

Bill Impacts of Home Electrification

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Research Question

The primary focus of this study was to answer the question:

“How does electrification impact residential energy bills?”

In a time of widespread affordability challenges, answering this question is paramount to understanding the impacts of scaling residential decarbonization.

This study focuses explicitly on:

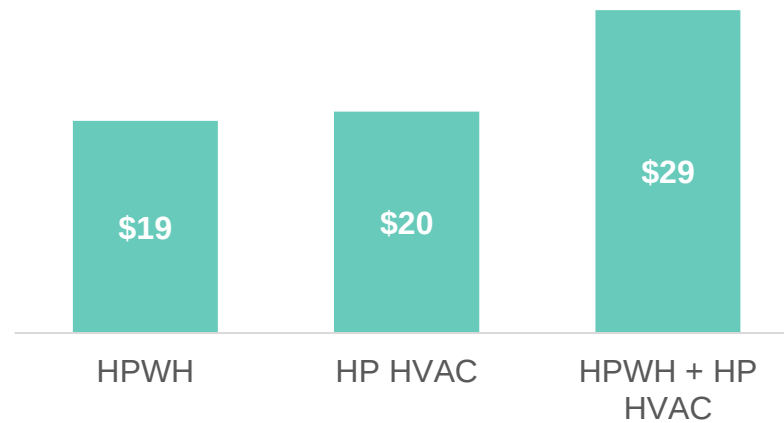
- Single-family homes
- Climate Zones 3 & 4 (Santa Clara and San Mateo Counties)

This study, [originally published in September 2023](#), has been updated multiple times to account for changes in electricity rates. Gas pricing forecasts change monthly and are a consistently moving target, so all updates reflect a “current snapshot”.

Summary of Findings

- **On average, a home saves \$30 a month by switching to heat pumps.**
- HPWH retrofits provide the **most consistent** bill savings of all modeled scenarios.
- HP HVAC retrofits see a **wider range** of bill impacts due to increased variables (technology, sizing, thermostat settings, etc.), but overall provide savings for most customers.
- Switching to an “electrification friendly” rate (E-ELEC or EV-2) **as quickly as possible** is key to unlocking savings. This makes **all household electricity use cheaper**, saving money.

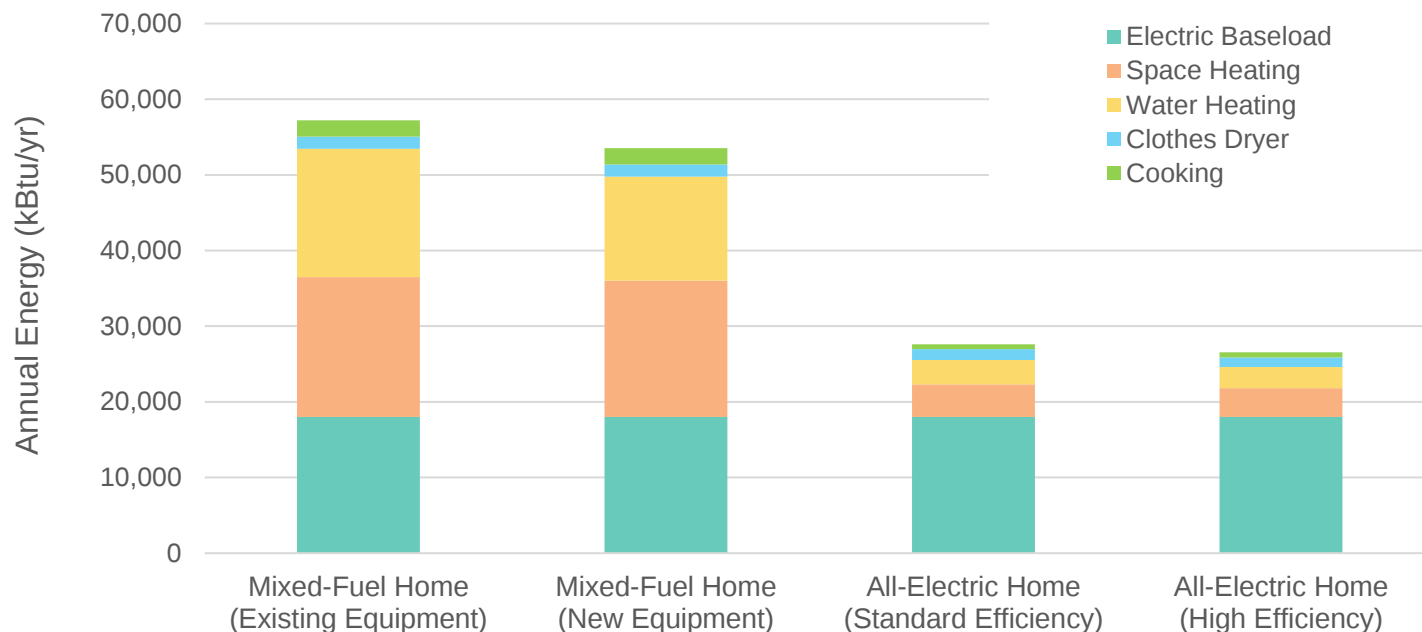
Average Monthly Bill Savings from
Home Electrification
(rates updated: 1/1/2025)



