A Customer-Oriented and Holistic Approach to Assessing Electrification Projects Using Cashflow Analysis

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ABSTRACT

With a shifting regulatory landscape and growing decarbonization goals, electrification is playing an increasingly prominent role in both utility programs and non-program projects. However, assessing fuel-switching measures from a customer perspective is complex due to factors like increased electricity demand, variable utility rates, accounting for load shifting, and potential front of the meter infrastructure upgrade costs. This highlights the need for more practical and transparent methods to quantify and communicate these impacts to different customers and other stakeholders. This research proposes using a cashflow-based approach, which is commonly used in sectors like solar and commercial financing for evaluating electrification packages, focusing on both financially vulnerable and market-rate customers. The method accounts for variations in utility rates, rebates, and financing options, providing a clearer picture of monthly bill impacts and project feasibility. This approach is most useful for forward-looking planning, such as identifying affordability gaps, setting incentive levels and better communicating the impacts of electrification projects to customers.

We applied this approach to high-rise multifamily buildings of varying vintages and customer types, and performed the analysis in five steps, 1) selecting electrification measures and assessing associated costs, 2) developing simulation models to estimate energy use, 3) applying different utility rate schedules to estimate annual energy costs, 4) quantifying project cashflow impacts, and 5) extrapolating results citywide. Key inputs for this analysis included incremental equipment costs, customer-specific rebate structures, rate schedules, projected energy savings, and financing terms. By evaluating monthly cashflow rather than just energy or emissions savings, this method provides a more holistic assessment of electrification's real-world impacts.

Ultimately, this approach offers a practical and customer-oriented framework that equips stakeholders with a more transparent and scalable way to evaluate the financial implications of electrification projects. While the method was applied to high-rise multifamily buildings in this study, its structure is adaptable across building types and program contexts. The example included illustrates how this framework can support more nuanced planning decisions, particularly in identifying affordability gaps and testing the impact of incentive or rate design options.

Introduction

Background and Motivation

The policy and regulatory landscape surrounding building decarbonization is undergoing a significant transformation. Jurisdictions across the country are increasingly adopting climate action plans, carbon reduction mandates, and electrification targets that prioritize the transition away from building equipment that relies on fossil fuel. These shifts have led to growing momentum around integrating electrification measures like electric space heating, domestic hot water systems, cooking and clothes drying equipment into energy efficiency programs.

Historically, energy efficiency programs have focused on reducing total energy consumption or peak demand, regardless of fuel type. However, with the introduction of greenhouse gas (GHG) reduction goals and environmental justice considerations, there is now stronger emphasis on fuel switching measures that replace equipment that uses fossil fuel with high-efficiency electric alternatives. This shift creates new complexities for program administrators and evaluators. Unlike traditional non-fuel switching measures, electrification increases the site's electricity bills, especially when time-of-use rates or peak demand charges are involved.

In this context, there is a growing need for new tools and approaches that can better assess the real-world financial and operational impacts of electrification, particularly at the customer level. The cashflow analysis proposed here is used in other sectors like residential solar, commercial financing, and energy retrofit projects to assess project-level affordability and financial viability. This approach is well positioned to help address some of the unique challenges associated with electrification that are highlighted above and are often difficult to capture using traditional evaluation methods. While not yet widely used in this context, we believe evaluators can play a vital role in advancing this type of assessment to support utility programs that are considering electrification. To support one of our clients in evaluating potential electrification packages for residential buildings, we conducted an analysis aimed at quantifying these impacts using a customer-oriented, cashflow-based approach.

Customer-oriented Approach

The cashflow-based approach presented in this paper helps address the complexities associated with examining electrification projects by incorporating the full spectrum of factors that influence a customer's monthly energy costs and overall financial experience. Specifically, the approach accounts for:

1. Reductions in gas consumption and increases in electricity use as a result of electrification.
2. The impact of different utility rate structures, including time-of-use (TOU), tiered, and fixed rates for both gas and electricity.
3. Special rates or protections available to financially vulnerable customers.
4. Customer-specific rebates and incentives, which can vary based on income qualifications or building characteristics.
5. Access to project financing, which influences monthly cash obligations and payback periods.
6. Infrastructure upgrade costs, such as electrical panel replacements or service upgrades required to support new electric end uses.

