Transforming Texas: How Heat Pumps Can Replace Electric Resistance Heat, Reducing Costs and Winter Power Peaks

Steven Nadel, Jennifer Amann, and Hellen Chen
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White Paper

ACEEE

About ACEEE

The **American Council for an Energy-Efficient Economy** (ACEEE), a nonprofit research organization, develops policies to reduce energy waste and combat climate change. Its independent analysis advances investments, programs, and behaviors that use energy more effectively and help build an equitable clean energy future.

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Jennifer Amann has more than 25 years of experience in researching, analyzing, and implementing buildings energy efficiency technologies, policies, and programs. She is widely recognized for her expertise in buildings-related energy policy, residential energy efficiency and decarbonization, appliances and lighting, and consumer education and behavior. A native Texan, she is enjoying the opportunity to work on this and other recent projects to advance energy efficiency to support a more reliable and resilient energy system in the state.

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Data and licensing information

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Executive summary

Key Findings

- Over 25% of Texas homes and apartments have a central air conditioner but use electric resistance for heating. Energy use can be reduced by 50% with peak winter power demand substantially reduced if a high-efficiency heat pump is installed the next time the air conditioner needs to be replaced, displacing most of the electric resistance heat.
- If heat pumps are steadily installed over the 15-year period it will take to replace current air conditioners, winter peak electric demand in Texas can be reduced by about 12,000 MW, equivalent to the power output of about 40 new gas power plants (300 MW each).
- On average, homeowners will earn a return on investment (ROI) of 49% with a simple payback of two years when replacing their central air conditioner with electric resistance heat. Over 80% of homes in our sample have an ROI of more than 20%. These ROIs are better than from investing in the stock market.
- In new construction, the average ROI is 103% for purchasing a heat pump instead of an air conditioner with electric resistance heat.
- While there are benefits for all housing types and regions of the state, savings are particularly compelling in the northern half and in multifamily housing statewide.
- State and local policy, as well as state and utility program offerings, can accelerate heat pump adoption, creating significant benefits for consumers and the electric grid. Examples include targeting the soon-to-start Home Energy Rebate program at residences now using electric resistance heat, providing complementary utility heat pump rebate programs with a focus on multifamily and low-income single-family homes, and updating local building codes.

Introduction

Over 25% of Texas households (2.76 million units in 2020) get their heating and cooling from a central air-conditioning system with electric resistance coils that heat air to be distributed throughout the home via ducts and registers.[1] These systems average about 9 kW of peak demand per home when temperatures drop and thus are one of the largest contributors to winter peak electric demand. While power demand in Texas generally peaks on hot summer days, winter peaks when cold fronts move through the state can be just as large—2021's Winter Storm Uri would have produced an all-time record peak if the power stayed on.

Homes and apartments can be upgraded to use a high-efficiency heat pump when the existing central air-conditioning unit and heating coils need replacement. Heat pumps are a cost-effective alternative to electric resistance heat, as they cut energy use and peak demand roughly in half. As a result, consumer space heating costs will be reduced by about 50%, helping to stretch consumer budgets. Other benefits

[1] Most of the remaining homes use gas for heating.

include a nearly 50% reduction in winter space heating electrical demand, helping to stretch electricity supplies for a growing Texas economy and population, and reduced emissions from power generation, helping Texas cities to meet air quality standards.

Findings

In this study, we look at a detailed sample of more than 350 Texas homes that presently use electricity as their primary source of heat. On average, installing a heat pump instead of a central air conditioner with electric resistance coils increases costs by about $391 for new construction and $697 when replacing an existing central air conditioner, a cost increase of 5% to 21% depending on air conditioner size. While a new air conditioner or heat pump will cost thousands of dollars, in this report we only look at situations in which a new air conditioner is being purchased and hence <u>concentrate on the cost difference between a heat pump and a central air conditioner with electric resistance heating coils.</u>

Based on our sample, we estimate that 15 years after existing equipment has been replaced, 15 years being its typical lifespan (ASHRAE 2019), Texas would see these benefits:

- Electricity savings could total almost 7 billion kWh (equivalent to the annual electricity use of over 660,000 average American homes).
- Winter peak demand savings could total about 12,000 MW (equivalent to the power output of about 40 new gas-fired power plants of 300 MW each).
- Incremental costs for the heat pumps would total about $1.6 billion, but annual energy bill *savings* would be about $1 billion *per year* (an average of $343 annually per Texas household).
- There would be a benefit-cost ratio of about 9:1 over the equipment lifetime.

In 2023, the U.S. Energy Information Administration (EIA) estimated that a new combined-cycle power plant costs over $1.3 million per MW. If, as a rough estimate, we assign one-third of this cost to the winter peak, since summer peaks will still be more common than winter peaks, the 12,000 MW of winter peak reductions from installing heat pumps instead of central air conditioners would avoid over $5 billion in power plant construction costs that are ultimately recovered in Texas electric rates. This is not even counting avoided transmission and distribution costs or the operating costs of these new power plants. Our analysis finds that installing heat pumps instead of air conditioners might cost a total of about $1.6 billion, and the heat pumps will have much lower operating costs than the systems they replace. In other words, installing heat pumps can reduce total capital costs by more than $3 billion, plus reduce heating costs by about 50%. This is an important opportunity to reduce growth in power costs, helping Texans keep more of the money they earn.

Our results are similar to the findings from the October 2024 study *Energy Efficiency and Demand Response in ERCOT* prepared by Texas A&M and commissioned by ERCOT, the power pool covering most of Texas. This study looked at a variety of energy efficiency and demand response scenarios, including one with minimum efficiency heat pumps and using the existing heat source as backup. For this scenario, the A&M study found 13,660 MW of winter peak demand reduction (slightly more than our estimate) and 1,680 MW of summer demand reduction (for which we did not prepare an estimate) (Xie and Texas A&M 2024).

By looking at individual homes we can better assess costs and benefits and separately analyze subsets of homes, such as new construction versus retrofits, single versus multifamily, owners versus renters, and the northern versus southern portion of the state. Figure ES-1 summarizes the ROI for some key subgroups in our analysis. In all cases, the ROI is substantially better than from the stock market or a bank certificate of deposit.

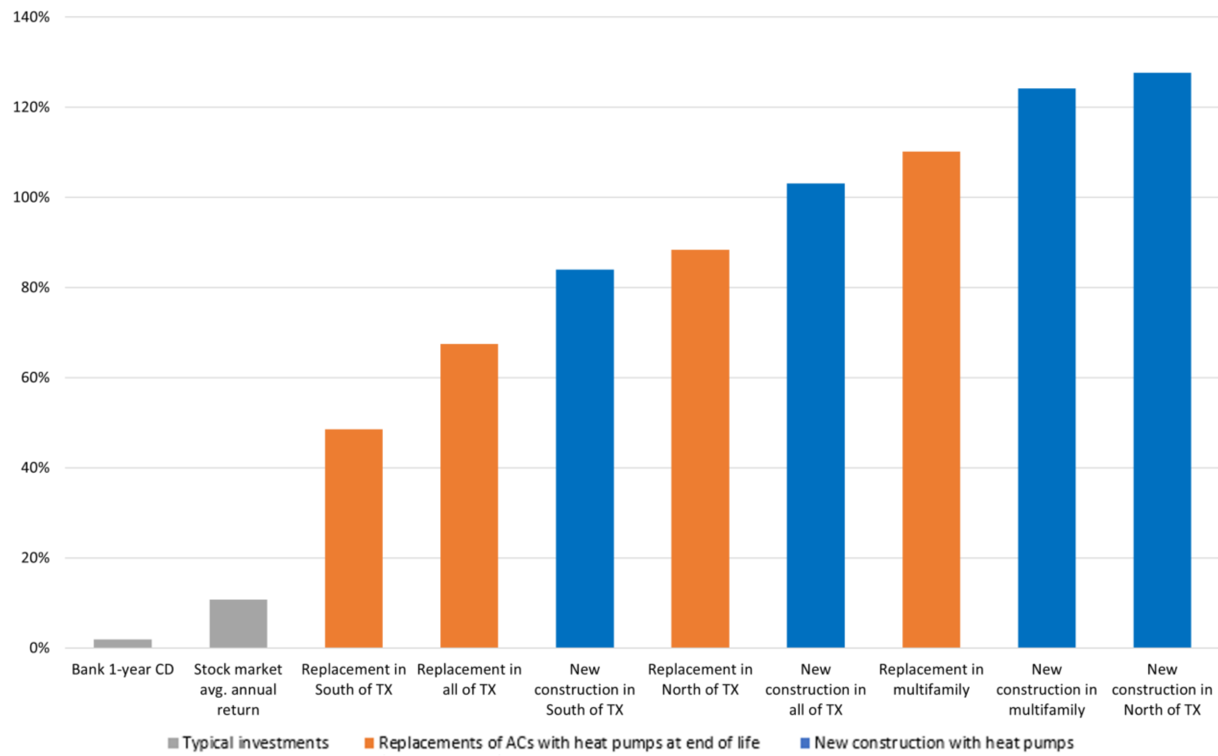

Figure ES-1. Return on investment for installing a heat pump at time of new construction or equipment replacement compared to average returns in the stock market or from bank certificates of deposit (CDs). Bank CD rates as of September 2024. Stock market returns are the 30-year annual average return on the S&P 500. North of Texas means more than 2,000 heating degree days (e.g., just north of Austin). Additional subgroups are discussed in the full report.

Programs and policies

As Texas moves forward with its applications to the Department of Energy (DOE) for the state's Home Energy Rebate programs, the State Energy Conservation Office should consider how to target homes with electric resistance heat as a priority in their programs. Utilities and the Public Utility Commission of Texas (PUCT) should consider how utility investments can expand the reach of these programs by offering complementary programs that target new construction and heating system replacements. As the PUCT considers the state's investor-owned utility energy efficiency portfolio, it should explore opportunities to increase residential program participation. The role of midstream programs that target distributors with incentives to stock heat pumps in lieu of central air conditioners with electric resistance coils should also be considered.

State and local governments have adopted restrictions on electric resistance heating through building codes, requirements for construction projects that receive public funding, and other policy mechanisms. The City of Austin's code, for instance, prohibits electric resistance heating. This is a practical and cost-effective example that could be adopted by other municipalities. Ultimately, something similar could be included in the state energy code, following the example of states such as Florida and Georgia. This change in the code can help the state manage the impact of a growing population on statewide energy demand.

Conclusion

Our analysis clearly shows that installing heat pumps at the time central air conditioners need replacement will have both peak demand reduction and economic benefits. Texas energy efficiency programs and policy should encourage the switch to heat pumps in order to reduce the use of inefficient electric resistance heat.

Introduction

Over 25% of Texas households get their heating and cooling from central air-conditioning systems that include electric resistance coils to heat air to be distributed throughout the home via ducts and registers. Sometimes the term “electric furnace” is used to describe the heating system in these homes. These units are common in single-family homes and are also often installed to heat and cool individual apartments. In 2020, there were more than 2.76 million homes and apartments in Texas with such systems (EIA 2023a).[2] These systems average about 9 kW of peak heating demand per home when temperatures drop.[3] Thus, according to the analysis conducted for this paper and described below, they can contribute nearly 12,000 MW of winter peak demand at the state level, the equivalent of the output of 12 large nuclear power plants (1,000 MW each) or 40 gas combined-cycle plants (300 MW each). Given the growth in Texas’s economy and population, power demand is growing rapidly. Heat pumps are a cost-effective alternative to electric resistance furnaces, since they reduce energy use and peak demand for space heating roughly in half, which dramatically stretches available power.

The impact of electric resistance heat on peak electric demand is illustrated in figure 1, which also shows how demand can be higher on cold winter days than on hot summer days. The significantly lower winter peak demand in most homes with heat pumps is illustrated in figure 2.

