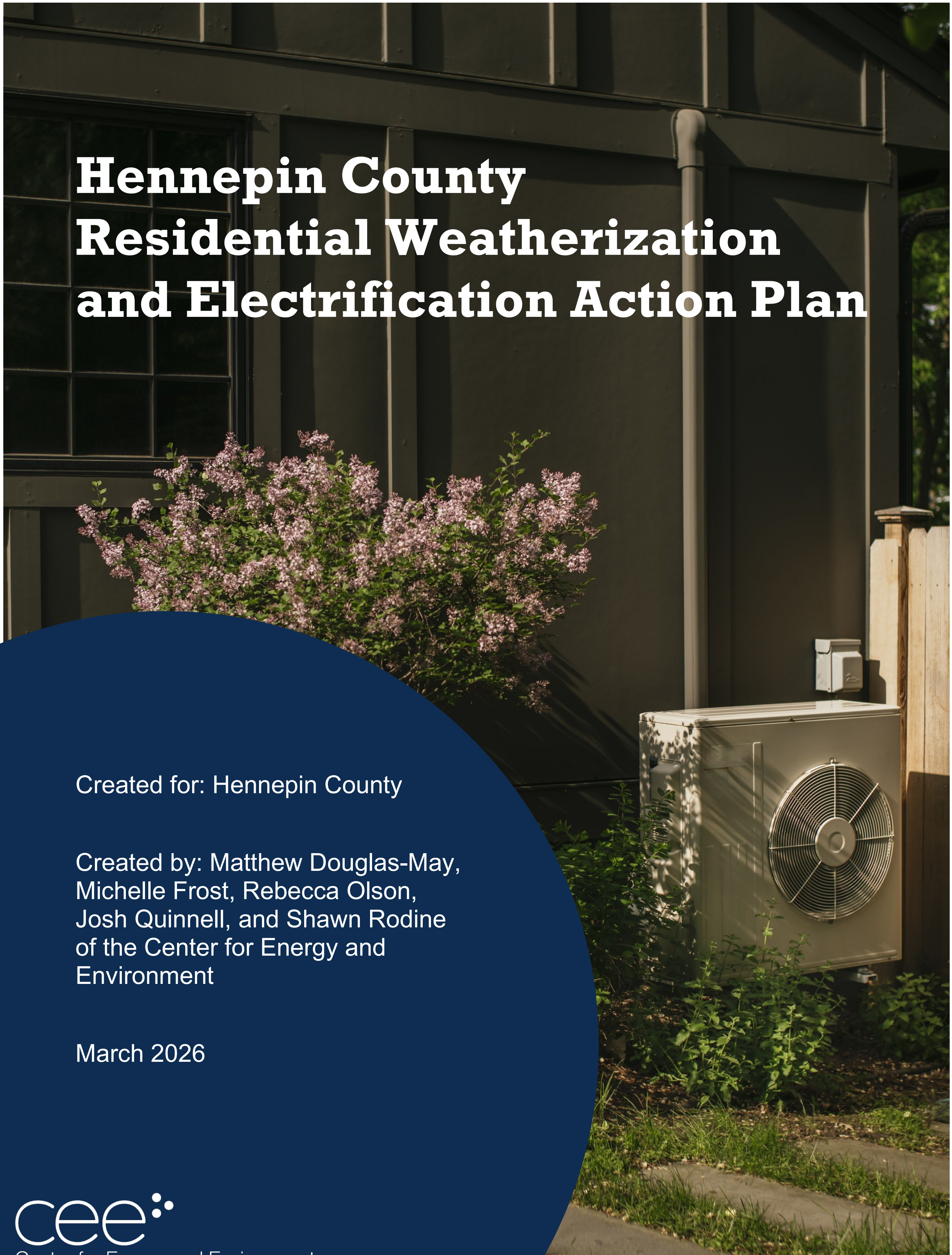

Hennepin County Residential Weatherization and Electrification Action Plan

Created for: Hennepin County

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CONTENTS

EXECUTIVE SUMMARY

Hennepin County has the climate goal of reaching net-zero emissions by 2050. Hennepin County's 1–4 unit residential homes can reach net-zero emissions by 2050, but doing so depends on rapidly reducing natural gas use in this sector. Residential emissions from electricity are trending downward, yet natural gas emissions from these homes remain effectively flat or increasing, making them critical to the County's climate strategy. The path forward is clear: systematically weatherizing homes and replacing gas equipment with efficient electric technologies.

This study answers two core questions:

1. What are the financial, labor, and emissions implications of weatherizing and electrifying all 300,000 1–4 unit homes in Hennepin County by 2050?
2. What actions can the County take to equitably accelerate this transition?

To address these questions, the project team:

- Built a modeling framework, using multiple high-resolution data sources, to estimate the costs, labor requirements, and emissions outcomes of weatherizing and electrifying every 1–4 unit home under several scenarios.
- Performed spatial analysis to identify where climate investments can deliver the greatest emissions reductions and equity benefits.
- Conducted stakeholder workshops and reviewed existing local and external programs to identify program gaps, barriers, and best practices for scaling weatherization and electrification.

Figure 1. Air source heat pumps are a key technology for decarbonizing homes.

Takeaways

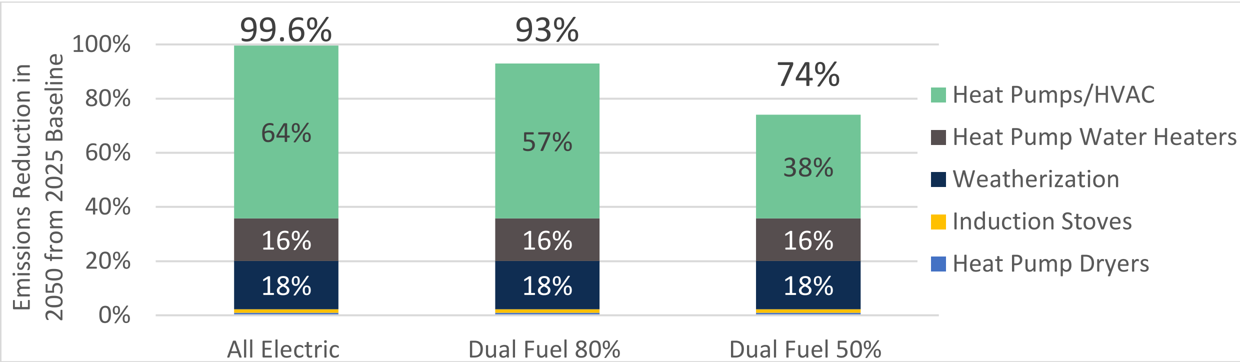
Existing technologies can effectively decarbonize all homes

Modeling shows that just three upgrades deliver nearly all the technically achievable greenhouse gas reductions in the 1–4 unit housing stock:

1. Comprehensive weatherization
2. All-electric or dual fuel air source heat pumps
3. Heat pump water heaters

Deploying these measures across all homes is sufficient to reduce residential emissions roughly 74–99% by 2050 in the modeled scenarios, essentially decarbonizing the sector while in many cases improving comfort and quality of life. Weatherization alone allows many homes to substantially reduce energy use and lower energy costs, especially in older, uninsulated housing stock. Other modeled measures to eliminate remaining natural gas use and facilitate electrification include induction stoves, heat pump dryers, EV charging circuits, and electrical panel upgrades. Figure 2 shows the emissions reduction achieved in the three modeled scenarios, which vary only by heating system: cold climate heat pump with electric resistance backup (All Electric), cold climate heat pump with gas back up (Duel Fuel 80%), and mid-efficiency variable-speed heat pump with gas back up (Dual Fuel 50%).

Figure 2. Emissions reductions achieved in 2050 by measure and model scenario



95% of households can save on energy bills

Most homes in Hennepin County can lower their energy bills through partial or full electrification when paired with special rates and appropriate equipment choices. A key enabler is Xcel Energy's electric space heating rate, which is available when electricity becomes a home's primary heating fuel. Nearly all homes (95%) can achieve bill savings under the Dual Fuel 50% modeling scenario. This scenario models a heat pump that meets 50% of the heating load combined with a gas furnace that meets the other 50% and qualifies for the electric heating rate.

In practical terms, installing a dual fuel heat pump allows many households to start saving money while taking a meaningful step toward decarbonization. All-electric scenarios can go further, eliminating fixed gas service charges and delivering greater emissions reductions, while still achieving bill savings for nearly two-thirds of residents when combined with weatherization and Xcel Energy's electric space heating rate, true even with competitively low natural gas prices. This removes a historical barrier for many households — electrification isn't necessarily a trade-off between climate benefits and household budgets.

Investing today in energy-smart homes delivers generational returns

Every major piece of gas equipment in the existing building stock will reach end of life at least once before 2050. The key decision point is whether those replacements are gas-to-gas or gas-to-electric. Weatherizing and electrifying every 1–4 unit home in Hennepin County is estimated to cost on the order of $10 billion in total capital investment. However, about $5 billion of that spending will occur regardless to replace failed equipment. According to rough estimates, the total upfront cost to weatherize and electrify the homes of county residents below 80% area median income is $3.3 billion, or approximately 31% of the total. The median upfront cost per dwelling of weatherization and electrification is $29,000 to $33,000.

In many scenarios, the incremental cost of choosing high-efficiency electric equipment instead of like-for-like gas replacements is modest, and in some cases can be fully offset by available incentives. When incentives from utilities, municipalities, tax credits, and special financing are layered, households can often reduce or eliminate the incremental cost of electrification while benefiting from lower operating costs and improved comfort, health, and safety. Upfront costs continue to inhibit adoption for many residents who don't have access to municipal rebates or face other income constraints.

Targeted funding and workforce growth make scaling retrofits achievable

To align the residential sector with the County's net-zero 2050 target, approximately 12,800 homes must be weatherized and electrified each year. Current weatherization and electrification activity in the County is far below this pace, indicating the need to substantially scale retrofits, market engagement, and enabling policy.

Meeting this accelerated pace is ambitious but possible. Aligning the natural replacement events of every furnace/boiler, water heater, and appliance with electrified counterparts and weatherization is the central implementation challenge. Doing so will require an estimated 579 additional workers across weatherization, electrical trades, and general contracting, representing a significant but manageable workforce expansion.

Actions can be targeted to maximize climate and equity impacts

The spatial analysis shows that many disadvantaged residents live in older homes with high potential for energy and bill savings through weatherization and electrification. Directing program resources toward these homes can simultaneously achieve large emissions reductions, energy bill savings, and substantial energy burden relief. At present, however, no low-income retrofit programs operating in Hennepin County consistently include electrification upgrades as a standard offering, leaving significant climate and equity benefits unrealized.

Meanwhile, many newer homes in the western parts of the County are effectively heat pump ready, with building envelopes and electrical infrastructure that can accommodate electrification with minimal additional cost. See more in the full plan and interactive online mapping tool.

Recommended Actions

Based on the data analysis, stakeholder input, and landscape research synthesized in this study, we recommend Hennepin County take the following actions.

Facilitate retrofits with County investment in high-impact programs:

1. Secure a funding source for weatherization and electrification programs.
2. Expand and scale a low-income weatherization and electrification retrofit pilot program.
3. Expand and/or create a deferred forgivable loan for weatherization and electrification.
4. Create and/or support a scalable network of contractors.
5. Create a weatherization and electrification cost-share rebate program.

Support programs and policies to clear barriers and amplify partners:

6. Ensure access to an advisor service for navigating programs and home projects.
7. Create a technical assistance and policy development service to help city governments advance home decarbonization.
8. Advocate to align and increase electrification in utility programs.
9. Create financial incentives for new developments to incorporate electrification.

Raise awareness and motivate action:

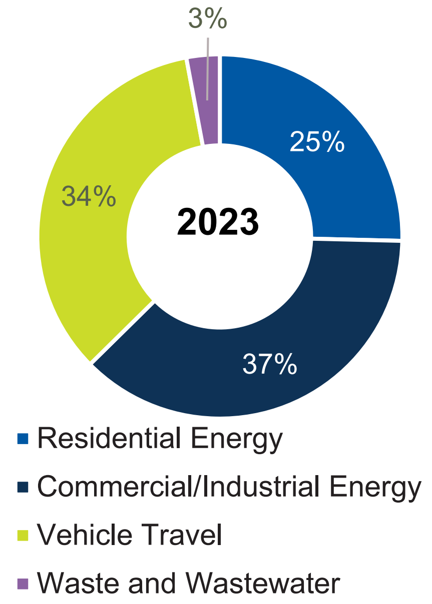
10. Conduct education and outreach campaigns to encourage residents and property owners to weatherize and electrify.

BACKGROUND

Hennepin County is home to nearly a quarter of the population of the state of Minnesota. To meet the County's climate goal of net-zero emissions by 2050, all homes in the county must be upgraded to eliminate carbon emissions. To understand what it will take to decarbonize all the 1–4 unit homes in the county, this study translated climate goals into project costs and building counts and developed concrete actions the Hennepin County government can take to equitably advance residential decarbonization.

Twenty-five percent of all greenhouse gas emissions in the County came from residential energy use in 2023.[1] Since 2006, residential electricity emissions have decreased by 47%, while residential natural gas emissions have increased by 25%.[2] The State of Minnesota's carbon-free electricity by 2040 law puts the electric grid on a path to decarbonization.[3] Transitioning the gas heating systems and appliances in homes to efficient, electric alternatives will tie residential energy use to the decarbonizing electricity grid and simultaneously address the challenge of increasing natural gas use and emissions.

Figure 3. Hennepin County 2023 GHG Emissions by Sector



Solutions to weatherize and electrify 1–4 unit residential buildings in Minnesota's cold climate are widely available on the market today. About 64% of all dwellings in the county are in 1–4 unit buildings,[4] commonly known as single-family homes, duplexes, triplexes, and quadplexes. Building on findings from a 2023 Center for Energy and Environment study for the City of Minneapolis[5] and based on field research, energy modeling, and stakeholder input, we studied insulation and air sealing, air source heat pumps, heat pump water heaters, induction stoves, and heat pump dryers as technologies that can decarbonize the residential building stock at the lowest upfront cost. Because of the solutions that exist at scale today, the 1–4 unit building stock is one of the largest sources of carbon emissions that Hennepin County can start to tackle immediately. This process of weatherization and electrification will represent a significant investment in and change to the 300,000 1–4 unit homes in the county and has the potential to improve residents' quality of life, lower energy bills, and reduce greenhouse gases.

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[1] Becky Alexander. 2022. *Hennepin County Greenhouse Gas Emissions Inventory and Analysis 2006–2020.* LHB. https://www.hennepin.us/climate-action/-/media/climate-action/Climate-action-plan/hennepin-county-ghg-emissions-inventory-2006-2020.pdf,

[2] *Ibid.*

[3] Minnesota Department of Commerce. February 7, 2023. "Governor Walz Signs Bill Moving Minnesota to 100 Percent Clean Energy by 2040." https://mn.gov/commerce/news/?id=17-563384.

[4] U.S. Census Bureau. 2023. "Units in Structure (ACS Table B25024)." *American Community Survey 5-year Estimates.* https://www.census.gov/programs-surveys/acs.

[5] Katie Jones, Rebecca Olson, Arbor Otalora-Fadner, and Josh Quinnell. 2023. *Minneapolis 1-4 Unit Residential Weatherization and Electrification Roadmap.* Center for Energy and Environment. https://www.mncee.org/sites/default/files/2023-02/Minneapolis%201-4%20Unit%20Residential%20Weatherization%20and%20Electrification%20Roadmap_Final%20%281%29.pdf.

METHODOLOGY

Overview

We developed an energy model of all residential 1–4 unit buildings in Hennepin County with representative accuracy down to the census-tract level. The results from the energy model's scenarios and spatial analysis were used to inform discussions with stakeholders and County staff to determine the most impactful actions for Hennepin County to take to further residential decarbonization.

Stakeholder Process, Landscape Analysis, and Case Study Research

One goal of this plan was to translate the results from the data analysis in this study into concrete, realistic actions in Hennepin County. To achieve this, we engaged stakeholders, analyzed existing programs and activities in Hennepin County, and researched best practices from across the country.

Stakeholder Workshops

We held four workshops, convening stakeholders from city governments, utilities, community-based organizations, nonprofits, housing developers, residential contractors, and Hennepin County. The list of workshop stakeholders can be found in Appendix E. Stakeholder Engagement. Through this process, we documented stakeholders' priorities, concerns, barriers, recommended best practices, and ideas related to creating an equitable residential weatherization and electrification action plan that can be integrated into County programs and processes. Feedback from stakeholders and County staff is integrated throughout this plan. The group's input informed the parameters of the energy model and scenarios, the direction of the landscape analysis, and the final recommended actions.

Landscape Analysis

We analyzed the existing landscape of home energy incentives, programs, and loans available in Hennepin County to identify gaps and opportunities for County action. We compiled a list of utility, municipal, state, and federal weatherization and electrification programs active in Hennepin County. We then conducted interviews with staff working closely with the programs, focusing on programmatic gaps and challenges**.** We also collected data from publicly available online sources such as program websites and published utility program results. Appendix C. Landscape Analysis contains the list of all the programs analyzed.

National Case Study Assessment

To gather national best practices, we researched local governments that have initiated electrification programs, focusing on county governments electrifying 1–4 unit residences. From those that had such programs, we selected three counties: Montgomery County, Maryland, Denver County, Colorado, and King County, Washington. We then conducted semi-structured interviews with program staff, focusing on program challenges, successes, and lessons learned.

Modeling Analysis

Central to this study is the building energy model created to evaluate potential decarbonization pathways for Hennepin County's 1–4 unit residential building stock. The objective of this model is to understand the energy, costs, and emissions of the existing building stock and estimate changes in these metrics based on the application of various efficiency and electrification upgrades by:

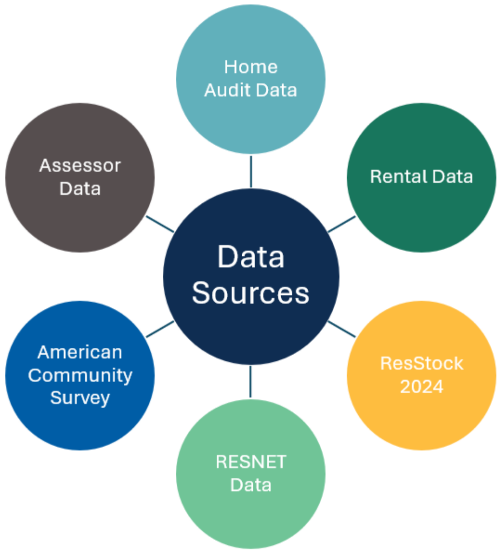
- Establishing a robust baseline building stock model from the best available data
- Soliciting stakeholder input on electrification assumptions and options
- Simulating the effects of specific efficiency and electrification measures on this building stock

The model is based on ResStock[6], a highly granular model of residential building stocks (v3.4) developed by the National Laboratory of the Rockies (formerly called the National Renewable Energy Lab) on behalf of the Department of Energy. For this project, ResStock was augmented with local data to improve the spatial resolution and accuracy of the outputs for Hennepin County. Customized efficiency and electrification solutions were developed specifically for this cold climate building stock.

Building Simulation Methodology

The model integrates four local datasets covering 1–4 unit residential buildings in Hennepin County: property tax assessor data, home energy audit data, Minnesota Weatherization Assistance Program data, and RESNET new construction data. Data gaps are filled using ResStock county-level probability distributions from the Residential Energy Consumption Survey and American Community Survey. Hennepin County tax assessor data provides ground truth information on every 1–4 unit residential building in the county. The remaining data sources provide information from a subset of these buildings on building envelopes, heating and cooling systems, and other appliances and equipment.