This comprehensive approach allows for a more granular and practical understanding of project impacts. The analysis ultimately produces a single net monthly cashflow estimate that reflects the added cost of electrification relative to a standard replacement scenario. While not always equal to the exact monthly bill or loan payment a customer would experience, this metric provides a customer-facing proxy for financial impact. It helps make electrification outcomes more tangible and relevant for customers, and more actionable for program designers.

In contrast to traditional cost-effectiveness tests like the Total Resource Cost (TRC), Program Administrator Cost (PAC), or Societal Cost Test (SCT), which are often conducted at the program or portfolio level, this method focuses on customer experience. While standard tests are useful for regulatory oversight and broad-level planning, they often fall short in capturing affordability, financing dynamics, and rate sensitivity, particularly for income-qualified customers. By offering insights at the project level, the cashflow-based approach provides program administrators and designers with a more nuanced understanding of what makes electrification feasible or attractive to individual customers. It can also inform optimal incentive design, ensuring rebates are sufficient to make projects cashflow-positive for a wide range of customer types without over or under incentivizing.

Cashflow Analysis Methodology

We propose a five-step analysis approach that integrates building performance modeling with financial analysis. This approach is designed to be transparent, replicable, and adaptable to different building types, customer segments, and utility contexts. Each step builds on the previous one to produce a clear and actionable estimate of the monthly cashflow implications of electrification packages.

Step 1 - Measure Selection and Cost Assessment

The first step in the analysis involves identifying the electrification measures to be evaluated and developing reliable cost estimates associated with their implementation. This step is foundational to the entire analysis, as the selection of measures and accuracy of cost inputs directly affect the usefulness of the final cashflow results.

Identifying Appropriate Electrification Measures

For users who do not already have a specific electrification project in mind, selecting the most appropriate measures requires an assessment of the existing building systems and an understanding of technically and economically viable replacements. These may include:

- Heating and cooling systems (e.g., converting gas-fired boilers or furnaces to cold-climate air-source heat pumps).
- Domestic hot water systems (e.g., replacing gas storage water heaters with heat pump water heaters).
- Cooking appliances (e.g., replacing gas ranges with induction cooktops)
- Clothes dryers and fireplaces, where applicable.
- Envelope upgrades (although not electrification measures themselves, these measures often complement other electrification measures by helping optimize equipment load).

To support this selection, users can reference published building decarbonization guides, potential studies, measure catalogs of different energy efficiency programs, technical reference manuals (TRMs), etc. Additionally, conducting walkthrough assessments or energy audits can help identify which systems are nearing end of life and are therefore most cost-effective to replace.

Estimating Incremental Measure Costs

Once appropriate measures are selected, users must estimate incremental costs[1]. In this analysis, incremental costs are estimated using the Replace on Burnout (ROB) assumption and are defined as the difference between the installed cost of the electrification technology and the baseline replacement that would have occurred otherwise. For example, if the baseline is a gas furnace replacement and the proposed measure is an air-source heat pump, the incremental cost is the added cost of the heat pump system compared to the gas furnace. To quantify the incremental costs in this scenario, users will need to estimate the equipment and installation costs of both the electrification technology and the baseline replacement. Sources of incremental cost data include quotes from local contractors, state or provincial TRMs, market research, etc. It is important to use regionally relevant data as installation and equipment costs can vary significantly by market.

The Replace on Burnout (ROB) assumption does not always align with how an individual customer experience costs. To make the methodology more customer specific, it is important to recognize that

[1] Incremental costs are defined differently by different programs and jurisdictions. We recommend calculating these values in accordance to whether a replace on burnout (ROB) or early replacement (ER) analysis is being analyzed.

users analyzing the early replacement scenario will need to estimate incremental costs by accounting for the age and condition of existing equipment and the costs of both standard and electrified options. While our case study applies a program-styles definition for consistency, the same methodology can accommodate customer specific costs when those inputs are available.