Note: Results include savings from electric rate optimization which lowers costs for all home usage. Therefore, savings do not stack linearly.

Annual Energy Comparison

Annual Energy Consumption by End-Use



Electrification reduces total site energy use by **nearly 50%**.

With carbon-free electricity, home emissions drop to zero, a reduction of **nearly 3 metric tons of CO₂ per year per home**.

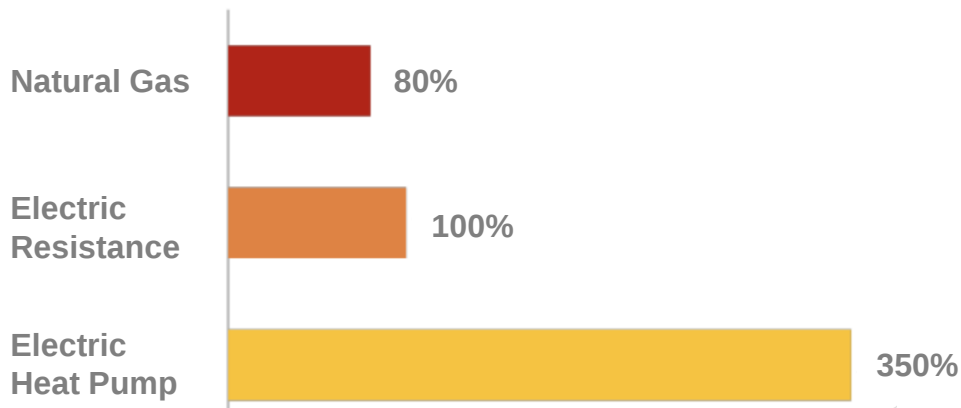
Why Electrification Saves Money

- Installing heat pumps or purchasing an EV unlocks access to rates with lower volumetric pricing (\$/kWh) – this makes **all electricity use cheaper** (lights, plug loads, A/C, existing appliances, etc.).
- Heat pumps *move* heat rather than *creating* heat – this makes them 2-3x more efficient than heating with gas or electric resistance.

A heat pump can create 3-4 kWh of heating for every 1 kWh of electricity consumed.

This leads to efficiencies **over 300%**.

Traditional Electric Resistance efficiency is limited to 100%, 3x less efficient than heat pump technology.