Figure 4. Data sources used to create the baseline model



These data are combined in the ResStock model where they are statistically sampled to create a synthetic building stock model that accurately represents the variations within Hennepin County's baseline 1–4 unit residential buildings down to the census tract level. Different scenarios of weatherization and electrification measures are then applied to the synthetic building stock to model the outcomes. Additional details on the development of the building model are presented in Appendix A. Model Methodology

Efficiency and Electrification Measures

The baseline building models are subject to several electrification and efficiency measures to assess their impact on energy, costs, and emissions. In this study, electrification measures are those that replace a device that consumes natural gas with one that consumes electricity. The electrification measures considered in this study are shown in Table 1; performance characteristics and cost assumptions are provided in Appendix A. These measures include the

[6] "ResStock v3.4; Highly Granular Modeling of the U.S. Housing Stock." National Renewable Energy Laboratory. DOE. https://resstock.nrel.gov/.

displacement of natural gas heating, water heating, cooking, and clothes drying devices with electric alternatives. These large appliances comprise over 99% of residential natural gas consumption. The selected decarbonization measures prioritize the most common, cost-effective approach to reduce energy use and emissions, leveraging solutions that are commercially available and technically proven. Other natural-gas-powered devices (e.g., fireplaces, grills, swimming pool heaters) represent very little net consumption and are not displaced as part of this study, but their natural gas use is tracked.

Table 1. Electrification Measures

Category	Existing Device	Electrified Device
Space heating	Boiler	Ductless air source heat pump
Space heating	Furnace	Ducted air source heat pump
Water heating	Gas tank water heater	Heat pump water heater
Cooking	Gas range	Induction range
Clothes drying	Gas clothes dryer	Heat pump clothes dryer

Additionally, a suite of five efficiency measures, collectively referred to as weatherization, is also considered in this study. Weatherization measures treat the building envelope, thereby lowering heating and cooling loads to improve occupant comfort, reduce space conditioning requirements, lower energy bills, and reduce emissions. Weatherization is generally the first step in a prudent decarbonization plan. However, the need for discrete weatherization measures varies greatly across the building stock according to each building's underlying attributes. This study applies weatherization measures only to buildings that qualify for it based on existing building parameters, such as existing insulation and air tightness levels in the building. Weatherization measures are shown in **Error! Reference source not found.**; performance assumptions and costs are provided in Appendix A.

Table 2. Weatherization efficiency measures and electrification infrastructure measures

Weatherization Measures	Electrification Infrastructure Measures
Comprehensive air sealing	Electric service panel upgrade
Wall cavity insulation	EV charging circuit
Attic insulation	
Rim joist insulation	
Continuous Exhaust Ventilation	

Lastly, two electrification infrastructure measures are included, electric panel upgrades and electric vehicle charging circuits. In some cases, the existing electric service in a building is insufficient to meet the requirements of new, large electrical loads. In these cases, electric service panels are upgraded to the current standard, 200A. The model assumes electric panels are upgraded when annual peak (15 min) amperage exceeds 80% of the existing service drop. Electric panels less than 100A are always upgraded. While transportation energy and emissions are not tracked in this model, 240 volt electric vehicle charging circuits are included in the suite of measures to facilitate transportation electrification.

Energy Rates

Energy costs in this project are determined by recent utility rates in Hennepin County summarized in Table 3. Natural gas costs are simplified into a fixed fee ($/month), a variable cost ($/therm), and a tax rate (%). They are modeled based on recent Center Point Energy bills. Two rates are considered: a low ($0.8/therm) rate and a high ($1.10/therm) rate to encapsulate the range of recent natural gas prices. These are referred to as the low and high gas costs, respectively. The monthly fixed charge is set to $9.50/month, and a blanket tax rate of 10% is applied to all bills.

Electricity rates are modeled based off recent Xcel Energy rates. The small portion of electric co-op customers (<1%) within Hennepin County is neglected in this study. Xcel Energy's main residential rate currently has a fixed monthly fee of $6.00/month and a rate of $0.181/kWh in the summer (May–Sept.) and a volumetric rate of $0.161/kWh in the winter. Additionally, Xcel Energy has a new electric heating rate open to customers that use electricity as their primary heating source (>50% load covered by electric heating system).[7] In all modeled scenarios, heat pumps were selected and sized such that they are the primary heating system and qualify for Xcel Energy's electric space heating rate ($0.111/kWh). Other associated riders and municipal fees are neglected.

Table 3. Assumed energy costs

Rate	Fixed Fee ($/mo)	Variable Cost
Natural gas – low	9.5	0.8 $/therm
Natural gas – high	9.5	1.1 $/therm
Electricity (May–Sept.)	6	0.181 $/kWh
Electricity (Oct.–Apr.)	6	0.161 $/kWh
Electricity (Oct.–Apr.) Space Heat	6	0.111 $/kWh

**State sales tax excluded Oct.–Apr. for primary heating fuel*

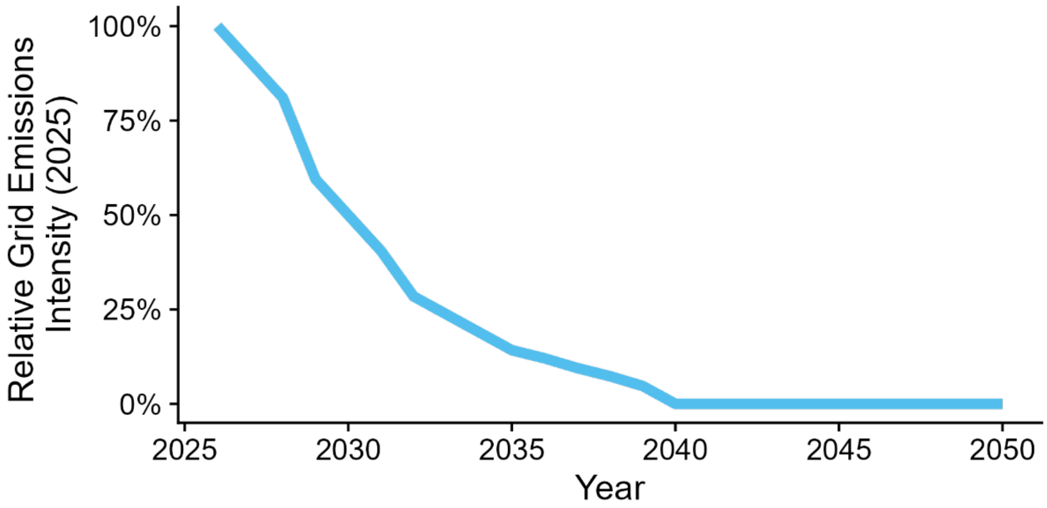
Emissions

Greenhouse gas (GHG) emissions in this project are calculated according to the present emissions intensity of the electrical grid and the fixed emissions intensity of combusting natural gas. The variable thermal content of natural gas and the GHG emissions associated with methane leakage are not considered. The natural gas emissions intensity is fixed at 0.00532 tonnes CO_2e/therm. The emissions intensity of electricity is 0.232 tonnes CO_2e/MWh. For future emissions forecasts, the natural gas emission intensity is held constant, and the electric emissions intensity drops to zero following trajectory established by Minnesota's Clean Electricity by 2040 Law.[8] The trajectory of grid emissions to comply with this statute is shown in

[7] "Electric Space Heating." Xcel Energy. Accessed December 31, 2025. https://mn.my.xcelenergy.com/s/residential/heating-cooling/heating-upgrade-rebates?utm_source=CEE%20Newsletter&utm_campaign=a2323243a1-EMAIL_CAMPAIGN_2025_09_09_05_01&utm_medium=email&utm_term=0_-a2323243a1-455562773.
[8] "Minnesota's Clean Electricity by 2040 Law." Minnesota Department of Commerce. Accessed December 31, 2025. https://mn.gov/commerce/energy/clean/cleanelectricity2040/.

Figure 5. As a final step, total emissions are balanced in the baseline scenario to match the accounting provided by the Hennepin County GHG Inventory.[9]

Figure 5. Estimated grid emissions intensity relative to 2025 values



Forecasting Labor Needs

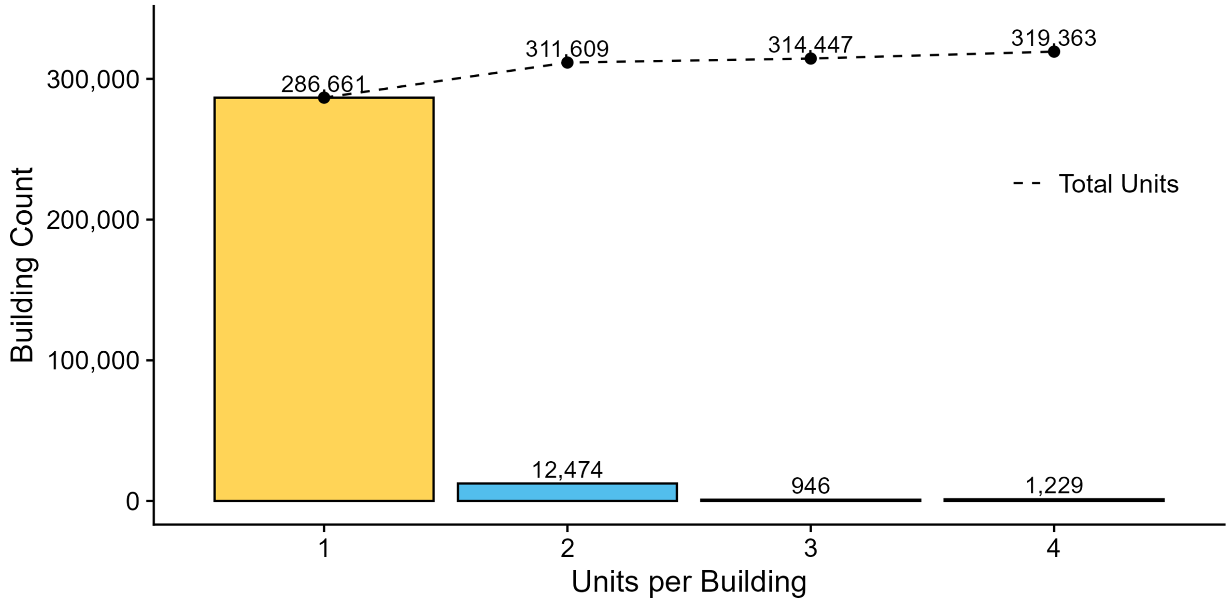
A baseline model of the existing rate of equipment replacement in 1–4 unit homes was developed using equipment lifetimes and count estimates. The model assumes an existing market equilibrium between retrofit demand and available labor capacity, meaning the current workforce of tradespeople is sufficient to meet baseline equipment replacement needs. This assumption establishes a clean baseline and focuses the analysis on incremental labor requirements needed to meet accelerated electrification and weatherization targets. The model also assumes current electrification activity (1–3% of building stock annually) and existing electric equipment replacements are too small to take into consideration. Future workforce challenges unrelated to building decarbonization are outside the scope of this analysis.

Existing Building Stock

The representative building stock model gives insight into the current characteristics of 1–4 unit buildings in Hennepin County, which informs the baseline scenario. The general makeup of the building stock is shown in Figure 6. It consists of 319,363 housing units from 301,210 buildings. Ninety percent (286,661) are single-family homes. Eighty-eight percent of these are single-family detached and 12% are single-family attached buildings. Eight percent (12,474) are duplexes and approximately 1% are triplexes (946) and quadplexes (1,229), each. Eighty-three percent of the 2–4 unit buildings are in Minneapolis. Twenty-one percent of the building stock is rental units.

[9] Becky Alexander. 2022. *Hennepin County Greenhouse Gas Emissions Inventory and Analysis 2006–2020*. LHB. https://www.hennepin.us/climate-action/-/media/climate-action/Climate-action-plan/hennepin-county-ghg-emissions-inventory-2006-2020.pdf.

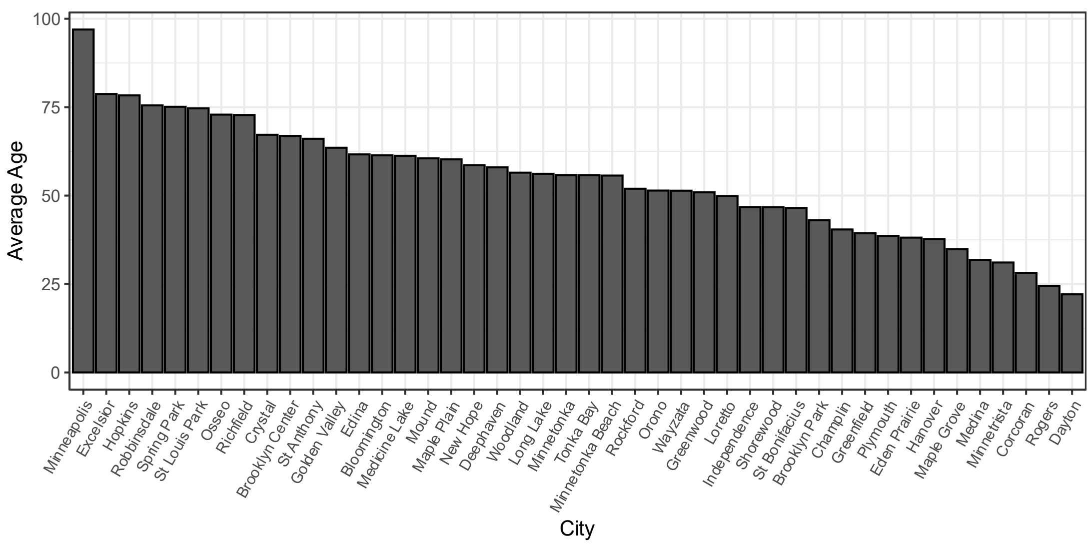
Figure 6. Building counts of 1–4 unit buildings in Hennepin County



Average building age varies significantly across the county as shown in Figure 7. Minneapolis has the oldest average building age at 96 years old, followed by Excelsior, Hopkins, and Robbinsdale at around 75 years old. The northwestern part of the county has the newest buildings. For example, Dayton and Rogers have average building ages less than 25 years. In the context of this study, most buildings in older cities predate energy code, whereas most buildings in the younger cities are subject to relatively modern building energy codes.

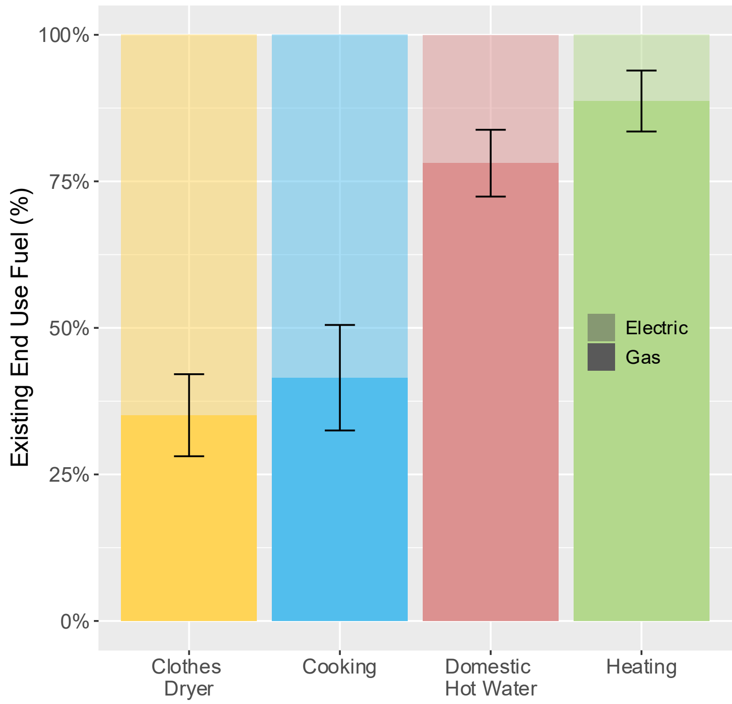
Building or unit sizes exhibit similar large variances. Cities located around Lake Minnetonka have average building sizes exceeding 4,000 sq. ft., while many smaller cities neighboring Minneapolis have average building sizes less than 2,000 sq. ft. In the context of this study, larger buildings require larger HVAC systems that use more energy and emit more carbon, which leads to greater absolute savings potential and higher retrofit costs.

Figure 7. Average age by municipality



The makeup of existing gas appliances in the building stock is shown in Figure 8. Makeup of existing gas appliances This data informs the required number of electrification measures to be considered. Ninety percent of 1–4 unit buildings in Hennepin County use natural gas as a primary heating fuel. Of these, 90% are forced air furnaces and 10% are boilers. Eighty percent of buildings use natural gas for water heating and 95% of them are relatively low-efficiency storage models. Most clothes dryers and cooking ranges are already electric; however, estimates for these two end-uses carry more uncertainty than heating and water heating due to reliance on state or regional ResStock estimates where local data are unavailable.

Figure 8. Makeup of existing gas appliances



Scenarios

The model is a scenario tool and is designed to study what-if situations that depend on prescribed changes to the building stock through the application of various efficiency and electrification measures and their assumptions to many buildings. Due to the overwhelming impact of space heating on residential energy use, this project focuses on scenarios that are differentiated by the choice of heating system and weatherization assumptions. These scenarios are outlined in Table 4. The Baseline Scenario represents the status quo; natural gas equipment is replaced with the same equipment on failure. The Weatherization Scenario eschews all electrification measures and only weatherizes the building stock as needed. This scenario is useful for isolating the impacts of weatherization.

The remaining three scenarios consider three different heating systems. They were selected based on stakeholder feedback during project workshops. The three heating systems include:

- **All Electric Scenario**: A cold climate air source heat pump (ASHP) with electric resistance (ER) backup
- **Dual Fuel 50% Scenario**: A dual fuel heating system that uses a lower cost variable speed heat pump to target 50% of the heating load to qualify for the Xcel Energy space heating rate and a high-efficiency gas backup to meet the remaining 50% of the heating load
- **Dual Fuel 80% Scenario**: A dual fuel heating system that uses the same cold climate heat pump as the All Electric Scenario to target 80% of the heating load and a high-efficiency gas backup to meet the remaining 20% of the heating load.

Table 4. Scenario definitions

Scenario	Heating System	Weatherization	Other Electrification*
Baseline	Like-for-like	No	No
Only Weatherization	Like-for-like	Yes	No
All Electric	Cold climate ASHP + electric resistance	Yes	All
Dual Fuel 50%	Variable speed ASHP + gas backup	Yes	All
Dual Fuel 80%	Cold climate ASHP + gas backup	Yes	All

**Other Electrification includes installing heat pump water heaters, induction stoves, heat pump dryers, EV charging circuits, and panel upgrades when needed or to replace gas equipment.*

DISCUSSION AND RESULTS

Greenhouse Gas Emissions Reduction

It is possible to achieve Hennepin County's goal of net-zero emissions by 2050 in all 1–4 unit residential buildings using the modeled equipment and measures, which are currently available at scale. The two pathways for emissions savings are via clean electricity from Minnesota's clean energy law, 100% Carbon-Free Electricity by 2040[10], and the displacement of natural gas consumption with clean electricity. **This study's modeling finds that space heating makes up 69% of energy use emissions in existing 1–4 unit buildings in Hennepin County, making heat pumps and weatherization the measures with the highest decarbonization potential**. The three model scenarios achieve different emissions reductions, based on the type of heating system installed to replace the existing gas heating system as shown in Table 5.