Estimating Available Program Incentives

Most electrification programs offer rebates or incentives that can reduce upfront customer costs. Users should research and apply any measure-specific incentives available to their project. This may include income-qualified rebates for low-income customers, equipment-specific rebates from utility or government programs, additional funding for enabling measures (e.g., panel upgrades). Program administrator websites, online rebate portals, or direct outreach to implementers can be valuable sources of up-to-date incentive values. Users must ensure the incentives applied in the analysis match customer eligibility and program requirements.

Accounting for Ancillary Upgrade Costs

In addition to the cost of the electrification measures themselves, many projects require infrastructure upgrades to accommodate new electrical loads. These may include electrical panel upgrades, wiring or circuit modifications, structural modifications (especially in older buildings), etc.

These upgrade costs can be highly site-specific, and often under- or over-estimated in early-stage analyses. When detailed project quotes are unavailable, users may apply average enabling cost estimates based on building type and age from published studies or past project data. Including these costs is essential to produce a realistic cashflow analysis and these costs should be developed using interviews with local contractors or performing literature reviews for existing studies that are most appropriate for the region.

Importance of Accurate Cost Data and Performing Sensitivity Analysis

Accurate and realistic cost inputs are critical to ensure that the cashflow outcomes of the analysis are meaningful. However, collecting reliable cost data can be challenging due to variability in project scope and contractor pricing, regional differences in labor and materials, uncertainty in future program incentive levels, etc. Given these challenges, it is often useful to perform sensitivity analyses around key cost drivers or to develop cost ranges (e.g., low/medium/high scenarios) when precision is limited.

Ultimately, the reliability of the proposed approach depends on the estimates developed in this step. While the cashflow model itself is flexible and transparent, its results are only as accurate as the assumptions about measure costs, rebates, and infrastructure requirements. Taking the time to develop defensible cost estimates either through real project data, stakeholder interviews, or validated references, ensures the accuracy and value of the analysis.

Step 2 - Building Simulation and Energy Use Estimation

Accurately quantifying the energy use impacts of electrification measures is central to any financial analysis. In this approach, we rely on building energy simulations to estimate changes in gas and electricity consumption resulting from electrification. These simulations offer several distinct advantages over simple deemed savings or annual consumption estimates. They offer 8760 hourly energy use values for both electrification and baseline scenarios. This allows users to apply customer-specific utility rates, including energy charges, demand charges, and non-volumetric fees, enabling a more accurate estimate of monthly bills and cashflow changes. Performing simulations also allows users to reflect local weather, building orientation, occupancy schedules, and control strategies, which are critical in evaluating technologies like heat pumps that have seasonal performance variations. Lastly, once these simulation models are built, they can be reused or adapted to assess a wide range of measure combinations and building scenarios. It is important to note that the analysis assumes no behavioral changes in response to electrification or time-of-use rate structures. Pre- and post-retrofit energy use profiles are based solely on equipment performance and building operation characteristics.

When building these models, users should take into account several key considerations. First, it is important to accurately input the building characteristics, including geometry, envelope performance (walls, windows, and roofs), infiltration rates, and thermal mass. The model should also reflect appropriate system configurations, representing both the baseline system (such as a gas boiler) and the proposed electrified system (such as an air-source heat pump), along with their respective distribution efficiencies and control strategies. Schedules and internal loads are also essential components, users should apply realistic occupancy, lighting, and plug load schedules tailored to the building type and customer segment being modeled. In addition, simulations should use location-specific weather data, typically in the form of typical meteorological year (TMY) files, to capture seasonal variations in energy demand. Given that these models help estimate the bill impact in both the baseline and electrification scenarios, they require a relatively higher level of rigor compared to what is typically used for energy savings calculations.