[2] Specifically, the state housing characteristics tables show 10.26 million homes and apartments, of which 5.27 million use electricity as their primary heating source. 1.95 million are heated with heat pumps, leaving 3.22 million with electric resistance heat. 83% of homes and apartments have central air-conditioning, and if we apply this same percentage to homes with electric resistance heat, 2.76 million homes and apartments have both electric resistance heat and central air-conditioning. According to RECS, 66% of Texas homes and apartments are single-family detached, meaning the remaining 34% are duplexes, townhomes and various types of multifamily dwellings. RECS does not provide data on space heating type broken down by type of home.

[3] Sources are noted in the methodology section below.

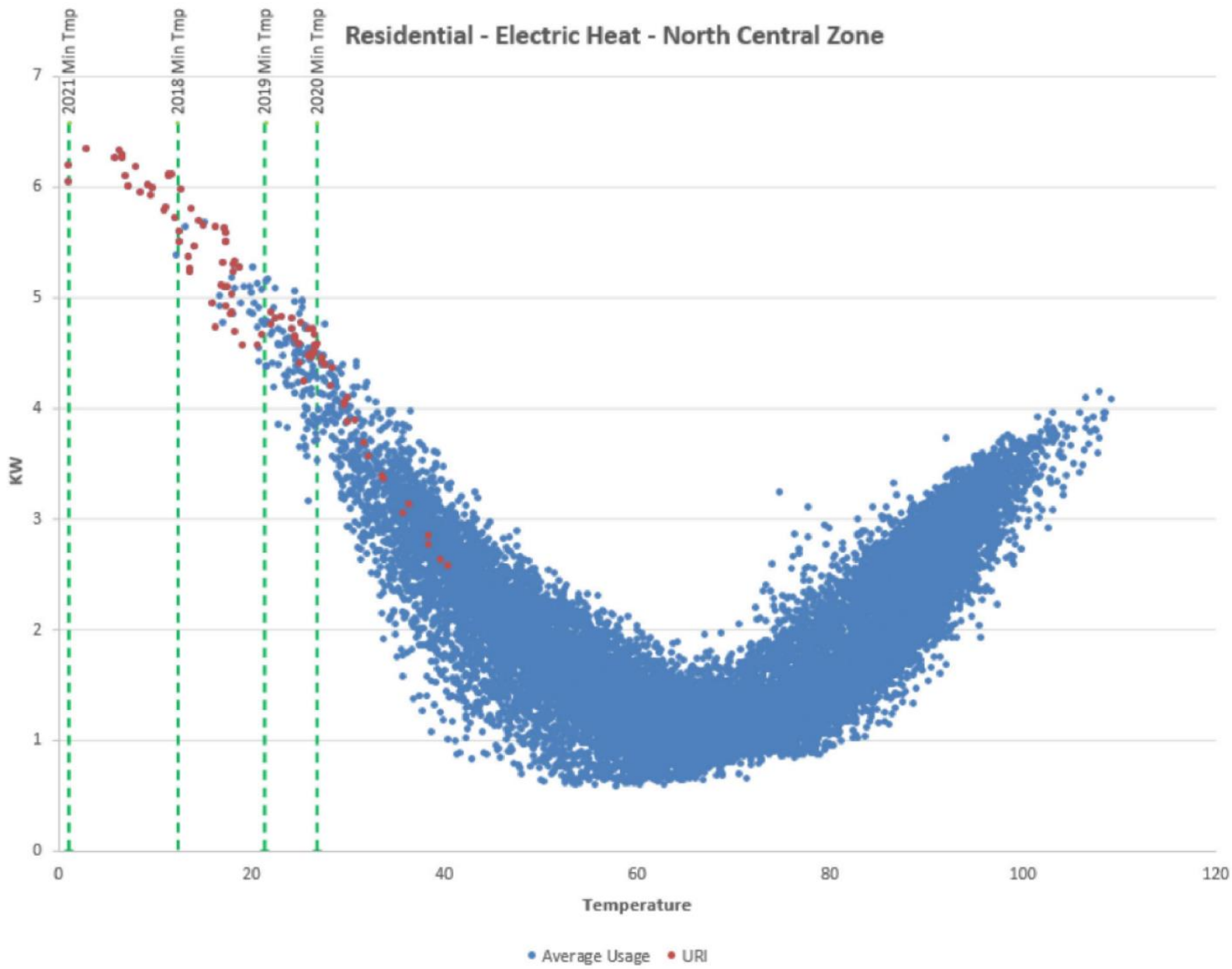

Figure 1. Demand in North-Central Texas homes as a function of outdoor temperatures. Demand is significantly higher at low winter temperatures than at high summer temperatures. *Source*: Barnes and NRG 2021.

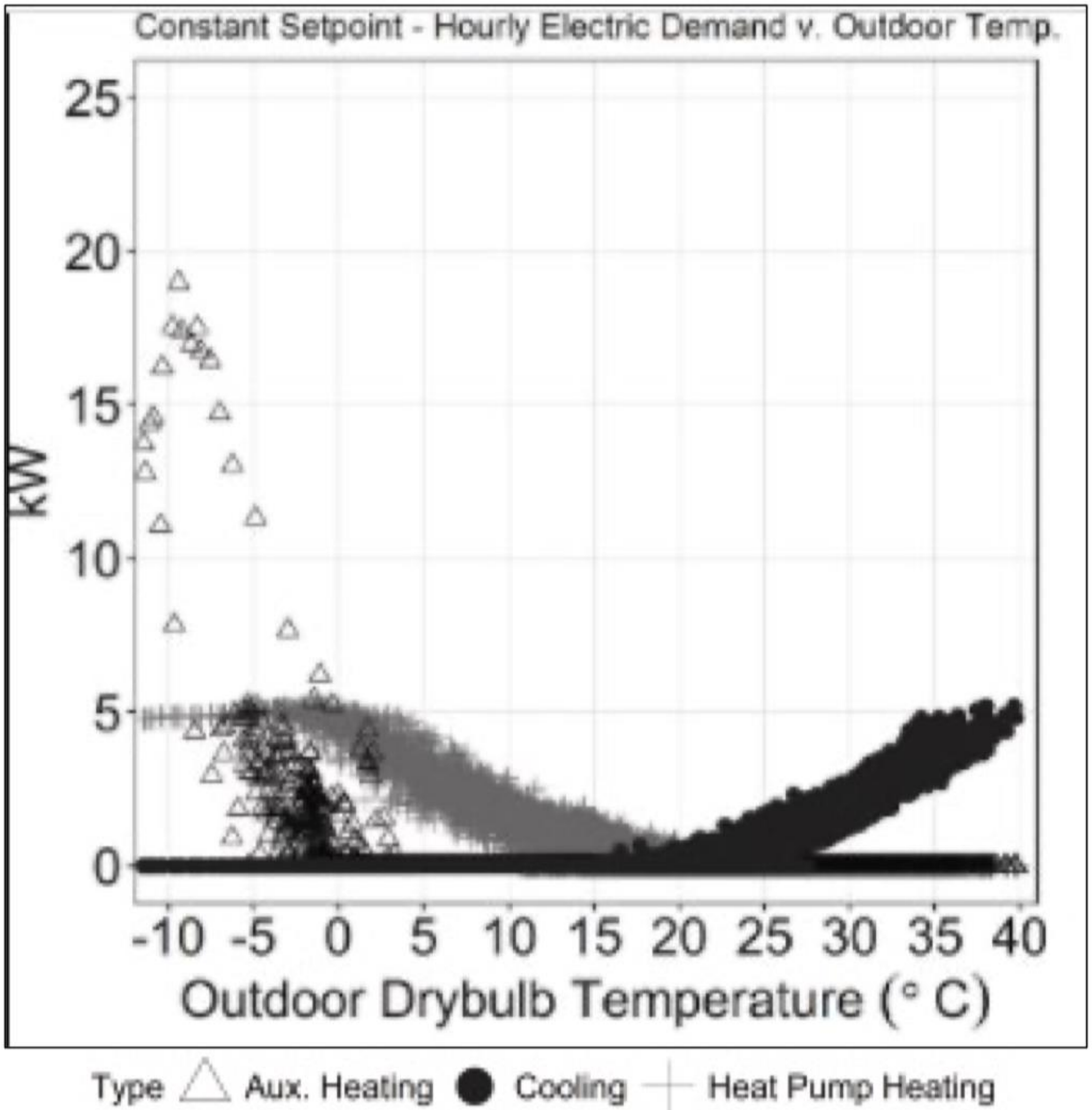

Figure 2. Data on heat pump performance during Winter Storm Uri showing how for many homes demand was no higher than during summer peaks but that a few homes still need supplemental electric resistance heat only when outdoor temperatures are below about 5°F. *Source*: White et al. 2021.

Homes with central air conditioners and electric resistance heat can be upgraded to use a high-efficiency heat pump when the existing central air-conditioning unit needs replacement. (A heat pump is essentially an air conditioner that can be run in reverse so it can provide indoor cooling in the summer but operate in reverse in winter to draw heat from outside air. Substantial heating energy and winter peak demand savings result from this upgrade. In addition, there are some cooling savings, since the average new heat pump has a higher cooling efficiency than the average existing central air-conditioning system. (Specific data on average cooling efficiency are shown in the appendix.) Even at winter design temperatures for Texas (i.e., the temperature expected during the very coldest hours of the year[4]), a high-efficiency heat pump will generally be nearly twice as efficient, using half as much electricity per unit heat output, as an electric resistance heater, even on the coldest days. As a result, consumer space

[4] For example, the winter design temperature in Dallas is approximately 15° F.

heating costs will be reduced by at least 50%, helping to stretch consumer budgets. Other benefits include reductions in peak electrical demand (as noted above, over 12,000 MW); reductions in emissions from power generation, helping major cities meet nitrogen oxide emissions standards; and reductions in greenhouse gas emissions.

A 2023 ACEEE analysis examined the potential impacts of 10 energy efficiency and demand response programs in Texas and found a potential to reduce peak electric demand in the state by about 18,000 MW in the winter and nearly 6,000 MW in the summer. The majority of winter peak savings came from replacing electric resistance heating with heat pumps. While Texas electric system peaks are primarily in summer, electric demand can also peak in winter due in substantial part to widespread use of electric resistance heat. Such a winter peak likely would have happened in 2021 during Winter Storm Uri if the power had stayed on (Nadel, Amann, and Chen 2023).

A 2023 journal paper by researchers at the University of Texas (Skiles, Rhodes, and Webber 2023) examined how the ERCOT load is evolving and what that will mean for the 2025–2050 period. They find that winter peak demand growth in Texas has been inconsistent and unpredictable, likely due to wide variations in temperature on winter peak demand days and the declining efficiency of electric heat pumps with colder temperatures. The study also suggests that winter peak demand is growing faster than summer peak demand in Texas. This is because the efficiency of cooling equipment has improved at the same time electric heating systems, such as heat pumps, are replacing gas furnaces. The study's authors note that winter peaks will continue to be erratic and can be expected to surpass summer peaks in some years. They recommend that resource planners address the uncertainty in winter demand projections by increasing winter preparedness on both the supply and demand sides of the power system. Heat pumps are one tool in the winter preparedness toolbox.

In 2023, the EIA (2023b) estimated that a new combined-cycle power plant costs over $1.3 million per MW. If, as a rough estimate, we assign one-third of this cost to the winter peak (since summer peaks will still be more common than winter peaks), the 12,000 MW of winter peak reductions from installing heat pumps instead of central air conditioners with electric resistance coils would avoid over $5 billion in power plant construction costs, not even counting avoided transmission and distribution costs or the operating costs of these new power plants. Our analysis finds that installing heat pumps instead of air conditioners with electric resistance coils might cost a total of about $1.6 billion, and the heat pumps will have much lower operating costs than the systems they replace. In other words, installing heat pumps can reduce capital costs by more than $3 billion, plus reduce heating costs by about 50%. This is an important opportunity to reduce growth in power costs and thus to help Texans keep more of the money they earn.