Factors that Could Lead to Bill Increases

Customers may experience bill increases in the following scenarios:

- Electrifies and remains on the wrong electric rate (e.g., E1 or TOU-C)
- Didn't previously have air conditioning before installing a heat pump
- Equipment on the wrong settings (e.g., HPWH on "Electric/Heater" mode)
- Additional new electric load added during remodel (e.g., new EV, expanded square footage with new lights and plug loads, deep freezer, etc.)
- Unusually low natural gas rates
- Climate zones much hotter/colder than Climate Zones 3 & 4
- Poor equipment sizing and installation (e.g., undersizing HPWH, old ductwork not replaced, relying on electric strip heating for HVAC, etc.)

Approach: Modeling Built on Real Customer Data



Annual gas and electricity usage based on real customer data to create a realistic “Baseline”



Hourly equipment energy profiles based on statewide modeling data and real equipment efficiencies



To be conservative, no load shifting was assumed for electric appliances



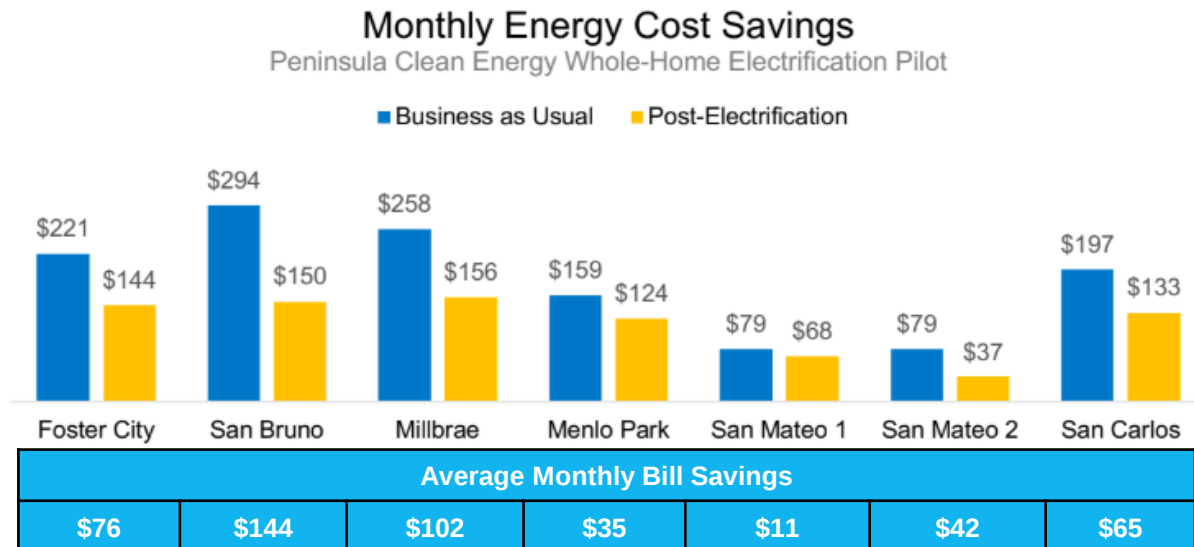
Detailed gas and electricity rates were applied to determine total annual energy bills

Validating with Real Customer Bills

Peninsula Clean Energy (PCE) fully electrified nine single-family homes in their service territory and is collecting 12 months of post-retrofit bill data.

Based on the [preliminary 7-month post-retrofit bill comparison](#):

- **Every home saved money** compared to what they would have paid on 2024 rates without electrification
- Average **\$60/month savings**
- Does not capture heating season, which is anticipated to increase bill savings



Note: Homes did not previously have air conditioning before installing heat pump HVAC systems.

Further Research Needed

Future analysis will also consider:

- Bill impacts of adding cooling to homes that previously didn't have A/C.
- Savings from replacing existing A/C with more efficient cooling systems.
- Difference in bill impacts for adding two-speed vs variable-speed HP HVAC.
- Additional value of load shifting to prioritize hours of lowest energy cost.
- Further bill savings potential from custom electrification rates available from SVCE.