Users who wish to perform simulations should consider creating archetype models for different vintages or configurations (e.g., pre-1980 vs. post-2000). This will help reduce the resources needed for this analysis and provide a scalable foundation for the analysis. However, users who want to avoid performing simulations due to limited resources, can consider developing approximate hourly energy use profiles using estimates of annual energy consumption, deemed energy savings and load shape libraries. Ultimately, the choice between simulation and alternatives depends on the purpose of the analysis and the level of precision required. For project-specific decision-making or incentive design, hourly simulations offer greater accuracy and flexibility and are highly recommended. For high-level scoping or exploratory work, deemed data may be sufficient. Regardless of the method, the key goal of this step is to produce realistic estimates of gas and electricity usage for both electrification and baseline scenario, ideally at hourly resolution, that reflect the building context and customer type. These outputs feed directly into rate calculations in the next step and form the basis for evaluating financial performance.

Step 3 - Application of Utility Rate Structures

Once hourly energy consumption profiles for both the baseline and electrification scenarios have been established, the next step in the analysis involves applying customer-specific utility rate structures to estimate annual energy costs. The hourly load data generated in Step 2 allows for a highly detailed and accurate cost analysis, as it enables the calculation of energy bills using the same time- and demand-based structures that utilities use to bill customers. Rather than relying on average or flat rate assumptions, this approach directly aligns energy usage with the corresponding rate at each hour of the year, capturing the effects of time-of-use (TOU) rates, tiered pricing, demand charges, and other dynamic pricing mechanisms. This level of granularity is particularly valuable in the context of electrification, as it allows us to evaluate not only the total energy use, but also when that energy is used. For instance, the shift from gas heating to electric heat pumps may increase consumption during winter morning and evening periods that may coincide with higher TOU rates or system peaks. By accurately pricing energy usage hour by hour, we can better understand how these shifts are expected to affect the customer’s annual and monthly energy costs. This analysis also allows the us to consider the impact of different rate schedules on project finances and the simultaneous comparison of both electricity and gas rate schedules, which is something often overlooked in simplified economic evaluations.

An important consideration during this step is the proper selection and application of rate schedules both before and after the electrification project is completed. Customers may be on fixed, tiered, or TOU rates, and financially vulnerable customers may have access to discounted or alternative rates. In many jurisdictions, these customers benefit from lower per-kWh costs, bill protection programs, or reduced demand charges. Failing to account for these differences can skew results and lead to misleading conclusions about affordability or savings. Additionally, it's essential to understand the non-volumetric components of utility bills, such as fixed monthly charges or minimum bill thresholds, which may persist regardless of changes in consumption, and can significantly impact the net cashflow, especially for customers with low energy use.

In this step, the we effectively construct an energy bill calculator that mimics how a utility would bill the customer, applying the relevant gas and electric rates to the pre- and post-electrification hourly load profiles. While this process can be time-intensive, it provides a much more accurate estimate of the customer's financial experience than traditional average-rate methods. The result is a precise, bottom-up estimate of annual and monthly energy costs under each scenario, which directly feeds into the cashflow modeling in the next step. This allows for a more realistic and customer-oriented understanding of how electrification will affect energy affordability across a range of building types and customer classes.

Step 4 - Cashflow Analysis

We perform the cashflow calculations using the incremental costs electrification, energy efficiency rebates that projects can leverage, utility bill impacts of electrification compared to baseline gas equipment (calculated in previous step), and any project financing options. While these calculations do not represent a customer's total upfront cost, they offer a practical view of the additional financial burden or benefit associated with electrification compared to a conventional replacement.

This step yields a customer-facing metric that represents the estimated change in monthly cash obligations due to electrification. The cashflow results provide a clear picture of how electrification may affect a customer's monthly financial position by comparing changes in energy costs and the cost of financing the project over time. Specifically, we calculate the net monthly cashflow as the difference between the projected monthly energy savings (or increases) and the monthly loan payment required to cover the upfront cost of the electrification project. A positive monthly cashflow indicates that the customer is saving money each month, even after accounting for loan payments, making the project financially beneficial from the outset. A neutral cashflow suggests the customer breaks even, while a negative cashflow signals an increase in monthly expenses, which may be acceptable if offset by other benefits (e.g., increased comfort, emissions reductions, or long-term savings once the loan is repaid).