The All Electric Scenario results in a 99.6% reduction in emissions, achieving Hennepin County's goal of net-zero carbon emissions by eliminating virtually all natural gas consumption in the residential 1–4 unit building stock. The Dual Fuel 50% Scenario has the lowest upfront and energy bill costs and achieves a 74% reduction in emissions by 2050 but fails to meet the County's emissions goal because approximately 50% of space heating will continue to rely on natural gas. The Dual Fuel 80% achieves a 93% reduction, demonstrating how confining natural gas use for space heating to the coldest days of the year allows dual fuel systems to nearly match the All Electric Scenario emissions outcomes.

Table 5. Greenhouse gas emissions reduction by scenario

Model Scenario	Emissions reduction achieved by 2050 from a 2025 baseline
All Electric	99.6%
Dual Fuel 50%	74.1%
Dual Fuel 80%	93.0%

Weatherization and heat pumps substantiate a majority of potential GHG emissions reductions as shown in Figure 9. Heat pumps provide 38 to 64% of net emissions reductions, depending on the scenario. Weatherization is the second largest source of emissions reductions, and in many cases also enables heat pump outcomes by reducing home heating loads. Heat pump water heaters contribute most of the remaining modeled emissions reductions, making them critical to achieving net zero. Electrifying ranges and clothes dryers contribute less than 2% of the modeled emissions reductions, but their electrification is important for homes pursuing the All Electric Scenario to eliminate gas connections and associated fixed fees of $114 per year.

[10] "Minnesota's Clean Electricity by 2040 Law." Minnesota Department of Commerce. Accessed December 31, 2025. https://mn.gov/commerce/energy/clean/cleanelectricity2040/.

Figure 9. Emissions reductions achieved in 2050 by measure and model scenario

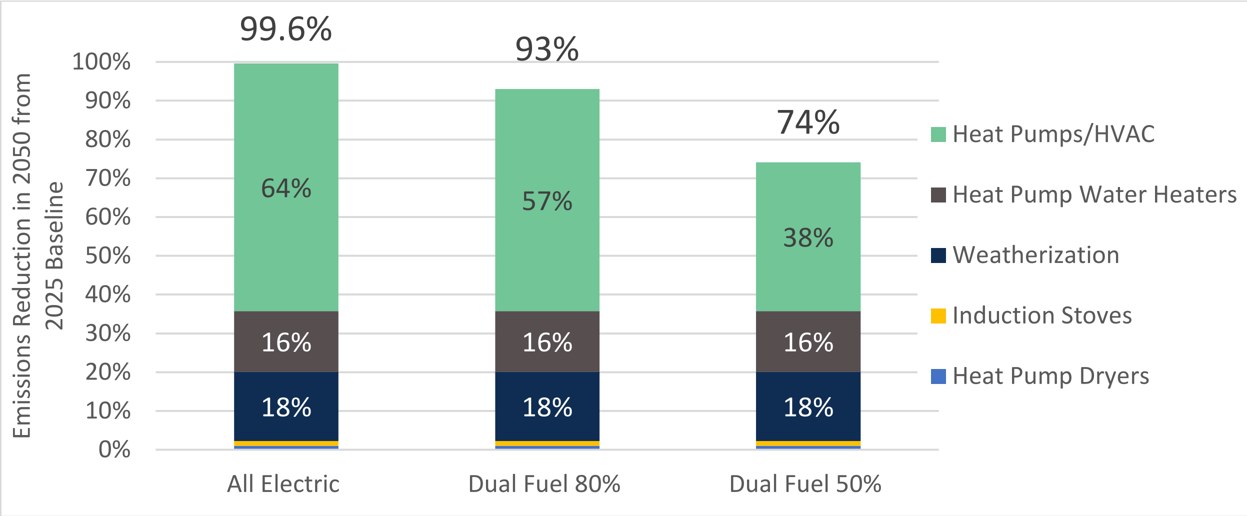
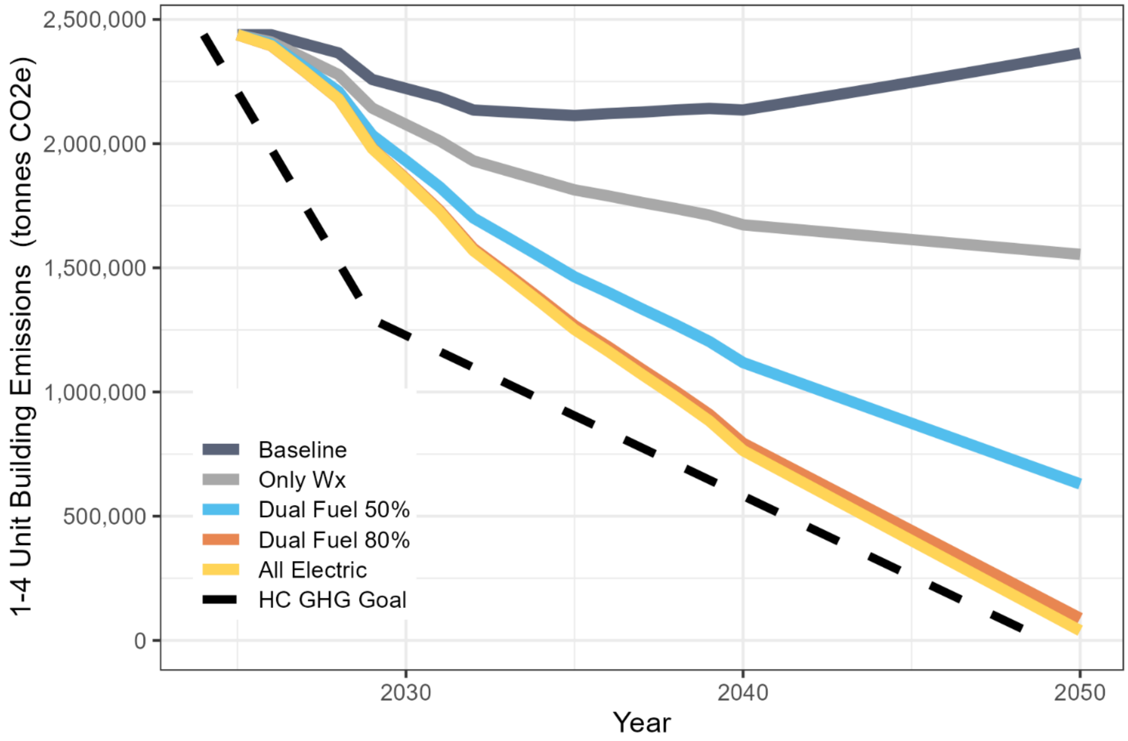


Figure 10 shows emissions reductions over time by scenario. In the Baseline Scenario, emissions decrease through 2035 but increase after because new construction continues to add natural gas load. The Only Wx scenario shows that weatherizing existing buildings alone is more than sufficient to offset new natural gas load of new construction and provide significant emissions reductions from 2025 levels. **The three electrification scenarios highlight how displacing natural gas use, primarily in space heating, is critical to meet 2050 emissions targets.**

Figure 10. Greenhouse gas emissions reductions over time by scenario



Upfront Costs

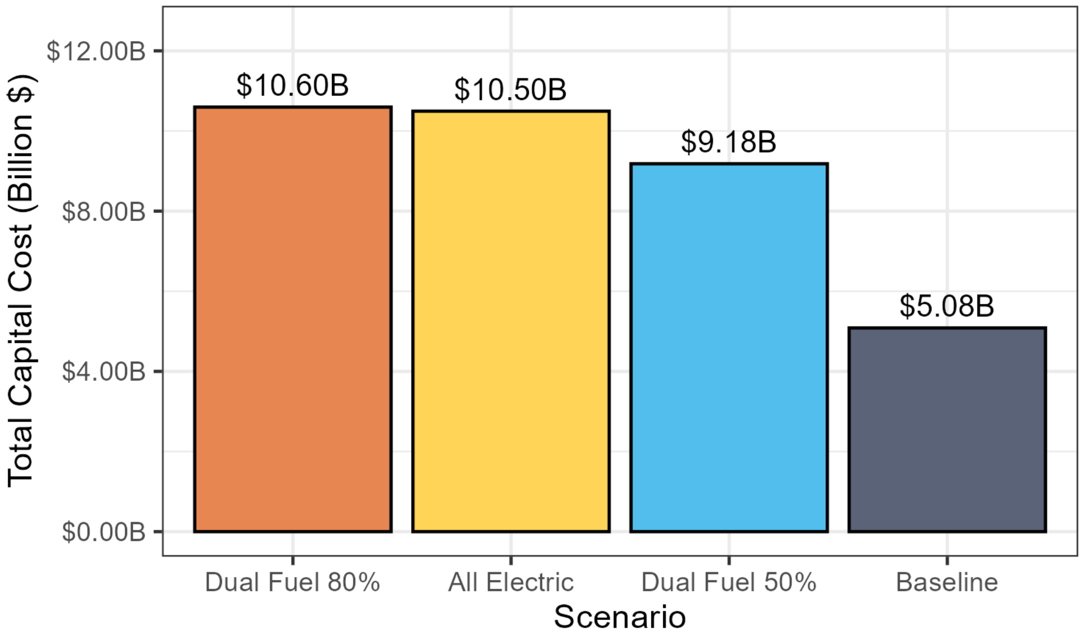
Between now and 2050, every home in Hennepin County will need to replace the pieces of equipment modeled in this study at least once as they reach end of life. As a result, a baseline cost of $5.08 billion is inevitable to perform like-for-like replacement of failed equipment.

The total upfront cost to weatherize and electrify the 301,210 residential 1–4 unit buildings in Hennepin County ranges from $9.18 billion to $10.6 billion across three electrification scenarios. All three electrification scenarios (All Electric, Dual Fuel 50%, and Dual Fuel 80%) include full weatherization plus equipment upgrades relative to the Baseline Scenario. Total upfront capital costs by scenario are shown in Figure 11.

The incremental cost of each scenario is the difference between the baseline cost and scenario cost. The Dual Fuel 50% Scenario costs $9.18 billion, representing a $4.1 billion incremental cost above baseline. The All Electric Scenario costs $10.5 billion, a $5.42 billion incremental cost. The Dual Fuel 80% Scenario is the most expensive at $10.6 billion, representing a $5.52 billion incremental cost above baseline, combining a cold climate heat pump with a high-efficiency gas furnace backup.

Looking at the share of homes occupied by lower-income residents helps illuminate the cost of making upgrades in the households that may need more financial support. According to rough estimates, the total upfront cost to weatherize and electrify the 1–4 unit homes of households with incomes below 80% area median income in the county is between $2.9 billion (Dual Fuel 50%) and $3.3 (Duel Fuel 80%), approximately 31% of total upfront cost.

Figure 11. Total upfront costs of electrification and weatherization



Median per-dwelling upfront costs are presented in Figure 12. The median baseline upfront cost is $15,900 per dwelling. The Dual Fuel 50% Scenario median upfront cost is $28,900, a $12,900 incremental cost above baseline. The All Electric Scenario costs $32,900 per dwelling, a $17,000 incremental cost above baseline. The Dual Fuel 80% Scenario costs $33,200, a

$17,300 incremental cost above baseline. The Dual Fuel 80% Scenario has the highest per-dwelling cost, marginally exceeding the All Electric Scenario.

Figure 12. Median per-dwelling upfront costs of electrification and weatherization

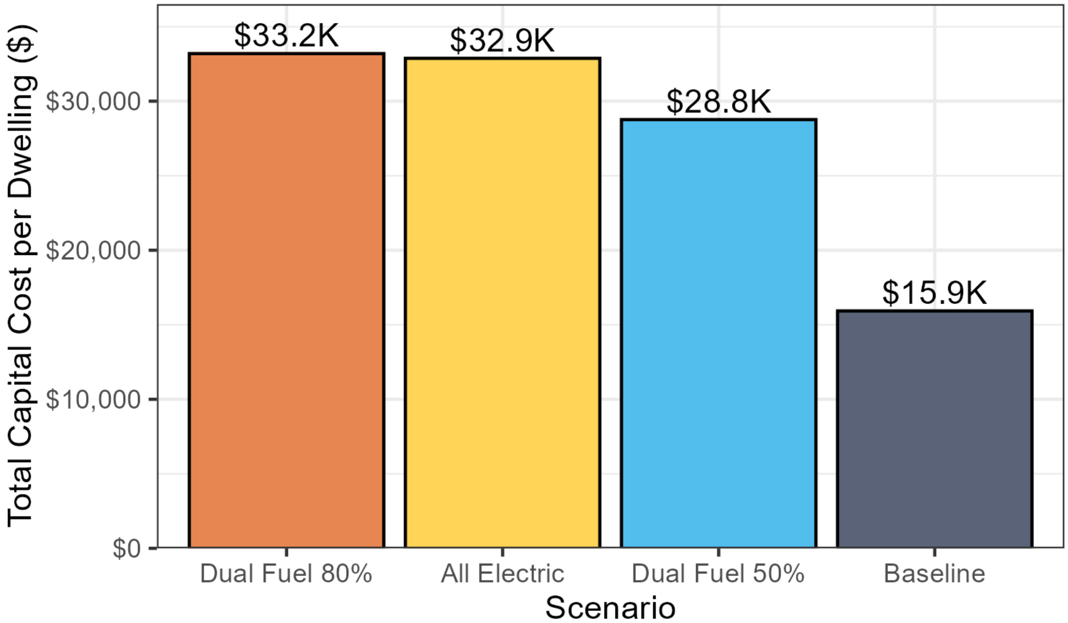


Figure 13 breaks out median upfront electrification costs per dwelling by specific equipment installed. The only difference between the three electrification scenarios is the type of heating system and resulting electrical panel upgrade requirements. Other equipment and upgrade costs do not vary by electrification scenario. Modeled equipment costs are listed in Appendix A. Model Methodology

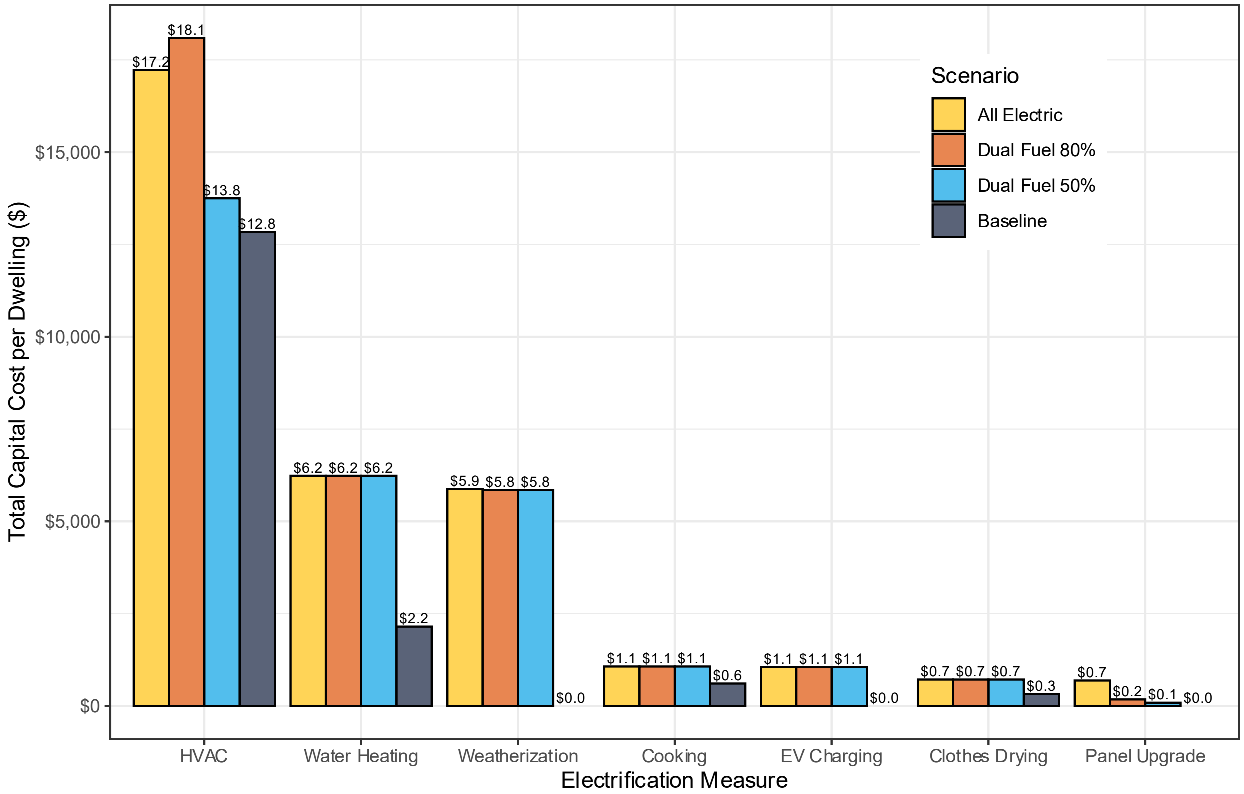
Weatherization upgrades cost approximately $6,000 per median household. Across all dwellings, weatherization accounts for 18% of total electrification scenario costs, with a range of 0–67% depending on dwelling characteristics. Weatherization is excluded from the Baseline Scenario because it has no discrete replacement cycle, making it a significant portion of incremental costs between baseline and electrification scenarios. Weatherization is a major cost driver, representing a substantial portion of incremental costs and the primary cost difference between baseline and electrification scenarios.

Median baseline HVAC replacement cost, defined as replacing a central air conditioner and gas furnace with like-for-like equipment, is $12,500 per dwelling. **In the Dual Fuel 50% Scenario, installing a variable speed heat pump with gas furnace backup costs approximately $13,600 per dwelling. This represents only $1,100 more than baseline, which existing utility incentives would displace.** In the All Electric Scenario, a cold climate heat pump with electric resistance backup heat costs $17,200 per dwelling, representing a median incremental cost of $4,700 over baseline. In the Dual Fuel 80% Scenario, pairing a cold climate heat pump (more expensive than variable speed) with high-efficiency gas furnace or boiler backup results in the highest HVAC costs.

Heat pump water heaters cost 2.8 times more than natural gas water heaters at $6,200 versus $2,200. This upgrade is included in all three electrification scenarios.

Panel upgrades are required when total electrical load exceeds 80% of the existing service capacity. **Panel upgrades are necessary for an estimated 18% of dwelling units in the All Electric Scenario**, as the combination of cold climate heat pump and electric resistance backup has the highest probability of exceeding existing service limits for homes with 100A service. Panel upgrades are rarely required for dual fuel heat pump installations, typically only for homes with high auxiliary electricity consumption.

Figure 13. Median per-dwelling upfront costs by electrification measure



The upfront costs presented in this analysis exclude all potential incentives. While the incentive landscape is complex, multiple pathways exist to substantially reduce effective costs for building owners. Utility incentives and municipal programs offer thousands of dollars in potential support. Special lending products may also eliminate borrowing costs entirely. While navigating the incentive landscape presents challenges, scenarios exist where a significant fraction or potentially the entire incremental cost of electrification and weatherization is offset by available incentives. Despite the substantial potential impact of incentives, it remains important to understand the total unsubsidized costs.

