UCLA Luskin Center for Innovation

UCLA California Center for Sustainable Communities

Impacts of Household Electrification on Energy Affordability in Los Angeles

ENERGY SPENDING AND BURDEN PROJECTIONS FROM THE L.A. RESIDENTIAL ENERGY TRANSITION TOOL

BY LAUREN DUNLAP, RACHEL SHEINBERG, WILL CALLAN, SAMANTHA SMITHIES, AND GREGORY PIERCE

AUGUST 2025
REPORT

UCLA Luskin Center for Innovation

Informing effective and equitable environmental policy

The Luskin Center for Innovation conducts actionable research that unites UCLA scholars with civic leaders to solve environmental challenges and improve lives. Our research priorities include the human right to water, community-driven climate action, heat equity, clean energy and zero-emission transportation. We envision a future where everyone has healthy, affordable, and resilient places to live, work, learn, and play.

AUTHORSHIP

This report was produced by the UCLA Luskin Center for Innovation and authored by the following researchers:

- Lauren Dunlap, Project Manager, Luskin Center for Innovation, ldunlap@ucla.edu
- Rachel Sheinberg, Graduate Student Researcher, Institute of Environment and Sustainability
- Will Callan, Graduate Student Researcher, Luskin Center for Innovation
- Samantha Smithies, Project Coordinator, California Center for Sustainable Communities
- Gregory Pierce, Research Director, Luskin Center for Innovation

ACKNOWLEDGMENTS

Funding for this research was provided by the Los Angeles Department of Water and Power. The authors would like to thank Eric Fournier, Spencer Mathews, and Stephanie Pincetl at the California Center for Sustainable Communities, as well as Daniel Coffee at the Luskin Center for Innovation, for their guidance and contributions to tool development. The authors also thank Sooji Yang for invaluable comments and feedback on the report; and Elizabeth Pontillo for copyediting.

We acknowledge the Gabrielino/Tongva peoples as the traditional land caretakers of Tovaangar (the Los Angeles basin and So. Channel Islands). As a land grant institution, we pay our respects to the Honuukvetam (Ancestors), 'Ahiihirom (Elders) and 'eyoohiinkem (our relatives/relations) past, present, and emerging.

To cite this report: Dunlap, L., Sheinberg, R., Callan, W., Smithies, S., and Pierce, G. 2025. "Impacts of Household Electrification on Energy Affordability in Los Angeles: Energy Spending and Burden Projections from the L.A. Residential Energy Transition Tool." escholarship.org/uc/item/602136rz

CONTENTS

EXECUTIVE SUMMARY

As Los Angeles transitions to renewable electricity to reduce planet-warming greenhouse gas emissions, residential building electrification is a crucial step. The city's grid is slated to be 100% carbon-free by 2035, which would enable all-electric households to have minimal carbon footprints. But the tens of billions of dollars required for the energy transition will also lead to higher electricity rates, potentially increasing energy bills for those using mostly electricity.

In this report, we estimate energy spending and energy burden — the percentage of household income that is being allocated toward energy — to examine how home electrification will affect ongoing household energy bills from the present day onward. Understanding these dynamics is crucial as Los Angeles works to achieve the climate mitigation benefits of renewable energy paired with electrification, while improving energy affordability in the city.

Projecting the pocketbook impacts of household electrification requires a complex set of predictions, assumptions, calculations, and data. In response to this need, UCLA researchers developed the L.A. **Res**idential **E**nergy **T**ransition (RESET) Tool for the Los Angeles Department of Water and Power (LADWP). Using real energy consumption data from the UCLA Energy Atlas, as well as data and projections from other credible sources, the L.A. RESET Tool models how a variety of electrification upgrades might affect energy bills for households of differing characteristics. LADWP is using this tool to inform the LA100 Plan, its roadmap to 100% carbon-free electricity.

Our goals for this report are to:

1. Publicly introduce the L.A. RESET Tool and its potential applications
2. Identify scenarios in which electrification will save households money on their energy bills — and when it will not
3. Discuss how decision-makers can support energy affordability through electrification, particularly for low-income households

We use a wide array of projections from the L.A. RESET Tool to examine how different electrification upgrades affect energy spending outcomes on average throughout Los Angeles. To our knowledge, our study is the first to document these impacts using metered energy consumption data from across the city — one of the unique inputs of the tool. We further illustrate potential electrification effects using a set of credible, representational household profiles in an effort to make potential individual outcomes more grounded for readers.

We analyze seven electrification upgrade scenarios for Los Angeles households across five building types. We present the following key findings, discussed in detail below, alongside visuals of the tool's outputs:

1. Most electrification upgrades lead to ongoing energy savings for LADWP customers, cutting some households' bills in half, while maintaining gas appliances nearly always leads to higher energy spending.

2. Households in different building types have substantially different energy savings potential in absolute dollars saved. Single-family detached households are the biggest savers, with projected annual savings of $145 to $1,074 in 2025, whereas units in multifamily buildings of 5+ units are projected to save $70 to $303.
3. High-efficiency upgrades lead to much greater savings than comparable low-efficiency upgrades. High-efficiency heat pumps can cut bills by up to 22%, while low-efficiency ones bring little savings (or even bill increases). Similarly, whole-home electrification can save households 27% to 39% if done with high-efficiency appliances, but savings shrink to 8% to 20% for low-efficiency options.
4. As the energy transition progresses, rising electricity and gas rates amplify the overall ranking of upgrade options. Households can substantially or completely offset these rate increases with high-efficiency, whole-home electrification.
5. Electric vehicle owners consistently pay less to power their vehicles than gasoline vehicle owners, though the difference temporarily vanishes during the priciest part of the transition to renewable electricity.

Based on our findings, we offer several recommendations to help decision-makers plan for a more equitable electrification transition:

1. **Prioritize high-efficiency appliances wherever possible.** Across building types, high-efficiency options lead to substantially higher savings, amounting to as much as $575 annually.
2. **Customize electrification programs to each building type.** The building type where an energy customer lives hugely impacts energy consumption patterns and affordability of different upgrade options.
3. **Consider on-bill financing where high annual savings are possible.** For households that save hundreds of dollars per year by electrifying, on-bill financing (zero-interest loans repaid through an added electric bill fee) could help cover up-front costs.
4. **Use building enclosure improvements to account for increased cooling use.** Building enclosure improvements could be added to any upgrade to magnify benefits and help offset post-electrification increases in appliance use.
5. **Don't expect households to cover the up-front costs of electrifying — provide substantial funding.** The costs of buying and installing electric appliances are steep. The ongoing utility bill savings may not be high enough to make the investment an appealing financial decision for households. Funding is needed to not only incentivize but enable households to electrify — especially those with low incomes.

1. INTRODUCTION

As Los Angeles transitions to renewable energy in order to reduce planet-warming greenhouse gas emissions, a critical step is for households to shift from using fossil fuels to using electricity for everything from cooking and heating to transportation. While fossil fuels like methane (or "natural" gas) and gasoline contribute to climate change, electricity is increasingly generated using renewable energy, minimizing the impact on climate change. In the City of Los Angeles, the grid is slated to be 100% carbon-free[1] by 2035 — meaning households fueled entirely by electricity would minimize their carbon footprints.

The city's transition to renewable electricity (known as "LA100") is critical for reaching climate goals and mitigating environmental injustice. This important step will eliminate emissions from existing electricity uses and unlock further emissions reductions through the electrification of buildings, transportation, and industry.[2] For households, this includes replacing stoves, heaters, vehicles, and more with efficient electric options. Households that electrify will have better indoor air quality without gas-burning appliances and lower carbon footprints as the grid's emissions decrease (Billimoria & Lee, 2021). The tens of billions of dollars required for the transition to carbon-free electricity will also lead to higher electricity rates, and households using more electricity could end up with higher energy bills as rates increase.

This report examines how household electrification will affect ongoing household energy bills both with present-day electricity rates and higher future rates. We examine both absolute spending in dollars and energy burden — the percentage of household income allocated toward energy — to include the context of differing ability to pay in our analysis.[3] Understanding these dynamics is crucial as Los Angeles works to achieve the climate change mitigation benefits of carbon-free energy paired with electrification, while improving energy affordability in the city.

1 Carbon-free energy includes renewable energy resources (solar, wind, and geothermal), as well as large-scale hydropower and nuclear power (LA100 Plan Website, 2025).

2 The City's 2023 greenhouse gas inventory lays out the complex web of emissions throughout Los Angeles (LA Sanitation and Environment, 2025). As this resource shows, LADWP's in-basin power generation facilities emitted 2.3 million metric tons (MMT) of carbon dioxide-equivalent greenhouse gases; across all its facilities, emissions amounted to 6.2 MMT. Meanwhile, the transportation sector in the city emitted at least 9.2 MMT — and as much as 25.1 MMT when including a broader set of emissions that the City has less control over. While counting emissions is complex, two conclusions coexist: Emissions power generation is far from being the largest single source of emissions in Los Angeles, but it is a critical one that the City can directly influence. Decarbonizing power generation is both a critical pathway to reaching the City's climate goals, and one of many climate change mitigation strategies.

3 Energy burden is a useful energy affordability metric for integrating differences in how electrification and energy prices affect households with different incomes. See the L.A. RESET Tool Handbook and chapter 13 of the LA100 Equity Strategies study for further discussion of energy burden (Pierce et al., 2023; Sheinberg & Callan, 2025).

With the potential for rising energy rates to lead to higher energy spending and burden, affordability strategies are ever more important. But it is difficult to know exactly how electrification will affect households' energy bills. The effects depend on many different factors, including energy prices, local climate, energy-related building characteristics (such as building type, vintage, enclosure performance, and square footage), and household choices and behavior (such as individual energy usage, building enclosure retrofits, and appliance adoption). While some of these factors are fixed, others can be influenced through policy, planning, and program design decisions.

Understanding how these factors and decisions interact, and how to achieve the best outcomes for household energy affordability, requires a complex set of predictions, assumptions, calculations, and data. This report presents a new data tool that UCLA researchers developed for the L.A. Department of Water and Power (LADWP) to address this complexity. This tool — the L.A. **Res**idential **E**nergy **T**ransition (RESET) Tool — models how household energy bills might change when households electrify, depending on historic energy consumption and building type. LADWP is using this tool to inform the LA100 Plan, a roadmap for the utility to achieve 100% carbon-free electricity that is based on models of future energy demand, generation resources, rates, and more. We describe the basics of how the tool works in the Methodology section. To learn more about its design, data, and assumptions, see the L.A. RESET Tool Handbook (Sheinberg & Callan, 2025).

Our goals for this report on the L.A. RESET tool are threefold. First, the report publicly introduces the L.A. RESET Tool and its potential applications. Second, we identify scenarios in which electrification will save households money on their energy bills — and when it may not. And third, we discuss how public policy and other decision-making can support electrification actions that improve energy affordability, particularly for low-income households. We use a wide array of projections from the L.A. RESET Tool to examine how different electrification upgrades affect energy spending outcomes on average throughout Los Angeles. We further illustrate potential electrification effects using a set of credible, representative household profiles in an effort to make potential individual outcomes more grounded for readers.

While up-front costs are a crucial factor in determining the overall feasibility and financial impact of upgrades, they are readily addressed by other analyses (Ducroquet & Osaka, 2025; Walker et al., 2022a, 2022b). We elected in this report to focus on the ongoing energy affordability implications of electrification.

We aim to address concerns that electrification could increase energy bills (an uncommon, but not impossible, outcome in Los Angeles based on our results). Understanding the effects of electrification on households' operational expenditures across scenarios and building types can inform electrification program design, as well as broader policy and investment decisions. Ongoing costs are particularly relevant to households that won't directly bear up-front electrification costs, either as a result of subsidies and direct install programs, or as renters. Future research could connect our analysis with existing up-front electrification cost studies to flesh out the overall household and societal costs and benefits of electrification.

The report is laid out as follows: The following section, Section 2, presents a review of some of the most relevant academic and gray literature on residential building electrification. Section 3 provides the methodology of L.A. RESET tool development and our analysis of the tool's outputs. Sections 4 and 5 present energy spending and burden findings using weighted averages across all census tracts, while Section 6 further illustrates these findings using sample household profiles. Section 7 provides recommendations and a conclusion.

While there are many nuanced observations to make based on the results in this report, one message is clear: Most electrification upgrades are projected to lead to ongoing energy savings for LADWP customers, cutting some households' bills in half, while maintaining gas appliances nearly always leads to higher energy spending. Select upgrades can bring household savings large enough to offset projected rate increases (based on LADWP's rate projections from 2022). In other words, a household using both electric and gas appliances in 2025 would see energy expenditures go up substantially by 2035, but some electrification upgrades could keep their spending at or below the current amount even as rates increase. However, most upgrades do not lead to savings high enough to offset rising rates that result from utilities investing in the energy transition over the coming decades. For electrification to be an affordability strategy, it will be critical to provide funding and support for households to pay for the capital costs of the up-front upgrades.

2. BACKGROUND AND LITERATURE REVIEW

Residential building electrification benefits, costs, and policy have become an increasingly mainstream issue. Academics, journalists, and other researchers are exploring the balance of up-front costs and potential ongoing savings, aiming to dispel misinformation, demystify new technologies for consumers, and fill information gaps in the literature. Recent news reports recognize that while electrification is an important strategy for reducing greenhouse gas emissions, it might not always be cost-effective at the household level (Brady, 2025), even with “generous” state and federal subsidies (Ducroquet & Osaka, 2025). The process can also be time-consuming and frustrating, given the number of household appliances and associated upgrades involved (Root, 2024). Overall, mainstream reporting emphasizes that the cost-effectiveness of electrification varies based on existing appliances, choice of replacements, home vintage, and the need for ancillary upgrades, local policy, and other factors.