This paper builds on our previous analysis of the efficiency and peak demand reduction benefits of heat pumps. The previous analysis was built on averages of high-level data. In this new study, we look specifically at a detailed sample of more than 350 Texas homes that presently use electricity as their primary source of heat and consider both high-efficiency heat pumps that meet new 2024 federal efficiency standards and even higher-efficiency ENERGY STAR®-certified heat pumps. By looking at individual homes, we can better assess costs and benefits and separately analyze subsets of homes, such as new construction versus. retrofits, single versus multifamily, owners versus renters, and the northern versus southern portion of the state. In this way, we can better identify specific program and policy opportunities.

Methodology

For this study, we look at the 355 Texas homes in the detailed dataset from the EIA's 2020 Residential Energy Consumption Survey (RECS) that have central air-conditioning and use electricity as their primary source of heat. This includes homes now using central air conditioners with an electric resistance heating coil and homes now using heat pumps, but we model them as instead using electric resistance heat. We include the latter to increase the sample size, allowing us to better analyze subgroups of customers.

For each home, we examine the costs and benefits of changing to an air-source heat pump when the existing central air conditioner needs to be replaced. We look separately at basic ducted heat pumps that just meet federal minimum efficiency standards as well as ENERGY STAR heat pumps. Further, we compare the costs and energy use of purchasing a heat pump relative to the costs and energy use of purchasing a new central air conditioner and using electric resistance heat.[5]

Energy consumption is based on each home's actual energy use in the RECS dataset, with energy savings calculated based on improvements in heating and cooling efficiency relative to the currently installed systems. Energy prices are based on each home's average actual price adjusted for changes in Texas electricity prices from 2020–2024. Heat pump prices came from a heating, ventilating and air-conditioning (HVAC) manufacturer and differentiated between prices for new construction, multifamily replacement, and single-family replacement.

For each home or apartment, we assumed 1 ton of cooling capacity (12,000 Btu per hour) per 550 sq. ft. of floor area (AC Express 2023; Austin Energy 2017).[6] We use these data to calculate the owner's ROI, and also the simple payback period for the investment. The ROI is the annual energy savings divided by the increase in purchase cost relative to purchasing just a central air conditioner. This figure can be compared to the ROI of other potential uses of the funds, such as investing in the stock market or a bank certificate of deposit. Simple payback is the incremental cost of the heat pump divided by annual savings. This indicates the number of years to recover the incremental investment. Details on assumptions for the analysis can be found in Appendix A.

We used this same sizing to estimate electric resistance peak kW load but then multiplied the resulting kW by 80% to allow for an average estimated oversizing of 20%.[7] This results in an average peak electric resistance heating load of about 9 kW, very similar to the 9.27-kW average estimated by Carl Raish at ERCOT from a sample of meter data on Texas homes that he analyzed.[8] Winter peak load savings are calculated using the performance of a typical heat pump at an outdoor temperature of 15° F, which is approximately the winter design temperature in Dallas. We also calculated winter peak savings for an outdoor temperature of 5° F, which was about the record temperature reached in Dallas during Winter Storm Uri in 2021. Coefficient of performance (COP) and the amount of heat provided both decline as temperatures drop, as illustrated in figure 3.

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[5] The costs for both heat pumps and central air conditioners include a blower to distribute the heated and cooled air around the home. For the air conditioners, we include the cost of the electric heating coil.

[6] 550 square feet per ton is an average. Proper sizing requires preparing a heat loss and heat gain analysis on each home, but RECS does not provide enough data for us to do these home-specific calculations.

[7] Twenty percent is a conservative estimate. Data reviewed by SPEER (undated) find about 40% typical oversizing in new Texas homes.

[8] Group email from Carl Raish dated June 5, 2024.

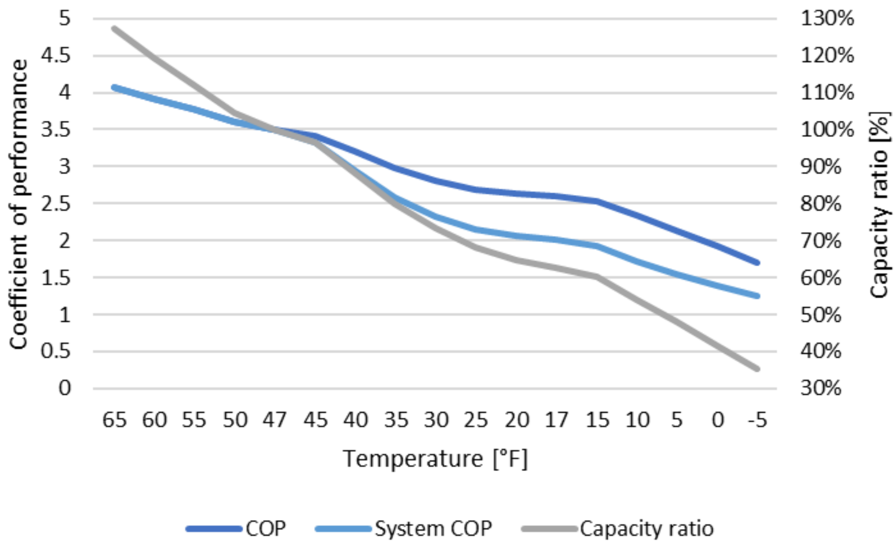

Figure 3. Coefficient of performance (COP), heating capacity ratio, and system COP as a function of outdoor temperature. COP (rated) is from manufacturer literature. Heating capacity ratio is the ratio of a heat pump's output at different temperatures relative to its output at 47° F. System COP is the overall COP for full heat output and factors in the COP and heat output at different temperatures with the remaining heat needed to meet rated capacity provided by electric resistance. COP and system COP are the same above 47° F because the heat pump provides all needed heat, and there is no use of electric resistance heat. The data shown here are for a 3-ton (36,000 BTU/hour) heat pump that just meets the DOE minimum efficiency standard.

Analysis: Costs, electricity, and demand savings for specific scenarios

Replacement of an existing air conditioner

Across our entire sample of individual homes and apartments, the average unit needs 3.2 tons of cooling capacity. Installing a heat pump that just meets federal efficiency standards instead of an air conditioner in these homes will increase upfront costs by an average of $697 per home at the time of replacement, including quite a few homes that will need two units. Relative to a central air conditioner with electric resistance coils, a heat pump costs about 5% more for a 2-ton unit, the common size for multifamily apartments, 12% more for a 3-ton unit like those used in small homes and large apartments, and 21% more for a 5-ton unit that is common in single-family homes.[9] Heating season energy savings will average $310 per year from the reduced use of electric resistance heat. There will also be some cooling season energy savings associated with the higher efficiency of heat pumps relative to central air conditioners; these savings average $33 per home annually, for average total heating plus cooling savings of $343 per year.

On average, a homeowner will earn an ROI of 49% on the investment ($343/$697), which is a much better return than saving money in a bank or even investing in the stock market. The investment will pay back in two years ($697/$343). This is illustrated in figure 4.

[9] Air conditioners and heat pumps are commonly rated in tons, where 1 ton is 12,000 Btu per hour. This is a metric that dates before air-conditioning; the approximate cooling capacity of a ton of ice is 12,000 Btu.

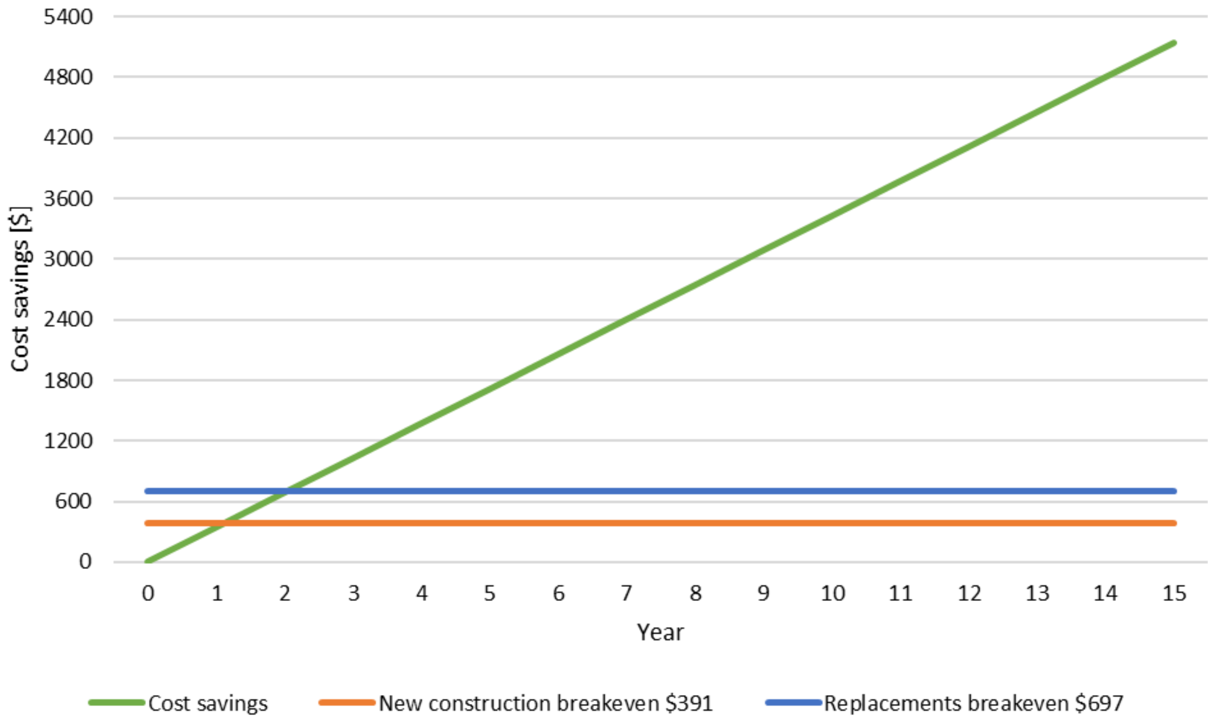

Figure 4. Average savings per household from purchasing a heat pump at time of replacement compared to the incremental cost of a heat pump relative to a central air conditioner with electric resistance strip heat. The incremental cost is paid back in one year for new construction and three years for equipment replacement.

We can also calculate ROI and simple payback[10] for each individual home. In this case, the average and median ROIs are 67% and 42% (average is higher due to outliers). The average and median simple payback are 3.2 and 2.4 years (again, average is higher due to outliers). But the economics varies from house to house. Figure 5 displays the distribution of ROI for individual homes. For replacement, most homes (83%) have an ROI of more than 20%, as shown in figure 6.

[10] Simple payback is the cost of the improvement divided by annual savings, without considering discounting or the time value of money. There is also a metric called discounted payback that does include discounting.