Bill Changes

Annual energy bill changes vary significantly across scenarios, driven by three primary factors: weatherization savings, switching to the Xcel Energy electric space heating rate for primary heating, and fuel-switching efficiency gains dependent on low or high natural gas prices. Electricity costs for all three electrification scenarios are modeled with the Xcel Energy electric space heating rate.

At high (1.1 $/therm) natural gas prices, nearly all (96–99%) of households would experience energy bill savings under all three scenarios. At current low (0.8 $/therm) natural gas prices, an estimated 95% of households experience energy bill savings under the Dual Fuel 50% scenario. The All Electric and Dual Fuel 80% scenarios yield a mix of bill decreases and increases for households at low natural gas prices, shown in Figure 14. Nearly all households in the County can make upgrades in line with the Dual Fuel 50% scenario and save on energy bills under the new Xcel Energy electric space heating rate and today's low natural gas prices.

Figure 14 presents the distribution of annual bill changes across households within selected scenarios at low natural gas prices. The distribution shows the variety of bill outcomes driven by variation in baseline building characteristics, heating loads, existing efficiency levels, and pre-retrofit electricity consumption.

Figure 14. Distribution of energy bill changes across the building stock by scenario with low natural gas prices ($0.80/therm)

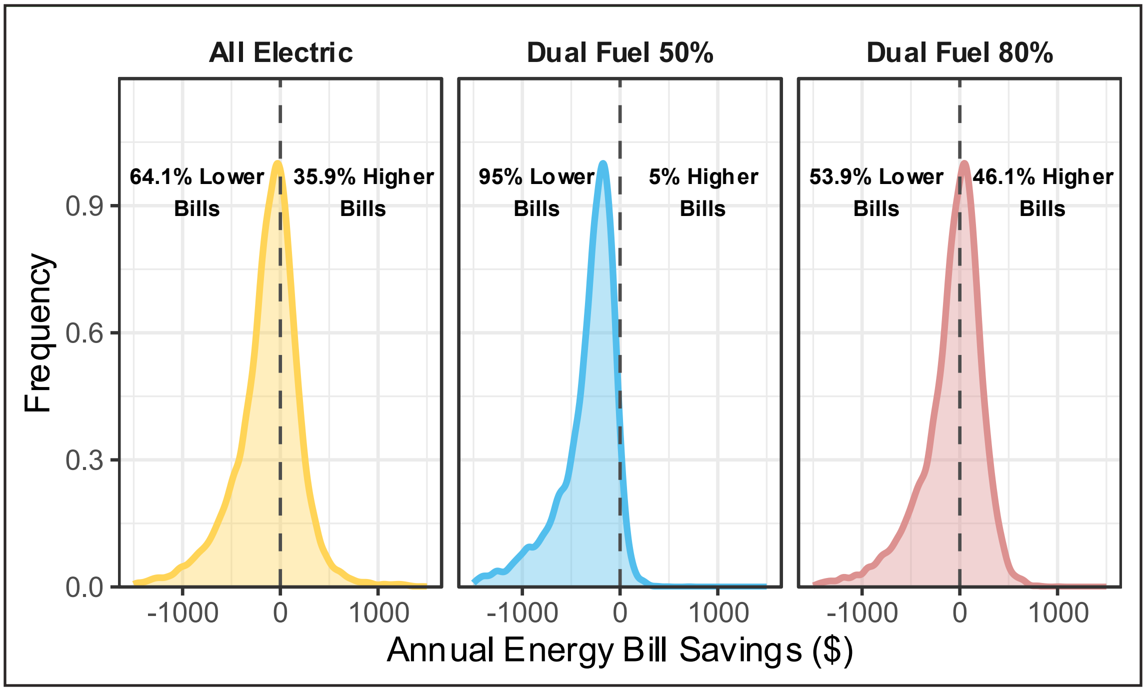
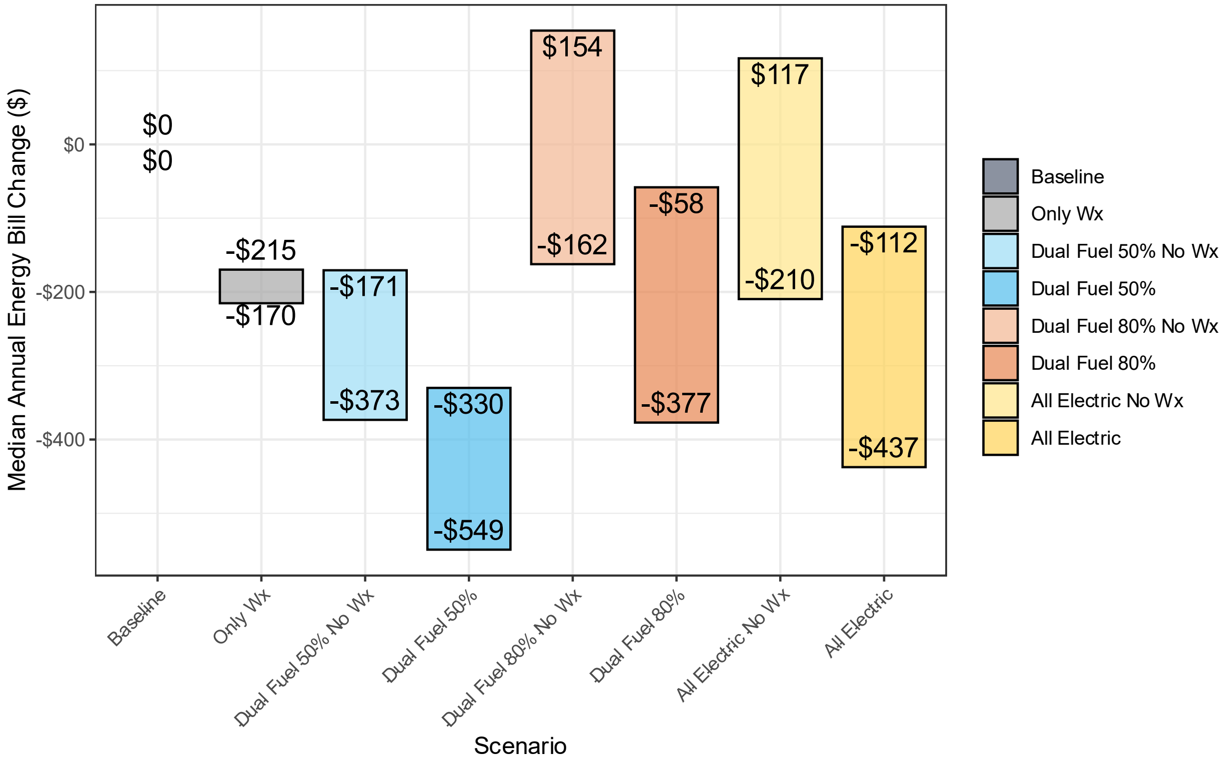


Figure 15 shows the median annual energy bill change by scenario, with ranges representing the difference between low (0.8 $/therm) and high (1.1 $/therm) natural gas price assumptions. The largest median bill savings, approximately $300–$500 per year, occur in the Dual Fuel 50% Scenario, where heat pumps operate in milder temperatures where they are most efficient, weatherization reduces overall consumption, and the favorable Xcel Energy space heating rate applies. In contrast, when weatherization is removed from the All Electric and Dual Fuel 80% scenarios, the result is median bill increases at low natural gas. This is because heat pumps serve most of or the entire heating load and therefore operate more often at lower efficiency in colder temperatures in these two scenarios. However, at high gas prices, median bill savings are found for all scenarios. The All Electric scenario shows slightly higher median bill savings than the Dual Fuel 80% scenario because moderately higher heating costs in the All Electric scenario are negated by eliminating fixed gas service fees of $114 per year.

The range between low and high natural gas price assumptions demonstrates the sensitivity of bill savings to commodity price volatility. At low natural gas prices (0.8 $/therm), bill reduction scenarios are narrower and scenarios with weatherization removed may show cost increases. At high natural gas prices (1.1 $/therm), the All Electric scenario shows consistent bill reductions, and even scenarios with weatherization removed become cost-neutral or favorable.

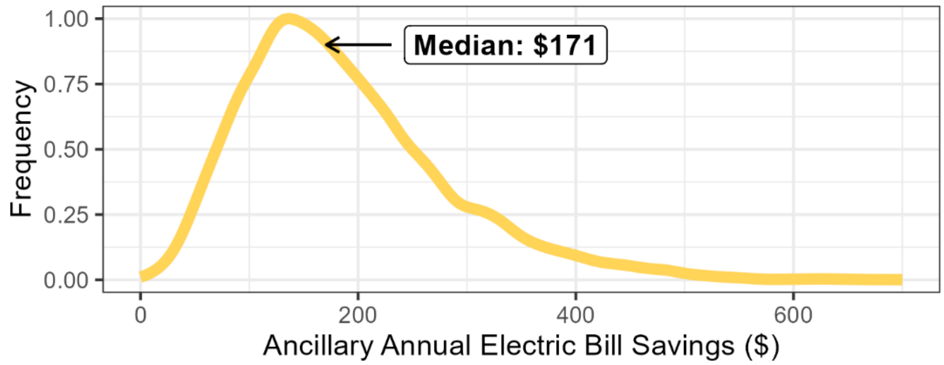
Figure 15. Median annual energy bill change by scenario (with and without weatherization)



**"No Wx" indicates that weatherization was removed from the scenario to show the bill impacts of equipment upgrades without weatherization.*

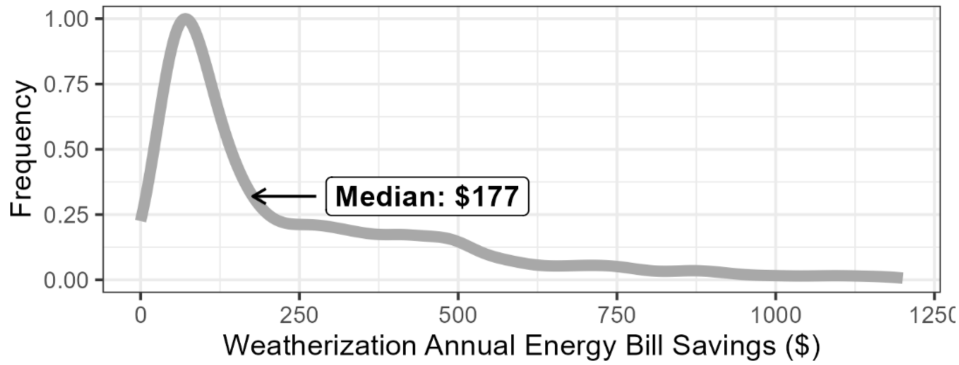
The Xcel Energy electric space heating rate is the most significant driver of bill savings across all three electrification scenarios. The distribution of these savings across the entire county is shown in Figure 16. The benefits of this rate extend beyond direct space heating savings because the rate applies to all electricity consumption during the heating season (October through April) for households with primary electric heat. This broad application means that non-heating electric loads including water heating, appliances, lighting, and plug loads also receive the discounted heating-season rate, generating substantial additional savings beyond space heating efficiency alone. Further, these ancillary electric savings also benefit from the state sales tax exemption. The median bill savings for non-heating electric loads are $171 per year under the Xcel Energy electric space heating rate. They are proportional to the amount of non-HVAC wintertime electricity consumption.

Figure 16. Distribution of Xcel Energy electric space heating rate savings for non-HVAC loads



Overall, weatherization is the second largest driver of bill savings, as shown in Figure 17. While median savings are larger ($177) than ancillary electric savings, this value does exclude approximately one-quarter of buildings that do not benefit from weatherization measures. While most buildings derive less than $250/year in weatherization savings, the long tail of the distribution demonstrates significant opportunities for very large savings. These opportunities effectively exist among buildings without wall or attic insulation. These scenarios demonstrate that while rate structures can substantially improve financial outcomes, energy consumption reductions through weatherization remain essential to maximizing bill savings. These results highlight the importance of the rate structure to making electrification financially viable but also reveal the vulnerability of savings in scenarios that rely primarily on rate benefits rather than structural energy consumption reductions via weatherization.

Figure 17. Distribution of weatherization bill savings



Pace of Work to Reach Reduction Targets

An estimated 12,800 homes will need to be weatherized and electrified annually to meet Hennepin County's goal of net-zero emissions by 2050. The Hennepin County 1–4 unit residential building stock is not static. New homes are built every year, and more importantly, existing homes are continuously retrofitted to replace heating systems, water heaters, and appliances that reach end of life. Except for weatherization, electrical panel upgrades, and EV chargers, the measures in this study can displace these existing retrofit measures. Hence, it becomes important to capture the costs and rate of change of the existing retrofit measures in the Baseline Scenario to facilitate comparison with decarbonization scenarios.

In this study, replace-on-fail means replacing a piece of equipment when it reaches the end of its useful life. The present replace-on-fail retrofit rate for natural gas appliances in the Hennepin County 1–4 unit building stock are determined from the existing building stock data and equipment lifetimes and are listed in Table 6, assuming a constant rate of replacement. Paired with cost estimates, these projects also provide the baseline annual spending rate on comparable measures across this building stock. Efficiency and decarbonization projects exceeding these project counts require additional labor force. Furthermore, projects with no baseline retrofit measure, such as electric service upgrades or weatherization, require all new labor.

Table 6. The current rate of replace-on-fail baseline natural gas retrofit measures

Baseline retrofit measure	Baseline projects per year (replace on fail)
Natural gas heating systems	14,500
Central air conditioning systems	15,400
Natural gas tank water heaters	25,000
Natural gas cooking ranges	11,000
Natural gas clothes dryers	9,600

Targets for determining the required number of efficiency and decarbonization projects are informed by Hennepin County's Greenhouse Gas Goals[11] to achieve zero net emissions (100% reduction) by 2050. These project counts are calculated for the All Electric Scenario since it is the only modeled scenario that can fully meet the 2050 goals. The results are shown in Table 7.

Table 7. The number of retrofit measures required per year to meet the 2050 emissions reduction target

Measure	Projects per year	Comparative Baseline Measures	Total projects by 2030	Total projects by 2050
Total Dwelling Retrofits	12,769	NA	63,847	319,234
Weatherization	11,887	0	59,433	297,165
Air Source Heat Pumps	12,705	15,400	63,525	317,627
Heat Pump Water Heaters	11,686	25,000	58,429	292,147
Induction Cooking Ranges	5,991	11,000	29,953	149,763
Heat Pump Clothes Dryers	4,983	9,600	24,916	124,578
Panel Upgrades	2,262	0	11,312	56,559
EV Charging Circuits	12,409	0	62,044	310,221

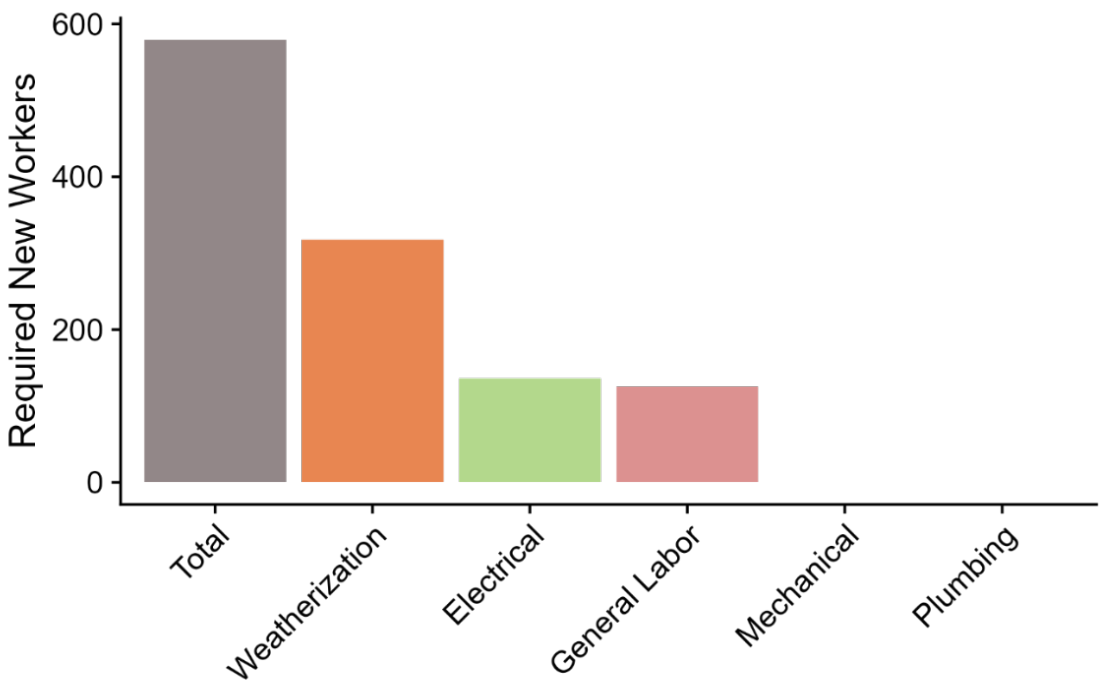
[11] Becky Alexander. 2022. *Hennepin County Greenhouse Gas Emissions Inventory and Analysis 2006–2020*. LHB. https://www.hennepin.us/climate-action/-/media/climate-action/Climate-action-plan/hennepin-county-ghg-emissions-inventory-2006-2020.pdf.

Labor Requirements

An estimated 579 new workers are necessary to complete projects at the rate needed to meet the County's 2050 emissions goal. The annual project pace targets are paired with an existing labor force model[12] to estimate the new workforce requirements shown in Figure 18. About half of the new workers needed are dedicated to weatherization. The rest are evenly split between electricians and general laborers (including apprentices). Importantly, this study found that no additional mechanical or plumbing tradespeople are needed to complete work on schedule, assuming these existing tradespeople can install heat pumps and heat pump water heaters. These values give scale to this decarbonization effort; other factors such as existing labor force trends, variances in emissions savings on a project-by-project basis, and assumptions about the labor force yield additional challenges and opportunities, but these are deemed out of scope for this project.

Stakeholder feedback led to the decision to neglect the County's 2030 emissions goal because it would require an extreme rate of work until 2030, followed by a drop off. The model showed that over 90% of the new workers needed before 2030 would not be needed after 2030, which raised serious concerns regarding job security and operational planning. To avoid this outcome, we modeled labor requirements linearly to keep them annually consistent to 2050.

Figure 18. Additional labor force required to meet 2050 emission reduction targets assuming a uniform rate of work



[12] Katie Jones, Rebecca Olson, Arbor Otalora-Fadner, and Josh Quinnell. 2023. *Minneapolis 1–4 Unit Residential Weatherization and Electrification Roadmap.* Center for Energy and Environment. https://www.mncee.org/sites/default/files/2023-02/Minneapolis%201-4%20Unit%20Residential%20Weatherization%20and%20Electrification%20Roadmap_Final%20%281%29.pdf.

MODEL RESULTS BY GEOGRAPHIC AREA

Overview

The energy model data inputs representing the county's 1–4 unit residential building stock are granular enough to produce results at the census tract level. This granularity allows us to visualize different outcomes across the county through mapping. By linking these results with publicly available census data,[13] population characteristics such as socioeconomic characteristics can be overlaid on the model results to highlight the spatial intersection between residents and the homes they occupy.

