

Residential Building Electrification Overview

September 9, 2021 Sustainability and Climate Action Plan Ad Hoc Committee

In this white paper, City staff highlight the benefits of, and barriers to, residential building electrification, while summarizing current programs available to assist those who want to learn more.

Summary

In its impact analysis delivered to Council on April 19, staff and its consultant found single-family residential building electrification to be one of the lowest cost emissions reduction opportunities in the buildings sector. The same could not be said for multi-family buildings. Single-family building electrification technologies are readily available, but barriers exist, including limited contractor availability, the high up-front cost of retrofit projects, and lack of awareness of the need to electrify. The City already offers some services to spur residential electrification, including a comprehensive home electrification evaluation and heat pump water heater incentives. City staff is currently working to expand services to include incentives for all types of single-family appliances, on-bill financing, and direct installation or contractor training. The City also intends to expand its outreach and marketing, including potentially helping residents identify end of life dates for certain appliances so the City can remind them an appliance is coming to end of life and the services available to them to electrify.

Residential Building Electrification Goals

After transportation electrification, single-family residential building electrification represents one of the largest and most cost-effective opportunities to reduce emissions. Technologies are available now to electrify all residential uses. Electrification is already mandated for new homes, but at only 100-200 new home projects per year in Palo Alto, significant progress cannot be achieved without addressing retrofits for existing homes as well. Single-family homes represented roughly 10% of all 2019 City carbon emissions, or 14% when upstream emissions are included.¹

Multi-family buildings present a different challenge. The building electrification measures analyzed for the multi-family sector were estimated to be very expensive. This is because of the space and layout challenges of retrofitting multi-family buildings. As a result, staff's and the consultant's impact analysis did not show much emissions reduction from multi-family building electrification. However, staff does not assume that its analysis was exhaustive. More work needs to be done to identify opportunities to electrify in the multi-family sector. Staff is continuing to explore heat pump technologies that are well suited for multifamily buildings.

Single-family Building Electrification Technologies

Technologies exist to electrify virtually all appliances in single-family homes. By far the most cost-effective retrofits for existing homes are heat pumps to replace gas furnaces in homes with central air conditioning and heat pump water heaters to replace gas tank water heaters. Heat pump space heating retrofits in homes without air conditioning provide the benefit of space cooling during the summer months. Tightening the building envelope in the home by reducing thermal leakage can make space heating

¹ Upstream emissions represent leakage from the gas extraction and transmission systems before the gas is delivered to Palo Alto. The impact of upstream emissions is estimated at the 20-year global warming potential for all leaked fuels.

conversions even more feasible and lower electric bills. Fortunately, these types of appliance retrofits represent 70% to 80% of all gas usage in the single-family homes sector.

Electric appliances that can replace gas appliances include:

- Induction cooktops to replace gas cooktops
- Heat pump clothes dryers to replace gas clothes dryers
- Electrification of space heating in homes with radiant heating
- Electrification of water heating in homes with gas tankless water heaters

Staff understands that these other appliances can cost significantly more up front to electrify, either because the cost of the appliance is significantly higher compared to the cost of an equivalent gas appliance (e.g. induction cooktops, gas clothes dryers), or due to the need for major configuration of home heating systems or challenges with finding the physical space to install electrified replacements (e.g. electrification of radiant heating or gas tankless water heaters). However, electrification of these technologies can allow the homeowner to disconnect entirely from the gas system, and the savings associated with this disconnection is likely to make these appliances far more cost-effective longer term.

Additional Benefits to Home Electrification

There are other benefits to home electrification besides the associated emissions reductions. Reducing reliance on gas in a home reduces the risk of gas leaks. Electrified appliances do not have combustion by-products, leading to improvements in indoor air quality. The operation of electric equipment such as induction cooktops improves safety compared to the use of gas stove. And unlike gas appliances, electric appliances can be fueled by readily available electric backup solutions, such as solar, storage, or backup generators.

Barriers to Home Electrification

Despite the benefits, staff has identified a number of barriers to electrification of single-family homes. These barriers have become apparent through surveys, discussions with program participants, discussions with community members, and market research and outreach projects undertaken jointly with other utilities and environmental advocacy organizations.