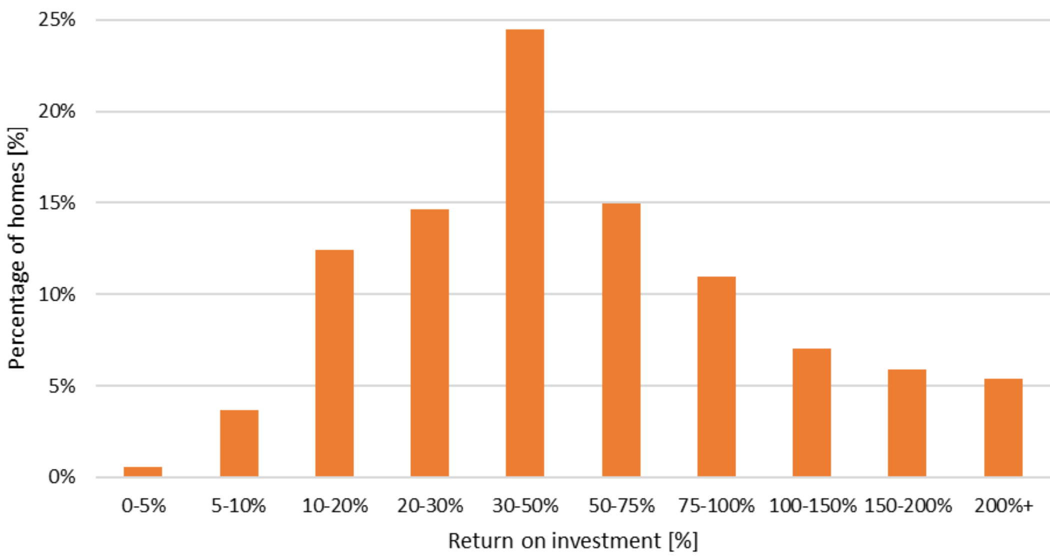

Figure 5. ROI distribution for equipment replacement by bin (*n* = 355). Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

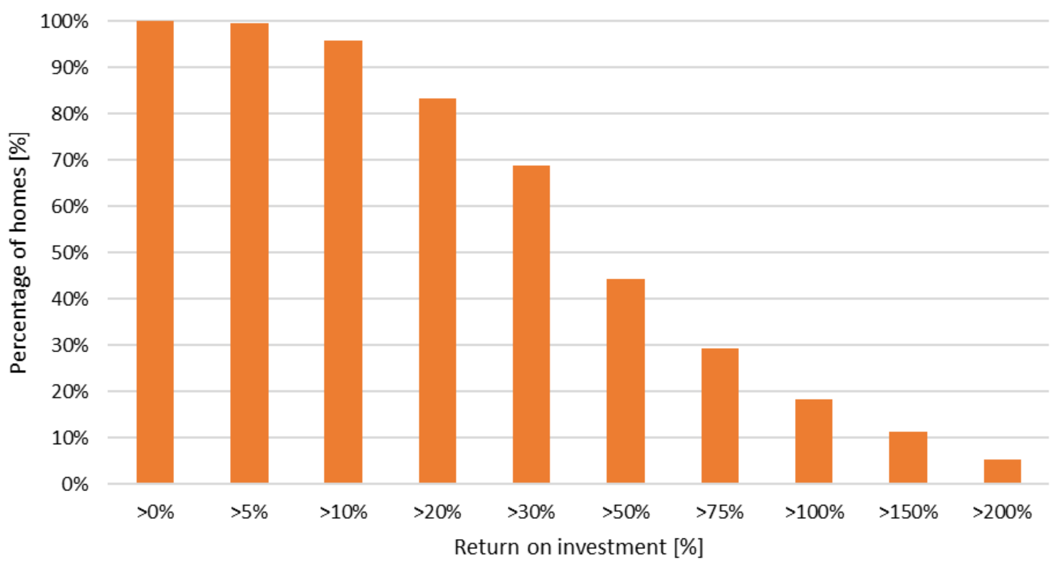

Figure 6. ROI distribution for equipment replacement done on a cumulative basis. Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

New construction

For new construction, we analyzed 151 homes in our dataset that were built over the 2000–2019 period. We used new construction heat pump costs; on average, these cost $391 more than purchasing a central air conditioner with electric strip heat. Based on these costs, we found an average ROI of 103% for purchasing a heat pump instead of an air conditioner with electric resistance heat. The average simple payback is two years due to some high outliers. The median ROI is 66%, and the median payback is 1.5 years. The distribution of ROI is illustrated in figure 7 by bin and cumulatively in figure 8; most homes (88%) have an ROI of 30% or more.

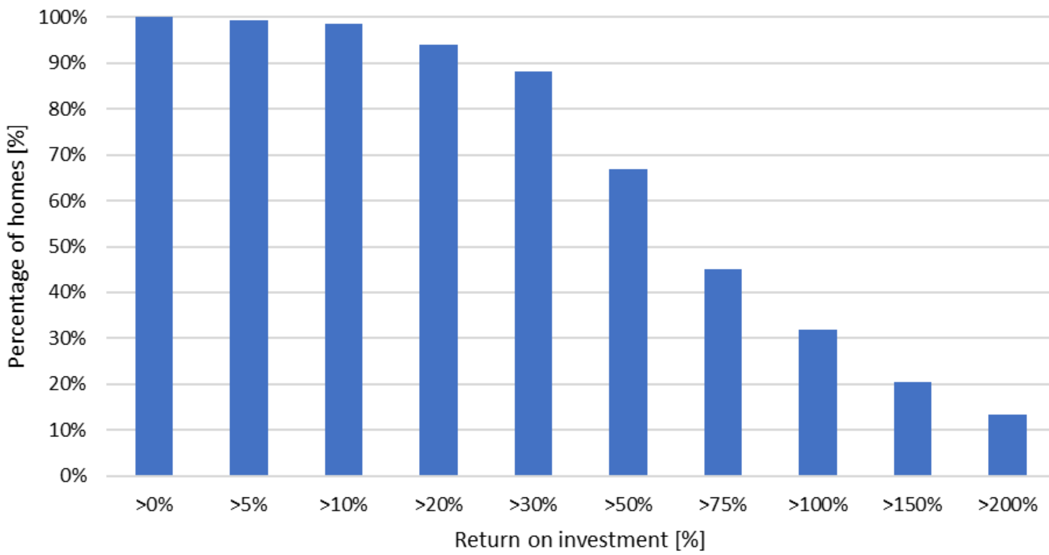

Figure 7. Overall ROI distribution for new construction by bin (*n* = 151). Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

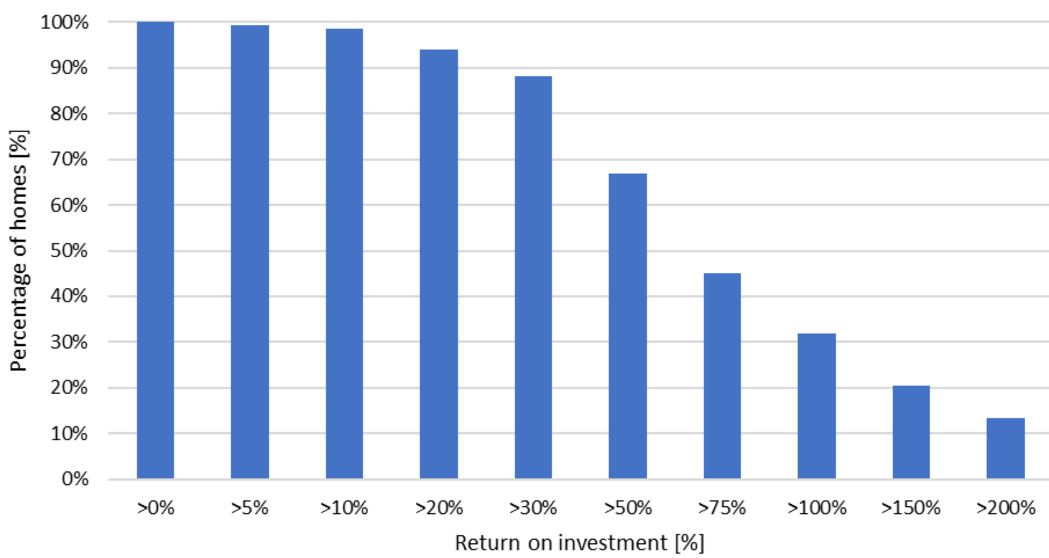

Figure 8. Overall ROI distribution for new construction done on a cumulative basis. Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

ENERGY STAR heat pumps

The above analyses are for heat pumps that just meet federal minimum efficiency standards. We also analyzed the additional costs and savings for ENERGY STAR heat pumps. In the present market, there is a substantial price premium for ENERGY STAR (average incremental cost of $639 compared to non-ENERGY STAR in our sample for new construction). Also, ENERGY STAR is only 0.3 HSPF2 points above the federal minimum, making for limited heating energy savings (average of $34 per year). Additional cooling season savings are also modest at an average of $9 per home annually. For new construction, the average ROI is fairly low, about 7%. Even minimum efficiency equipment is quite efficient—the current federal standards only took effect in 2024. For equipment replacement, the ROI is slightly lower, about 6%. When sales of ENERGY STAR units increase, prices may come down, but at present equipment prices, the economics of ENERGY STAR heat pumps in Texas are marginal for both new construction and replacements. Additionally, given our finding about the unremarkable economics for ENERGY STAR heat pumps at current prices and efficiencies, all of the subsequent sections cover only equipment just meeting federal minimums.

ROI for specific subgroups

Single-family versus multifamily

We separately analyzed single-family and multifamily homes, which we define as two units or more. For new construction, the average ROI is 124% for multifamily and 96% for single-family homes. The median ROI is 83% and 63%, respectively. The median simple paybacks are 1.2 years for multifamily and 1.6 years for single-family homes. A multifamily has a modestly higher ROI, most likely because the heat pump units generally have a modest heating capacity (usually no more than 3 tons), and the increased cost for heat pumps in these smaller sizes is low.

For replacement, the average ROI for substituting a heat pump for an air conditioner with electric resistance heat is 110% for a multifamily and 52% for a single-family. The median ROI is 78% for a multifamily and 37% for a single-family, and the median simple paybacks are 1.3 and 2.7 years, respectively.

The distribution of ROI for single-family and multifamily homes are shown in figures 9 and 10. In these, we show new construction and retrofits separately.

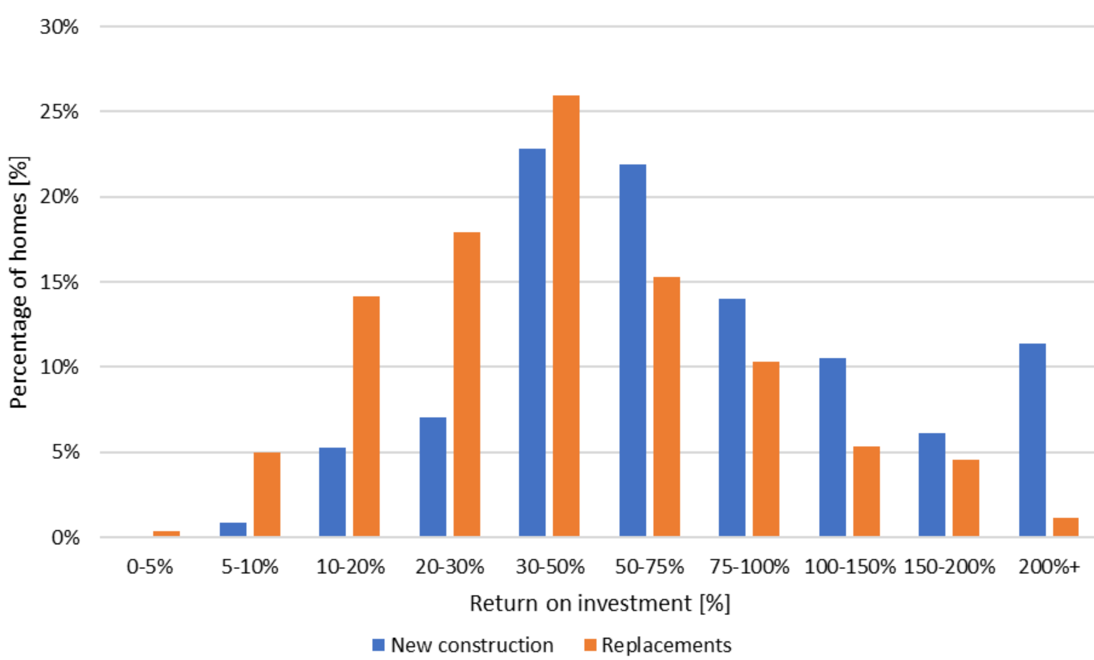

Figure 9. Single-family home ROI distribution for new construction and retrofits (n = 114 for new construction only and n = 262 for retrofits). The high number of homes with ROI greater than 200% for new construction is due to the small price increment for 2-ton heat pumps in new construction. Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