For mapping purposes, each census tract in Hennepin County is associated with a set of final model results that represent the 1–4 residential dwellings within it. Then, within each tract, the median household value is calculated for key model outcomes. The median value represents the midpoint of the distribution, with 50% of households above and 50% of households below it. The model outcomes include:

- The number of weatherization measures needed to make a home heat-pump ready, more comfortable, and more affordable to heat and cool. This value ranges from 0–3, and includes air sealing, wall insulation, and attic insulation.
- The energy savings associated with completed home weatherization, referred to as *weatherization potential.*
- The upgrade costs to fully weatherize homes and install electric replacements for natural gas equipment.
- The utility bill changes associated with weatherizing and switching appliances from natural gas to electricity.
- The greenhouse gas savings potential in 2050.

Not all census tracts in Hennepin County contain 1–4 unit residential dwellings. In the maps that follow, any census tract without these home types is shown with a white background with black hatching. The top 10% of census tracts with the highest levels of socioeconomic disadvantage (defined in Appendix B. Mapping) are outlined in black on each map. Figure 21, Figure 22, and Figure 23 show the model outcomes for just the All Electric Scenario.

Interactive Online Map

We created an interactive online map for individuals to further explore the results of the study, which can be accessed here.[14] Results are available at the census tract level as discussed earlier, and users can navigate and zoom in to different areas of the county to explore the key model outcomes which are described in detail below. Crucially, in the interactive online map, model results can be filtered by scenario (including Dual Fuel 50%, Dual Fuel 80%, All Electric, and Only Weatherization), while the map extracts included in this paper focus on the All Electric scenario and weatherization due to space constraints. Additionally, the maps that are included here are formatted differently than those included in the online map. We provide a high-level summary of geographic findings in the section below. For more details on the online map, see Appendix B. Mapping

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[13] U.S. Census Bureau. 2023. *American Community Survey 5-year estimates*. https://www.census.gov/programs-surveys/acs.

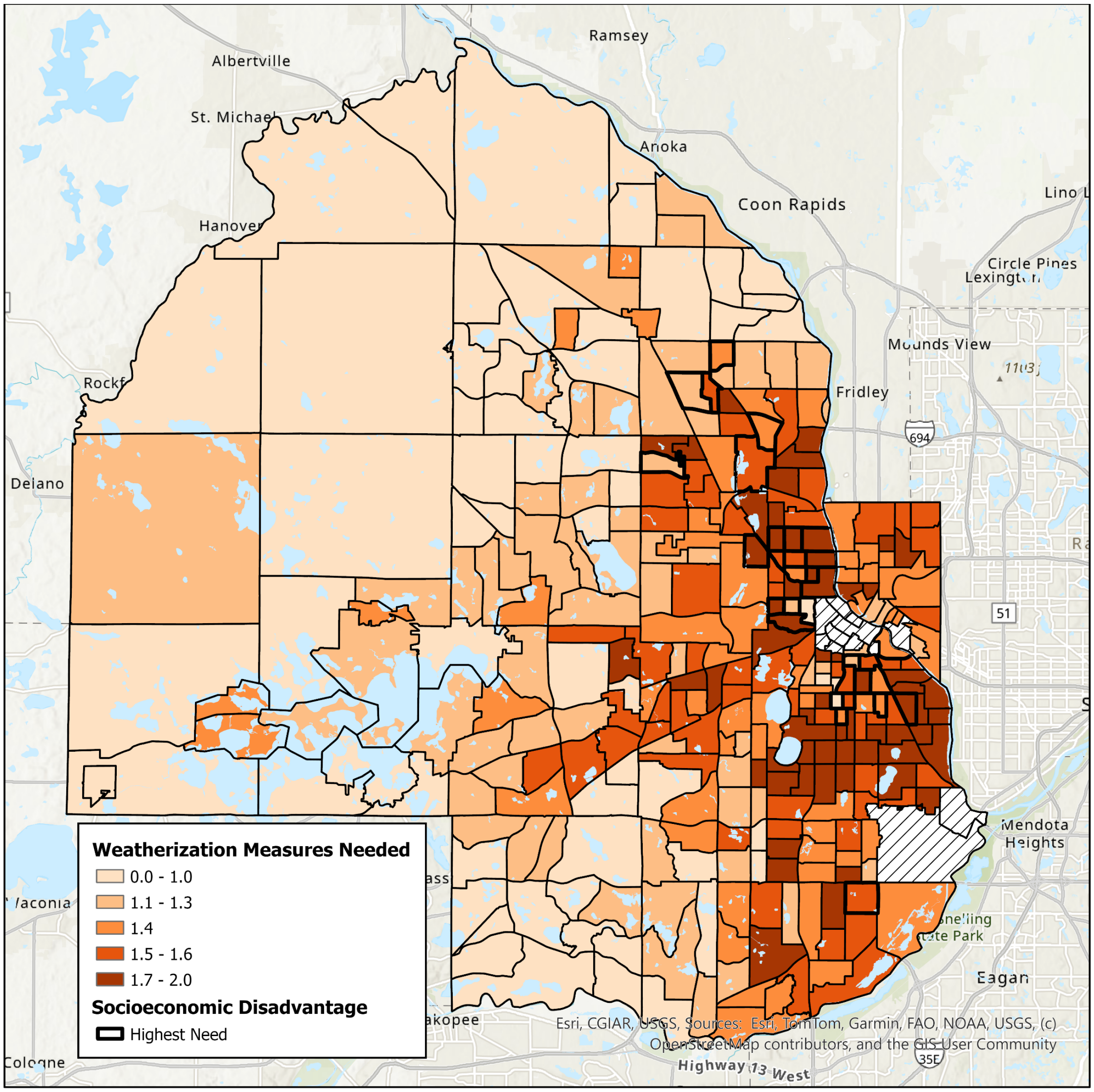
[14] CEE. 2026. *Interactive Online Map, Hennepin County Residential Weatherization and Electrification Action Plan.* https://experience.arcgis.com/experience/3aebb85947194eaeb9e9b8453abe020b/.

Weatherization Need

Figure 19 shows the median number of weatherization measures needed per household. Weatherization offers two key benefits — it reduces household energy use and utility bills and it prepares homes to efficiently adopt heat pumps. The most critical measures such as air sealing, attic insulation, and wall insulation are included here, with the range spanning zero to three. On the map, the darkest orange areas indicate where the greatest number of weatherization upgrades are needed, while the palest areas are more likely to be heat pump ready.

Weatherization is most lacking in the county's oldest housing stock, which includes significant portions of Minneapolis, Brooklyn Center, Bloomington, and other first-ring suburbs. By contrast, most homes in many of the western suburbs do not need weatherization, making them ready to adopt heat pumps. Many of the most socioeconomically disadvantaged census tracts also tend to have a greater relative need for weatherization measures because of their location in areas of the county with older housing.

Figure 19. Median number of weatherization measures needed by census tract

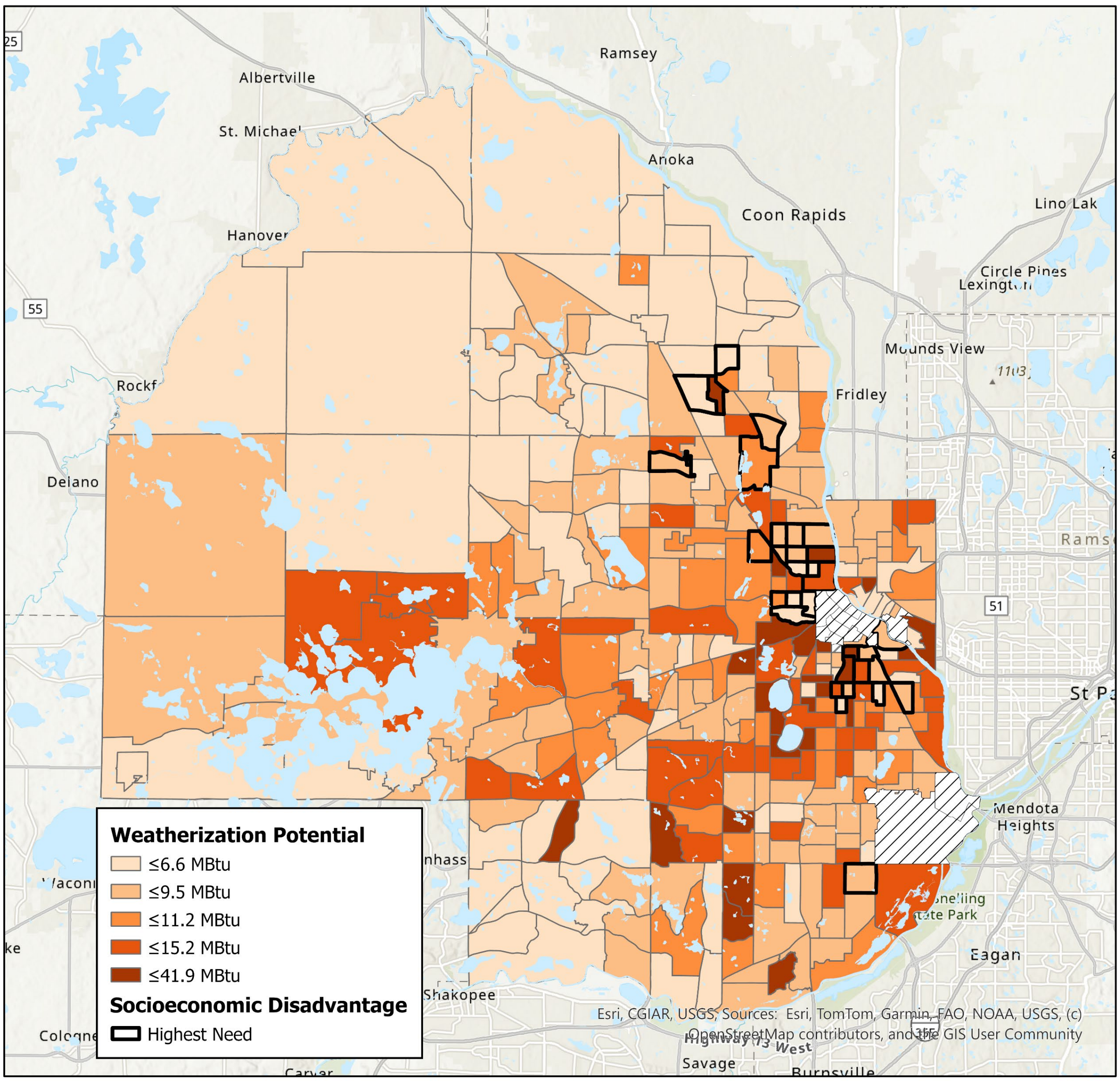


Weatherization Potential

Figure 20 shows the estimated energy savings that would result if homes were fully weatherized. The darkest orange census tracts represent parts of the county with the greatest savings potential, representing a 17–39% decrease in energy use, while the lightest orange sections show areas already largely weatherized, with only modest additional savings possible. Across the county, full weatherization of all homes would lower median household energy use by 15%. Areas with older housing stock and larger homes tend to have the greatest weatherization potential. This is particularly notable in the area north of Lake Minnetonka.

The most disadvantaged areas, outlined in black, show a range of weatherization potential depending on location. Overall, significant weatherization opportunities exist across most of the county, with the largest savings concentrated in Minneapolis and the first-ring suburbs.

Figure 20. Median weatherization potential per dwelling, by census tract

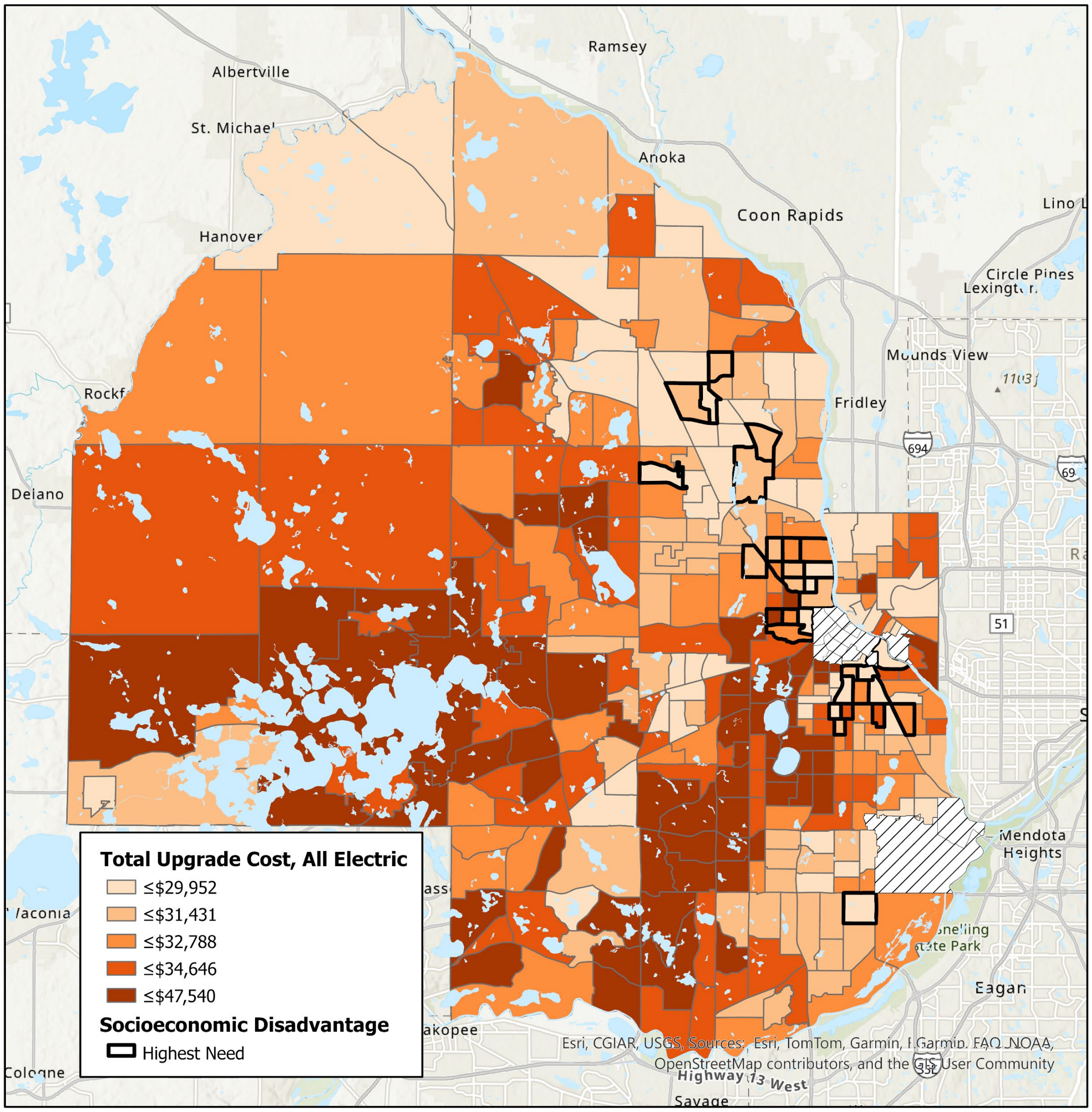


Upfront Upgrade Costs

Total upgrade costs for the All Electric Scenario are shown in Figure 21. These costs include full weatherization plus installation of a cold climate air source heat pump with electric resistance backup, an induction stovetop, a heat pump water heater, a heat pump clothes dryer, EV charging circuit, and, where necessary, a panel upgrade. Not all homes require every upgrade, which is reflected in the median upgrade cost.

Across the county, the median cost is about $33,000, with a range of $25,000 to $48,000. Weatherization upgrades account for 10% to 40% of these totals. Upgrade costs tend to be higher in areas with older homes that require more weatherization and in neighborhoods with larger homes. While many disadvantaged areas show somewhat lower upgrade costs compared to other parts of the county, the financial burden remains significant.

Figure 21. Median upgrade costs per dwelling, all electric scenario, by census tract

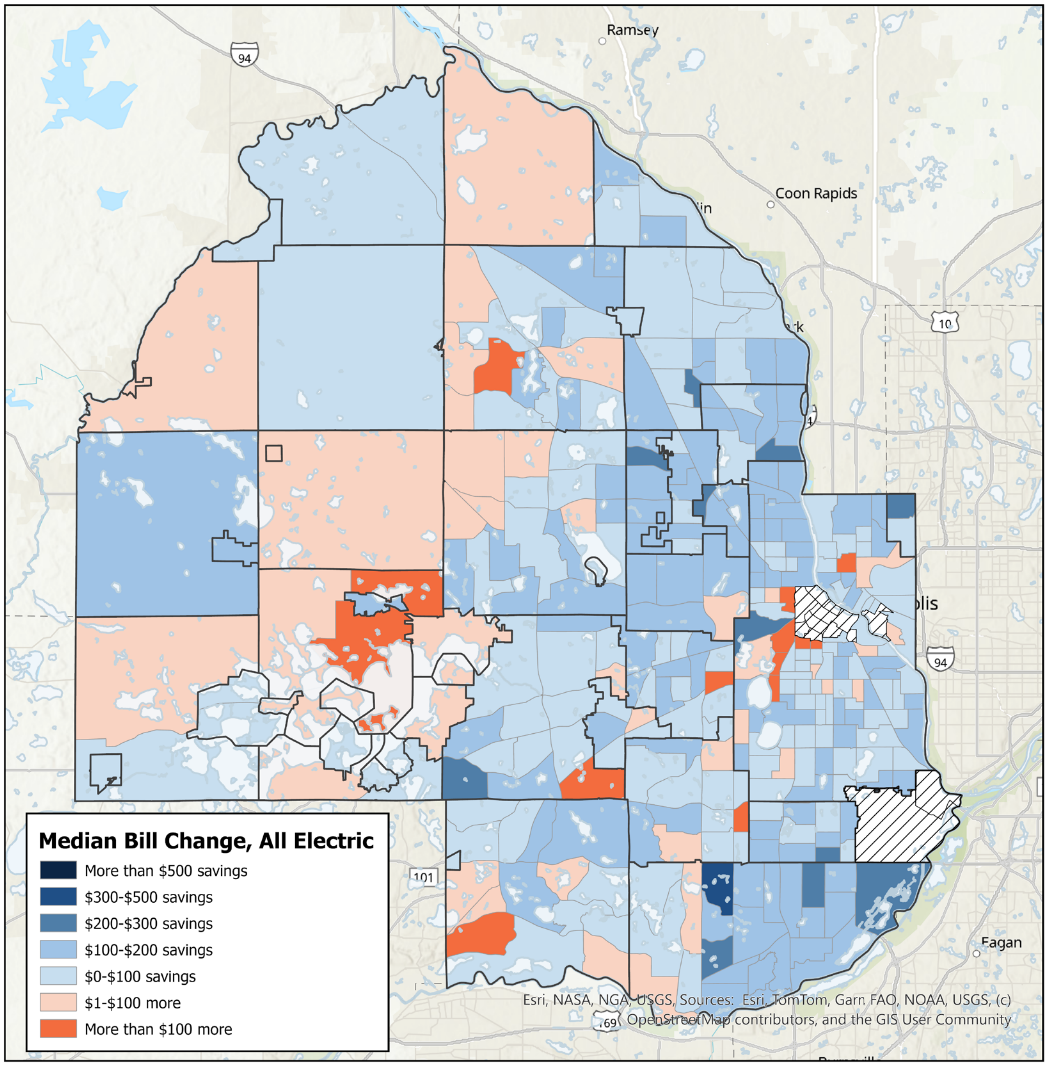


Utility Bill Changes

Figure 22 shows the median estimated household bill changes for the All Electric Scenario in which households completely discontinue natural gas use. This scenario assumes full weatherization. Under these conditions, most census tracts see most households spending less overall on utility bills, with the median bill change showing net savings. Electric bill costs were modeled using Xcel Energy's electric space heating rate, which lowers electricity costs during the winter. In the All Electric Scenario, households also avoid the fixed monthly charge for natural gas service.