- **Lack of awareness:** Many members of the community are unaware of the need to electrify their homes to combat climate change. Extensive outreach and engagement is needed.
- **Misconceptions and unfamiliarity:** People may be unfamiliar with the technologies available or why building electrification is important. One frequently encountered misconception, for example, is the assumption that electrification involves converting to electric resistance cooktops rather than induction cooktops. Another frequent misconception is that electric heating is less efficient than gas heating, which stems from a lack of familiarity with the efficiencies of heat pumps.
- **Fundamental disagreement on goals, facts, or forecasts:** People may simply disagree with the goal of electrifying residential buildings. They may believe that there are other cheaper alternatives than electrification, that the focus of electrification should be on businesses rather than residents, or that the cost of new technologies (e.g. synthetic natural gas) will lower, eliminating the need for building electrification.
- **Inconvenience:** Electrification retrofits are fairly involved. Even if people are made aware of the need to electrify, agree it is a worthwhile goal, and are given information on how to electrify, they may still simply not have the time, money, or capability to handle an electrification project.
- **Concerns about ability to keep specific gas appliances:** Some people are very attached to specific gas appliances, such as gas stoves. These residents may be willing to electrify some appliances, but

not all. This helps to reduce emissions, but could result in steadily increasing gas rates as the same infrastructure must be maintained with less revenue.

- **Concerns about upfront cost of conversion:** While building an all-electric home from scratch is cheaper than building a mixed-fuel home, retrofits are different. An average complete home electrification retrofit project can cost around \$25,000 and can cost significantly more depending on the home's layout. This makes financing and incentives critical to enable participation of more homeowners, particularly low-income community members.
- **Concerns about electric reliability:** Recent outages and the PG&E Public Safety Power Shutoff program have raised concerns about the reliability of the electric grid, which raises concerns about relying even further on electricity. While most gas appliances need electricity to operate (e.g. a gas furnace with a forced air fan system requires electricity to operate), it is easier to create backup power solutions for the electric components of gas appliances than fully electric appliances. This issue will need to be addressed. Electric reliability and backup power solutions have been included as a work item in the Sustainability and Climate Action Plan (S/CAP).
- **Cost of electricity vs. cost of gas:** Electric rates in Palo Alto are significantly lower than in PG&E territory, while gas rates are only slightly below PG&E. This means electrifying a home has less of an impact on a homeowner's energy bill than in PG&E territory. But a home electrification project still has the potential to increase a homeowner's electric bill. The electric utility's tiered electric rates (which increase with increasing electric usage) mean that an electrification project or purchase of an EV can put a homeowner into a higher tier of electric usage. All-electric rates or other alternative rate designs could relieve this issue. In addition, gas rates are expected to increase more rapidly than electric rates over the next decade, making electrification more cost-effective.
- **Lack of availability of contractors with expertise:** Because there is not yet a large market for home electrification projects, fewer contractors are familiar with the technologies. In addition, some technologies, like heat pump water heaters, require different certifications than their gas counterparts. Both a plumber and an electrician are needed for a heat pump water heater, while only a plumber is needed to install a gas tank water heater. This issue can be mitigated with contractor training programs and direct installation and group buy programs.
- **Different incentives for owners of rental property:** Renters who want to electrify cannot do so without the landlord's consent. Landlords do not have a financial incentive to electrify, and may find it inconvenient when they do not immediately, directly benefit from retrofits. On-bill financing and direct installation programs could remedy this issue by making electrification easy for the landlord while enabling pass-through of the financing charges to the renter. Additionally, it may help for landlords to understand that when re-renting a house or unit, they can use the benefits of an all-electric home as a "selling" point for potential tenants.

Services and Resources Available for Residents who want to Electrify

The City already provides some resources to help residents electrify:

- **Get a Home Electrification Evaluation from the Home Efficiency Genie:** The utility's award-winning [Home Efficiency Genie](#) program offers residents help over the phone in understanding their energy and water bills, evaluating new energy technology, and electrifying their homes. Residents can then follow up with a virtual home assessment (via video call) or an in-person house call. The Genie can provide efficiency and electrification recommendations and help with contractor selection.
- **Educational Resources:** Get information about the building electrification technologies on the City's [Electrification web page](#).
- **Heat Pump Water Heater Incentives:** The City offers [incentives for heat pump water heaters](#) and is currently working on expanding these incentives to other appliances and identifying funding for expanded incentive programs.

These programs have had limited uptake in part due to lack of awareness and the barriers listed above. Some of the new programs and services described below along with greatly expanded outreach and engagement should increase uptake for these voluntary programs and incentives.

List of all Goals and Key Actions Related to Residential Electrification

Below is a list of goals and key actions related to residential electrification. The wording of the key actions is abbreviated. See the Goals and Key Actions document for the full wording of each Key Action.

Goals:

- Electrify most single-family appliances
- Seek additional opportunities for commercial and multi-family electrification

Relevant Key Performance Indicators:

- Households that have electrified at least one appliance
- Number of fully-electrified single-family homes

Key Actions:

- C1. Enable any resident to receive guidance on reducing their building and transportation emissions
- E1. Launch comprehensive residential program services and incentives to promote voluntary electrification
- E3. Ensure low income residents can electrify and can maintain cost-effective gas heating if electrification is unaffordable or infeasible.
- E4. Develop electric rate options for electrified homes, EV charging.
- E5. Adopt an all-electric reach code for residential major renovations, new ADUs.
- C2. Complete study to identify additional key actions to achieve 80% reductions by 2030 (incl. study of multi-family building electrification)
- C5. Present options for Council consideration to accelerate emissions reduction activities in this Plan through mandates or price signals
- C6. Complete study of alternatives available to fund post-2025 key actions (e.g. carbon tax, parcel taxes, or other mechanisms)
- C7. Complete affordability study to identify vulnerable populations who may need help with electrification, subsidies needed.