This reporting coheres with a diverse literature assessing the impacts of household electrification on energy consumption, energy costs and burden, greenhouse gas emissions, and equity. Researchers aim to inform policymakers of cost-effective approaches to electrification in both the near- and long-term (Billimoria et al., 2021), asking how household upgrades affect both energy consumption and spending (Weber & Wolff, 2018). Many studies focus on electrifying the especially carbon-intensive end use of space heating, measuring energy costs and emissions (Walker et al., 2022a), heat pump adoption over time (Deetjen et al., 2021), and electrification’s impact on renters (Weber & Wolff, 2018). While some analyze real project outcomes (Walker et al., 2022b), others model their results based on data for variables like housing type and vintage (Moe & Gibbs, 2023). They also develop methods for better measuring expenditures, as in Yang et al.’s study of “implicit energy burden” (Yang et al., 2025).

These studies use a variety of data sources to calculate energy burden. For income, many rely on Census data (Yang et al., 2025; Moe and Gibbs, 2023; Drehobl et al., 2020), while one uses survey data specific to the sample in its case study (Weber and Wolff, 2018). Energy consumption is often modeled (Yang et al., 2025; Moe and Gibbs, 2023), and the use of real income (Weber and Wolff, 2018) is relatively rare. Energy expenditures are taken from actual utility bills and forecasts (Yang et al., 2025; Moe and Gibbs, 2023).

Studies that focus on California tend to conclude that household electrification has overall benefits that are unevenly distributed. Mahone et al. estimated that replacing gas furnaces with heating, ventilation, and air conditioning (HVAC) heat pumps would result in bill savings for all single-family and low-rise multifamily homes, for both retrofits and new construction. Due to higher utility rates, however, Southern California households would see lower savings (2019). Moe and Gibbs found that four high-efficiency upgrade scenarios resulted in consumption and utility bill decreases for several home types in Richmond, CA, but noted that single-family homes, older homes, owners, and higher-income households saw higher savings. They also cautioned that lower-efficiency upgrades could increase utility bills citywide (Moe and Gibbs, 2023).

Studies that focus on narrower geographies and diverse household characteristics are able to produce specific insights and recommendations about electrification's impact on low-income and otherwise vulnerable ratepayers. Moe and Gibbs found that lower-income residents would see lower savings than wealthier counterparts, and emphasized that electrification could be burdensome for renters — because landlords are more likely to pay for natural gas than electricity, renters might be more sensitive to electricity bill increases that result from appliance upgrades (2023). Yim and Subramanian suggested three policy options for reducing the energy burden of low- and medium-income Californians: percentage of income payment plans, rate designs that make electrified heating more affordable, and implementing an income-based fixed charge (2023). Sandoval et al. focused their analysis on low-income households, renters, households in multifamily buildings, and households that do not use cooling in Los Angeles, all of which they define as vulnerable. Using the National Renewable Energy Laboratory's simulated ResStock data (the same building type-efficiency profile data that underpins our analysis), they estimated that while high-efficiency upgrades will reduce energy burden and consumption, low-efficiency upgrades will increase both. Both findings were more pronounced for low-income households (Sandoval et al., 2025).

Community-based organizations and government agencies have conducted research to address specific questions of electrification equity in Los Angeles. In 2021, Strategic Actions for a Just Economy (SAJE) warned about the costs of decarbonization being passed on to vulnerable renters, such as those living in rent-stabilized buildings and affordable housing (Kirk, 2021). In 2022, the City of L.A.'s Climate Emergency Mobilization Office outlined the need to craft electrification policies that would 1) avoid increased rent, utility costs, and the threat of displacement for tenants; and 2) equitably distribute electrification's environmental and economic benefits (French, 2022).

As Sandoval et al. observe, researchers should direct their attention not just to the deployment of electrification technology in general, but also to its equitable deployment (2025). By using outputs from the L.A. RESET Tool, our study describes electrification's potential impacts on a diverse set of Los Angeles residents. To our knowledge, our study is the first to document these impacts using metered energy consumption data from across the city, which we describe in the next section.

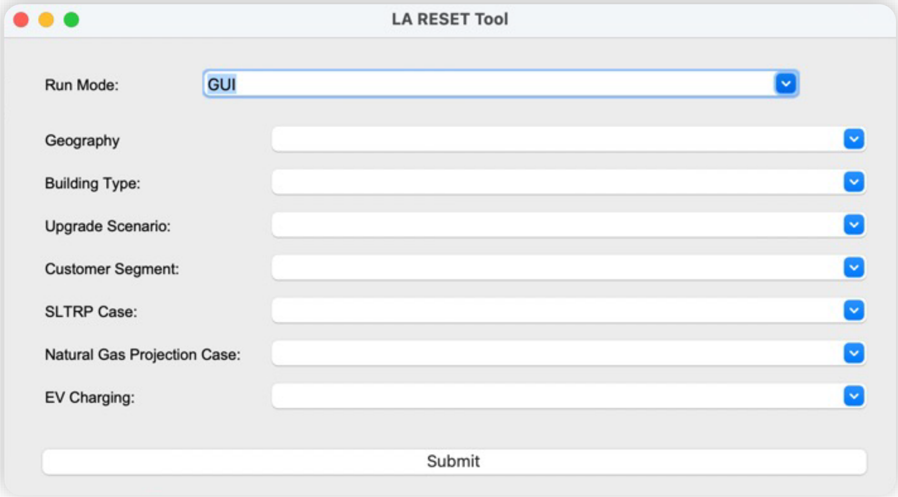
3. METHODOLOGY

3.1. The L.A. Residential Energy Transition Tool

This report presents results from the L.A. Residential Energy Transition Tool (the L.A. RESET Tool), a tool developed by UCLA researchers for the Los Angeles Department of Water and Power (LADWP) to project energy spending and burden impacts of different electricity generation and rate scenarios across Los Angeles. The models, data, and assumptions underlying the tool's calculations are documented in the L.A. RESET Tool Handbook published alongside this report (Sheinberg & Callan, 2025). The tool calculates a wide array of potential outcomes for households, aggregated at the census tract-, ZIP code-, or council district-level across a selection of building types and electrification upgrade scenarios. The tool calculates these outcomes based on a set of assumptions about electricity pricing, natural gas pricing, and electric vehicle charging. Figure 1 shows a screenshot of the interface through which users select analysis options.

FIGURE 1

Graphical user interface (GUI) of the L.A. RESET Tool



The outcomes leverage granular data on building characteristics, energy consumption, and census tract-level demographics to produce recommendations about electrification for L.A.'s most in-need residents. The tool's inputs make it especially well-suited for projecting spending in Los Angeles.

With access to aggregated metered consumption data following California Public Utilities Commission (CPUC) guidelines from the UCLA Energy Atlas,[4] the tool incorporates real

4 The Energy Attributes Dataset is built on data from the California Center for Sustainable Communities at UCLA's (CCSC) Energy Atlas. The Energy Atlas links utility account and billing data to building attributes across California, including in Los Angeles.

consumption patterns across the city into its projections. It also uses projections related to decarbonization more broadly, such as natural gas price forecasts from the California Energy Commission (CEC) that account for both home electrification and decarbonization of the grid. Finally, its underlying electricity rate projections come directly from LADWP's integrated resource planning process, which considers several scenarios for achieving a 100% carbon-free grid by 2035 for the City of Los Angeles. For the purposes of this report, we input the rate projections from the 2022 Strategic Long-Term Resource Plan into the tool. LADWP has since updated the rate projection inputs to reflect the ongoing LA100 Plan process, but the updated projections were not public as of the time of our analysis.

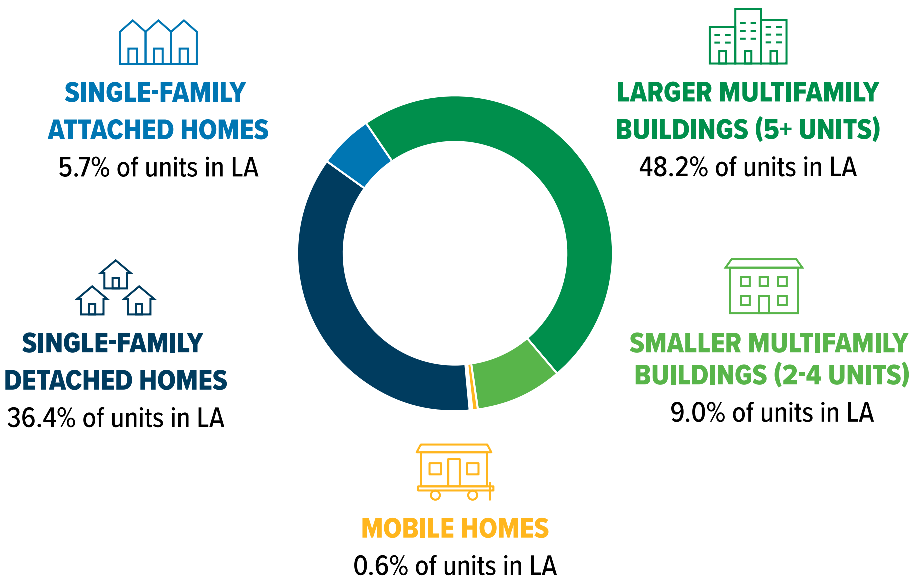
3.2. Scenarios and Variables

3.2.1. Building Types

The tool projects energy outcomes for households living in units across five building types: single-family homes, both detached and attached (i.e., townhomes or row houses); units in smaller and larger multifamily buildings (those with two to four units and those with five or more units, respectively); and mobile homes. In this report, we sometimes present outcomes for all five types and other times focus on the most common types in L.A. (single-family detached and multifamily with five or more units, which collectively make up about 85% of units in the city). We also often include mobile homes, which make up a small proportion of homes in the city but present distinct nuances that we thought were important to capture. Figure 2 shows the five building types and their prevalence in L.A.

FIGURE 2

Housing building types*



*Percentages derived from the 2023 American Community Survey using the five-year estimates.

FIGURE 3

Building energy upgrade scenarios

BASELINE (NO UPGRADES)

A household with gas appliances and no electrification upgrades

LOW-EFFICIENCY HEAT PUMPS

Space heating and cooling replaced by minimum-efficiency heat pumps with electric backup heating and cooling

ResStock scenario name: "Heat Pumps, Min-Efficiency, Electric Backup"

HIGH-EFFICIENCY HEAT PUMPS

Space heating and cooling replaced by high-efficiency heat pumps with electric backup heating and cooling

ResStock scenario name: "Heat Pumps, High Efficiency, Electric Backup"

HEAT PUMP WATER HEATERS

Gas water heaters replaced by heat pump water heaters

ResStock scenario name: "Heat Pump Water Heaters"

LOW-EFFICIENCY, WHOLE-HOME ELECTRIFICATION

Gas appliances replaced by a lower-efficiency heat pump, heat pump water heater, electric resistance dryer, and electric range

ResStock scenario name: "Whole-Home Electrification, Min-Efficiency"

HIGH-EFFICIENCY, WHOLE-HOME ELECTRIFICATION

Gas appliances replaced by a high-efficiency heat pump, heat pump water heater, ventless heat pump dryer, and electric oven with induction range

ResStock scenario name: "Whole-Home Electrification, High Efficiency"

HIGH-EFFICIENCY, WHOLE-HOME ELECTRIFICATION + ENCLOSURE

All upgrades in high-efficiency, whole home electrification, plus upgraded insulation and sealing

ResStock scenario name: "Whole-Home Electrification, High Efficiency + Enhanced Enclosure Package"

3.2.2. Building Upgrade Scenarios

The tool sets a baseline for household energy consumption based on average household-level historical energy consumption patterns, assuming the following gas end uses for all homes: space and water heating, clothes drying, and cooking. It then estimates consumption under 10 potential scenarios for building electrification and/or building enclosure improvement. The tool therefore calculates household energy use and spending outcomes for 11 building electrification scenarios (including the baseline scenario and 10 upgrade scenarios). The assumptions and energy use calculations for each scenario are published by the National Renewable Energy Laboratory. See our handbook for details.

This report focuses on seven of the 11 scenarios, shown in Figure 3. We selected these seven scenarios to keep the level of detail digestible. We exclude the two enclosure-only scenarios, keeping our focus on those that include fuel switching from natural gas to electricity. We also exclude the whole-home electrification plus basic enclosure upgrade, which has results that fall in between the enhanced enclosure and no enclosure upgrade. Finally, we exclude the minimum-efficiency heat pumps with existing heating as a backup, opting to use the two heat pump options with electric backup to compare efficiency levels. Each excluded scenario has slightly different outcomes, which are not meaningful in the high-level findings of this report, and their exclusion enables us to present the remaining results more clearly.

3.2.3. Energy Generation and Price Scenarios

For the purposes of this report, the electricity supply scenarios were based on projections from the 2022 LADWP Strategic Long-Term Resource Plan (SLTRP). The 2022 SLTRP projects electricity rates and other outcomes for four scenarios. The SB 100 scenario represents a baseline in which LADWP follows the California state renewable energy requirements set by SB 100 to reach 100% zero-carbon resource supply for retail sales by 2045. The other three scenarios are Cases 1, 2, and 3, each of which represents a local energy transition that is faster than the state requires. To learn more about each case and the assumptions underlying it, see the 2022 SLTRP report (2022 SLTRP Report, 2023). We primarily report outcomes under the Case 1 scenario, which, as of spring 2025, was the most aligned with LADWP's stated intentions for future electricity generation and resulting prices (though the utility will publish updated projections soon, as discussed in section 3.5, below). The natural gas price scenarios are described in the handbook; we report results from the "moderate" price scenario.