The orange hued tracts on the map highlight areas in which at least half of homes are impacted by a bill increase in modeling. These are generally in neighborhoods with newer, larger homes that wouldn't achieve bill savings with weatherization and would see bill increases by switching from natural gas to all-electric heating. Among the scenarios, the All Electric Scenario represents the most extreme outcome for utility bill changes. By contrast, the Dual Fuel 50% Scenario delivers greater bill savings across more households (see the online map for details).

Figure 22. Median utility bill changes, low gas rates, all electric scenario, by census tract

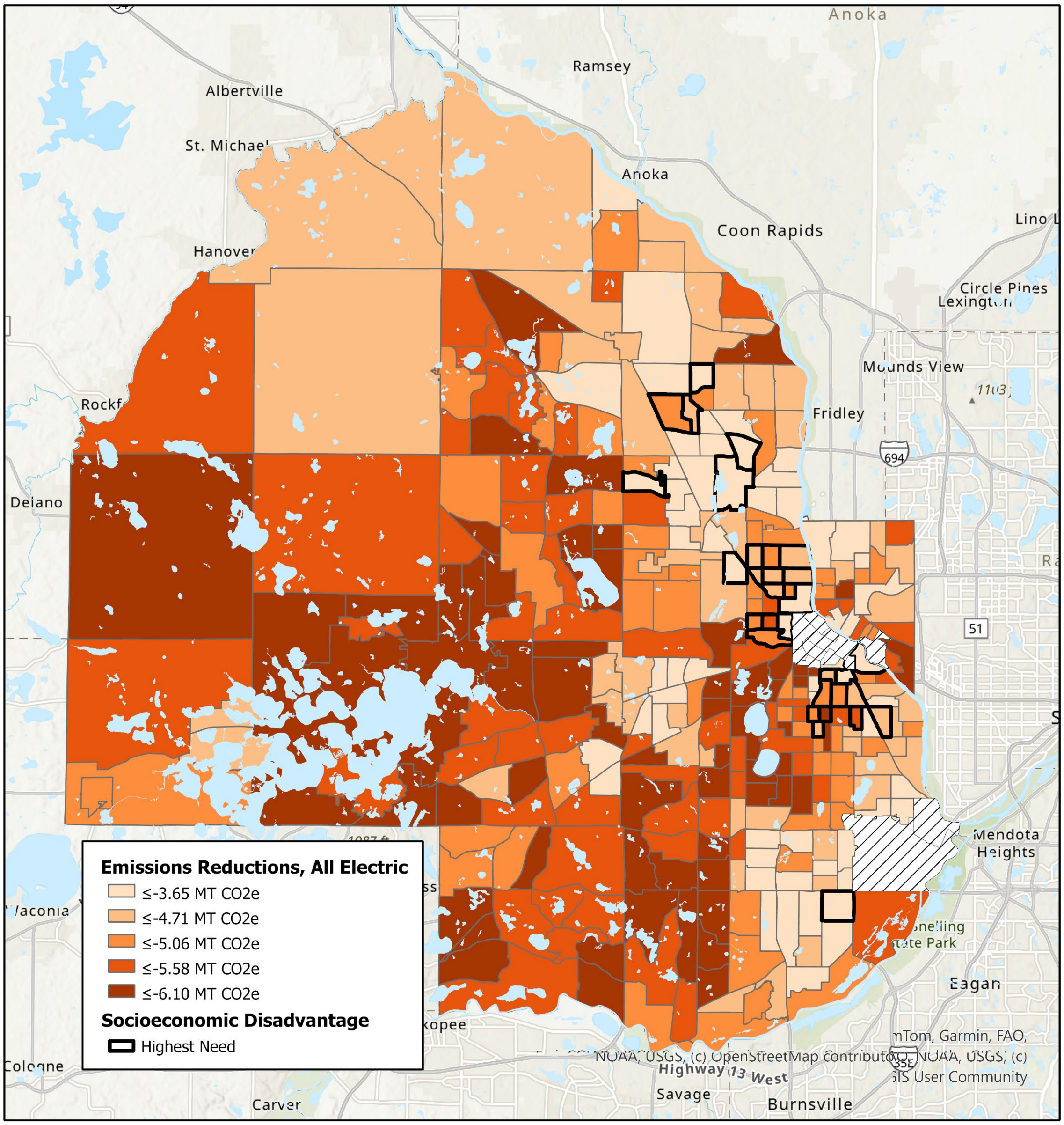


Decarbonization Potential

Figure 23 shows the median household reduction in greenhouse gases by 2050 for the All Electric Scenario, mapped at the census tract level. Areas with larger homes and correspondingly higher natural gas use achieve the greatest per-household reductions.

Decarbonization potential is widely distributed throughout the county, though it varies by community. Areas of greatest economic need exhibit differing levels of potential, while many wealthier neighborhoods have the highest per-dwelling reductions, since those homes tend to be larger with greater energy use. Importantly, though not shown here, all scenarios deliver significant emissions reductions across the county.

Figure 23. Decarbonization potential per dwelling, all electric scenario, by census tract



Spatial Analysis Takeaways

The areas of Hennepin County with the oldest housing stock have significant opportunities for savings from weatherization measures. These areas include portions of Minneapolis, Richfield, Bloomington, St. Louis Park, Brooklyn Center, Brooklyn Park, Robbinsdale, Crystal, New Hope and the swath of housing that extends from Minneapolis to Lake Minnetonka. While some homes in these cities are heat pump ready, significant weatherization work is required to reduce energy use, make homes more comfortable, and prepare them for heat pump adoption. Many areas with significant weatherization needs are also some of the poorest parts of the county where more financial and logistical support will be needed to help homeowners complete these projects.

Large parts of the county with newer homes, particularly the western suburbs, tend to have fewer weatherization needs. These dwellings are more likely to be heat pump ready. Cities such as Eden Prairie, Maple Grove, Medina, Corcoran, Dayton, and Rogers can focus on building awareness and knowledge of heat pump technology and its benefits to lay the groundwork for adoption.

The upgrade costs across the entire county are significant. The additional incremental costs of installing electric equipment inhibit adoption. Low-income residents will be particularly sensitive to costs, and the county and cities must devise ways to support them.

STAKEHOLDER FEEDBACK

Stakeholder input was essential to ensure the action plan addresses barriers, gaps, and the needs of communities in Hennepin County and achieve climate and equity goals. Over three workshops and one survey, we collected feedback from stakeholders working in energy and housing within Hennepin County. See Appendix E. Stakeholder Engagement for the full list of stakeholders.

At the first workshop, stakeholders viewed preliminary model results, provided input on the data model, and identified advantages, concerns, and observations regarding the various scenarios. In the second workshop, stakeholders were presented with revised data model results and a series of maps showing disparities across Hennepin County. They discussed priorities for where the county should focus efforts along with project targets to meet county climate goals. In the survey distributed between workshops 2 and 3, stakeholders were asked to identify barriers and gaps for different demographic groups and housing types, along with resources that would help them electrify their homes. At the third workshop, stakeholders first identified successes, barriers, and gaps in the programs with which they most closely work. Then, they identified strategies to help different demographic groups and housing types weatherize and electrify their home. Finally, stakeholders brainstormed programs the county could pilot and scale, taking into consideration gaps they could fill and whether these would duplicate existing work.

In a fourth workshop comprising only County staff, we discussed barriers faced by the County and how to integrate the plan’s actions into County programs and processes. The feedback from stakeholders and County staff is integrated throughout this plan. The group’s input directly informed the parameters of the energy model and scenarios, the direction of the landscape analysis, and the final recommended actions. Takeaways from stakeholder input are as follows.

Opportunities

Stakeholders described weatherizing and electrifying residential homes as an opportunity to:

- Improve quality of life for residents with financial and health benefits.
- Significantly impact the County's ability to meet climate goals.
- Spur organizations to work together to achieve common goals and help people.
- Create new jobs and economic opportunities.

Figure 24. Stakeholders discussing strategies to electrify newer homes at workshop 3

Barriers

Over the course of the workshops, the stakeholders discussed barriers to weatherization and electrification faced by different income groups, home types, contractors, and program implementers. The largest barriers identified were:

- High upfront costs for low- and moderate-income homeowners and the risk of rental property upgrade costs or energy bill changes being passed on to low-income tenants
- Lack of awareness of the technologies, programs, and incentives available to weatherize and electrify and their benefits
- Difficulty navigating and enrolling in programs and stacking incentives
- Challenges training new workforce and licensing and adapting contractor businesses

Priorities

Throughout discussions of the energy model, barriers, and actions, stakeholders emphasized the need for different technological and programmatic decarbonization pathways to balance bill costs, upfront costs, and emissions reductions. Developed with feedback, the three modeled scenarios present three technological pathways that residents can choose based on their goal to maximize cost savings (Dual Fuel 50%), emissions reductions (All Electric), or future flexibility (Dual Fuel 80%).

Programmatically, stakeholders identified different approaches to address the needs of various groups:

- Fully covering upfront costs of upgrades for low-income residents
- Education and incremental cost-coverage for middle- and high-income residents
- Connections to programs and incentives for rental property owners
- Targeting homes with a high need for weatherization across income groups, home type, and age given their high potential for energy savings and bill savings

The "Recommended Actions" section of this plan reflects the recommendations from stakeholders to overcome barriers and advance weatherization and electrification.

LANDSCAPE ANALYSIS

Hennepin County contains an array of home retrofit programs, rebates, and loans supporting home energy retrofits. These include utility, municipal, and state rebates and loans, city retrofit programs integrated into existing affordability and health and safety programs, and low-income home energy retrofit programs offered by the state and utility companies. Many of these programs provide models to scale county-wide or replicate in other cities in the county. While the landscape of existing programs has grown in recent years and these programs play an important role in driving existing weatherization and energy-efficiency retrofits, significant gaps still exist to meet Hennepin County's goal of net-zero emissions by 2050. See Appendix C. Landscape Analysis for the list of programs analyzed for this study.

Lack of electrification in low-income programs

Currently, no low-income energy retrofit programs in Hennepin County consistently perform electrification upgrades. While existing utility and city programs are upgrading weatherization and HVAC systems in low-income rental and owner-occupied homes, the programs predominantly replace gas space heating systems and water heaters with higher-efficiency gas systems. A few of these programs have installed heat pumps and heat pump water heaters in select cases, but on a scale of less than a few dozen per year among all the programs. The Weatherization Assistance Program (WAP) is unable to do fuel-switching under federal guidelines. As a result, the implementer, Sustainable Resources Center, does not currently do fuel switching for WAP or the other utility programs that they implement. CenterPoint lists heat pumps paired with a gas furnace as eligible measures in its low-income programs. However, CenterPoint's HERO program was the utility's only low-income program that anticipated installing heat pumps in 2025 and projected installing just eight.[15] The Minneapolis Healthy Homes Program is not consistently installing electrification but rather prioritizes weatherization and health and safety upgrades as budgets are limited. The Minneapolis 4D program is doing the most fuel-switching of any low-income program, but does not do fuel-switching in situations where it could increase tenants' energy bills. The Xcel Energy electric space heating rate will likely make electrification viable for more rental properties.

Hennepin County started a low-income weatherization pilot in 2025 integrated into the County's Lead and Healthy Homes program. Adding electrification to the County's weatherization pilot and expanding it to a permanent program would address the existing gap. Another action could be to integrate weatherization and electrification more effectively into the County's existing Home Repair Loan, which is a forgivable deferred loan for income-qualifying homeowners.[16]

Existing incentives do not cover incremental costs for all residents

The incentive landscape for home weatherization and electrification rebates is evolving. CenterPoint Energy and Xcel Energy offer rebates covering up to $3,000 for insulation and air sealing, $2,000 for a cold climate heat pump, a $600 bonus for installing a heat pump after insulation, $500 for a heat pump water heater, and $1,500 for electrical panel upgrades. In many cases, utility rebates can cover the incremental cost of a heat pump over a traditional air conditioner. For all other measures, utility rebates lower but do not eliminate the upfront cost.

[15] CenterPoint Energy. 2023. "CenterPoint Energy's 2024–2026 Energy Conservation and Optimization Plan." https://efiling.web.commerce.state.mn.us/documents/%7BF0910D89-0000-C71C-8C47-2453DD698C4C%7D/download?contentSequence=0&rowIndex=1.

[16] "Home Repairs." Hennepin County. Accessed December 31, 2025, https://www.hennepincounty.gov/services/grants-funding-opportunities/home-repair-maintenance-loans.

The cities of Edina, Hopkins, Minneapolis, Plymouth, and St. Louis Park offer rebates that when combined with the existing utility rebates can significantly lower or eliminate the incremental costs of weatherization and electrification upgrades. However, over 50% of the population of Hennepin County lives in cities without local rebate programs.[17] Residents that do not qualify for low-income programs and live in these cities only have access to utility rebates for incentives. Hennepin County could create a weatherization and electrification rebate program of its own or develop a technical assistance service to help other city governments create or expand their own cost-share programs.

Difficulty navigating programs

Navigating the landscape of existing programs is complex and coordination between program implementers is lacking. Income-qualified residents often struggle to determine which utility, city, or state programs fit their needs and income eligibility. There is limited coordination between program implementers, so stacking resources from separate low-income programs is uncommon with some exceptions. Residents looking to take advantage of market rate incentives also often need guidance on stacking rebates and navigating the home upgrade process. Ensuring that an advisory or navigation service is available to residents of all incomes is critical to help them identify the programs that fit their needs and guide them through the upgrade process.

Significant gap in retrofit pace

The pace of energy retrofits is currently far below the rates needed to achieve Hennepin County's Climate Action Plan goals. Due to differences in reporting across programs, it is impossible to calculate the exact number of retrofits being completed by the existing programs. However, based on multiple public program data sources, our best estimate is that 1,200 to 3,000 homes are being weatherized each year in Hennepin County through the existing rebate programs, and utility, state, and municipal low-income weatherization programs. This is far below the target of weatherizing nearly 12,000 dwelling units per year modeled in this study. About 12,000 heat pumps and heat pump water heaters will also need to be installed each year to reach the County's goals.

NATIONAL CASE STUDY ASSESSMENT

A select few county governments in the United States have launched residential electrification programs in the last five years. Montgomery County, Maryland created an electrification direct incentive program available to all county residents. The City and County of Denver, Colorado enacted a program covering the full cost of weatherization, electrification, and health and safety improvements for low-income residents with respiratory conditions. King County, Washington, started a heat pump installation program that uses an innovative contractor network to install heat pumps for low-income households at no cost to them.

The following summarizes the lessons learned from these programs based on research and interviews with staff from the three local governments.

Electrify MC – Montgomery County, Maryland

[17] "Historical Estimates of Minnesota and its Cities' and Townships' Population and Households, 2000-2024." Minnesota State Demographics Center. July 2025. https://mn.gov/admin/assets/mn_cities_townships_historical_estimates_sdc_2000-2024_tcm36-700203.xlsx.

Electrify MC is a residential electrification pilot program funded by Montgomery County, Maryland. Started in 2023, the program helps residents transition from home appliances using fossil fuels to electric alternatives, while promoting other energy efficient upgrades. The program is available to residents of all income levels in Montgomery County and was created to complement the statewide EmPOWER Maryland program, which offers weatherization incentives. Through the program, point-of-sale direct incentives are offered for appliances such as heat pumps (including cold climate, air-to-water, and geothermal), heat pump water heaters, electric clothes dryers (Energy Star-listed), and induction and electric stoves.[18] The point-of-sale incentives eliminate the need for residents to cover upfront costs while waiting for a retroactive rebate but was administratively challenging for the County to set up via a competitive bid contract. The County contracted Elysian Energy, an energy services company specializing in energy efficiency and electrification, as the implementer.

The total program budget includes $775,000 for incentives and additional funding to support a customer-facing help desk designed to assist navigation, coordination, and customer inquiries. One-time funding for the program comes from the County General Fund that was passed following the release of the County's Climate Action Plan.[19] As a result, the program must compete with other county services for future funding, but a gradual ramp-up in project pace enabled the sustainability team to stretch the funding allocation over multiple years. As of December 2025, 379 incentives have been issued to 151 households.

Montgomery County also created the Healthy, Efficient, Electrified, Climate-Adapted Pilot (HEECAP) Homes Grants Program to serve low- and moderate-income homes in Montgomery County with health and safety repairs and climate adaptation measures. At the time of interviewing, HEECAP was a newer program, and therefore this summary focuses on Electrify MC.

Denver Healthy Homes Program – City and County of Denver, Colorado

The Denver Healthy Homes program is a city/county-led initiative aimed at electrifying and weatherizing low-income homes and improving indoor air quality. Started in 2023, the program aims to provide access to affordable home upgrades to 100 low-to-moderate-income single-family homes, as well as 100 low-to-moderate-income multifamily residences. The County worked with two nonprofits, Energy Outreach Colorado and BlocPower, to implement the respective parts of the program. Our interviews and research focused exclusively on the single-family home portion. Each home received a healthy home assessment (including sampling and lab testing for airborne contaminants), health and safety upgrades, critical home repairs (e.g., water/sewer pipe leaks), and insulation and air sealing measures, as needed. The program covered the cost of replacing gas appliances with high-efficiency electric alternatives such as cold climate heat pumps, heat pump water heaters, induction stoves, and heat pump dryers.[20] Households are also enrolled in Energy Outreach Colorado's community solar program, which helps lower their monthly electric bills.

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[18] "Electrify MC." Montgomery County, Maryland Department of Environmental Protection. Accessed December 31, 2025. https://www.montgomerycountymd.gov/DEP/energy/homes/electrify-mc.html.
[19] Jeremy Good and Lindsey Shaw (Montgomery County staff) in discussion with Matthew Douglas-May, Shawn Rodine, and Sally Bauer. May 20, 2025.
[20] "Healthy Homes Program." City and County of Denver. Accessed December 31, 2025. https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-and-Resiliency/Cutting-Denvers-Carbon-Pollution/Electrifying-Denvers-Homes/Get-a-Heat-Pump/Healthy-Homes-Program.

To be eligible for the Healthy Homes Program, Denver County residents must 1) own a single-family home, townhome, or mobile home, 2) have a household income at or below 80% of the area median income (AMI), and 3) have at least one person in the household with a respiratory condition.[21] The program is financed through the Climate Protection Fund, which is funded through a 2.5% sales tax in the City and County of Denver.[22] In addition, the program has successfully leveraged funding from Xcel Energy and philanthropy through a partnership with the International Council for Local Environmental Initiatives (ICLEI).