This approach allows users to assess project feasibility not just in terms of long-term payback or cost-effectiveness, but in terms that are directly meaningful to customers, how will this affect my bill each month? It also helps program designers determine the level of incentives needed to bring projects into a favorable cashflow range, especially for financially vulnerable customers, thereby enabling more targeted and equitable program delivery. We calculate project cashflows using the equations shown below.

Equation 1. Project Cost Calculation

$$PC = IMC + AUC \quad - Incentives$$

$$IMC = ML\ Cost_{Electrification} - ML\ Cost_{Gas\ Equipment}$$

Where,

PC	= Project Costs associated with electrification
IMC	= Incremental Measure Costs of electrification measures
AUC	= Ancillary Upgrade Costs associated with any infrastructure upgrades need to support electrification
ML Cost $_{Electrification}$	= Material and Labor costs associated with electrification

ML Cost $_{Gas\ Equipment}$ = Material and Labor costs associated with the like-for-like replacement of the existing gas equipment
Incentives = Available energy efficiency rebate.

Equation 2. Annual Energy Cost Savings Calculation

$$Annual\ ECS = Utility\ Bill_{Gas\ Equipment} - Utility\ Bill_{Electrification}$$

Where,
Annual ECS = Annual Energy Cost Savings associated with electrification.
Utility Bill $_{Gas\ Equipment}$ = Annual utility bill with baseline gas equipment.
Utility Bill $_{Electrification}$ = Annual utility bill after electrification.

Equation 3. Monthly Payment Value

$$Payment_{monthly} = \frac{\mathrm{PC} \times \mathrm{r} \times (1+r)^n}{(1+r)^n - 1}$$

Where,
Payment $_{monthly}$ = Monthly payment associated with a loan to finance the costs for implementing electrification.
PC = Project Costs associated with electrification.
r = Monthly interest rate of the loan.
n = Total number of payments (loan term in months)

Equation 4. Electrification Cashflow Calculation

$$Cashflow_{monthly} = \frac{Annual\ ECS}{12} - Payment_{monthly}$$

Where,
Cashflow $_{monthly}$ = Monthly cashflow associated with electrification.
Annual ECS = Annual Energy Cost Savings associated with electrification.
Payment $_{monthly}$ = Monthly payment associated with a loan to finance the costs for implementing electrification.

Step 5 - Scaling and Scenario Testing

Once cashflow results have been developed for individual customer types or archetypes, they can be scaled to understand broader impacts at the neighborhood, program, or city-wide level. The monthly cashflow outcome calculated for specific archetypes, such as different building vintages, configurations, and customer segments, can serve as representative values that are then weighted and extrapolated based on the distribution of building stock and customer demographics in the target geography. For example, if a city has 10,000 high-rise multifamily units built before 1980, and a simulation shows that retrofitting this archetype with a standard electrification package results in a negative $30 monthly cashflow for low-income tenants but a neutral outcome for market-rate tenants, this information can be used to estimate the total financial burden or benefit across the entire building segment. These estimates can also inform program administrators on how many customers may require additional incentives to reach affordability thresholds and which neighborhoods may need targeted outreach or deeper interventions.

There are several considerations users must keep in mind when scaling the results. First, archetypes must be carefully selected to reflect the actual diversity of building types and customer classes. Relying on overly simplistic or generic models may result in misleading aggregate impacts. Second, assumptions used in the original cashflow analysis, such as energy prices, incentive levels, financing terms, or usage patterns, may not hold uniformly across all customers or regions. Users should be cautious about applying results too broadly without sensitivity testing key inputs. Geographic differences in utility rate structures, housing stock, and infrastructure readiness can significantly affect the extrapolated outcomes.

Application of Analysis Methodology

We applied the cashflow-based analysis approach to assess the electrification potential of high-rise multifamily buildings in San Francisco that comprised of a total of 117 units. The goal of this application was to help assess the financial impacts of various electrification and energy efficiency packages on multifamily buildings, with special attention to affordability outcomes for financially vulnerable households.