3.2.4. Electric Vehicle Scenarios

There are two variables for electric vehicles (EVs) in this analysis. We used the tool to project how much energy each household would use to fuel a vehicle, either in the form of gasoline or electricity, for both electric and internal combustion engine (ICE) vehicles. EV charging method is a user input in the tool. There are three possible scenarios: All EV charging is done using home chargers (so costs add to household electric bills), public Level 2 charging stations, or public DC fast-charging stations. For this report, we chose public Level 2 charging stations as our default selection, as they are theoretically available to any household (though in practice, they can still be difficult to find and use). The EV section of the report illustrates the impact of different charging scenarios.

3.3. Analysis Methodologies

The results in Sections 4 and 5 represent the average outcome across Los Angeles, by building type. Using the RESET Tool's census-tract level results, we calculate weighted averages (by number of units) for energy spending and burden for each building type citywide.

The household profile analysis illustrates potential impacts of electrification upgrades for illustrative L.A. households. We designed seven household profiles to serve as examples. There are three apartments in apartment buildings with five or more units and three single-family detached homes, all with varied income levels and corresponding usage levels for energy and vehicle miles traveled. There is also one mobile home profile. The income and usage numbers were selected to show a range of outcomes, modeled on actual household data from the UCLA Energy Atlas. These numbers do not represent official income classifications; they are illustrative of a range of possible household scenarios. The profiles (detailed in Section 6) were then used as inputs for the RESET Tool, and the results are presented and analyzed in Section 6.

3.4. Caveats and Assumptions

There are several limitations to this research. The topics covered are complex, with many areas of uncertainty — different electrification scenarios, policy choices, societal factors, and more. We discuss important caveats below.

3.4.1. Behavioral Changes and New Appliances

This analysis does not account for changes in behavior due to electrification, climate change, or other factors. In all cases, the RESET Tool assumes that households will maintain the same appliance use across all electrification scenarios and over time. If a household keeps the thermostat set to 78 degrees with its baseline equipment, the tool assumes it will do the same after electrifying. In short, we do not account for potential rebound effects — the possibility that households that switch to a more efficient device might use it more because they use less energy and, therefore, pay less per unit of service (see, for example, Gillingham et al., 2016).

Here is an example of the rebound effect: A household with an inefficient air conditioner typically sets the thermostat to 80 degrees. Then, the household switches to a high-efficiency heat pump that can keep the home at 70 degrees without using more energy than the old unit. Now, the household uses the same amount of energy, but gets to enjoy a safer, more comfortable temperature. In reality, this household does not save energy or money, but does have an improved thermal comfort outcome. The RESET Tool would project that the household would keep the thermostat set at 80 degrees and that its energy use, and therefore spending, would go down. Even with the rebound effect, there is still likely a benefit; however, our analysis will show the benefit in terms of the possible energy savings if each household maintains the same level of energy services before and after any upgrades.

The rebound effect is specifically important to consider for energy-insecure households — lower-income households that limit their energy use because they cannot afford to pay higher bills (Pierce et al., 2023). These households often must choose between using a sufficient amount of energy to maintain health and comfort and spending their money on other goods and services, like water, food, and healthcare. Households that underconsume energy will benefit from efficient appliances, but they may benefit in the form of increased energy services rather than bill savings.

Similarly, the tool does not adjust energy consumption behavior to account for new appliance end uses. This is primarily an issue for upgrade scenarios that include heat pumps. These appliances can be used for both heating and cooling, whereas gas furnaces can be used only for heating. Because the tool does not account for additional consumption from this potential new end use, spending and burden may be underestimated for segments where many households have historically lacked access to cooling equipment and, thus, have been historically under-consuming. However, like with some cases of the rebound effect, households that install a heat pump but did not previously have an air conditioner will gain the ability to better maintain thermal comfort.

3.4.2. Data Availability and Uncertainty

It is important to note that the tool's granularity is fundamentally limited by data accessibility and privacy rules. For example, while academic researchers can request access from utilities to household-level electricity and natural gas consumption data under nondisclosure agreements and strict cybersecurity requirements, these values must be aggregated into groups that contain at least 100 residential customers before they can legally be shared (California Public Utilities Commission, 2014; Ruddell et al., 2020). Thus, for segments in the tool with at least one but fewer than 100 customers, consumption values have been "masked" and replaced with countywide medians. Additionally, income data from the American Community Survey is available at levels no smaller than census tract. This is one reason that census tract is the tool's smallest offered geographic region.

Critically, the data input into the tool has associated uncertainty. Much of the input data represents medians or average values for certain geographies, and the income data from the American Community Survey often has large margins of error. Additionally, the projections for future energy prices, particularly for natural gas, are uncertain, but based on the best available estimates we could find.

Finally, as discussed above, the tool currently uses the electricity rate projections from LADWP's 2022 Strategic Long-Term Resource Plan (SLTRP). The utility is in the process of finalizing the 2024 version of the SLTRP, renamed the LA100 Plan, which will include updated rate projections that take into account things like supply chain and construction delays from the Covid-19 pandemic, the higher cost of capital associated with inflation, and any impacts from loss of federal funding. All of the results presented here would be affected by increased electricity rates. Therefore, when the 2024 LA100 Plan is published, we aim to release a summary of updated results. In the meantime, readers can see the different results in LADWP's LA100 Plan presentation from May 15, 2025.[5]

5 See the slides published on the LADWP LA100 Plan website on May 15 (specifically, slide 34 compares 2022 and 2024 projections) (LA100 Plan Website, 2025).

4. CITYWIDE ENERGY SPENDING, SAVINGS, AND BURDEN

4.1. 2025 Energy Spending and Savings Projections

Utilizing present-day energy rates, Figure 4 presents projected energy spending and savings for 2025 under each upgrade scenario and for each building type. Table 1 presents a heat map of net energy bill savings in 2025, both in dollars saved per year and the percentage of the baseline spending that those savings represent. These results include only building energy use (such as cooking, water heating, space heating, and cooling), with transportation-related energy use excluded. These results reveal several patterns:

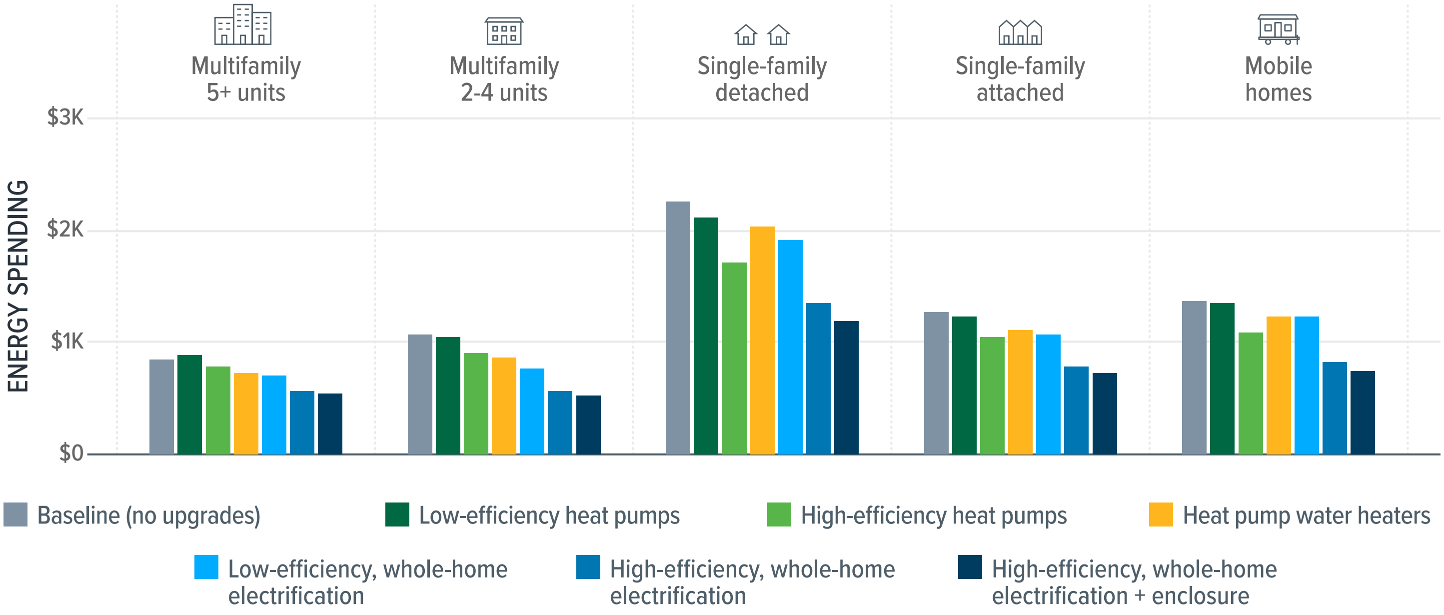
- Most upgrades lead to modest or substantial ongoing energy savings and reduce energy burden.
- The impact of upgrade scenarios varies significantly by building type.
- High-efficiency upgrades lead to much greater savings than low-efficiency upgrades.

Finding: Most upgrades lead to modest or substantial ongoing energy savings and reduce energy burden.

These projections show that at current electricity and gas rates, almost all modeled electrification upgrades reduce annual energy spending relative to staying on gas. Across these results, only one scenario leads to increased spending in 2025: Installing low-efficiency heat pumps in units in larger multifamily buildings is projected to increase annual energy bills by $29 (3% more than the baseline annual spending).

FIGURE 4

Average annual household energy spending* in 2025



*Includes natural gas and electricity for building use only (no vehicle fuel or charging)

TABLE 1

Average household energy bill savings relative to baseline (in dollars saved and percent bill reduction) in 2025

	Multi-family 5+ units	Multi-family 2-4 units	Single-family detached	Single-family attached	Mobile home
Baseline annual spending	**$860**	**$1,070**	**$2,270**	**$1,260**	**$1,370**
Low-efficiency heat pumps	**–$29** –3%	**$23** 2%	**$145** 6%	**$25** 2%	**$16** 1%
High-efficiency heat pumps	**$70** 8%	**$156** 15%	**$548** 24%	**$212** 17%	**$282** 21%
Heat pump water heaters	**$120** 14%	**$196** 18%	**$237** 10%	**$148** 12%	**$130** 10%
Low-efficiency, whole-home electrification	**$138** 16%	**$307** 29%	**$346** 15%	**$192** 15%	**$129** 9%
High-efficiency, whole-home electrification	**$282** 33%	**$494** 46%	**$921** 41%	**$477** 38%	**$540** 39%
High-efficiency, whole-home electrification + enclosure	**$303** 36%	**$533** 50%	**$1,074** 47%	**$546** 43%	**$624** 46%

Bill savings: <$0 (bills increase) | $0–$250 | $250–$500 | $500–$1,000 | $1,000+

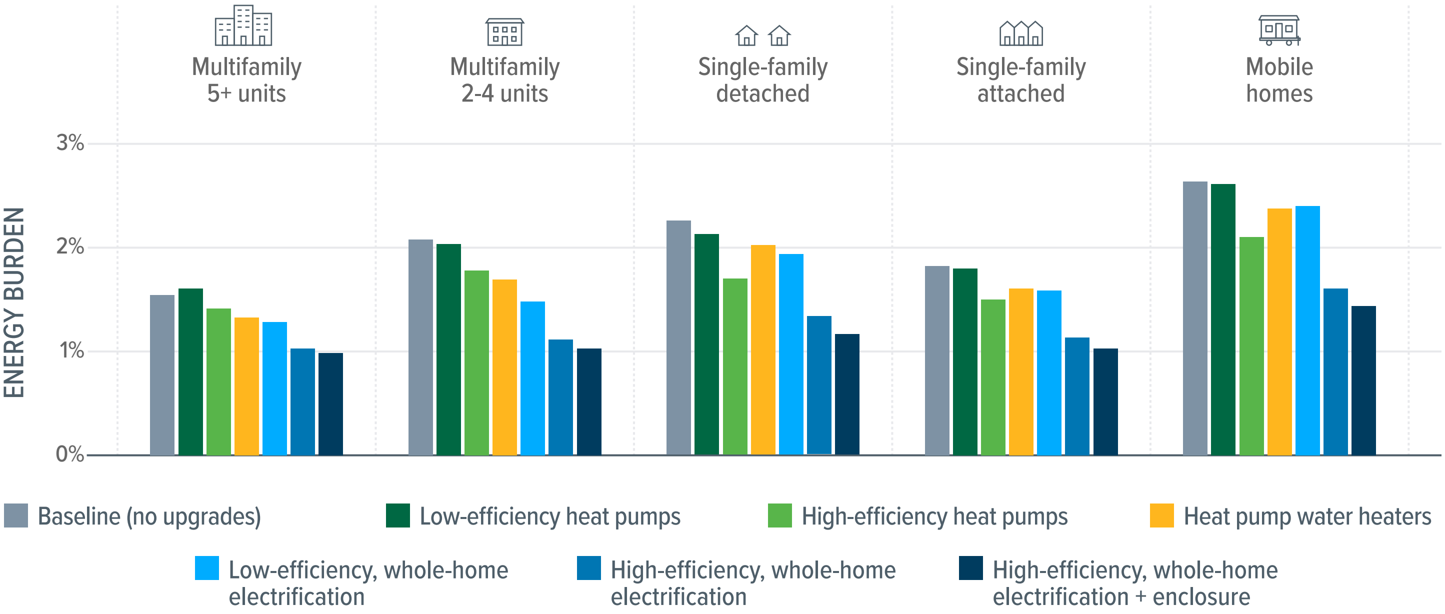
Electrifying an entire home produces a wide range of energy savings depending on the building type and upgrade scenario. Savings range from $129 to $1,074 per year, reducing household bills by at least 9% and as much as 50%. Across all building types, the biggest affordability gains come from high-efficiency whole-home electrification, particularly when paired with an enhanced building enclosure upgrade. While low-efficiency whole-home electrification brings bill reductions between 9% and 29%, bill reductions from high-efficiency whole-home electrification range from 33% to 50%.