Summary of Conclusions

- Home electrification typically results in average **bill savings of \$20-30 per month**.
- Switching to the E-ELEC or EV-2 rate **as quickly as possible** after installing heat pumps helps ensure bills don't increase.
- These "electrification friendly" rates with lower \$/kWh make **all home electricity cheaper**, saving money.
- Programming and behavioral changes to prioritize running equipment during lower-cost hours can help **provide even greater bill savings**.

APPENDIX

Approach: Detailed Summary

1

Total annual electricity and gas usage for the existing Mixed-Fuel home was **based on 2022 median SVCE customer metered data** for single-family homes.

2

Hourly load profiles (Btu/hr) are based on modeling data from the CPUC's [Database of Energy Efficiency Resources \(DEER\)](#) for space heating, water heating, cooking, and clothes drying.

3

Hourly gas appliance energy use was **normalized to align with [SVCE's 2019 Buildings Baseline Study](#)** to match total annual therms consumed per device (e.g., 211 therms/yr for space heating).

4

The same hourly load profiles were used to calculate electric appliance energy consumption based on equipment efficiency. To be conservative, **no load shifting was assumed**. Electric space heating efficiency was **derated based on 2022 historical weather data** and sample equipment performance curves from NEEP.

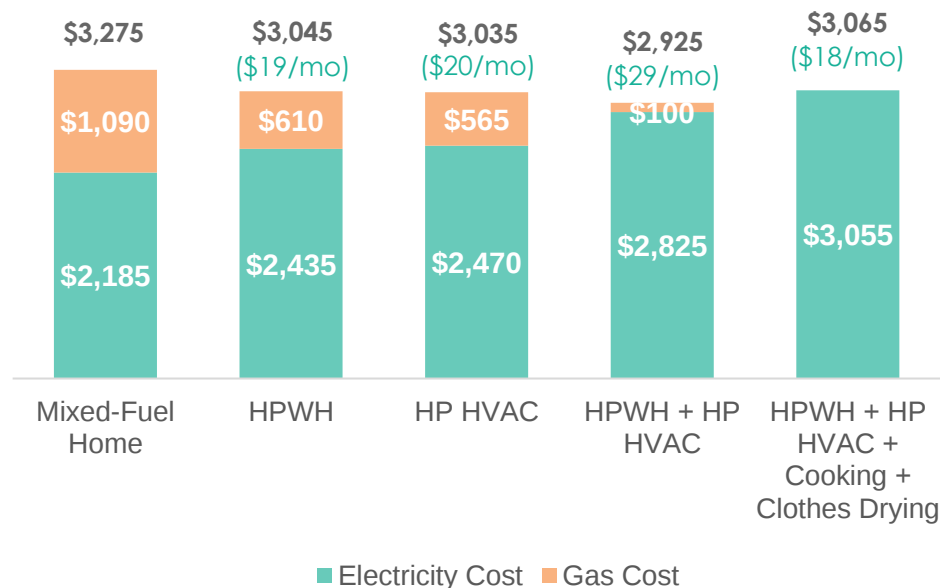
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Hourly electricity and natural gas consumption was combined with **detailed rate calculations and PG&E's latest 2025 gas cost forecast and 2025 electric rates** to determine total annual energy costs.

Summary of Findings (Detailed)

- Home electrification results in average **bill savings of \$20-40 per month** for most homes.
- HPWH retrofits provide the **most consistent** bill savings of all modeled scenarios.
- HP HVAC retrofits see a **wider range** of bill impacts due to more variables (type of equipment, size, thermostat settings, etc.), but overall provide savings for most customers.
- Switching to an “electrification friendly” rate (E-ELEC or EV-2A) **as quickly as possible** is key to unlocking savings and avoiding bill increases.