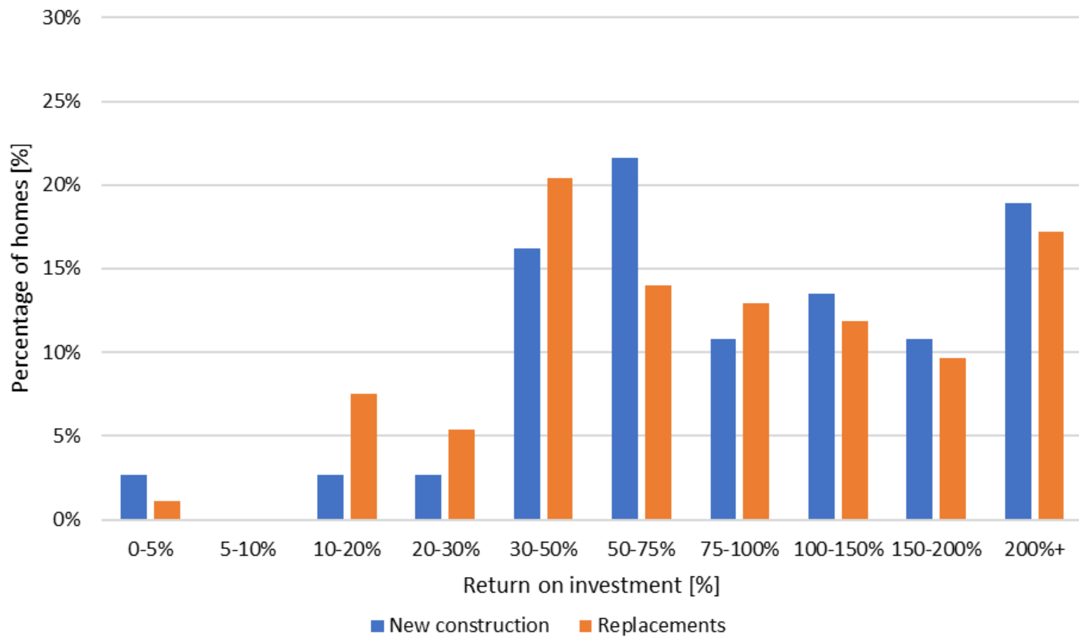

Figure 10. Multifamily home ROI distribution for new construction and retrofits (*n*=37 for new construction only and *n*=93 for retrofits). Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

Owner- versus renter-occupied homes

For installing a heat pump at the time of replacement instead of an air conditioner with electric resistance heat, the average ROI is better for rental properties (96%) than for owner-occupied homes (52%). This is likely due to the high proportion of multifamily homes among rental properties. ROI distributions for owner- and renter-occupied homes are shown in figures 11 and 12.

The ROI for a rental property is also affected by who pays the energy bill. If the landlord pays the energy bills, the ROI we provide here will be the landlord's ROI. But if the tenant pays the energy bill, the ROI for either the tenant or the landlord will depend on whether the landlord raises the rent slightly to help pay for the new heat pump. If the rent does not change, the tenant will save without any cost, while the landlord will pay for the heat pump and not get any energy bill savings but could potentially get other benefits, such as reduced tenant turnover.

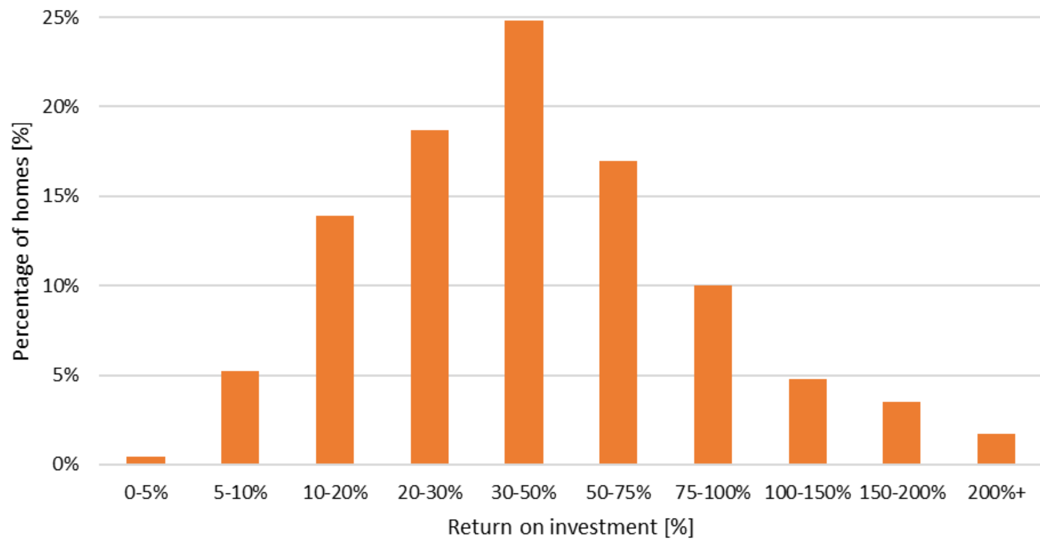

Figure 11. Owner-occupied home ROI distribution for retrofits (*n* = 230).

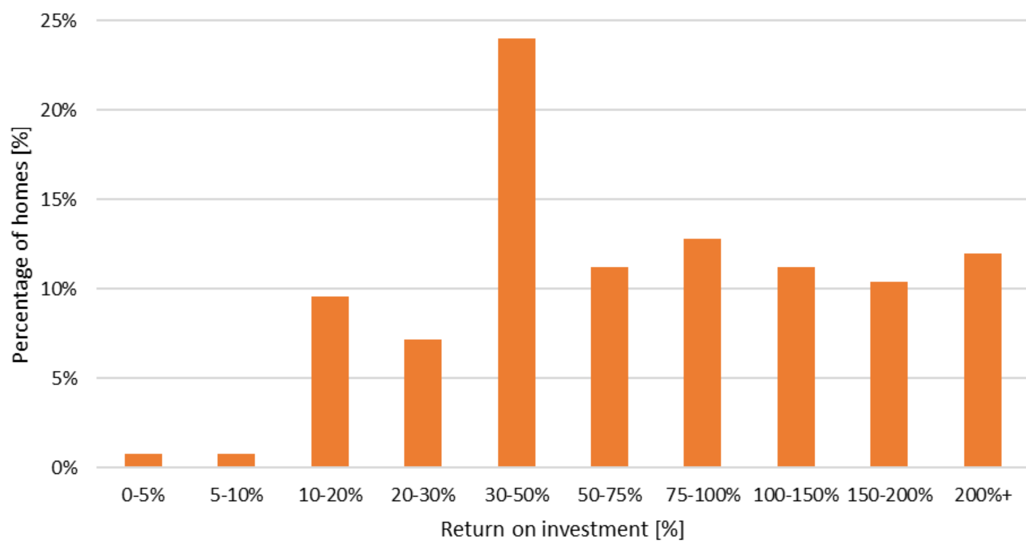

Figure 12. Renter-occupied home ROI distribution for retrofits (*n* = 125). Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

Above versus below U.S. median income

We also looked at patterns by household income. First, we note that lower-income households are more likely to have an electric resistance furnace than higher-income households; therefore, these households are more likely to have the higher heating bills associated with electric resistance heat.[11] For this analysis, we divided our sample of Texas households into annual household income above and below $75,000, which is approximately the U.S. median household income. For the lower-income group, the average and median ROIs are 75% and 48% for replacement systems. For the higher-income group,

[11] At a national level, 13% of households with incomes below $60,000 per year have these systems compared to 9% of households with incomes above $60,000 per year (EIA 2023a). RECS does not provide regional data on this metric nor summary tables that make the division at $75,000 per year of annual household income.

the average and median ROIs are 56% and 37%. We believe that the ROIs are better for the lower-income group due to smaller homes and a greater prevalence of renting, especially in multifamily properties, than for the higher-income group. This said, many low-income households may struggle to find the money to replace an air conditioner. The distribution of ROIs for these two groups is summarized in figures 13 and 14.

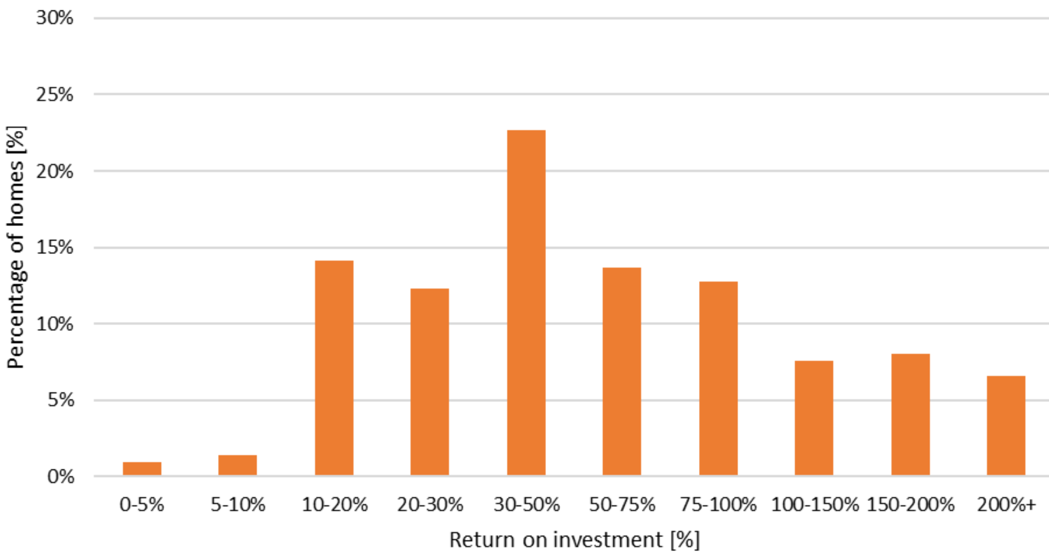

Figure 13. Households that make below the U.S. median income ROI distribution for retrofits. (*n* = 212). Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

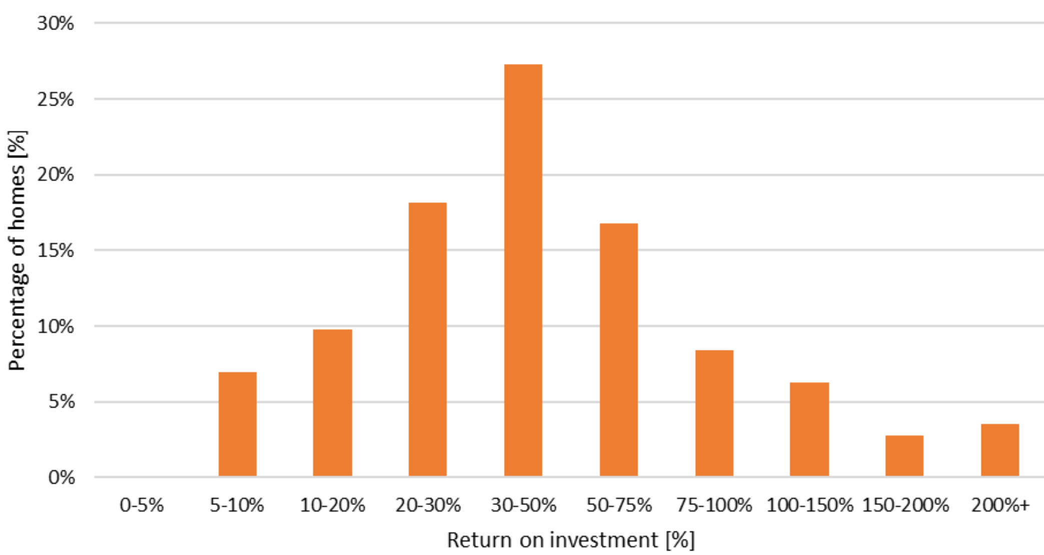

Figure 14. Households that make above the U.S. median income ROI distribution for retrofits. (*n* = 143). Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

North versus south of the state

The analyses above are for the entire State of Texas, but some regions are warmer than other regions. To address this, we separated our sample into north and south regions, dividing it between homes with more than 2,020 annual heating degree days (HDD) and homes with fewer than 2,020 HDD, using 30-year averages. An illustrative map of north versus south is in figure 15. Heat pump economics are generally good throughout the state but are better in the north than the south. Even in the south, much of the savings are for heating.