Electrifying only part of a home can also produce substantial energy savings, ranging as high as $548, representing as much as a 24% bill reduction. Low-efficiency heat pumps lead to little to no savings, peaking at a 6% reduction (and even increase spending in one case, as noted above). High-efficiency heat pumps and heat pump water heaters reduce energy spending slightly more, bringing bill decreases ranging from 8% to 24%.

Figure 5 shows projected energy burden — the percentage of a household's income that is spent on energy in a given time period — in 2025. Like Figure 4, these results include only building energy use, not vehicle charging or fuel. Whereas energy spending tells us how upgrades affect how much households spend in dollars, energy burden accounts for household income. If two households use the same amount of energy, the lower-income one will have a higher energy burden.

FIGURE 5

Average annual household energy burden* by building type and upgrade scenario in 2025



*Includes natural gas and electricity for building use only (no vehicle fuel or charging)

Figure 5 reveals the same patterns among the upgrade scenarios as Figure 4. Baseline energy burden ranges from 1.6% to 2.6%, and all upgrade scenarios either maintain the same level or reduce energy burden. Low-efficiency heat pumps are least beneficial, barely reducing energy burden in most cases. High-efficiency heat pumps result in an energy burden between 1.4% and 2.1%, and heat pump water heaters result in an energy burden between 1.3% and 2.4%. Turning to whole-home electrification, the best energy burden improvements again come from the high-efficiency option, particularly paired with enhanced building enclosure, which leads to energy burden levels as low as 1%.

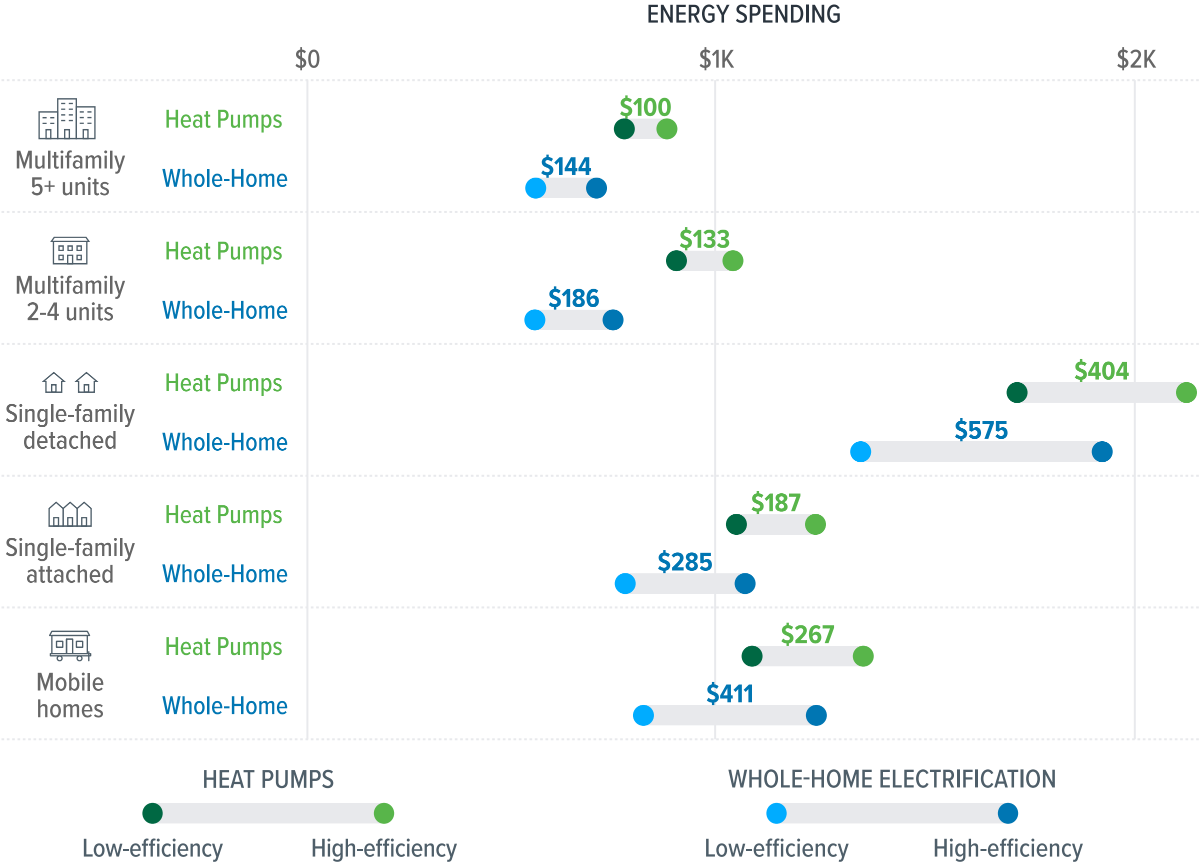
Finding: High-efficiency upgrades lead to much greater savings than low-efficiency upgrades.

Across the board, high-efficiency appliances yield substantially more savings than similar low-efficiency upgrades. Table 1 shows that high-efficiency heat pumps produce anywhere from two to 20 times the savings as their low-efficiency counterparts. Similarly, whole-home electrification brings two to five times higher savings when high-efficiency appliances are installed rather than low-efficiency appliances.

Figure 6 compares high- and low-efficiency heat pumps (in dark and light green) and whole-home electrification (in light and dark blue), using 2025 estimates. For each type of upgrade, the figure shows the difference in annual spending between the high-efficiency version and the low-efficiency version. The projected annual savings from using high-efficiency appliances instead of their low-efficiency equivalent range from $100 to $575. Savings are substantially higher for single-family detached homes, both in absolute dollar savings and percentage of spending.

FIGURE 6

Comparing energy spending* with high- and low-efficiency electrification measures in 2025



*Includes natural gas and electricity for building use only (no vehicle fuel or charging)

Finding: The impact of upgrade scenarios varies significantly by building type.

The effects of different upgrade scenarios clearly vary across building types. The magnitude of potential savings varies substantially. Residents of single-family detached homes see the largest absolute savings in dollars per year — as much as $1,074 per year with the most energy-efficient upgrade. This is likely due to having the largest baseline annual spending as a result of larger square footage and gas end uses. These homes also see the widest range of potential cost savings. Single-family attached homes have substantially lower spending, likely because they share walls with other homes, reducing potential for heat transfer between each unit and the outdoors.

On the flip side, multifamily homes in buildings with five or more units see the smallest absolute savings in dollars. This is at least in part because these households — which comprise nearly 50% of units in L.A., as shown in Figure 2 — already spend the least on energy. Interestingly, more often than not, units in smaller multifamily buildings with two to four units see the highest percentage bill reductions, as high as 50% with a high-efficiency, whole-home electrification plus enclosure upgrade. This may be because smaller multifamily buildings in L.A. tend to be older and built without insulation, so this package represents a more substantial upgrade for these units relative to other building types (Modeling Retrofit Scenarios, 2025). This effect may be magnified, given that, compared with larger buildings, each unit in a small multifamily building may have more external walls that allow for greater heat transfer between each unit and the outdoors.

If selecting a partial-electrification upgrade option, multifamily and single-family homes may benefit from different selections. High-efficiency heat pumps are the best partial electrification option for mobile homes and single-family homes in terms of energy affordability, more than doubling the percentage bill reduction for mobile and single-family detached homes from 10% to over 20% relative to heat pump water heaters. In contrast, units in multifamily buildings of all sizes may benefit more from heat pump water heaters, which bring $30 to $50 more in annual savings than the high-efficiency heat pumps. This difference may be because multifamily homes tend to use space heating and cooling less due to smaller size and less heat transfer with the outdoors (as described above). Meanwhile, hot water use is likely more comparable across building types, assuming similar household sizes.

The energy burden impacts also reveal differences in household income across building types. While mobile homes have substantially lower spending than single-family detached households, they have high spending relative to their household incomes, as shown by the higher energy burden for these homes. For mobile homes, it is particularly important to consider not only energy savings but also energy burden alleviation.

4.2. 2035 Energy Spending and Savings Projections

The projections for 2035 (Figure 7 and Table 2) show similar patterns of electrification impacts against a backdrop of energy prices that are projected to increase faster than the rate of inflation. These projected increases, which outpace historical changes, primarily reflect increased revenue requirements associated with the renewable energy transition.

Finding: As the energy transition progresses, rising rates amplify the overall ranking of upgrade options.

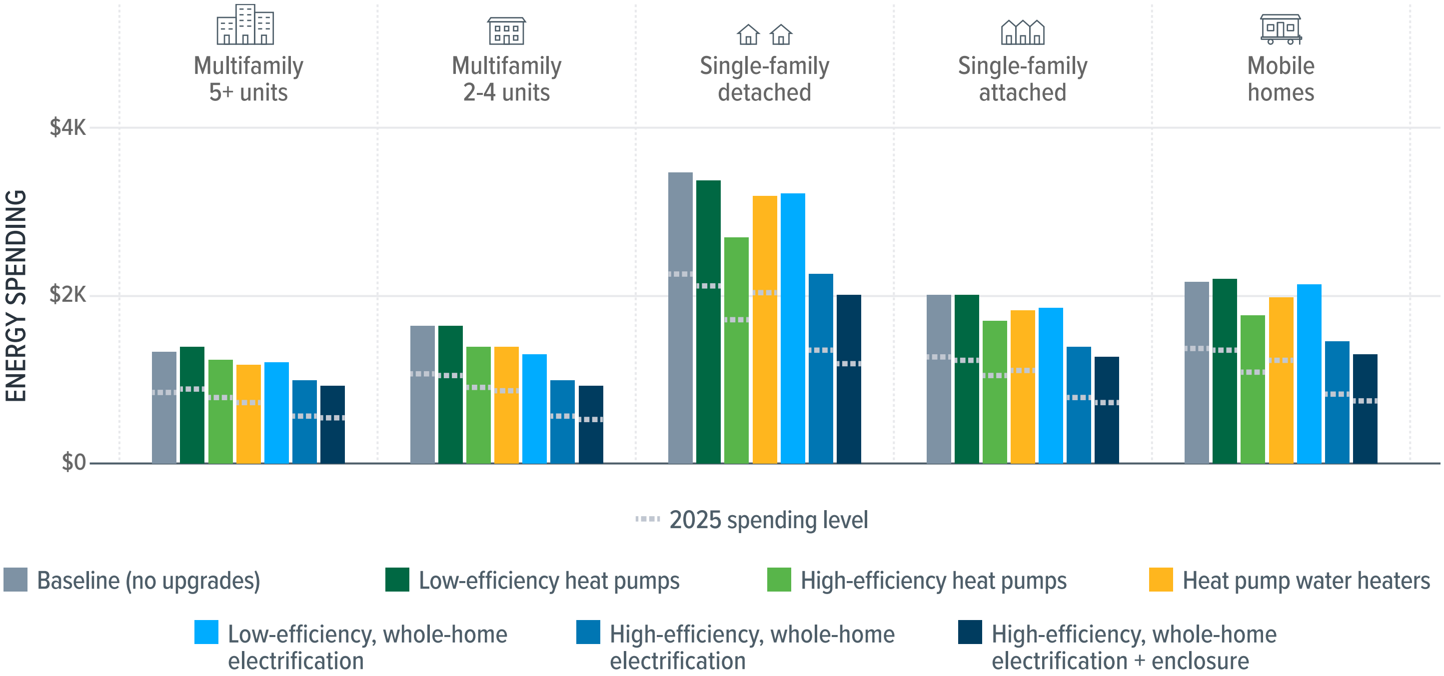
There are no notable differences between 2025 and 2035 in terms of the most and least effective upgrades at improving affordability, nor in the patterns across building types. Low-efficiency heat pumps remain the least beneficial option for reducing ongoing bills, bringing bill changes ranging from savings of 3% to increases of 4%. High-efficiency, whole-home electrification remains the most beneficial, cutting bills by 27% to 43% with an enclosure upgrade.

Rising rates lead to higher spending and higher energy burden,[6] making affordability strategies, such as bill assistance programs and incentives for high efficiency appliances, ever more important. As electricity prices increase over time, building enclosure quality and appliance efficiency become even more salient. The largest savings opportunity — whole-home electrification with an enhanced enclosure upgrade — leads to savings as high as $1,477 for single-family detached homes.

6 The calculations show inflation-adjusted rates and income, assuming that incomes rise proportionally to inflation. If incomes do not increase in pace with inflation, then energy burden will be higher than shown here.