Bill Impacts of Electrification Scenarios
(rates updated: 1/1/2025)



Annual Usage Summaries

Annual Energy Usage	kWh	therms
Mixed-Fuel Home (New Gas Equip)	5,280	355
Mixed-Fuel Home (Existing Gas Equip)	5,280	392
All-Electric Home (Low Efficiency)	8,318	-
All-Electric Home (Std Effic)	8,044	-
All-Electric Home (Hi Effic)	7,778	-
Gas Furnace (New)	-	180
Gas Furnace (Existing)	-	185
Heat Pump Space Heater (Low Effic)	1,325	-
Heat Pump Space Heater (Std Effic)	1,261	-
Heat Pump Space Heater (Hi Effic)	1,112	-
Gas Water Heater (New)	-	137
Gas Water Heater (Existing)	-	170
Heat Pump Water Heater (Low Effic)	1,093	-
Heat Pump Water Heater (Std Effic)	937	-
Heat Pump Water Heater (Hi Effic)	820	-
Gas Clothes Dryer	-	16
Electric Clothes Dryer (Vented)	426	-
Electric Clothes Dryer (Ventless)	372	-
Gas Cooking	-	21
Electric Cooking	193	-

High-efficiency space and water heating equipment can save as much as 25% over low-efficiency devices.

This table reflects total annual usage, but *when* energy is consumed has significant implications - **using less electricity between 4-9pm increases customer savings** on most residential rates and provides greater grid-level emissions reductions.

Showing Our Work

	Mixed-Fuel	MF + HPWH	MF + HP HVAC	HPWH + HP HVAC	All Electric
Annual kWh	5,280	6,218	6,510	7,447	8,012
Annual Therms	392	222	207	38	0
TOU-C: Annual Cost	\$2,183	\$2,632	\$2,746	\$3,195	\$3,470
TOU-C: avg \$/kWh	\$0.413	\$0.423	\$0.422	\$0.429	\$0.433
EV-2: Annual Cost	\$2,079	\$2,434	\$2,471	\$2,826	\$3,057
EV-2: avg \$/kWh	\$0.394	\$0.391	\$0.380	\$0.379	\$0.382
E-ELEC: Annual Cost	\$2,212	\$2,561	\$2,627	\$2,977	\$3,195
E-ELEC: avg \$/kWh	\$0.419	\$0.412	\$0.404	\$0.400	\$0.399
Gas: Annual Cost	\$1,091	\$610	\$565	\$101	\$0
Gas: avg \$/therm	\$2.78	\$2.75	\$2.73	\$2.66	-
Post-Retrofit Costs on TOU-C:		\$3,242	\$3,311	\$3,296	\$3,470
TOU-C Post Retrofit Savings:		\$32	(\$37)	(\$22)	(\$196)
Rate Optimization Added Savings:		\$198	\$275	\$369	\$413
Net Annual Savings:		\$230	\$238	\$347	\$217
Avg Monthly Savings:		\$19	\$20	\$29	\$18

Key Takeaways:

- HPWH saves more therms per kWh added (hence slight bill savings even when staying in TOU-C)
- HP HVAC adds more kWh per avoided therm (slight bill increase when staying on TOU-C)
- HP HVAC adds more load during Winter Off-Peak TOU period, so optimizing to EV-2 or E-ELEC has a larger savings impact (as reflected in avg \$/kWh)
- The less gas consumed the cheaper it becomes since less above-baseline (tier 2) gas prices are activated

Methodology: Details

- A “hybrid” combination of real customer usage data (AMI) and modeled data
- Existing mixed-fuel baseload usage from AMI data
 - 5,620 kWh and 392 therms annually (space and water heating, cooking, and clothes drying)
 - Median SVCE 2022 single-family, non-NEM res customers on E-TOU-C (62k SAIDs)
 - Represents a median SFH size of 1,830 square feet
- Space & Water Heating: DEER database usage profiles
 - Natural-gas fired space and water heating equipment load profiles from CPUC database
 - Normalized annual gas appliance usage to align with SVCE AMI total usage data
 - Space Heating (COP=3.5) : 322 → 185 therms/yr
 - Water Heating (UEF=3.5): 167 → 170 therms/yr
 - Electric space/water heating appliance loads converted from gas profiles using COPs
- All-Electric SFH Usage Profile (Hybrid)
 - 8,660 kWh/yr (Code Min), 8,385 kWh/yr (Std. Effic.) & 8,120 kWh/yr (High Effic.)
 - Does not assume load shifting
 - Modeling accounts for Baseline usage (for both the All-Electric and Mixed-Fuel cases)
 - Includes A/C, plug loads, lighting, appliance fans and motors (e.g., dryer tumbler)

“Baseline” electricity use for this study comes from real customer metered data.