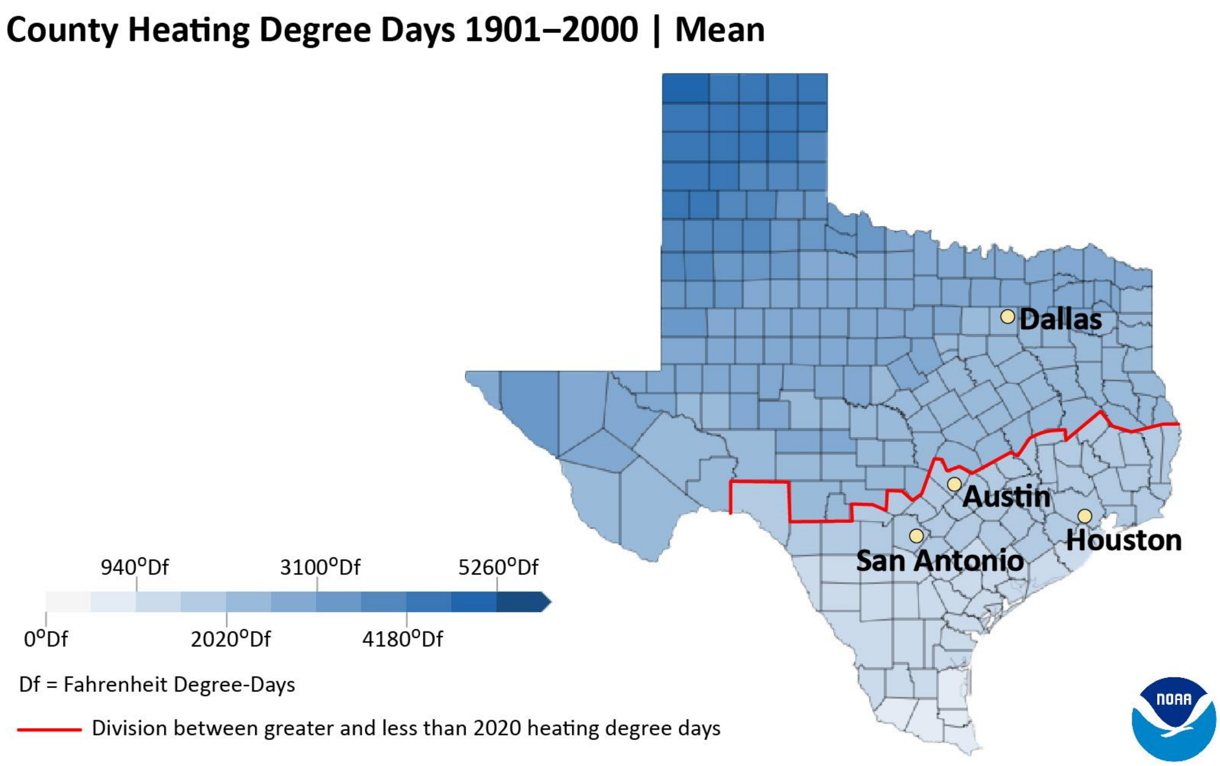

Figure 15. Heating degree days by county showing north versus south.

For new construction, we found an average and median ROI for a heat pump of 128% and 89%, respectively, in the north, but 84% and 57% in the south. All of these ROIs are strong, but they are stronger in the north. For replacement, we found an average and median ROI of 88% and 65% in the north for heat pumps, but 49% and 34% in the south. These ROIs are well above bank and average stock market ROIs, with the north being stronger. The distribution of ROIs in the north and south are illustrated in figures 16 and 17.

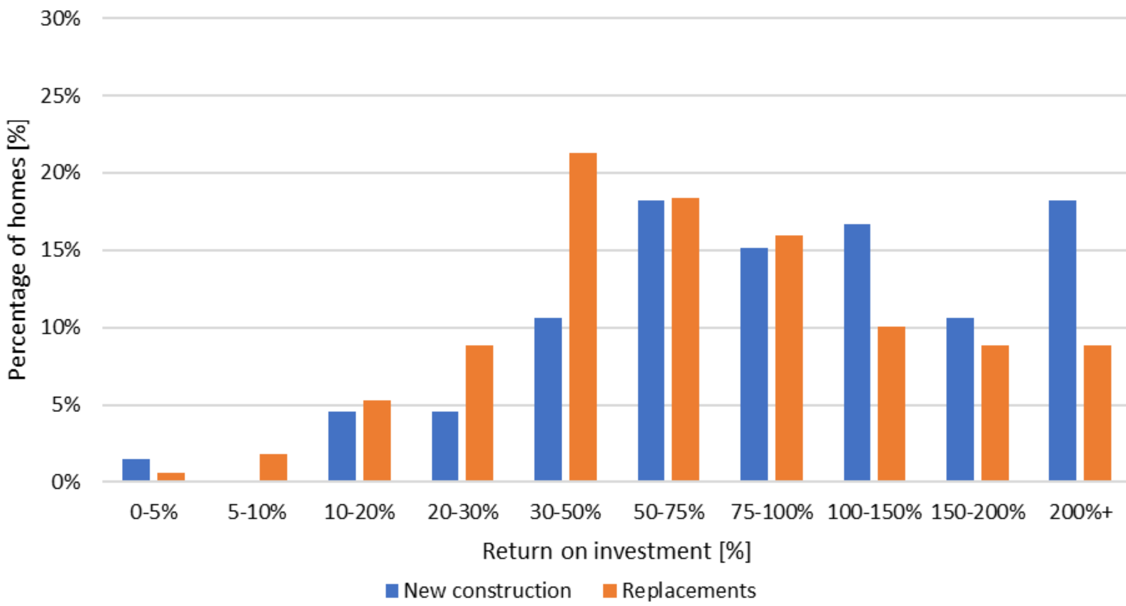

Figure 16. Northern region home ROI distribution for new construction and retrofits (*n* = 66 for new construction only and *n* = 169 for retrofits). Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

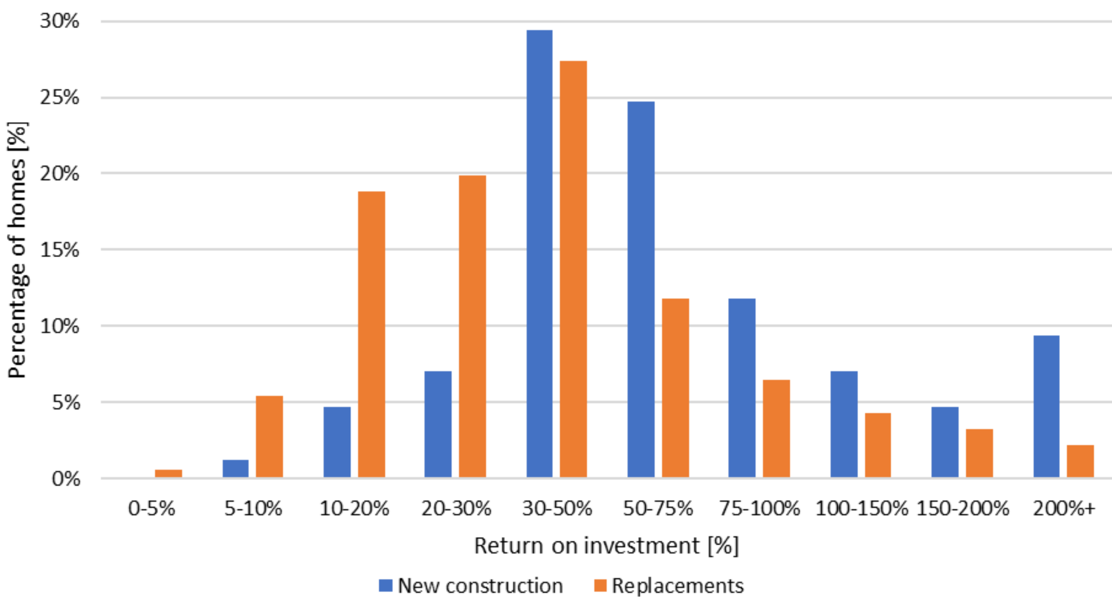

Figure 17. Southern region home ROI distribution for new construction and retrofits (*n* = 85 for new construction only and *n* = 186 for retrofits). Note that bin sizes are not uniform; we varied them to better break down the smaller ROI numbers.

Summary of costs and savings

Table 1 shows a summary of the average and median return on investment, and average and median simple payback for new construction and replacements in homes and apartments. Bear in mind that outliers affect some of the averages, which is why the average results often differ from the median results.

Table 1. Summary of results

Characteristic of homes	New construction: Average ROI [%]	New construction: Median ROI [%]	New construction: Average payback [years]	New construction: Median payback [years]	Replacements: Average ROI [%]	Replacements: Median ROI [%]	Replacements: Average payback [years]	Replacements: Median payback [years]
Overall	103%	66%	2.02	1.52	67%	42%	3.21	2.36
Single family (1 unit)	96%	63%	1.99	1.59	52%	37%	3.60	2.71
Multifamily (2 or more units)	124%	83%	2.10	1.21	110%	78%	2.11	1.29
Owner occupied	94%	60%	2.00	1.68	52%	37%	3.62	2.72
Renter occupied	121%	80%	2.06	1.24	96%	66%	2.46	1.52
Below median income (<$75,000/yr.)	112%	72%	1.97	1.38	75%	48%	2.95	2.07
Above median income (>$75,000/yr.)	94%	65%	2.07	1.55	56%	37%	3.59	2.70
Regions (30-yr. avg HDD) **North (>2020 HDD)**	128%	89%	1.86	1.12	88%	65%	2.33	1.54
South (<2020 HDD)	84%	57%	2.14	1.76	49%	34%	4.01	2.97
Energy Star heat pumps overall	7%	6%	31.8	16.9	6%	5%	30.9	20.0

Statewide costs and savings

Based on our sample of 355 homes and apartments, a sample that was selected by EIA to be representative of the broader population, we can roughly estimate the statewide impacts of replacing air conditioners using electric resistance heat with heat pumps at the time that existing equipment needs to be replaced. Key inputs to these calculations and the results of these calculations are provided in table 2. These estimates should be considered rough, since the sample size is moderate and we did not include discounting for the time value of money (which would reduce both the costs and benefits, but probably not by the same amount).