Due to the intensive nature of the retrofits, longer-than-expected project timelines, and changes in contractor management, staff from the City and County expect to complete about 37 single-family projects in the first three years of the program.[23]

Energize Heat Pump Program – King County, Washington

The Energize Heat Pump Program is a publicly funded, equity-focused program aimed at reducing greenhouse gas emissions and increasing climate resilience. The program launched in 2024 and installs heat pumps in low- and moderate-income homes in King County. Eligibility depends on two factors: home location and income level. Residents must live in the Community Service Area, a predominantly low-income area just south of Seattle. Households at or below 80% AMI receive 100% cost coverage for the upgrades, while households between 80% and 120% AMI receive partial cost (80%) coverage.[24]

Funding for the program comes from several sources. The program started with local seed money from the King County Climate Equity bond, as well as grant money from Washington State University's Community Energy Efficiency Program (CEEP). The program now primarily obtains funding from the Climate Commitment Act (CCA), a statewide cap and invest program that funds grants through the Washington State Home Electrification and Appliance Rebates (HEAR) program. Additionally, CCA funding via the Washington State Department of Ecology has helped the County expand services.[25]

The County succeeded in installing 100 heat pumps between April 2024 and February 2025.[26] According to program staff, they completed 77 projects in the first half of 2025 and expect to complete another 77 in the second half of the year, bringing the annual project total to over 150. This exceeds the higher end of the program's initial goal of 120 to 150 installs per year.[27]

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[21] *Ibid.*
[22] "Case Study: Denver Healthy Homes Program." Rewiring America. 12/13/2023. https://homes.rewiringamerica.org/ra-policy-site/local-government-leaders/case-studies/west-denver-co-denver-healthy-homes-program.
[23] Jeff Tejral and Steve Dunn (city and county of Denver staff) in discussion with Matthew Douglas-May, Shawn Rodine, and Mauricio Leon Mendez. June 23, 2025.
[24] "Energize- Single Family Homes." King County, Washington. Accessed December 31, 2025. https://kingcounty.gov/en/dept/executive/governance-leadership/climate-office/focus-areas/building-decarbonization/energize.

[25] "Energize program marks 100th install, expands with CCA funding support." King County, Washington. Accessed December 31, 2025. https://kingcounty.gov/en/dept/executive/governance-leadership/climate-office/about/newsroom/energize-100th-install.
[26] *Ibid*
[27] Nicole Sanders and S. Neil Larsen (King County staff) in discussion with Matthew Douglas-May, Shawn Rodine, and Sally Bauer. July 30, 2025.

Best Practices and Lessons Learned

Creating different program types helps to meet the needs of different income and demographic groups

- A retrofit program that covers the full cost of upgrades for households below 80% AMI or disadvantaged areas is the best way to reach this group.
    - Whole-home retrofit programs are slow and resource intensive in financial terms and for program administration, service delivery, and case management. However, they have incredible health, quality of life, and equity outcomes for homes that would likely not be upgraded otherwise.
    - Program plans should include high-touch advising to support residents before, during, and after the upgrade process.
    - Partnerships with community-based organizations are important for reaching the target households and getting real-time program feedback.
    - Deferred maintenance and pre-weatherization frequently need to be addressed for lower-income households, which comes with extra cost. Limiting program scopes to weatherization and heat pumps could maximize GHG reductions achieved with program dollars but would require deferring homes with pre-weatherization needs.
- Serving 80%–150% AMI or even greater than 150% AMI households with lower-touch rebate programs is a way to scale retrofits with less funding and county staff involvement.
    - Electrify MC is an example of a comprehensive direct incentive program with staff capacity for extensive quality assurance, contractor management, and customer support. A utility rebate match program like those offered by the Cities of Minneapolis or St. Louis Park is a lighter touch option.
    - These programs still require an advising service to help participants navigate the process.
- As an example of this two-pronged approach, Montgomery County offers both Electrify MC and HEECAP to reach residents of all income levels. King County offers the Energize Heat Pump program to low- to middle-income households in specific areas of the county and has coordinated with a different City-operated program, Energy Smart Eastside, to reach other more affluent areas.

Hiring staff and an implementer with deep weatherization and electrification experience improves program outcomes

- Staff and implementers with extensive weatherization and electrification experience, particularly around heat pump equipment sizing, installation, and commissioning, are essential for effective program operation. Together, they can:
    - Manage contractor relationships, facilitate training, and do quality assurance.
    - Provide high-quality advising or customer service to residents.
    - Address technical issues with projects as they come up. Every house is unique.

- Denver and Montgomery County hired expert implementers to deliver their programs, and all three jurisdictions employed a staff person with technical expertise to manage the program.

Creating or supporting a broad network of contractors allows for scalability

- Working with a single implementer and contractor can provide consistency but may limit the number of projects that can be completed initially.
    - Montgomery County worked with a single implementer contractor in their pilot program, which assures high quality but limits scalability. The Denver implementer, Energy Outreach Colorado, initially worked with a single general contractor, then pivoted to managing multiple contractors themselves.
- A network of multiple contractors actively managed by the County or implementer will likely provide scalability while assuring quality.
    - King County built a network of 18 different contractors with close oversight by County staff. This has put the program on track to meet its goals.

Leveraging other utility, city, and state programs and funding sources can help support programs but requires coordination

- Leveraging outside funds to implement directly worked well for Denver and Montgomery County.
    - Denver leveraged funding from Xcel Energy and ICLEI (Local Governments for Sustainability USA) to fund additional healthy homes projects implemented by Energy Outreach Colorado.
    - Montgomery County created Electrify MC to complement the statewide EmPOWER Maryland program which offers weatherization incentives.
    - In Hennepin County, Sustainable Resources Center (SRC) models this by successfully leveraging funding from CenterPoint Energy's Low-Income Weatherization Program to implement more weatherization retrofits.
- King County refers some applicants to other programs that install heat pumps and offer weatherization, including local Weatherization Assistance Program providers. However, coordinating referrals, logistics, and project timelines has been challenging. King County has succeeded in securing funding to implement weatherization projects directly through the Energize program.

Securing a local funding source provides multi-year support for programs

- To create a multi-year weatherization and electrification program, a local funding source is important to weather changing funding landscapes beyond the local government's control.
- Each jurisdiction funded its program either exclusively or partially through a funding source at the local level (Montgomery County's General Fund, Denver's sales tax-funded Climate Protection Fund, King County's Climate Equity Bond and Washington State's Climate Commitment Act).

CONCLUSION AND RECOMMENDATIONS

Hennepin County's goal of net-zero emissions by 2050 can be achieved in all 1–4 unit homes through weatherization and electrification with technologies that are available at scale. These technologies and measures are weatherization, all electric or dual fuel air source heat pumps, heat pump water heaters, induction stoves, heat pump dryers, electrical panel upgrades, and EV-charging circuits. These measures were modeled in this study because of their relative cost-effectiveness and broad availability. To meet the goal of net-zero emissions by 2050, about 12,800 homes will need to be weatherized and electrified annually, which will result in a total upfront capital cost of around $10 billion dollars by 2050. This is a $5 billion incremental upfront cost beyond what would already be spent to replace equipment that reaches end of life.

Importantly, this study found that nearly all households can save money on energy bills with weatherization and dual fuel heat pumps under Xcel Energy's recently updated electric space heating rate and today's low gas prices. Under the Dual Fuel 50% scenario, 95% of homes could achieve bill savings and still reduce greenhouse gas emissions by 73%. The All Electric scenario can effectively eliminate carbon emissions, and nearly two-thirds of households will still save on energy bills.

A group of high-impact homes with greater weatherization needs have a significant opportunity to achieve deep energy bill savings and emissions reductions. The spatial analysis shows that targeting County investment in the high-impact homes located in socioeconomically disadvantaged areas would enable the County to meaningfully work toward its climate and equity goals. This would also address the lack of consistent electrification upgrades in existing state, utility, and city low-income retrofit programs.

Stakeholders emphasized the need for different weatherization and electrification pathways to address the barriers and needs of various demographic groups and housing types in the County. Key barriers to residential weatherization and electrification that stakeholders identified were high upfront costs, difficulty navigating complex programs, and lack of awareness of the technology options and their benefits. The following recommendations address these pathways and barriers.

Making these favorable economic and environmental outcomes known to residents, property owners, contractors, utility program implementers, and community organizers is critical. Interventions that put this information in front of contractors and compel contractors to provide it to their customers will lead to more weatherization and heat pump installations. Combining concerted efforts by the County to increase awareness and knowledge among residents and their networks with funding resources that lower upfront costs would dramatically advance the County's progress toward its climate goals.

Recommended Actions

Hennepin County can take powerful steps to advance weatherization and electrification in 1–4 unit residential buildings. These recommended actions were developed through discussions with stakeholders and County staff on the model results, landscape analysis, and best practice research. The actions will enable the County to fill existing gaps, remove barriers, and ensure County resources have the largest impact toward achieving Hennepin County's climate goals and improving quality of life for its residents.

Hennepin County is surrounded by partners in this work, including community-based organizations, local governments, housing and energy nonprofits, utilities, and state agencies. To leverage the strong foundation of existing partners, programs, policies, and progress, County staff and CEE organized the County's role in the recommended actions into three categories: **Lead** (County staff or a hired contractor implement an action), **Partner** (support other organizations or programs working on an action), and **Advocate** (for policy or funding change).

Actions to Facilitate Retrofits

The County should invest in high-impact programs that facilitate weatherization and electrification in target homes and areas. These actions can be implemented as soon as funding is secured.

1. Secure a funding source

Impact: Funding is critical to achieving the County's climate goals. Filling the gaps and standing up programs that accelerate residential weatherization and electrification will take funding and resources. Securing a local, long-term funding source would empower the County to take consistent, high-impact action to decarbonize homes and meet the County's climate goals, year over year. Examples of local funding sources that other counties in the country have secured for home decarbonization work can be found in the

National Case Study Assessment section of this plan.

Tactic 1.A: Create and pass a local funding source. A local funding source generated through channels controlled by the County, such as sales or property tax levies, would provide reliable funding for multi-year programs.

County Role: Advocate

Tactic 1.B: Pursue state or federal funding. In the absence of local funding, state and federal funding can support starting programs. Hennepin County is experienced in winning and utilizing these funding sources.

County Role: Lead

2. Expand and scale a low-income weatherization and electrification retrofit pilot program

Impact: Weatherizing and electrifying low-income residents' homes with high weatherization potential will have the greatest impact on lowering energy bills, reducing greenhouse gas emissions, and filling the existing electrification gap in low-income programs. This constitutes a win at every level. The spatial analysis shows that the areas in Hennepin County with the highest potential savings from weatherization and highest concentrations of socioeconomically disadvantaged residents lie in portions of Minneapolis, Richfield, Bloomington, St. Louis Park, Brooklyn Center, Brooklyn Park, Robbinsdale, Crystal, and New Hope.

Tactic 2.A: Build on existing County programs to establish a low-income weatherization and electrification program that covers the full cost of upgrades. Hennepin County's housing and economic development team conducted a weatherization pilot program in 2025, which can be expanded into a full program with a future funding source. The County can leverage the pilot's program infrastructure for procuring contractors, identifying high-need and high-impact homes, and managing retrofits.

County Role: Lead

3. Expand and/or create a deferred, forgivable loan for weatherization and electrification

Impact: Deferred and forgivable loans empower lower-income homeowners to complete home upgrades that would otherwise be unattainable.

Tactic 3.A: Emphasize weatherization and electrification measures in Hennepin County's Existing Home Repair Loan. This deferred and forgivable loan is funded through the federal Community Development Block Grant (CDBG). It can currently be used for weatherization and HVAC improvements but is more often used for emergency, accessibility, or life and safety repairs and deferred maintenance. Integrating education in conversations between program staff and loan-recipients around weatherization and electrification and stacking outside incentives would help loan recipients choose to include energy retrofits in their project scopes more often.

County Role: Lead

Tactic 3.B: Secure a state or local capital source to administer a weatherization and electrification specific deferred loan. For owners and projects not requiring the intensive staff support of the CDBG HOME Repair Loan program, a new weatherization and electrification program could circumvent the County's long waitlists.

County Role: Lead

4. Create and/or support a scalable network of contractors

Impact: A robust network of contractors who can complete home energy retrofits is critical to successfully implement this plan's actions connected to facilitating retrofits.

Tactic 4.A: Build a rotating bench of weatherization, HVAC, and electrical contractors based on the existing procurement model established through Hennepin County's Lead and Healthy Homes program. This model works well for Hennepin County now and was successful in King County, Washington.

County Role: Lead

Tactic 4.B: **Support workforce development efforts** to grow the number of insulation, HVAC, electrical, and plumbing contractors capable of installing electrification technologies.

County Role: Partner

5. Create a weatherization and electrification cost-share rebate program

Impact: Reducing or eliminating the incremental cost of electrification is critical to removing economic barriers to electrification, especially for middle-income residents. Incentives beyond utility rebates will make electrification an easier choice for residents living in cities without municipal incentive programs and the many households who prioritize cost-effectiveness in home upgrade decisions.

Tactic 5.A: Pilot a green cost-share program in socioeconomically disadvantaged areas in the county. This approach would enable the County to roll out the program systematically while reaching residents with higher needs first. Cities in the county that currently do not have green cost-share programs and have high concentrations of socioeconomically disadvantaged residents include Richfield, Bloomington, Brooklyn Center, Brooklyn Park, Robbinsdale, Crystal, and New Hope.

County Role: Lead

Actions to Support programs and policies

The County should support programs, policies, and actions carried out by other organizations or the County itself that clear barriers and amplify the impact of other partners. These actions can require fewer County resources and may be acted upon in the absence of new funding.

6. Ensure access to an advisor service for navigating programs and home projects

Impact: The existing patchwork of programs and services is complex and managing home upgrade projects can be difficult. An independent advisory service is critical to help residents enroll in the programs that best suit their needs, secure and stack available financial incentives, and successfully complete home upgrades.

Tactic 6.A: Continue to connect residents with existing advisor services. The County already connects residents to existing advisor services and programs operated by nonprofit organizations and utility program implementers and should scale this as opportunities arise.

County Role: Partner

Tactic 6.B: Integrate advising into new or expanded County programs.

County Role: Lead

7. Create a technical assistance and policy development service to help city governments advance home decarbonization

Impact: Hennepin County is in a unique position to support city governments (individually or in cohorts) with taking actions to further residential weatherization and electrification. City governments have access to different levers and funding mechanisms than the County to impact housing and energy. Supporting local governments to use these levers would be an efficient way for the County to clear barriers and support home decarbonization beyond County-operated programs. Two models for this type of support include the former Hennepin County Efficient Buildings Collaborative, which helped cities develop energy benchmarking policies, and the existing Hennepin Planning Grants program, which supports cities with planning efforts.[28]

County Role: Lead set up of the service and partner with cities.

Hennepin County could support city governments to:

Tactic 7.A: Pass a local municipal funding source for home weatherization and electrification like a utility franchise fee.

Tactic 7.B: Develop a municipal cost-share program aligned with other rebate programs to reduce incremental costs of home upgrades.

Tactic 7.C: **Develop a 4d Rental Green Cost Share program** to incentivize decarbonization retrofits in affordable rental properties. Many cities provide 4d property tax credits to property owners that commit to maintaining affordable rents. As shown in Minneapolis, adding

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[28] "Hennepin Planning Grants." Hennepin County. 2025. https://www.hennepin.us/en/economic-development/programs/hennepin-planning-grants.

weatherization and electrification incentives to 4d programs in cities with sufficient affordable rental properties can drive rental retrofits.[29]

8. Advocate to align and increase electrification in utility programs

Impact: Utility energy programs and rebates through the Energy Conservation and Optimization Act (ECO) are significant drivers of the existing home energy retrofits in the County. Utilities update their offerings every three years, making this a significant opportunity for Hennepin County to advocate for utility program updates that align with the County's goals. The next ECO triennial planning and approval process will take place in 2026.

Tactic 8.A: Advocate in the 2027–2029 ECO utility program triennial planning cycle. The County should advocate for consistent electrification in Xcel Energy and CenterPoint Energy's low-income retrofit programs and increased incentives for weatherization, heat pumps, and heat pump water heaters.

County Role: Advocate

9. Create financial incentives for new developments to incorporate electrification

Impact: While most of the homes that will be in Hennepin County in 2050 exist today, pushing new development toward electrification can cost-effectively ensure they are low carbon from the start.

Tactic 9.A: Identify funding to require efficient, electrified space and water heating in new housing developments that receive County funding.

County Role: Partner

Actions to Raise Awareness

The County should promote information that helps residents and property owners confidently choose electric options with every home upgrade. Awareness of the electric technologies and financial incentives available, along with their benefits, is a critical first step in normalizing weatherization and electrification.

10. Conduct education and outreach campaigns to encourage residents and property owners to weatherize and electrify

Impact: The opportunity to electrify arises every time a heating system, water heater, or appliance reaches end of life. The County can continue to leverage its participation in efficiency and electrification outreach programs and expand its engagement team's work with trusted messengers to ensure residents and property owners are empowered to electrify when the opportunity arises.

Tactic 10.A: Conduct neighborhood-scale resident education and outreach campaigns.

County Role: Lead and Partner

Tactic 10.B: Conduct resident education and outreach campaigns on AC to heat pump replacement. Target areas of the county with newer homes that have sufficient insulation, making them heat pump ready. Cities with most homes fitting these parameters include Eden

[29] "4d energy efficiency." City of Minneapolis. Accessed April 9, 2025. https://www.minneapolismn.gov/government/programs-initiatives/environmental-programs/green-cost-share/energy-efficiency/4d/

Prairie, Maple Grove, Medina, Corcoran, Dayton, and Rogers. That said, all cities in the County contain heat pump ready homes that could be reached with targeted outreach and marketing.

County Role: Lead and Partner

Tactic 10.B: Conduct a landlord education and outreach campaign on weatherization and electrification resources. Minneapolis is a clear place to target, as the city contains a third of all 1–4 unit rental properties in the county. However, portions of Hopkins, Bloomington, Brooklyn Park, Brooklyn Center, St. Louis Park, and Edina also have high proportions of residents renting 1–4 unit homes.

County Role: Lead and Partner

Closing

Hennepin County can use the findings and actions in this plan to remove barriers, fill gaps, influence policy change, and facilitate retrofits to accelerate residential weatherization and electrification. By developing and funding programs, supporting partners, and conducting advocacy and outreach, Hennepin County has powerful levers to transform the buildings we call home, improve quality of life, and achieve the County's climate goals.

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APPENDIX A. MODEL METHODOLOGY

Data Sources

The model integrates four local datasets covering 1–4 unit residential buildings in Hennepin County. Hennepin County property appraisal data provides authoritative building characteristics (size, type, construction year, unit count, primary fuel, heating system) for all such buildings in the county. Three supplementary datasets include home energy audit data, Minnesota Weatherization Assistance Program data, and RESNET new construction data. These data sources supply performance details for a subset of buildings, including envelope properties (insulation, air tightness, window characteristics) and mechanical system specifications (type, fuel, efficiency). Data gaps are filled using ResStock county-level probability distributions, derived from the federal Residential Energy Consumption Survey and American Community Survey.

Data Transformation

Raw data are integrated into a unified dataset through standardization and cleaning. This process includes: (1) structural corrections (typos, inconsistent names, formatting issues, missing values); (2) conversion of raw values to ResStock variables and discrete categories (e.g., construction year → decade, building size → size bin, continuous insulation values → standard R-values); and (3) derivation of probability distributions for all 158 ResStock input parameters. Probability distributions incorporate parameter interdependencies to reflect realistic building characteristics observed in the raw data.

Statistical Sampling

Probability distributions are sampled deterministically using quota-based sampling to generate a synthetic building stock of N = 10,000 representative buildings, with each building representing approximately 30 dwelling units in Hennepin County. The quota-based sampling algorithm proceeds as follows:

1. **Sequential conditional sampling**: High-level building characteristics with no or minimal dependencies (location, building type, vintage) are sampled first. Census block assignment occurs at this stage, conditioning subsequent block-level characteristics.
2. **Dependent characteristic sampling**: Subsequent characteristics are sampled conditioned on previously selected characteristics, following defined dependency relationships.
3. **Independent characteristic assignment**: Characteristics with no dependency relationships (e.g., behavioral and appliance-related attributes) are assigned via random draws from marginal distributions after structural and envelope parameters are fixed.
4. **Quota enforcement**: A filter is applied to meet the target sample size (N = 10,000). Buildings are selected in order of decreasing joint probability until the quota is reached.