This is important because underestimating this usage can distort projected bill impacts of electrification.

Efficiency Assumptions

Assumption	Value	Data source
HPWH UEF (low efficiency)	3.0	Based on lowest available in the market
HPWH UEF (standard)	3.5	EnergySTAR, average of all EnergyStar HPWH (no derate)
HPWH UEF (high eff)	4.0	EnergySTAR, average of best in class EnergyStar HPWH (no derate)
Heat Pump Space Heater HSPF (Code Min)	8.8	Federal minimum efficiency (rating at 17F)
Heat Pump Space Heater HSPF (standard effic.)	11.7	COP = 3.5 equivalent (at 47F), derated via local weather data
Heat Pump Space Heater HSPF (high effic.)	13.3	COP = 4.0 equivalent (at 47F), derated via local weather data
Existing Tank Water Heater UEF	0.53	<u>EIA 2010 efficiencies</u> derated per <u>NIST NBSIR 78-1460</u>
New Tank Water Heater UEF	0.66	EnergySTAR
Existing Gas Furnace Efficiency	0.78	Pre-2015 D.O.E. minimum furnace efficiency standard
New Gas Furnace Efficiency	0.80	<u>U.S. Department of Energy minimum efficiency standards</u>
Percentage of dryer energy use that is from tumbler	10%	assumption

How were space heating systems derated?

- COPs were **calculated on an hourly basis** using 2022 hourly historical weather data for San Jose.
- COPs were derated via **linear interpolation** between their rated performance at 47°F and 17°F.
- COPs were capped at the 47°F rated performance for all heating hours with outside temperatures above 47°F **in order to avoid overestimating efficiency**.
- 17°F COPs for the “standard” and “high efficiency” scenarios were based on the median COP of 2.62 found in [Joule’s “Coming in from the cold: Heat pump efficiencies at low temperature” \(Sept 2023\)](#).
- 17°F COP for the Code-Minimum system was based on the Federal minimum efficiency requirement for the South-West region of 8.8 HSPF.

Heat Pump Space Heating Description	Rated COP at 47F	Rated COP at 17F	Net Annual COP
Code Minimum System	3.3	2.58	3.27
Standard Efficiency	3.5	2.62	3.43
High Efficiency	4.0	2.62	3.89

Energy Rate Assumptions

- Electric rates based on SVCE bundled rates (current as of 2/15/2025)
 - Includes:
 - PG&E Transmission and Distribution (T&D) rate components
 - SVCE Generation rate (4% discount to PG&E Gen rate), including PCIA and FFS
 - Used current electricity rates for all 12-months of the analysis (conservative approach)
- Gas rates based on PG&E Residential Gas Rate Forecast (Feb 2025)
 - Actual monthly rates: Jan-Feb 2025
 - Forecasted monthly rates: Mar-Dec 2025
- Baseline allowances incorporated based on PG&E Territory X
 - Represents 99.8% of SVCE customers
 - Represents 63% of PCE customers

Annual bill costs are most sensitive to fluctuations in gas prices, especially during the Winter season when space heating dominates usage.