We estimate that in the 15th year, after existing equipment has been replaced, electricity savings would total almost 7 billion kWh (equivalent to the annual energy use of about 660,000 typical American households), winter peak demand savings would total over 12,000 MW (equivalent to over 40 new gas-fired power plants of 300 MW each),[12] incremental costs would total about $1.6 billion, but annual energy bill savings would be $1 billion per year, resulting in a benefit-cost ratio of about nine over the equipment lifetime. The energy and peak savings are illustrated in figure 18.

Table 2. Estimate of statewide costs and savings

Metric	Value and units	Notes
Average annual energy savings per home	2,535 kWh	Average from analysis; includes 2,300 kWh heating and 235 kWh cooling
Average winter peak savings per home	4.4 kW	Average from analysis for an outdoor temperature of 15° F
Average electricity rate	$0.145	Average from analysis adjusted to 2024 per assumptions in appendix
Average cost per home	$590	Average from analysis, weighting new construction 35% and replacements 65%. Texas housing stock grew 7% in three years (Henderson 2024). At this rate, new construction will be 35% of the stock in year 15.
Number of homes with central air-conditioning and electric resistance heat	2.76 million	RECS 2020 (EIA 2023a). Homes with electric space heat minus homes with heat pump times 83% with central air-conditioning
Estimated equipment life	15 years	ASHRAE (2019)
Annual savings in 15th year		
kWh	6,985 million	
Household equivalents	665,228	Average U.S. household uses 10,500 kWh/year (EIA 2023c)
MW	12,057	
Power plant equivalents	40.2	Based on 300-MW power plants
15-year cost	$1,626 million	
Annual energy bill savings	$1,014 million	
Energy bill savings over lifetime	$15,203 million	
Simple benefit-cost ratio	9.4	

[12] If we instead assume a 5° F minimum temperature (e.g., Dallas during Winter Storm Uri), the COP of heat pump and its heat output declines (see figure 2) and peak savings are instead about 8,845 MW. These figures are based on a unit just meeting the DOE efficiency standards. Higher-efficiency equipment, particularly equipment designed to operate well at cold temperatures, will save more.

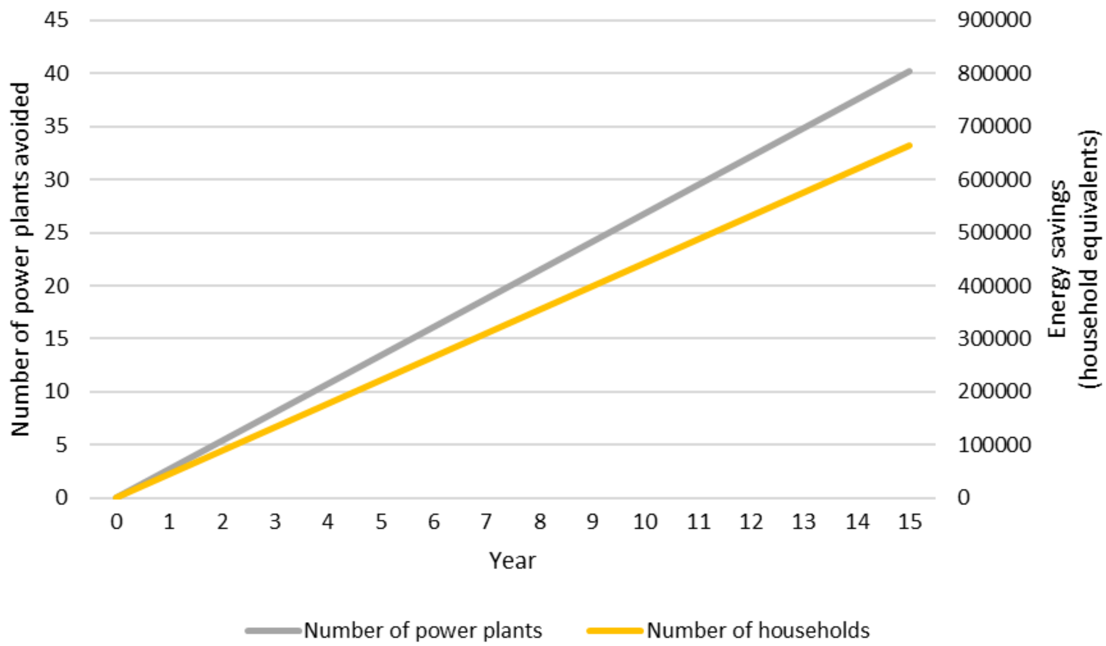

Figure 18. Energy and winter peak savings grow over time. Energy savings expressed in household equivalents based on average annual electricity consumption of U.S. households. Power plant equivalents based on 300-MW power plants.

We chose not to estimate summer peak savings as much of these savings will be captured by replacement air conditioners and are not primarily due to switching to heat pumps. Also, RECS does not provide state-level data on subsets of home such as single-family versus multifamily or owner versus renter. Thus, we are not able to estimate energy and peak demand savings for these subsets, only for the Texas housing stock as a whole.

Program and policy options to increase heat pump adoption

Federal, state, and utility programs can help offset the cost to install a heat pump, while building codes and standards require the adoption of heat pumps through mandates.

Program opportunities

Governments, utilities, and other efficiency program administrators offer financial incentives, such as rebates, tax credits, and financing, to promote energy efficiency in single-family and multifamily homes, including installation of high-efficiency heat pumps.

Utility programs across the country offer rebates and incentives for energy efficiency measures, which often include heat pumps. As of the time of this report, at least a dozen Texas municipal utilities and cooperatives offer rebates for heat pumps. These rebates range in amount depending on the unit type (package or mini-split; air-source or geothermal), energy efficiency rating (SEER), tonnage, and the combination of other installed measures. Investor-owned utility customers may be eligible for incentives from third-party contractors. One mechanism for increasing adoption of heat pump replacements for electric resistance heating is for utilities to drop incentives for central air conditioners and to focus incentive programs on heat pumps.

Leveraging federal rebates and tax incentives

The Inflation Reduction Act of 2022 (IRA) has committed $8.8 billion to the Home Energy Rebates Program, which will help lower household energy bills and reduce greenhouse gas impact. Texas's share is $689 million. Within the Home Energy Rebates Program are two initiatives: Home Efficiency Rebates (HOMES) and Home Electrification and Appliance Rebates (HEAR). HEAR can help income-qualified households save up to $14,000 in home upgrades, including up to $8,000 off a heat pump used for space heating and cooling). As of October 2024, the DOE has approved 19 states' applications, including nine states in which rebates are already available (DOE 2024a). These incentives will cover a substantial share of the cost of these efficiency upgrades, but for low-income customers, additional assistance will often be needed to help cover remaining costs. Also, given the more than 10 million homes and apartments in Texas, the DOE program funds will only last a few years; for the longer term, substantial additional funds will be needed. The IRA also revised and extended tax credits for clean energy upgrades to allow homeowners to claim up to $2,000 for qualifying heat pumps installations, as well as up to $1,200 per year for other efficiency measures. States and utilities are exploring ways to complement and leverage these federal incentive dollars.

Case studies of illustrative programs

CenterPoint Energy

CenterPoint Energy, which serves the City of Houston and surrounding areas, launched the Multifamily Market Transformation Program in 2015. The goals of the program are not only to replace central air-conditioning/electric resistance heating systems with heat pumps but also to increase familiarity with heat pump technologies across the market while prioritizing low-income households. In this "name your own incentive" program, multifamily building owners bid on how much incentive they will need to make improvements, which can include other solutions that complement heat pump retrofits. These bids are scored by amount of energy reduced and number of units covered. The program has been publicized to multifamily property owners, maintenance companies, HVAC installers, distributors, and manufacturers, as well as nonprofit and government agencies that are involved with low-income housing.

In 2022, over $2.1 million total was awarded to nine for-profit entities and two nonprofits to retrofit 1,230 units through this program (Pooley and Wiese 2023). Programs like these could greatly improve the ROI and payback for multifamily replacements of electric resistance furnaces with heat pumps, particularly if CenterPoint increases its program budget and other Texas utilities implement similar programs. Programs such as this also help address the split incentive problem, whereby often the landlord pays for new equipment but the tenant, not the landlord, most often pays the energy bills and, therefore, benefits from the improvement. Payments to landlords to help cover the extra cost of heat pumps can address this problem.

Public Utility Commission of Texas (PUCT) Heat Pump Working Group

The PUCT established a working group to develop updates to the Texas energy efficiency Technical Reference Manual (TRM) for variable speed heat pumps (PUCT Docket No. 56510). Previously, utilities had very little incentive to promote higher-efficiency systems without new measures in the TRM that more accurately reflect cost effectiveness of newer and more efficient variable speed pumps. Such heat pumps can be particularly useful in providing additional reductions in winter peak electric demand, as shown by a field study in Tennessee (Shirey et al. 2024). While there is likely still work to be done in future Texas TRM updates, this is an important step in the right direction for investor-owned utility efficiency programs to start building out heat pump incentives.

New York State

New York illustrates a process that Texas could follow, but with adaptations for the many differences between the two states. New York was the first state to receive money from the IRA Home Energy Rebates Program. The New York State Energy Research and Development Authority (NYSERDA) received $158 million for its HEAR program and intends to offer its rebates first to low-income New York State residents, then expand to other eligible residents (DOE 2024b).

In addition to the state's IRA-funded programs, New York residents can also take advantage of the state's existing EmPower+ statewide program, including heat pump incentives. EmPower+ provides financial assistance for energy improvements for low- to moderate-income households; the newly awarded HEAR funds are now expanding EmPower+ (NYSERDA 2024a).

Additionally, the New York State Clean Heat Initiative includes rebates and financing for heat pumps for all customers, not just low- and moderate-income customers. Residents and building owners who participate in the program are also eligible for IRA tax credits (NYSERDA 2024b). A contractor-based program led by New York State utilities, the NYS Heat Pump Program, is focused on transitioning residents and businesses from electric resistance, oil, or propane to heat pumps (both air and ground source) and heat pump water heaters. These three heating types are targeted because they are expensive per unit of heat provided.

NYSERDA also offers the Comfort Home program to promote insulation and sealing of air infiltration and duct leaks to make homes more efficient and easier to fully heat with heat pumps, even in New York's cold climate (NYSERDA 2024c). It is important that state policies and programs are intentionally designed with whole-home efficiency, affordability, and equity in mind; New York has a suite of programs to address these needs. However, in the case of New York State's ambitious Clean Heat 2030 goals, there may be unintended consequences of cost burden to households that are not eligible for rebates and/or cannot justify the cost even after rebates are applied (Hanley 2023).

Policy options

Because electric resistance heat is expensive for residents and can cause extreme peaks in winter electricity demand, several state and local governments have adopted restrictions on electric resistance heating through building codes, requirements for construction projects receiving public funding, and other policy mechanisms. These examples illustrate a variety of approaches that can be used to promote heat pump adoption as an alternative to electric resistance heating in residential and commercial buildings.

Local and state code and similar requirements

The City of Austin adopted an amendment to the 2006 International Energy Conservation Code (IECC) residential building energy code, effective January 1, 2008, to prohibit the use of electric resistance as the primary heating source in residential buildings (City of Austin 2007, Ordinance No. 20071018-088). The restriction has been retained through subsequent adoption of revised codes. Austin's current code is the 2021 IECC with the following local amendment language:

> **R40/3.9 Space Heating.** The use of electric resistance as a primary source of space heating is prohibited in all dwelling units having a conditioned floor area in excess of 500 square feet.
>
> **Exception**: Buildings where dwelling units are cooled using chilled water (City of Austin 2024).