FIGURE 7

Average annual household energy spending,* by building type and upgrade scenario in 2035



*Including natural gas and electricity for building use only (not EV charging)

TABLE 2

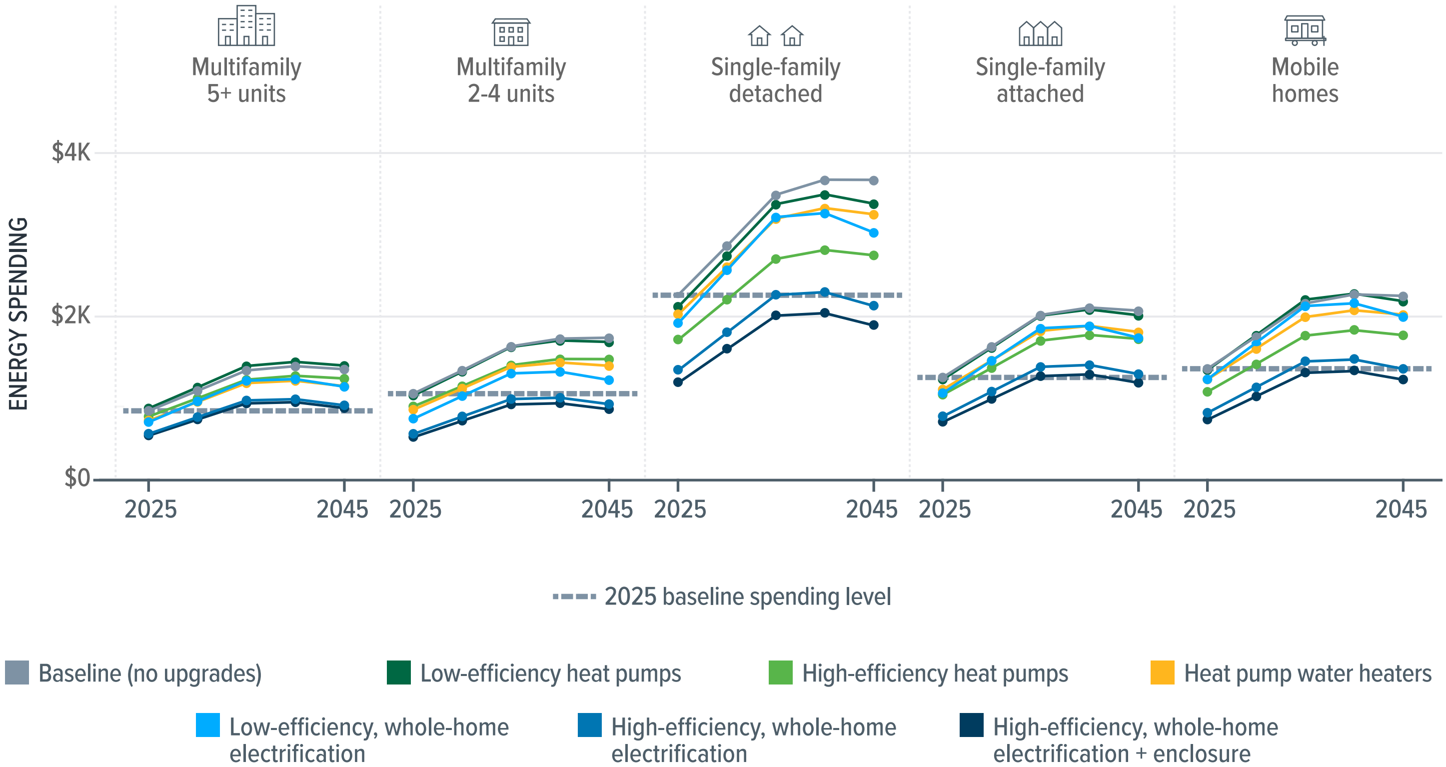
Bill savings by upgrade scenario and building type in 2035

	Multi-family 5+ units	Multi-family 2-4 units	Single-family detached	Single-family attached	Mobile home
Baseline annual spending	**$860**	**$1,070**	**$2,270**	**$1,260**	**$1,370**
Low-efficiency heat pumps	**–$54** –4%	**$7** <1%	**$114** 3%	**$7** <1%	**–$46** –2%
High-efficiency heat pumps	**$113** 8%	**$230** 14%	**$784** 22%	**$313** 15%	**$394** 18%
Heat pump water heaters	**$155** 12%	**$251** 15%	**$292** 8%	**$195** 10%	**$167** 8%
Low-efficiency, whole-home electrification	**$125** 9%	**$331** 20%	**$272** 8%	**$162** 8%	**$32** 2%
High-efficiency, whole-home electrification	**$367** 27%	**$644** 39%	**$1,224** 35%	**$633** 31%	**$709** 33%
High-efficiency, whole-home electrification + enclosure	**$403** 30%	**$711** 43%	**$1,477** 42%	**$747** 37%	**$849** 39%

Bill savings	<$0 (bills increase)	$0–$250	$250–$500	$500–$1,000	$1,000+

FIGURE 8

Average energy spending* and change in spending by upgrade scenario, relative to the 2025 baseline, 2025–2045



*Includes natural gas and electricity for building use only (no vehicle fuel or charging)

Finding: Many households can counter rising rates with high-efficiency, whole-home electrification.

As discussed in the introduction, transitioning to renewable energy will bring costs that increase electricity rates, leading to higher baseline spending. Figure 8 presents each upgrade scenario's spending outcomes from 2025 through 2045. The figure illustrates how rising rates are projected to increase spending for any individual upgrade scenario. The horizontal gray dashed line on each panel represents the 2025 baseline spending, allowing a comparison of present-day spending without upgrades to future spending with each upgrade.

Again, Figure 8 illustrates that rising energy rates lead to higher energy bills for households that keep using the same appliances. And again, it shows that almost all electrification upgrades will lead to lower spending for any given year. But it also shows that some upgrades go a step further — they keep spending at or below the 2025 baseline level. In other words, they could potentially enable households to avoid seemingly inevitable bill increases.

We can illustrate this point with the example of single-family detached homes, which have a 2025 baseline spending level of $2,269. With no upgrades, spending for this building type reaches as high as $3,681 in 2040. But high-efficiency, whole-home electrification with an enclosure upgrade brings 2040 spending down to $2,049 — lower than the spending in 2025 before electrification. And without an enclosure upgrade, 2040 spending is only slightly higher than the 2025 baseline.

Other building types can similarly avoid major bill increases. Smaller multifamily homes can keep spending below the 2025 baseline with high-efficiency, whole-home electrification, even without an enclosure upgrade. The other three building types see, at most, small increases with these upgrade options.

While other electrification options certainly help manage bill increases, these results emphasize that high-efficiency, whole-home electrification is the gold standard for ongoing energy affordability. This upgrade can keep household energy spending to near present-day levels as rates go up, particularly when paired with a building enclosure upgrade. Apart from low-efficiency heat pumps, the other upgrades all lead to much lower energy expenditure increases over time than the baseline, no-upgrades scenario.

4.3. Impacts of Energy Transition Trajectory

With so much discussion of increasing rates, we turn next to one more important question: What if rates do not increase as much? As described above, all results thus far assume that rates follow projections from the SLTRP Case 1 scenario, the case that the City of L.A. and the Los Angeles Department of Water and Power (LADWP) selected to proceed with in 2022 (2022 SLTRP Report, 2023). Below, we title this scenario the Los Angeles 2035 Mandate, which would produce a 100% carbon-free energy utility by 2035. These results would be different under a scenario where LADWP transitions to renewable energy on a less aggressive timeline. To illustrate, we use the SB 100 SLTRP case, which is based on California state requirements rather than more ambitious local targets. Below, we title this slower transition scenario the California 2045 Mandate.

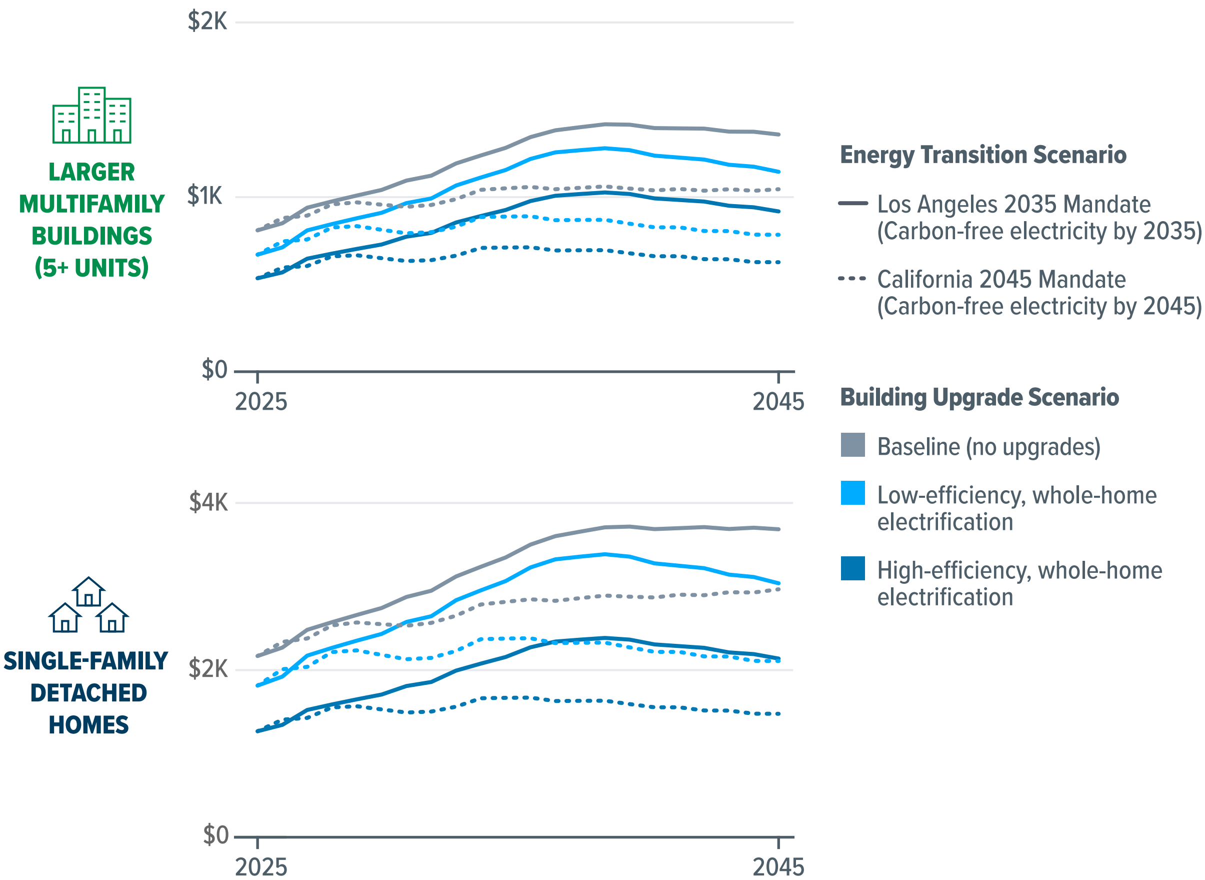
It is critical to note that the California 2045 Mandate does not follow current local requirements established by the Los Angeles City Council (LA City Council, 2021). The slower transition will lead to higher carbon emissions, undermining LADWP's commitment to a highly ambitious climate change mitigation strategy. It may also sacrifice air quality improvements that benefit L.A. residents — particularly those in over-polluted communities. However, we include this analysis to illustrate the impacts of rate increases and the importance of policy and investment to mitigate them.

Finding: A slower energy transition and the resulting lower electricity rates lessen energy bill increases.

Figure 9 shows energy spending under the faster (Los Angeles 2035 Mandate, solid lines) and slower (California 2045 Mandate, dotted lines) rate scenarios for the two most prevalent building types under three upgrade scenarios. The figure illustrates that the trajectory of the energy transition has a substantial effect on energy spending. A slower energy transition is projected to lead to lower baseline spending, with the largest difference around 2035–2040 (when overall spending peaks). This is because a slower transition is projected to cost substantially less, on the order of $18-20 billion; LADWP's 2022 SLTRP projects costs around $80 billion or more for Case 1 and around $65 billion for the SB 100 scenario — see page 5-5 of the report (2022 SLTRP Report, 2023). These costs may not all be passed onto ratepayers, depending on external funds that LADWP can obtain. Regardless, projected increasing rates will lead to higher spending for the same amount of energy use.

FIGURE 9

Spending* increases under faster (2035) and slower (2045) transitions to renewable electricity



*Includes natural gas and electricity for building use only (no vehicle fuel or charging)

The slower transition leads to slower projected growth in electricity rates, leading to lower baseline spending than the 2035 mandate. However, it is again important to note that a slower transition to renewable energy will cause LADWP's greenhouse gas emissions to remain higher for longer. As discussed above, transitioning to carbon-free energy is not the only way to reduce the city's emissions, with the transportation sector comprising a larger proportion of emissions. However, decarbonizing the power sector is an important climate change mitigation strategy — indeed, emissions reductions in the power sector have already driven much of the 44% reduction in stationary energy emissions that the City achieved from 1990 to 2023 (LA Sanitation and Environment, 2025). Ultimately, implementing the slower transition would not conform to the city's current commitments to one of the most ambitious renewable electricity transitions in the country.

5. VEHICLE, SOLAR, AND DISCOUNT ENROLLMENT DYNAMICS

While the previous section examined general patterns of energy spending, savings, and burden across the City of L.A., this section analyzes how outcomes may differ for households with varying experiences: those with electric vehicles, those with solar panels on their properties, and those who receive discounts on their energy bills.