This deterministic approach ensures that the frequency of each building characteristic combination in the sample matches its probability in the real population, and each sampled building represents an equal number of real dwellings. Sampled building attributes are validated against raw data distributions to confirm the sampling process accurately reproduces observed building characteristics.

Building Simulations

Annual (8,760-hour) energy simulations are performed for each of the 10,000 buildings using EnergyPlus (via OpenStudio and HPXML) with TMY2020 weather data. Occupancy profiles, thermostat setpoints, and appliance schedules are derived from ResStock county-level probability distributions, applying ResStock's standard assumptions where local data are unavailable.

Simulations produce hourly and annual time-series data for all end-uses across all fuel types (electricity, natural gas, other) for each building. The baseline scenario represents current as-built performance (building stock without modifications). Aggregated baseline results are validated against utility billing data from approximately 450 local 1–4 unit buildings to ensure model accuracy. Additional scenarios apply consistent retrofit measures (e.g., full electrification, dual fuel, weatherization only) to all buildings in the building stock to evaluate population-level impacts.

Table 8. Qualifications and outcome assumptions for weatherization measures

Measure	Qualifications	Energy Outcomes
Comprehensive Air Sealing	ACH50 > 8 or ACH50 > 15	0.85 ACH50 or 0.75 ACH50
Wall Cavity Insulation	< R-8	R-12 & 0.9 ACH50
Attic Insulation	< R-30 or < R-49	R-30, R-60 & 0.9 ACH50
Rim Joist Insulation	< R-5	R-15 & 0.95 ACH50
Continuous Exhaust Ventilation	< 50% code ventilation by infiltration	NA

Figure 25. Distribution of weatherization costs for all 1–4 unit dwellings in Hennepin County

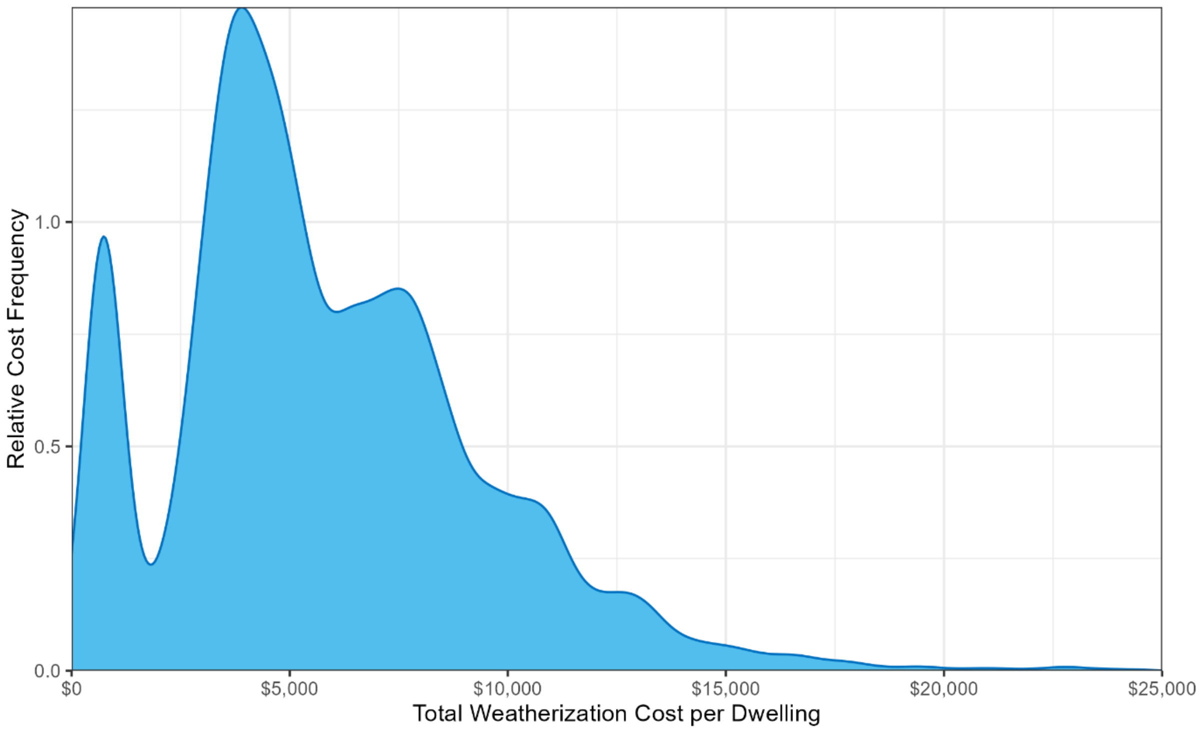

Table 9. Measures considered in this analysis

Category	Measure	Scenarios	Performance	Estimated average cost
Space Heating and Cooling	Natural Gas Furnace and Central Air Conditioner	Baseline	96% AFUE SEER 14	$12,744
Space Heating	Natural Gas Boiler (no cooling equipment included)	Baseline	96% AFUE	$14,117
Space Heating and Cooling	Cold Climate ASHP – Ducted (with backup natural gas furnace or electric plenum heater)	All Electric, Dual Fuel 80%	SEER 18, HSPF 10	$17,715
Space Heating and Cooling	Cold Climate ASHP – Ductless (with back up natural gas boiler or electric resistance heaters)	All Electric, Dual Fuel 80%	SEER 18, HSPF 10	$23,594

Space Heating and Cooling	Variable Speed ASHP – Ducted (with back up natural gas furnace)	Dual Fuel 50%	SEER 18, HSPF 9	$15,155
Space Heating and Cooling	Variable Speed ASHP – Ductless (with back up natural gas boiler)	Dual Fuel 50%	SEER 18, HSPF 9	$17,018
Water Heating	Natural Gas Tank 50 Gal	Baseline	UEF = 0.59	$2,352
Water Heating	Heat Pump Water Heater 60 Gal	All Electric Dual Fuel 80% Dual Fuel 50%	UEF = 3.45	$5,412
Water Heating	Heat Pump Water Heater 80 Gal	All Electric Dual Fuel 80% Dual Fuel 50%	UEF = 3.45	$6,560
Cooking Range	Gas Range	Baseline	ANSI/RESNET/ ICC 301-2019	$1,287
Cooking Range	Induction Range	All Electric Dual Fuel 80% Dual Fuel 50%	ANSI/RESNET/ ICC 301-2019	$2,276
Clothes Drying	Gas Clothes Dryer	Baseline	CEF = 3.48	$841
Clothes Drying	Heat Pump Clothes Dryer	All Electric Dual Fuel 80% Dual Fuel 50%	CEF = 5	$1,850
Electric Infrastructure	EV Charger	All Electric Dual Fuel 80% Dual Fuel 50%	48A	$1,052
Electric Infrastructure	Panel/Service drop upgrade	All Electric Dual Fuel 80% Dual Fuel 50%	200A	$3,896

Table 10. Average equipment lifetime used for modelling rate of replacement

Equipment	Department of Energy Average Rated Lifetime (years)
Central Air Conditioner	15
Air Source Heat Pump	14
Gas Furnace	18
Gas Boiler	25
Gas Water Heater and Heat Pump Water Heater	12
Cooking Range and Clothes Dryer	12

APPENDIX B. MAPPING

The energy model data inputs representing the county's 1–4 unit residential building stock are granular enough to produce results at the census tract level. This granularity allows us to visualize different outcomes across the county through mapping. By linking these results with publicly available census data,[30] population characteristics such as socioeconomic characteristics can be overlaid on the model results to highlight the spatial intersection between residents and the homes they occupy. We created an interactive online map for individuals to further explore the results of the study, which can be accessed here.[31]

Scenarios

As described earlier in this paper, the impacts of four key weatherization and electrification scenarios were modeled. In the online interactive map, model results are available for each of the four scenarios, which are summarized again here.

- *Weatherization Only*: this scenario models the impacts of only improving the building stock with key weatherization measures, including air sealing, attic insulation, and wall insulation. This scenario is useful for isolating the impacts of weatherization.
- *Dual Fuel 50%:* this scenario models the impacts of full weatherization combined with a dual fuel heating system and appliance electrification. A lower cost variable-speed heat pump is used to meet approximately 50% of the home's heating load, enabling eligibility for Xcel Energy's space heating rate, while a high-efficiency gas furnace provides backup for the remaining 50%. The scenario also includes additional electrification measures - heat pump water heaters, induction stoves, heat pump dryers, EV charging circuits, and electrical panel upgrades when required or when replacing gas equipment.
- *Dual Fuel 80%:* this scenario models the impacts of full weatherization combined with a dual fuel heating system. A cold climate heat pump is used to meet approximately 80% of the home's heating load, while a high-efficiency gas furnace provides backup for the remaining 20%. The scenario also includes additional electrification measures - heat pump water heaters, induction stoves, heat pump dryers, EV charging circuits, and electrical panel upgrades when required or when replacing gas equipment.
- *All Electric:* this scenario models the impacts of full weatherization combined with an all electric heating system consisting of the same cold climate heat pump utilized in the dual fuel 80% scenario, with electric resistance backup. The scenario also includes additional electrification measures - heat pump water heaters, induction stoves, heat pump dryers, EV charging circuits, and electrical panel upgrades when required or when replacing gas equipment.

Key Metrics

By applying the scenarios to the county's residential 1-4 unit building stock, key outcomes were estimated and are available to explore in the interactive online map. These include:

- *Mean Weatherization Measures Need:* This metric measures the current weatherization need by calculating the average number of insulation improvements that are not yet

[30] U.S. Census Bureau. 2023. *American Community Survey 5-year estimates*. https://www.census.gov/programs-surveys/acs.
[31] CEE. 2026. *Interactive Online Map, Hennepin County Residential Weatherization and Electrification Action Plan.* https://experience.arcgis.com/experience/3aebb85947194eaeb9e9b8453abe020b/

installed by census tract. Weatherization measures include air sealing, attic insulation, and wall insulation. Values range from 0 (all measures installed) to 3 (none installed). These results are available only for the "Weatherization Only" Scenario.

- *Median Energy Savings from Weatherization*: This metric estimates the median percent reduction in household energy use achievable through weatherization improvements alone at the census tract level. Higher values indicate greater potential energy savings from insulation and air sealing upgrades. These results are available only for the "Weatherization Only" Scenario.
- *Total Upgrade Costs:* This metric shows the census tract level median total upfront cost per household to install modeled weatherization and electrification equipment under this scenario. Under the weatherization only scenario, this metric shows the baseline cost per household of replacing all gas equipment with similar gas equipment plus weatherizing homes that need it.
- *Incremental Upgrade Costs:* This metric represents the census tract level median additional cost per household of installing modeled weatherization and electrification equipment compared to installing baseline gas equipment. Under the weatherization only scenario, this metric shows the median cost of weatherization on its own.
- *Annual Bill Impacts:* This metric shows the census tract level median estimated change in annual household energy bills after upgrades are completed. Negative values indicate bill savings, while positive values indicate increased annual energy costs. The online map uses the low cost estimate of natural gas prices (0.8 $/therm), providing a conservative impact of bill savings.
- *2050 Emissions Reductions* This metric estimates the census tract level median reduction in annual greenhouse gas emissions (MTCO2e) per household by 2050 under this scenario. Higher values indicate greater emissions reductions.

Equity Overlays

Three key equity layers are available within the interactive online map. Equity indicators are calculated independently of scenario modeling results and remain constant across all decarbonization scenarios.

- *High Socioeconomic Disadvantage*: This indicator identifies census tracts experiencing elevated socioeconomic disadvantage using a composite index modeled after the socioeconomic status theme of the CDC/ATSDR Social Vulnerability Index (SVI).[32] Using 2023 American Community Survey (ACS) 5-year estimates and Low Income Energy Affordability Data from the Department of Energy, tract-level percentile rankings were calculated for the following indicators: energy burden[33], concentration of poverty[34], share of residents without a high school diploma[35], and unemployment rate[36]. Percentile rankings for each variable were summed to create a composite socioeconomic disadvantage score. Census tracts were then ranked based on this composite score. Tracts classified as High Socioeconomic Disadvantage represent those falling within the

[32] CDC. 2024. *Social Vulnerability Index.* https://www.atsdr.cdc.gov/place-health/php/svi/index.html
[33] US Department of Energy. 2024. *Low Income Energy Affordability Data.* https://www.energy.gov/scep/slsc/lead-tool.
[34] ACS 2023 5-year Estimates, Table B17024.
[35] ACS 2023 5-year Estimates, Table B06009.
[36] ACS 2023 5-year Estimates, Table DP03.

top 20 percent of composite scores countywide. This measure is adapted from, but does not replicate, the CDC/ATSDR Social Vulnerability Index methodology.[37]

- *High Renter Share:* Using data from the 2023 American Community Survey 5-year estimates[38], this indicator identifies the top 20% of census tract with the greatest proportion of renters.
- *Majority of Households Below 80% AMI*: Using ACS household income distribution[39] and household size[40] in conjunction with the HUD AMI thresholds[41] adjusted for household size, a weighted tract-level estimate of households below 80% AMI was calculated. Tracts where more than 50% of households fall below this threshold are flagged.

[37] CDC. 2022. *CDC/ATSDR SVI 2022 Documentation.* https://svi.cdc.gov/map25/data/docs/SVI2022Documentation_ZCTA.pdf
[38] ACS 2023 5-year Estimates, Table B25032.
[39] ACS 2023 5-year Estimates, Table B19001
[40] ACS 2023 5-year Estimates, Table B11016
[41] US Department of Housing and Urban Development. Income Limits for HUD Programs. FY 2023. https://www.huduser.gov/portal/datasets/il.html

APPENDIX C. LANDSCAPE ANALYSIS

Table 11. Energy programs, incentives, and lending products researched

Type	Name of Program/Incentive/Lending Product	URL/Info Source
Incentives	CenterPoint Energy Rebates	Residential | Home Page | CenterPoint Energy
	Xcel Energy Rebates	Xcel Energy Home Rebates
	Wright-Hennepin Electric Cooperative Association Rebates	Residential Programs and Rebates
	Minneapolis Green Cost Share Bonus Rebates	Minneapolis Green Cost Share Bonus Rebates
	St. Louis Park Climate Champions for Homes	St. Louis Park Climate Champions Program
	Edina Community Climate Action Fund	Edina Community Climate Action Fund
	Hopkins Climate Solutions Fund	Hopkins Climate Solutions Fund
	Coon Rapids Green Homes Program	Coon Rapids Green Homes Program
	City of Plymouth Home Energy Rebate Program	City of Plymouth Home Energy Rebate Program
	State Rebates	Minnesota Residential Heat Pump Rebate Program
	Federal Inflation Reduction Act Rebates (administered by the State of Minnesota)	Save Energy Minnesota
	Federal Energy Efficiency Tax Credit (expired December 31, 2025)	Energy Efficient Home Improvement Tax Credit
Low-Income Retrofit Programs	Xcel Energy Home Energy Savings Program (HESP)	Income-Qualified Home Energy Savings Program
	Home Energy Squad	Home Energy Squad
	CenterPoint Energy Low-Income Rental Efficiency (LIRE)	CenterPoint Energy Income-Qualified Rental Efficiency Program
	CenterPoint Energy Low-Income Weatherization	CenterPoint Income-Qualified Weatherization Program
	CenterPoint Energy Homeowner Efficiency Redo Opportunity (HERO)	Homeowner Efficiency Redo Opportunity

	CenterPoint Energy Nonprofit Affordable Housing	CenterPoint Energy Nonprofit Affordable Housing Program
	City of Minneapolis 4D Program	City of Minneapolis Energy Efficiency for 4D Housing
	City of Minneapolis Healthy Homes Weatherization	Minneapolis Healthy Homes Weatherization
	City of Edina 4D Program	City of Edina 4d Program Guide
	Weatherization Assistance Program	Weatherization Assistance Program
Lending Programs/Products	Hennepin County Home Repair Loan	Hennepin County Home Repair Loan
	Minneapolis 0% APR Energy Efficiency Loan	Minneapolis Energy Efficiency Loan
	Minnesota Housing Finance Agency Home Improvement Loans	Statewide Home Improvement Loans
	Minnesota Housing Finance Agency Home Energy Loan	Statewide Home Energy Loans
	City and Neighborhood Loans	City-Specific Loans

APPENDIX D: JURISDICTION CASE STUDIES

County Staff Interviewed

Montgomery County, Maryland

- Jeremy Good, Residential Energy Performance Manager
- Lindsey Shaw, Section Chief, Buildings and Transportation Programs

City and County of Denver

- Jeff Tejral, CASR Electrification Manager
- Steve Dunn, CASR Electrification Navigation Administrator II

King County, Washington

- Nicole Sanders, Building Decarbonization Manager
- S. Neil Larsen, Energize Project Manager

APPENDIX E. STAKEHOLDER ENGAGEMENT

Acknowledgements

We would like to acknowledge and thank the stakeholders who gave their time and expertise to shape this plan and ground it in the realities our communities face. A special thank you to the Hennepin County staff who guided, reviewed, and contributed to this plan.

Participating Stakeholders

- Emily Ziring, City of St. Louis Park
- Ellie Rabine, City of St. Louis Park
- Kelly Fischer, City of Minneapolis
- Eric Fowler, Fresh Energy
- John Vaughn, Fresh Energy
- Audrey Pallmeyer, Cooperative Energy Futures
- Carmen Carruthers, Citizens Utility Board (CUB) of Minnesota
- Jake Soper, City of Lakes Community Land Trust
- Azad Lassiter, Urban Homeworks/Housing in Action
- Andrea Peterson, HIRED
- Daniel del Toro, Unidos MN
- Alison Thorson, Unidos MN
- Greta Huff, CAPI USA Immigrant Opportunity Center
- Monse Perez Barrios, COPAL
- Dan Roberts, Sustainable Resource Center (SRC)
- Dana Thorgrimson- Smith, Sustainable Resource Center (SRC)
- Yusra Murad, Inquilinxs Unidixs for Justice
- Josh Martin, Xcel Energy
- Marty Kapsch, CenterPoint Energy
- David Daher, Visionary Heating and Cooling
- Mitchel Hansen, Harrison Neighborhood Association
- Andrea Siegel, Tangletown Neighborhood Association
- Michael Jensen, Hennepin County, Housing and Economic Development
- Melisa Illies, Hennepin County, Housing and Economic Development
- Julia Welle-Ayres, Hennepin County, Housing and Economic Development
- Zack Avre, Hennepin County, Housing and Economic Development
- Sally Bauer, Hennepin County, Climate and Resilience
- Mauricio Leon Mendez, Hennepin County, Climate and Resilience
- Maddy Hohenstein, Hennepin County, Climate and Resilience
- Diana Chaman Salas, Hennepin County, Climate and Resilience
- Jessica Spanswick, Hennepin County, Climate and Resilience
- Matthew Douglas-May, CEE
- Josh Quinnell, CEE
- Becky Olson, CEE
- Michelle Frost, CEE
- Najma Ahmed, CEE
- Adnan Hilal, CEE
- Shawn Rodine, CEE