New Services and Efforts Currently in Progress

Below is a list of new services currently in development. The code(s) at the beginning of each item ties to the S/CAP Goals and Key Actions and 3-Year Work Plan, and indicates the key action this activity implements. Staff is evaluating the resource needs to implement these programs. Not all can be implemented with existing funding and staffing.

- **Expanded outreach and engagement:** City staff is currently developing an engagement and outreach plan to build awareness in the community of the need for climate action and how building electrification can combat climate change.
- **Expanded sales, marketing, and persuasion efforts:** Utilities staff is developing dashboards and devoting more staff time to more closely track program participation and identify where more marketing is needed to raise awareness and generate leads for program participation, where customer experience needs to be improved, and where business processes need to be streamlined.

- **(C1, E1, E3) Program expansions:** Utilities staff is currently in negotiations with multiple 3rd party program providers to add new features to building electrification programs, which may include:
 - Online tools to help residents plan building electrification projects
 - Creating a one-call service for all electrification
 - Adding contractor training or direct installation services to the Home Efficiency Genie program
 - Putting in place an outreach program with the goal of creating a database of the location and age of existing gas-fired home equipment and appliances
 - Adding additional support for income-qualified customers
- **(E1) Expanded incentives:** Utilities staff is working on expanding its incentive program to a wider range of home appliances.
- **(E1) On-bill financing program development:** Utilities staff has been working with experts in the field of on-bill financing to create a roadmap to launch an on-bill financing program.
- **(E5) Expansion of All-Electric Reach Code to ADUs and major renovations:** The 2019 Energy Reach Code ordinance mandates all-electric design for residential new construction projects. Staff is developing a proposal for Council to expand this code to ADUs and major renovations.
- **(E4) All-electric rate development:** Staff is beginning a study of electric rates this fall and will be evaluating residential rate designs with an eye toward reducing barriers to electrification.
- **Permit streamlining efforts:** City staff from several departments are collaborating to streamline and shorten permitting processes for a variety of energy technologies, including electrification.
- **Pilot program for multi-family building electrification:** The City has received a grant to pilot mini-split heat pump space heating systems in a multi-family building in Palo Alto as a replacement for gas fired wall heaters.

2021-2024 S/CAP Implementation Plan: Other Service Additions and Studies Proposed

Below is a list of studies staff is planning to initiate. The code(s) at the beginning of each item ties to the S/CAP Goals and Key Actions and 3-Year Work Plan, and indicates the key action this activity implements.

- **(C2) Seek additional multi-family building electrification opportunities:** In its April 19, 2021 impact analysis staff and its consultant, AECOM, identified steps the community could take that would reduce community emissions to 72% below 1990 levels. Staff will do a study in the coming year to identify the remaining 8% emissions reductions to reach 80% below 1990 levels. Multi-family building electrification will be more closely evaluated as part of this study.
- **(C5) Evaluate additional long-term policies to encourage electrification:** Voluntary programs and outreach are an important first step to encouraging community electrification, but staff is also committed to bringing the Council ideas for additional steps the community could take to encourage electrification, such as mandates to replace appliances (either on burnout, at the sale of a home, or by a date certain). Carbon pricing is another possible approach. Staff would do a study of legal issues, administrative issues, and the impacts of these measures on the community before bringing any ideas forward for Council consideration.
- **(C6) Evaluate Additional Funding Sources for Community Electrification and Income-Qualified Services:** As larger numbers of people electrify their homes a substantial amount of additional funding will be needed. Staff and its consultant estimate the total cost of converting all single-family homes to all-electric homes would be over \$300 million. To the extent financing and incentives are needed to complete this effort, additional funding sources will be required.
- **(E7) Complete a study of reliability and resiliency needs for an electrified community:** Electric system resiliency and reliability will become even more important in an electrified community. Staff is doing some preliminary analysis of these issues this summer and will develop a work plan and resource needs for an expanded study, including evaluation of the role of solar and storage. On August 16, 2021 City Council directed staff to develop a plan for accelerating the exploration of expanded energy

storage systems and to identify the resources for staff to implement. This energy storage work plan will be under development in late 2021.

- **(C4) Evaluate staffing and business processes needed for community electrification:** While starting new programs and getting more residents to participate is the highest near-term priority, the City also needs to look ahead to identify the resources needed to handle greater numbers of home electrification projects.