5.1. Electric Vehicle Ownership and Charging

We looked at how electric vehicle (EV) ownership and home charging stations affect spending outcomes. Figure 10 shows outcomes for total household energy spending for households with either internal combustion engine (ICE) or electric vehicles. Whereas prior results have only included spending from energy used inside the home (cooking, space heating and cooling, water heating, etc.), the results in Figure 10 include vehicle charging and fuel. For electric vehicles, this includes either charging at home (where expenditures are included in the household's energy bills) or the expenditures resulting from charging at a public charging station. For gasoline vehicles, this includes an estimate of the cost of gas. The amount of fuel (gasoline or electricity) required is estimated based on the vehicle miles traveled in each census tract, details of which are in the L.A. RESET Tool's technical handbook (Sheinberg & Callan, 2025).

In Figure 10, we show three potential outcomes:

1. Spending for EV owners who pay residential electricity rates to charge their vehicles (e.g., if they are using Level 1 or 2 home chargers or subsidized public chargers)
2. Spending for EV owners who pay typical public charging rates, based on an estimated electricity rate from standard public Level 2 chargers.[7]
3. Spending for gasoline vehicle owners who pay standard gas station prices to fuel their vehicles.[8]

The figure shows these results for two building types (larger multifamily buildings and single-family detached homes) and three upgrade scenarios (baseline and high- and low-efficiency, whole-home electrification) between 2025 and 2045.

Finding: Electric vehicle owners pay less to fuel their vehicles, except when electricity rates peak during the energy transition.

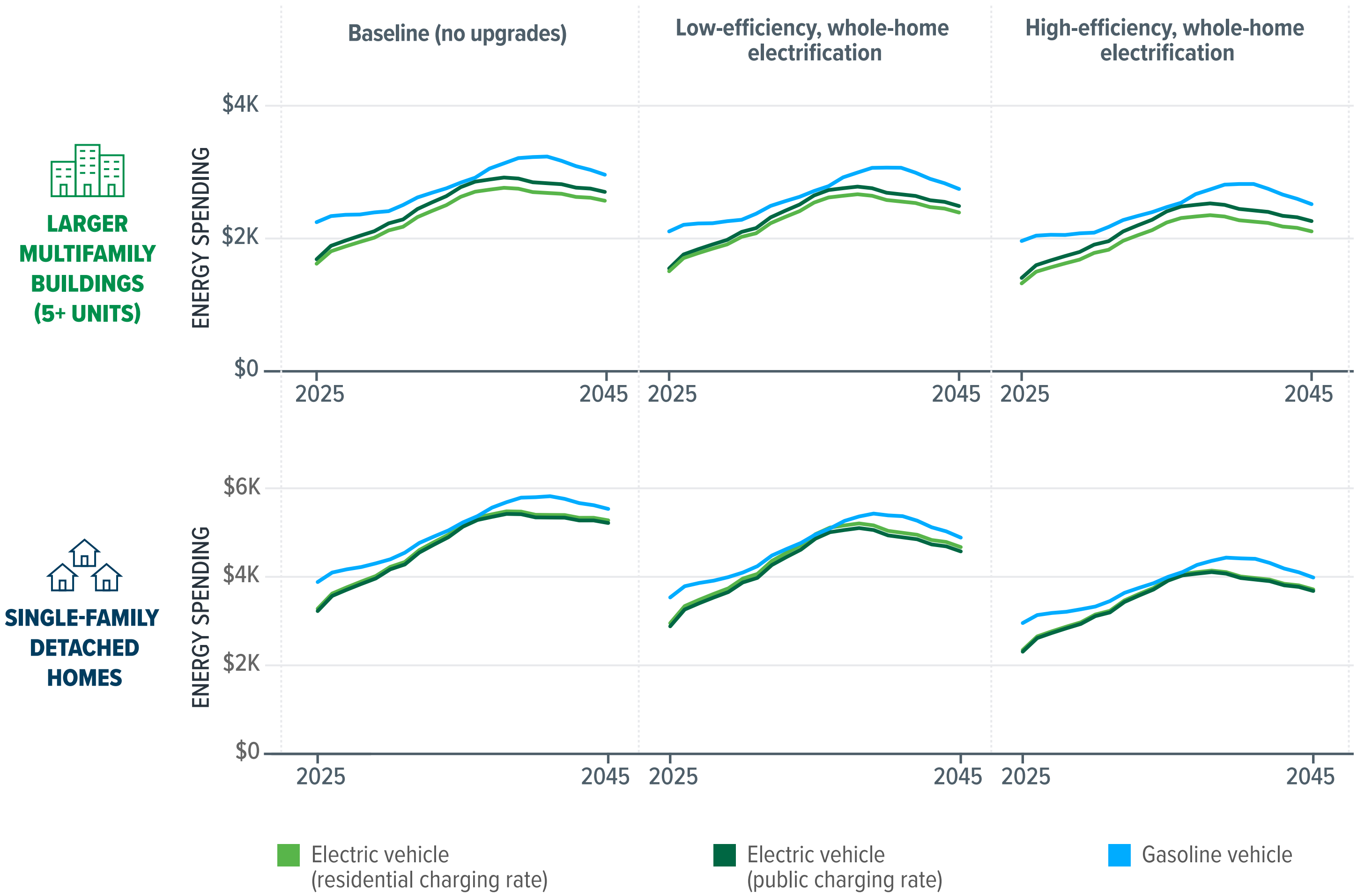
In 2025, EV owners are consistently projected to spend less on energy than ICE vehicle owners, due to the higher cost of gasoline compared with electricity. This is true regardless of building type, charging rate, and electrification scenario. In 2035, higher electricity rates are projected to cause the savings for EV owners to decrease or disappear. However, by 2045, when electricity rates start to come back down after the primary energy transition costs are paid for, the savings return.

7 Public charging rate (price) is based off of a sample of Level 2 chargers across L.A. County.

8 Gasoline price projections represent a combination of estimates from the U.S. Energy Information Administration's 2023 Annual Energy Outlook (AEO) and California-specific estimates surrounding the state's Low Carbon Fuel Standard (LCFS) program (Sheinberg & Callan, 2025).

FIGURE 10

Vehicle ownership and EV charging rate impacts on total household energy spending (including both building and vehicle energy)



Finding: Residential electricity rates can reduce spending, but home charging can push electricity use into higher-cost tiers.

The impacts of charging on spending vary. For households in larger multifamily buildings, the ability to charge at a residential rate[9] decreases spending by up to $90 per year; for single-family homes, however, charging at home may lead to slightly higher spending than public charging (by $17 to $44, a difference so slight that it is difficult to discern from this figure). Ultimately, these results demonstrate that, depending on how public charging costs evolve, EV customers without access to home charging can still see reductions in total energy spending relative to ICE vehicle ownership. That being said, for many households, home charging can somewhat reduce costs and make EVs an even better financial choice in terms of fuel costs.

9 Multifamily building residents often do not have an opportunity to charge at residential rates, as chargers in apartment buildings (when they exist) are likely to have higher prices per kilowatt-hour (kWh). However, these results show that access to residential charging rates, whether through home charging or public charging at reduced prices per kWh, would support affordability for multifamily building residents who own EVs.

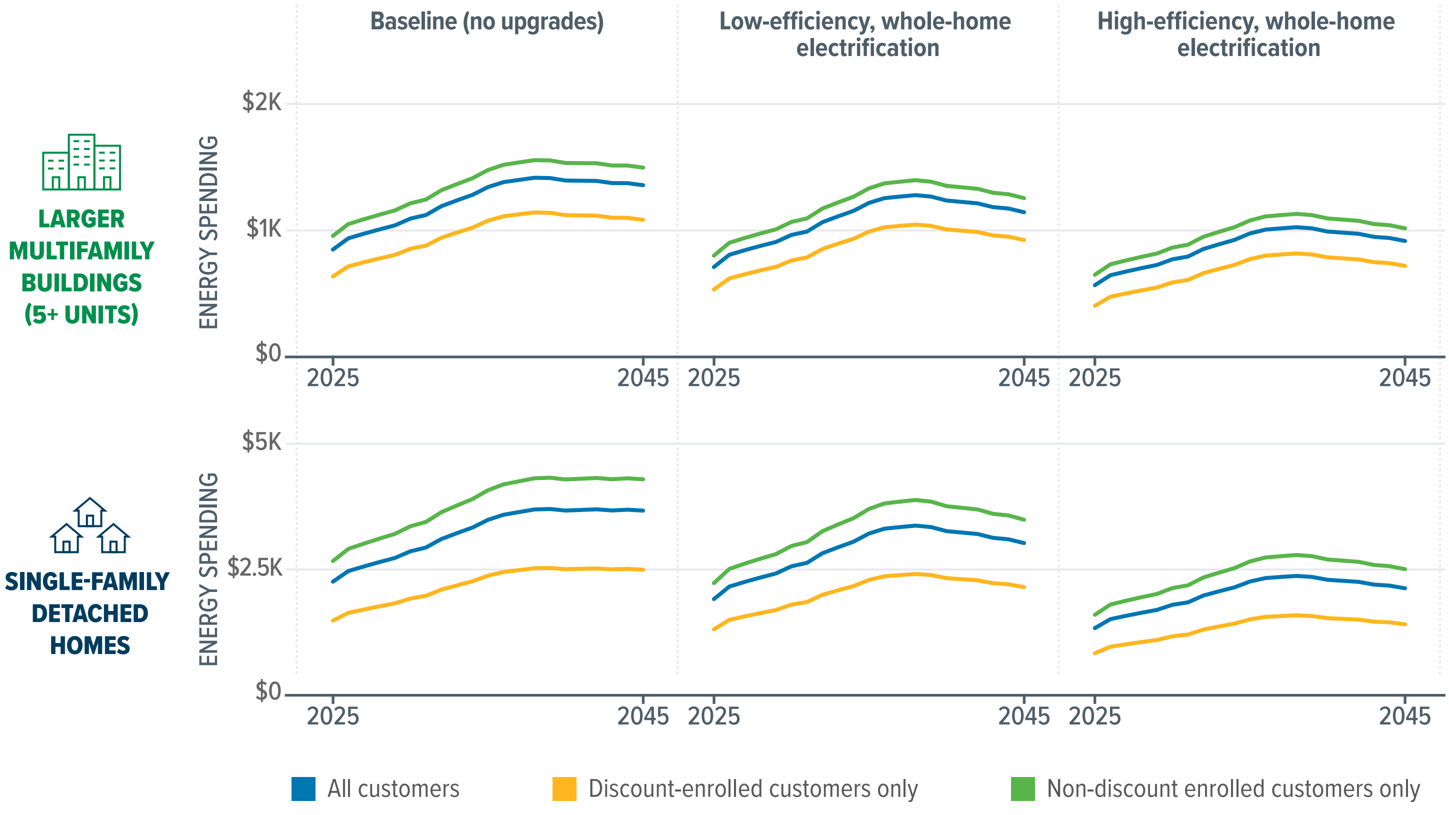
Additionally, these results illustrate one of many ways electricity rate structures play a role in the economics of electrification. The Los Angeles Department of Water and Power (LADWP)'s current tiered-rate structure means households can only use a certain amount of electricity at the lowest residential rate (called the baseline allowance). Once a household's electricity use exceeds the baseline allowance, the price per kilowatt hour of electricity goes up. This is likely why single-family households — which have higher energy use but the same baseline allowance as their multifamily counterparts — are predicted to have higher spending when charging at home than when using public Level 2 chargers. The tiered-rate structure disincentivizes home EV charging for households that use up their baseline allowances (or come close).

5.2. Utility Bill Discount Program Enrollment

There are multiple programs designed to reduce energy bills for low-income customers. The EZ-SAVE and Lifeline programs, the two main electric bill discount programs available to LADWP customers, are both included in the L.A. RESET Tool. Figure 11 compares building-only energy spending and burden for households that are enrolled in both EZ-SAVE and Lifeline and those enrolled in no discount programs.