Electricity Rate Details

TOU Period / Residential Rate	E1	TOU-C	EV-2A	E-ELEC
Winter Off-Peak	\$0.39499	\$0.45763	\$0.29844	\$0.33591
Winter Partial-Peak	\$0.39499	\$0.45763	\$0.46620	\$0.34923
Winter Peak	\$0.39499	\$0.48656	\$0.48240	\$0.37052
Summer Off-Peak	\$0.39499	\$0.49865	\$0.29816	\$0.38276
Summer Partial-Peak	\$0.39499	\$0.49865	\$0.49854	\$0.43763
Summer Peak	\$0.39499	\$0.57833	\$0.60724	\$0.59555

Notes: 1. Rates reflect 2025 SVCE Bundled Rates as of 2/15/2025, including PCIA and FFS charges

2. Generation rates reflect a 4% discount compared to PG&E for all rates

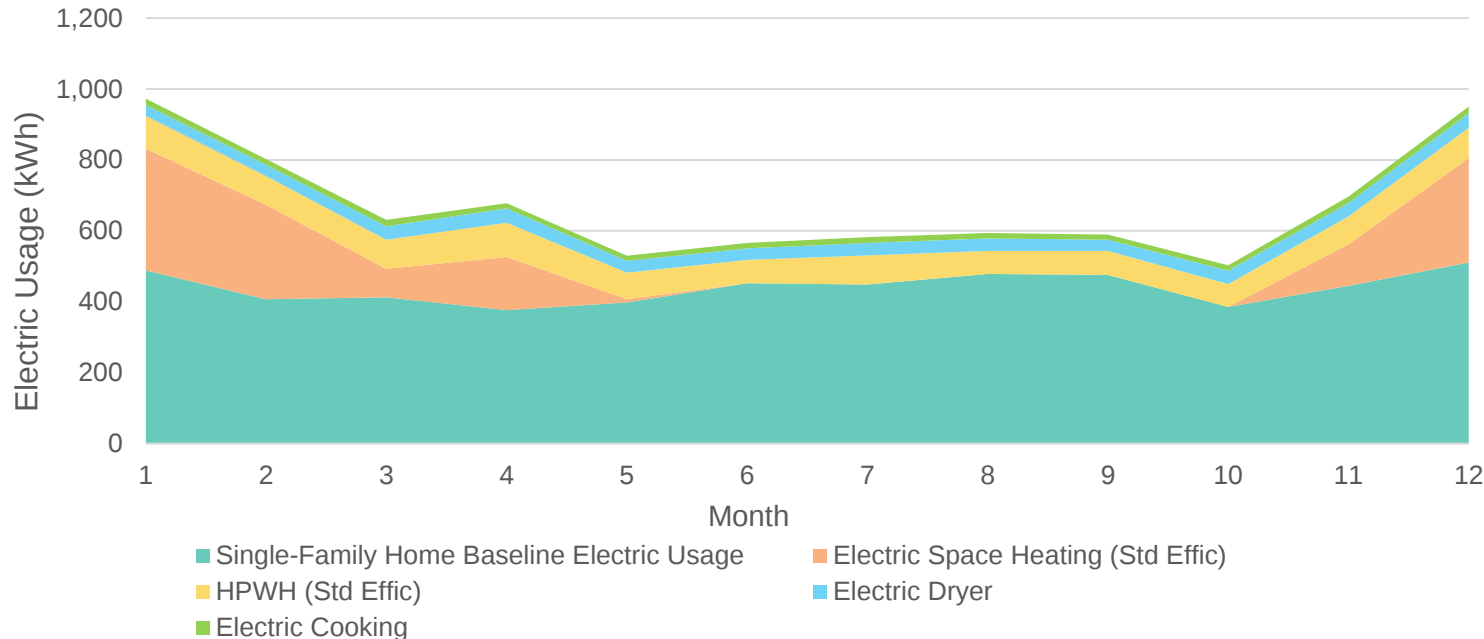
3. E-ELEC rate includes a \$15 monthly fixed customer charge

4. TOU = Time-of-Use

5. E1 and TOU-C include baseline and above baseline costs, as well as variations by end-use code, not shown above.

Annual Electric Usage Profile - All-Electric Home

All-Electric SFH Monthly Electric Usage
(Standard Efficiency)



Electrification increases total annual electricity consumption by **roughly 50%**.