Other local jurisdictions in Texas should consider similar policies, perhaps laying the foundation for statewide requirements in the long term. For example, if Houston were to adopt similar requirements for new construction, based on annual energy savings of 256 kWh per home in South Texas for new construction and assuming 14,500 new homes and apartments being built each year, the 10-year average (Heckler 2023), over decade energy bill savings for households in these new homes and apartments would total about $30 million. By the 10th year, winter peak demand savings would be about 650 MW and annual consumer energy bill savings over $5 million.[13]

Georgia, Florida, and Washington State have adopted amendments to the IECC that restrict the use of electric resistance heating. Georgia enacted a statewide prohibition on electric resistance as the primary heating source in homes through an amendment to the 2015 IECC effective January 1, 2020. The restriction applies to all new homes and to renovations of homes built after 1996.

> **R403.1.2.3 Primary Heat Source**. For new dwelling unit central HVAC systems, or replacement HVAC systems installed in dwelling units that were originally permitted after January 1, 1996, electric resistance heat shall not be used as the primary heat source. Primary heat source is defined as the heat source for the original dwelling unit system (Georgia 2024).

In 2020, Florida enacted an amendment to the state's residential energy code for homes in climate zone 2 (all counties north of Palm Beach County). As of December 31, 2023, builders must comply with the 2021 IECC as amended in the Florida Building Code. The current code includes this language:

> **R403.7.2. Electric Space Heating (Prescriptive)**. Electric resistance space heating shall not be the primary heating system used in Climate Zone 2 (Florida Building Code 2023).

The 2021 Washington State Energy Code as amended in November 2023 includes provisions to encourage the adoption of high-efficiency heat pumps. As of March 2024, in addition to the prescriptive code requirements, builders must meet additional requirements based on an energy efficiency (EE) credit system. Builders can choose non-electric-resistance heating pathways that range from 0.5 to 3 EE credits (WA SBCC 2023c).

California's building energy code (Title 24, Part 6) includes separate chapters covering single-family, multifamily, and commercial (nonresidential and hotel/motel) occupancies. As of 2022, the Title 24 prescriptive compliance path for each building type prohibits the use of electric resistance heating with some exceptions (CEC 2022). Specific language can be found in Appendix B of this paper. This same language is in the CEC-approved 2025 Title 24.

State and local governments can also use legislation instead of codes to restrict the use of electric resistance heating. One example is the Connecticut general statute, under the Department of Housing general provisions Section 8-37jj on electric resistance as primary source of heat:

> (a) The Department of Housing may not approve electric resistance as the primary heat source in new, subsidized housing except where justified by a life-cycle cost analysis whose methodology has been approved by the division of the Office of Policy and Management responsible for energy matters.

[13] Since Harris County has about twice the population of Houston, if Harris County were to adopt such requirements, the savings would roughly double.

> (b) If the Department of Housing or the Connecticut Housing Finance Authority uses electric resistance space heating as the primary heating source in any new construction, it shall construct the unit in such a way as to be eligible for any available energy conservation incentives provided by the electric distribution company, as defined in section 16-1, or the municipal utility furnishing electric service to such unit" (*Conn. Gen. Stat. § 8-37jj*).

A Connecticut senate bill was introduced in 2022 to try to expand this statute beyond the Department of Housing, which is responsible for only a small portion of new construction, to prohibit electric resistance as the primary heat source (Connecticut General Assembly 2022). The bill was not passed and has not yet been reintroduced. However, efforts like those in Connecticut could provide a pathway for more states to adopt building codes that require heat pumps as an alternative to electric resistance heating.

The federal building code Title 10 Part 434 includes the Energy Code for New Federal Commercial and Multifamily High Rise Residential Buildings 403.2.6.4. Also known as Heat Pump Auxiliary Heat Standards, this code mandates that:

> Heat pumps having supplementary electric resistance heaters shall have controls that prevent heater operation when the heating load can be met by the heat pump. Supplemental heater operation is permitted during outdoor coil defrost cycles not exceeding 15 minutes (10 CFR Part 434).

States that have adopted this restriction on supplementary heat include:

- California: residential code 110.2(b)
- Florida: residential code 403.1.3 and commercial code C403.2.4.1.1
- Georgia: commercial code 501.1
- Washington: residential code R403.1.2

Other policy options

Some states and utilities are establishing separate rate classes for homes with heat pumps because these homes can be less expensive to serve due to the combination of substantial energy use but smaller peak load impacts. Individual utilities and the PUCT might want to explore the cost of service for homes with heat pumps to see whether a separate rate class might make sense to encourage heat pumps while adhering to cost of service principles. Thus far, it has been cold states that have adopted such rates (e.g., Colorado, Maine, Massachusetts, and Minnesota (Kresowik 2024; Yim and Subramanian 2023)), but given Texas's periodic high winter peaks, this option should at least be explored for Texas.

Recommendations and next steps

Our analysis demonstrates the large winter peak demand reductions and energy and cost savings for heat pumps relative to electric resistance heat in both new construction and replacement markets in Texas. While there are benefits for all housing types and regions of the state, savings are particularly compelling in the northern half of the state and in multifamily housing. State and utility program offerings and state and local policy can accelerate heat pump adoption and create significant benefits for consumers and the electric grid.

As Texas moves forward with its applications to the DOE for the state's Home Energy Rebate programs, the State Energy Conservation Office should consider how to target homes with electric resistance heat as a priority in their programs.

Utilities and the Public Utilities Commission of Texas (PUCT) should consider how utility investments can expand the reach of these programs by offering complementary programs that target new construction and heating system replacements. As the PUCT considers the state's investor-owned utility energy efficiency portfolio, it should explore opportunities to increase residential program participation. The role of midstream programs that target distributors with incentives to stock heat pumps in lieu of central air conditioners and electric furnaces should also be considered.

The City of Austin's code amendment prohibiting electric resistance heating provides a practical and cost-effective example that could be adopted by other municipalities or in the state energy code. This change in the code can help the state manage the impact of a growing population on statewide energy demand.

Our analysis clearly shows that installing heat pumps at the time central air conditioners need replacement has both peak demand reduction and economic benefits. Texas energy efficiency programs and policy should encourage the switch to heat pumps in order to reduce the use of inefficient electric resistance heat.

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Appendix A: Assumptions

Assumptions		Notes				
Residential electricity price						
2020 (in 2020$)	$ 0.1196	EIA Electric Power Monthly (Feb. issues from year-to-date for prior year)				
2023 (in 2023$)	$ 0.1432	EIA Electric Power Monthly (Feb. issues from year-to-date for prior year)				
2024 (in 2024$)	$ 0.1451	EIA Electric Power Monthly (based on mid-year)				
2031 (in 2024$)	$ 0.1451	Assume level with 2024				
Multiplier from 2020 price	1.21					
Assumed SEER of existing AC (circa 2013)	14	Unit is halfway thru its 15 year life in 2020				
Assumed HSPF of existing HP (circa 2013)	8.2	Unit is halfway thru its 15 year life in 2020				
SEER to SEER2 adjustment factor	0.95	From Trane literature				
HSPF to HSPF2 adjustment factor	0.85	From Trane literature				
Basecase SEER2	13.3					
Basecase HSPF2	7.0					
SEER2 NAECA minimum, split HP <4 tons	14.3					
SEER2 NAECA minimum, split HP 5 tons	13.8					
SEER2 NAECA minimum, single package HP	13.4	Not used				
SEER2 E-Star for HP	15.2					
HSPF2 NAECA minimum split	7.5					
HSPF2 NAECA minimum single package	6.7	Not used				
HSPF2 E-Star split	7.8					
HSPF2 E-Star single package	7.5	Not used				
COP @ 15 F	2.56	For 3 ton representative unit used in 2023 ACEEE Texas report				
HP pct of heat at 15 F	0.611	For 3 ton representative unit used for pricing in this report				
System COP at 15 F	1.953					
COP @ 5 F	2.140					
HP pct of heat at 5 F	0.489					
System COP at 5 F	1.558					
Equipment costs	NAECA relative to AC			Energy Star HP increment		
(values shown are midpoint of a range)	New constr.	MF repl.	SF repl.	New const	MF repl.	SF repl.
2 ton (and 1 ton)	87	87	360	834	834	1,015
3 ton	305	305	781	392	392	536
4 ton	523	523	916	493	493	642
5 ton	741	741	1,051	594	594	748
6 ton (3+3)	610	610	1,562	783	783	1,071
7 ton(3+4)	828	828	1,697	885	885	1,177
8 ton (3+5)	1,047	1,047	1,833	986	986	1,283
9 ton (4+5)	1,265	1,265	1,968	1,087	1,087	1,389
10 ton (5+5) (and 11 ton)	1,483	1,483	2,103	1,188	1,188	1,495
Incremental markup	1.240	For wholesaler and mechanical contractor (replacement)				
(from DOE TSD, for Texas)						
General contractor markup for Texas	1.15	10-20% from HomeGuide (additional markup for new construction)				

Appendix B: California code language

<u>**California commercial code language**</u>

> **140.4(g) Electric resistance heating.** Electric resistance heating systems shall not be used for space heating.
>
> **Exception 1 to Section 140.4(g):** Where an electric resistance heating system supplements a heating system in which at least 60 percent of the annual energy requirement is supplied by site-solar or recovered energy.
>
> **Exception 2 to Section 140.4(g):** Where an electric resistance heating system supplements a heat pump heating system, and the heating capacity of the heat pump is more than 75 percent of the design heating load calculated in accordance with Section 140.4(a) at the design outdoor temperature specified in Section 140.4(b)4.
>
> **Exception 3 to Section 140.4(g):** Where the total capacity of all electric resistance heating systems serving the entire building is less than 10 percent of the total design output capacity of all heating equipment serving the entire building.
>
> **Exception 4 to Section 140.4(g):** Where the total capacity of all electric resistance heating systems serving the entire building, excluding those allowed under Exception 2, is no more than 3 kW.
>
> **Exception 5 to Section 140.4(g):** Where an electric resistance heating system serves an entire building that is not a hotel/motel building; and has a conditioned floor area no greater than 5,000 square feet; and has no mechanical cooling; and is in an area where natural gas is not currently available.
>
> **Exception 6 to Section 140.4(g):** Heating systems serving as emergency backup to gas heating equipment.

<u>**California single-family code language**</u>

> **150.1(c)6. Heating system type.** Heating system types shall be installed as required in Table 150.1-A. For climate zones 3, 4, 13 and 14, the space conditioning system shall be a heat pump, or shall meet the performance compliance requirements of Section 150.1(b)1.

[Per Table 150.1-A, electric resistance heating is not allowed as the primary heating source in any California climate zone.]

> **Exception to Section 150.1(c)6:** A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed 2 kW or 7,000 Btu/hr. and is controlled by a time-limiting device not exceeding 30 minutes.

<u>**California multifamily code language**</u>

> **170.2(c)4E. Electric-resistance heating.** Electric-resistance heating systems shall not be used for space heating.
>
> **Exception 1 to Section 170.2(c)4E:** Where an electric-resistance heating system supplements a heating system in which at least 60 percent of the annual energy requirement is supplied by site-solar or recovered energy.

Exception 2 to Section 170.2(c)4E: Where an electric-resistance heating system supplements a heat pump heating system, and the heating capacity of the heat pump is more than 75 percent of the design heating load calculated in accordance with Section 170.2(c)1 at the design outdoor temperature specified in Section 170.2(c)2.

Exception 3 to Section 170.2(c)4E: Where the total capacity of all electric-resistance heating systems serving the entire building is less than 10 percent of the total design output capacity of all heating equipment serving the entire building.

Exception 4 to Section 170.2(c)4E: Where the total capacity of all electric-resistance heating systems serving the entire building, excluding those allowed under Exception 2, is no more than 3 kW.

Exception 5 to Section 170.2(c)4E: Heating systems serving as emergency backup to gas heating equipment.