FIGURE 11

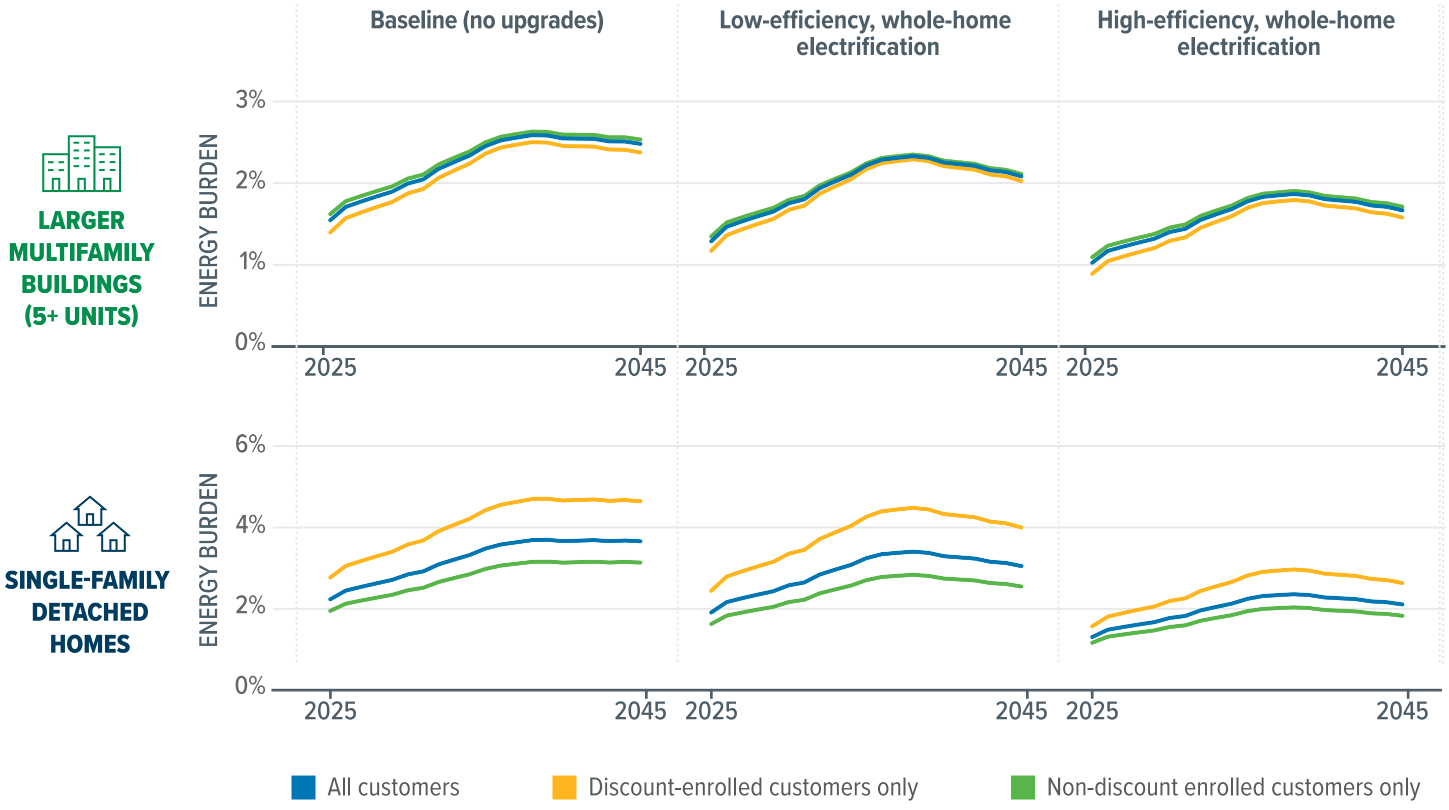
Energy spending and burden:* Discount-enrolled vs. non-discount-enrolled customers



*Includes natural gas and electricity for building use only (no vehicle fuel or charging)

FIGURE 12

Energy spending and burden:* Discount-enrolled vs. non-discount-enrolled customers



*Includes natural gas and electricity for building use only (no vehicle fuel or charging)

Finding: Discount program enrollees predictably spend less on energy — but not all have lower energy burdens.

Figures 11 and 12 show that those enrolled in discount programs have lower spending across all upgrade scenarios, for both building types. However, the energy burden effects are quite different for different building types. For multifamily homes, energy burden is lower for discount program enrollees; for single-family homes, however, energy burden is substantially higher for discount program enrollees. This suggests that the difference in income between discount-enrolled and non-discount-enrolled customers is far greater for those living in single-family homes than in multifamily housing.

5.3. Solar and Net Energy Metering

Single-family households with solar panels on their homes can enroll in LADWP's net energy metering program, which allows them to use the solar power generated by their panels and send any excess electricity to LADWP's electric grid. Households receive payment for the excess electricity their homes provide to the grid, which reduces their electricity expenditures. Net metering is primarily available to single-family residents. However, a limited number of multifamily households have participated through LADWP's pilot Virtual Net Energy Metering (VNEM) program (Pierce et al., 2023). The benefits these households receive are incorporated into the data in the L.A. RESET Tool and represented in the results below.

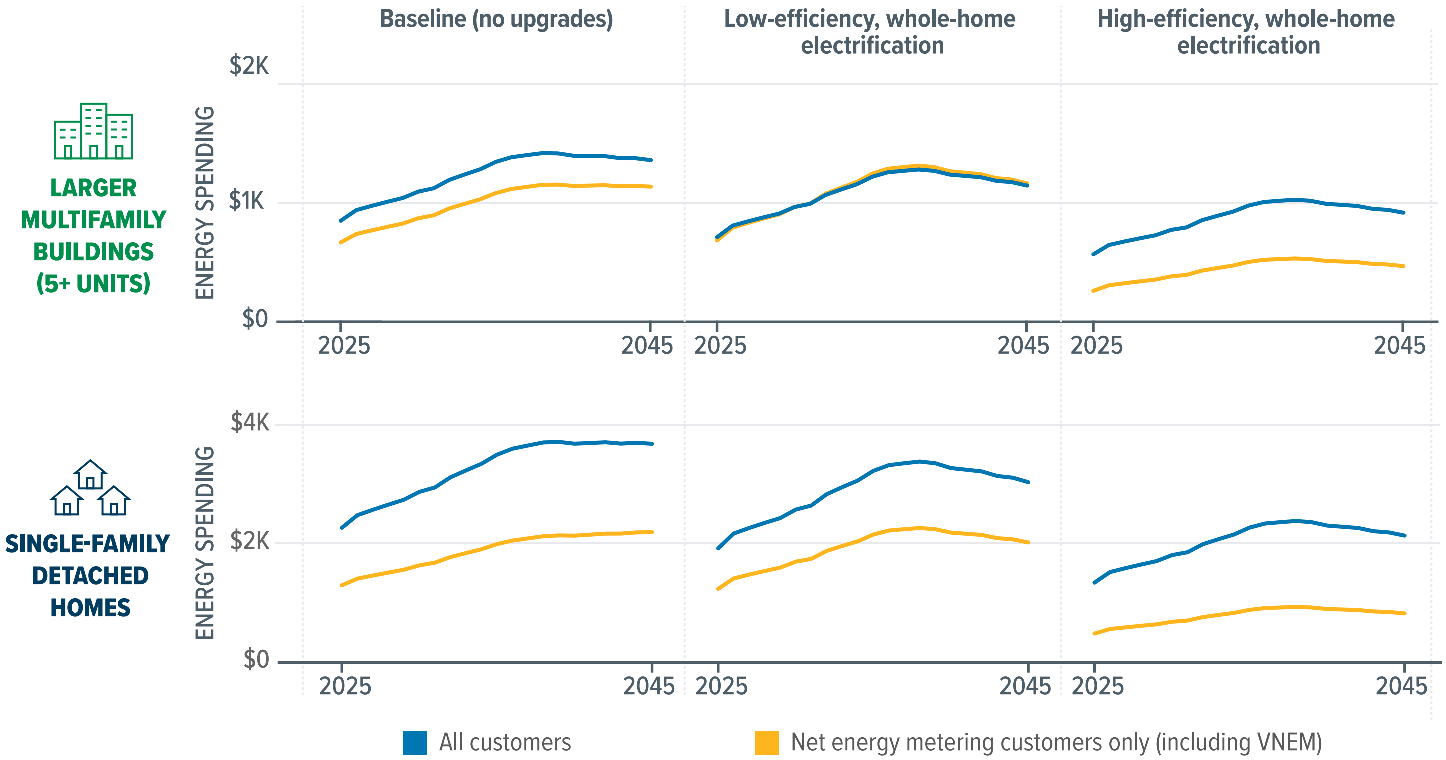
Finding: Solar installations and net energy metering magnify the benefits of efficient electrification.

Figure 13 compares energy spending for customers enrolled in net energy metering with the average across all customers. It shows that customers with net energy metering (including VNEM) generally have lower energy spending than the average. Again, the pattern differs for multifamily and single-family home residents and across upgrade scenarios. Single-family net energy metering customers spend less on energy than average across the shown electrification scenarios. For multifamily households, savings are still present (though less dramatic) for the baseline and high-efficiency, whole-home electrification scenarios, but essentially disappear with low-efficiency electrification.

These results highlight that solar installation and net energy metering provide mechanisms to limit electricity bills for customers, particularly in conjunction with efficient electrification. However, for multifamily households, low-efficiency electrification may effectively negate the benefits of net energy metering for residents, likely because solar allocation only offsets a small fraction of increased electricity consumption. Further, for multifamily households, the benefits would likely need to come through community solar, an expanded virtual net energy metering program, or another creative approach to provide solar to these households.

FIGURE 13

Energy spending:* Customers with net energy metering vs. all-customer average, 2025



*Includes natural gas and electricity for building use only (no vehicle fuel or charging)

6. L.A. CITY HOUSEHOLD ENERGY SPENDING AND BURDEN PROFILES

To further illustrate the energy spending and burden dynamics of home electrification, we designed seven archetypal household profiles to represent realistic circumstances through theoretical examples. As described in the methodology section, we selected the parameters to be roughly representative of typical households in Los Angeles. We include three apartments in larger multifamily buildings, three detached single-family homes, and one mobile home, all with varying income levels and energy consumption levels that correspond appropriately to income. Our goal was to represent a spectrum of residential customer types.

Figure 14 shows the details of the household profile design, including the annual household income, annual electricity consumption (in kilowatt-hours, or kWh), annual gas consumption (in therms), and whether the household is enrolled in LADWP's EZ-SAVE bill discount program. Figure 15 shows the 2025 energy spending and burden outcomes that the L.A. RESET Tool projects for each representative household across all upgrade scenarios, based on the inputs in Figure 14.

For the apartments, the pattern of savings across the different upgrades is all the same, but with different total spending levels. In all cases, minimum-efficiency heat pumps are the only upgrade that leads to increased spending and energy burden. The two other partial electrification measures (heat pump water heaters and high-efficiency heat pumps) lead to some small savings, with water heaters outperforming heat pumps for space heating and cooling.

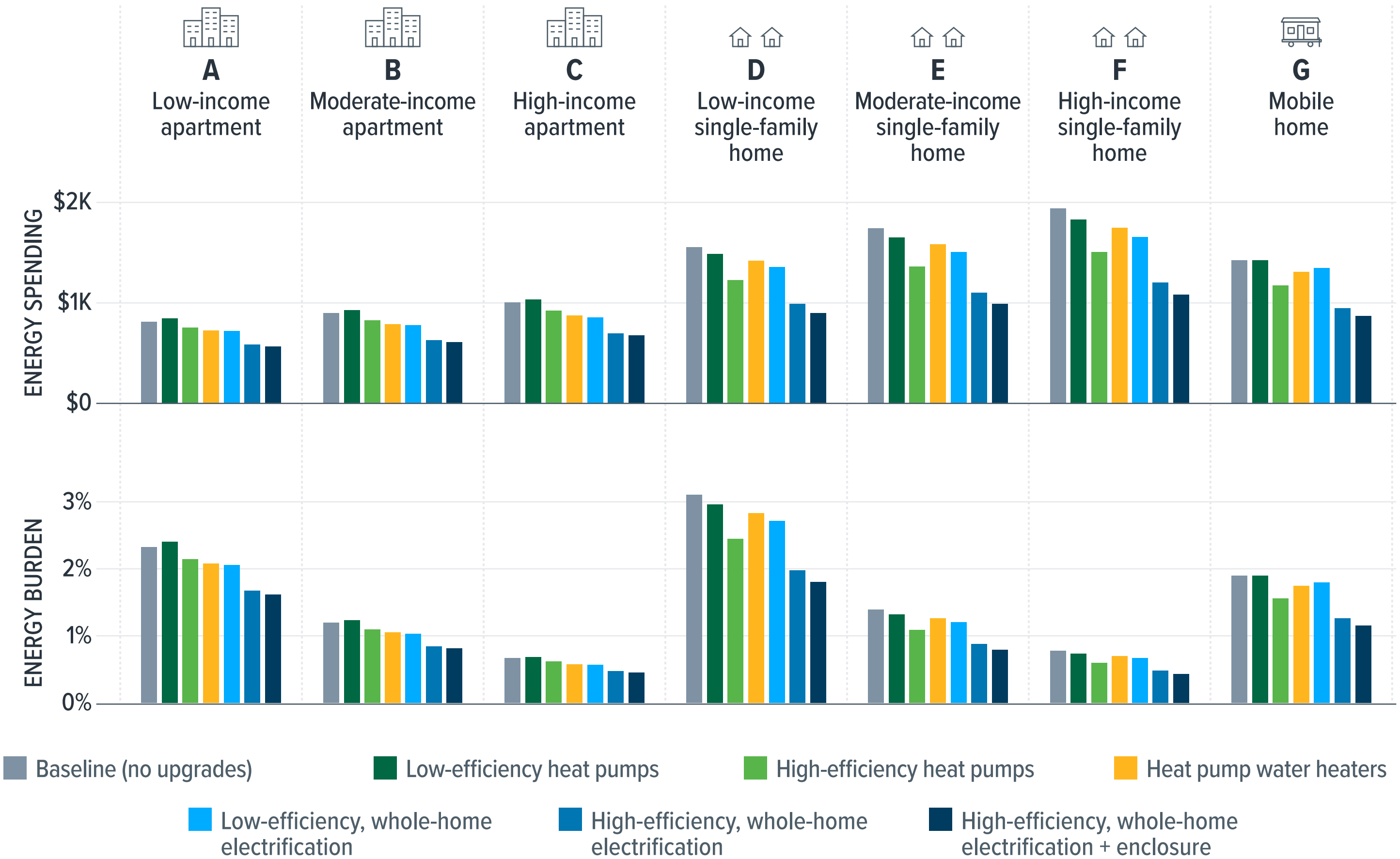
FIGURE 14

Household profile income, energy consumption, and discount program enrollment

	A Low-income apartment	B Moderate-income apartment	C High-income apartment	D Low-income single-family home	E Moderate-income single-family home	F High-income single-family home	G Mobile home
Annual Household Income	$35,000	$75,000	$150,000	$50,000	$125,000	$250,000	$75,000
Annual Electricity Use	2,500 kWh	2,700 kWh	3,000 kWh	4,200 kWh	4,600 kWh	5,000 kWh	4,000 kWh
Annual Gas Use	115 therms	145 therms	175 therms	350 therms	400 therms	450 therms	300 therms
Discount Enrollment	EZ-SAVE	NONE	NONE	EZ-SAVE	NONE	NONE	NONE

FIGURE 15

Household profile annual energy spending and burden* in 2025



*Includes natural gas and electricity for building use only (no vehicle fuel or charging)

Low-efficiency, whole-home electrification also brings slight savings. The biggest savings come from high-efficiency, whole-home electrification, particularly when paired with an enclosure upgrade.

For single-family detached and mobile homes, the pattern is fairly similar. The primary differences between these and the apartments are that low-efficiency heat pumps do bring some small savings, and the heat pumps for space heating and cooling outperform the heat pump water heaters. All of these patterns hold over time through 2045, as shown by Figure 15.

The same patterns appear when looking at energy burden, which is proportional to spending for each household. In the case of these archetypal example households, the energy burden is the highest for the low-income single-family home — these households have the lowest income relative to the amount of energy they use. For all profiles, energy burden is fairly low in 2025, with the highest being 3.1% for the low-income single-family home under the no-upgrade scenario. In 2040, energy burden peaks, reaching as high as 5% (again for the low-income single-family home).

7. CONCLUSION

This study arrives at several consistent findings. They hold whether we consider 2025 or 2035, single-family homes or multifamily homes. The primary finding is that most upgrades lead to lower energy expenditures and lower energy burdens for customers of the Los Angeles Department of Water and Power (LADWP). In nearly all cases, maintaining gas appliances leads to higher household energy expenditures. At the same time, details around electrification matter enormously. For example, we found that high-efficiency appliances can bring up to 20 times greater savings than low-efficiency ones, and that high-efficiency, whole-home electrification brings greater benefits than partial-home electrification.

Decision-makers must integrate a wide array of considerations into home electrification policy and program design. Our findings outline a clear, if general, policy strategy: City leaders must target specific household types with incentives for specific upgrades. This can enable many Los Angeles residents to benefit from the energy transition, rather than face major energy bill increases — which is especially critical for low-income residents.

That said, we want to emphasize the benefits we expect, based on the tool's outputs, to accrue to certain residential segments. In summary, estimated annual household savings from building electrification in 2025 are as follows:

- Larger multifamily homes (five or more units): $70 to $303 (up to 35% bill reduction; note that low-efficiency heat pumps are projected to increase spending)
- Single-family detached homes: $145 to $1,074 (up to 47% bill reduction)
- Smaller multifamily homes (two to four units): $23 to $533 (up to 50% bill reduction)
- Single-family attached homes: $25 to $546 in 2025 (up to 43% bill reduction)
- Mobile homes: $16 to $624 (up to 46% bill reduction)

7.1. Recommendations

Based on our findings, we offer several recommendations for how state and local decision-makers can plan for the equitable distribution of electrification benefits.

Recommendation 1. Prioritize high-efficiency appliances wherever possible. Across building types, choosing high-efficiency options rather than comparable low-efficiency ones leads to substantially higher savings. In 2025, the average annual energy bill savings due to a switch from low- to high-efficiency appliances can range from $100 to $575, leading to overall savings (relative to baseline) as much as 20 times higher in some cases.

Recommendation 2. Customize electrification programs to major building types. The building type where an energy customer lives hugely impacts energy consumption patterns and changes which affordability measures will be effective. For example, single-family detached homes generally see the highest energy savings from electrification measures ($145 to $1,074). However, other building types may see comparable savings relative to their overall spending (e.g., units in smaller multifamily buildings are projected to save 50% on their bills with high-efficiency, whole-home electrification plus an enhanced enclosure upgrade). Therefore, while electrification may be a promising affordability measure for many building types once completed, single-family detached households may be more able to offset the up-front costs of electrification with the larger absolute savings.

Recommendation 3. Consider on-bill financing where high annual savings are possible. For households that stand to save hundreds of dollars per year by electrifying — namely, single-family detached homes — on-bill financing could be a feasible way to cover up-front costs. On-bill financing provides households with zero-interest loans that are repaid through an extra charge on the electric bill, which high monthly savings may fully offset. There are many caveats to this, but ultimately, it is a creative, low-cost funding option to provide for households that need a bit less support and can expect enough ongoing savings to make it pencil out.

Recommendation 4. Use building enclosure improvements to account for increased cooling use. Our projections do not account for households using existing appliances more, or even starting to cool their homes for the first time, as a result of electrification (see Section 3.5 for a discussion of the rebound effect). This could lead to higher bills than shown here. Along with a focus on high-efficiency appliances, building enclosure improvements could be added to any of the appliance upgrades as a way to offset potential increases.

Recommendation 5. Don't expect households to cover up-front costs of electrification — provide substantial public funding. The costs of buying and installing electric appliances — especially high-efficiency options — are very steep. While our study does not assess these costs, it acknowledges the substantial literature that does (see Less et al., 2022). Even in the best case scenario, where ongoing bill savings are high enough to offset the up-front costs over the lifetime of the appliance, households have to both have the funds to pay for them and be willing to trust that the investment will pay off (or at least break even). But in many cases, the projected savings may not be high enough to make the investment an appealing financial decision for households. Local and state administrators and policymakers should strive to provide funding not only to incentivize but to enable households to electrify — especially those with low incomes. This is especially crucial as electricity rates increase throughout the energy transition, and it is important for these resources to be available as soon as possible.

7.2. Future Research Needs

As LADWP continues its energy transition planning and as updated data becomes available, we hope to update the results presented here. As we discuss in Section 3 (Methodology), the L.A. RESET Tool depends on a variety of data sources, some of which are inherently uncertain. For example, rate projections for both electricity and natural gas depend on a host of economic and political assumptions. To ensure the L.A. RESET Tool stays useful, its underlying data sources — and, where appropriate, its structure — should be updated at least every three years.

Beyond this, there are several interesting and useful directions for future research to build on and complement this study:

- **Expected life and net present value of upgrades:** As stated multiple times, we do not examine the up-front costs of upgrades. However, it would be useful to conduct a follow-up study that integrates our findings with cost data — as well as product lifetimes — to understand how electrification might affect households' pocketbooks overall. This would help policymakers and program designers to understand the exact level of subsidy or incentive that might be needed to make electrification economically advantageous.
- **Greenhouse gas and air pollutant emissions:** We have provided here a study of the ongoing financial benefits of residential electrification. But typically, these benefits are not the foremost factor motivating electrification from a social and public health standpoint. Climate mitigation benefits (reduced greenhouse gas emissions) and health benefits (reduced air pollution in homes and beyond) tend to be the most salient reasons for electrification. Quantifying the amount of both types of pollution avoided by each upgrade option would help to measure the overall impacts of each upgrade scenario. These benefits, while not directly financial, could join with the bill savings to offset upgrade costs from a societal cost perspective.
- **Broader geographic scope:** There are many ways that these results are geographically dependent. To apply findings outside Los Angeles would take substantial updates to this tool and additional data; however, it could lead to interesting, policy-relevant findings. The methodology used here could be applied in other cities, regions, states, or nationally to inform larger-scale decision-making.

8. REFERENCES

2022 Power Strategic Long-Term Resource Plan. (2023). Los Angeles Department of Water and Power. https://www.ladwp.com/sites/default/files/2023-08/2022%20LADWP%20Power%20Strategic%20Long-Term%20Resource%20Plan_0.pdf

Billimoria, S., Guccione, L., Henchen, M., & Louis-Prescott, L. (2021). Chapter 33: The Economics of Electrifying Buildings: How Electric Space and Water Heating Supports Decarbonization of Residential Buildings. In *World Scientific Encyclopedia of Climate Change* (Vols. 1–3, pp. 297–304). World Scientific. https://doi.org/10.1142/9789811213960_0033

Billimoria, S., & Lee, M. (2021, March 29). Eight Benefits of Building Electrification for Households, Communities, and Climate. *RMI.* https://rmi.org/eight-benefits-of-building-electrification-for-households-communities-and-climate/

Brady, J. (2025, April 24). Some Los Angeles fires victims are rebuilding their homes without gas appliances. *NPR.* https://www.npr.org/2025/04/23/nx-s1-5345817/la-fires-electrification

California Public Utilities Commission. (2014). *Decision 14-05-016: Order Instituting Rulemaking to Consider Smart Grid Technologies.* https://docs.cpuc.ca.gov/publisheddocs/published/g000/m090/k845/90845985.pdf

Deetjen, T. A., Walsh, L., & Vaishnav, P. (2021). US residential heat pumps: The private economic potential and its emissions, health, and grid impacts. *Environmental Research Letters*, 16(8), 084024. https://doi.org/10.1088/1748-9326/ac10dc

Ducroquet, S., & Osaka, S. (2025, April 14). Which home energy upgrades will save you money? We did the math. *The Washington Post.* https://www.washingtonpost.com/climate-environment/interactive/2025/home-efficiency-emissions-cost/

French, E. (2022). *Report on Equitable Building Decarbonization: Equity Focused Policy Recommendations for the City of Los Angeles.* https://www.climate4la.org/wp-content/uploads/2022/09/Report-on-Equitable-Building-Decarbonization-FINAL-September-15-2022.pdf

Gillingham, K., Rapson, D., & Wagner, G. (2016). The Rebound Effect and Energy Efficiency Policy. *Review of Environmental Economics and Policy,* 10(1), 68–88. https://doi.org/10.1093/reep/rev017

Kirk, C. (2021). *Los Angeles Building Decarbonization: Tenant Impact and Recommendations.* Strategic Actions for a Just Economy. https://www.saje.net/wp-content/uploads/2021/12/LA-Building-Decarb_Tenant-Impact-and-Recommendations_SAJE_December-2021-1.pdf

LA100 Plan Website. (2025, June 16). Los Angeles Department of Water and Power. https://www.ladwp.com/who-we-are/power-system/la100-plan

LA City Council. (2021). *Council File: 21-0352: LA100 / Strategic Long Term Resource Plan / 2035 100% Carbon-Free Energy / Los Angeles Department of Water and Power.* LACityClerk Connect Council File Management System. https://cityclerk.lacity.org/lacityclerkconnect/index.cfm?fa=ccfi.viewrecord&cfnumber=21-0352

LA Sanitation and Environment. (2025, March 24). *Report-Back on Council File 22-1402: Annual Community and Municipal Greenhouse Gas Inventory Reports.* LACityClerk Connect Council File Management System. https://cityclerk.lacity.org/lacityclerkconnect/index.cfm?fa=ccfi.viewrecord&cfnumber=22-1402

Modeling Affordable Multifamily Housing Retrofit Scenarios: California. (2025, February). *RMI*. https://rmi.org/wp-content/uploads/dlm_uploads/2025/02/CA_Retrofit_Scenarios.pdf

Moe, A., & Gibbs, P. (2023). *Equitable Electrification Analysis for Existing Buildings in Richmond, CA* (No. NREL/TP--7A40-86954, 1998661, MainId:87729; p. NREL/TP--7A40-86954, 1998661, MainId:87729). National Renewable Energy Laboratory. https://doi.org/10.2172/1998661

Pierce, G., Coffee, D., Sheinberg, R., Patterson, S., Trumbull, K., Dunlap, L., Sundar, S., Pugh, C., & Murillo, A. (2023). *LA100 Equity Strategies Chapter 13. Energy Affordability and Policy Solutions Analysis.* UCLA Luskin Center for Innovation. https://escholarship.org/uc/item/8h37k87j

Root, T. (2024, March 21). Emission Impossible. *Grist.* https://grist.org/buildings/electrify-home-improvement-decarbonize-solar-induction-heat-pump/

Ruddell, B. L., Cheng, D., Fournier, E. D., Pincetl, S., Potter, C., & Rushforth, R. (2020). Guidance on the usability-privacy tradeoff for utility customer data aggregation. *Utilities Policy,* 67, 101106. https://doi.org/10.1016/j.jup.2020.101106

Sheinberg, R., & Callan, W. (2025). *The Los Angeles Residential Energy Transition Tool Technical Handbook.* The UCLA Luskin Center for Innovation. http://innovation.luskin.ucla.edu/publication/the-los-angeles-residential-energy-transition-tool-technical-handbook/

Walker, I., Less, B., & Casquero-Modrego, N. (2022a). Carbon and energy cost impacts of electrification of space heating with heat pumps in the US. *Energy and Buildings,* 259, 111910. https://doi.org/10.1016/j.enbuild.2022.111910

Walker, I., Less, B., & Casquero-Modrego, N. (2022b). *The Costs of Home Decarbonization in the US.* https://escholarship.org/uc/item/2s4768d2

Weber, I., & Wolff, A. (2018). Energy efficiency retrofits in the residential sector—Analysing tenants' cost burden in a German field study. *Energy Policy,* 122, 680–688. https://doi.org/10.1016/j.enpol.2018.08.007

Yang, Y., Adhikari, R., Lou, Y., O'Donnell, J., Hewitt, N., & Zuo, W. (2025). Long-term impact of electrification and retrofits of the U.S residential building in diverse locations. *Building and Environment*, 269, 112472. https://doi.org/10.1016/j.buildenv.2024.112472

UCLA LUSKIN CENTER FOR INNOVATION

Informing effective and equitable environmental policy

innovation.luskin.ucla.edu