In this analysis, the electrification measure packages were modeled under a Replace on Burnout (ROB) scenario. This means that equipment replacements were assumed to occur at the natural end of life, with incremental costs calculated as the difference between the cost of the electrified technology and the baseline replacement that would otherwise have been installed. It is important to note that this assumption implies that multiple end uses, such as water heating, space heating, and space cooling, are all replaced simultaneously. While this situation is unlikely to occur in practice, it provides a standardized way to compare electrification packages across building vintages and customer types. This methodology is also applicable to early replacement scenarios, but in those cases care must be taken in how incremental measure costs are defined. For example, if existing equipment still has significant useful life remaining, the baseline replacement costs may effectively be zero, which changes the calculation of incremental costs and the resulting cashflow impacts. Clarifying the replacement assumption and ensuring that incremental measure costs are applied consistently for producing meaningful results that reflect the customer-facing financial implications of electrification.

We began with developing measure packages tailored to common building types and vintages. We then estimated the incremental equipment and infrastructure upgrade costs for each package, and identified the applicable rebates, including those specifically targeted at financially vulnerable households. We leveraged the building simulation models we developed for our previous non-residential reach code alteration study, to estimate the electrification and baseline hourly energy use profiles (TRC Reach Code 2021). These hourly energy consumption results were paired with utility rate structures to estimate changes in utility bills and monthly cashflows.

To reflect the diversity of the building stock, we developed representative electrification scopes for multifamily prototypes across four vintage categories: pre-1950, 1950–1980, 1980s, and 1990–present. Notably, older buildings were modeled without existing cooling systems, while the newest vintage included central air conditioning as part of the baseline. These assumptions significantly influenced the energy and utility bill impacts of electrification, particularly in relation to the added benefit of cooling. Cooling was included in the baseline for post-1990 buildings based on a review of program participation data and local building stock characteristics. In San Francisco, cooling is not common in older multifamily buildings, but it is prevalent in newer construction due to changing customer expectations and evolving construction practices.

Table 1 below shows the electrification scope. This analysis focused on HVAC and hot water end uses because they account for most of the annual energy consumption and Greenhouse GAF (GHG) emissions of MF dwelling units. Attic and wall insulation measures were selected to support 1) reducing heating and cooling load for improved comfort, performance, and energy cost, and 2) reduce equipment rated size to minimize impacts on electric panels and minimize upsizing utility service lines.

Table 1. Electrification Scope

Measures	Performance	Applied When
Packaged terminal heat pump (PTHP)	SEER = 14, HSPF = 8	Existing Hydronic* or Steam† Boiler Serving baseboards. Existing PTAC**
Central heat pump water heater with storage (HPWH)	UEF = 3.0	Always
Attic insulation	R30	R-11 (Pre 1980 Vintages) R-16 (1980s Vintage) R-19 (1990-Present Vintage)
Wall insulation	R13	R-5 (Pre 1980 and 1990-Present Vintage) R-6 (1980s Vintage)

*Applied to 1950-1980, 1980s, 1990-Present.
†Applied to Pre 1950s vintage.
**Applied to 1990-Present

Hourly outputs from the simulation models were analyzed using Clean Power San Francisco (CPSF)[2] electric rates. We used CPSF's E-TOU-C rate schedule for the baseline scenario and the E-ELEC rate schedule for the electrification scenario. E-TOU-C is a standard time-of-use rate with three pricing periods, peak, off-peak, and partial-peak, designed to encourage load shifting to off-peak hours. E-ELEC is a newer electrification-focused rate that offers lower volumetric charges to support electric space and water heating but includes a higher fixed monthly service charge.

Table 2 below shows the results of the analysis we conducted to apply the appropriate utility rate structure to hourly energy consumption profiles. Each building scenario was evaluated under both Regular CPSF rates and California Alternate Rates for Energy (CARE) rates to isolate the impact of rate structure on monthly cashflow outcomes, with CARE rates representing households earning less than 80% of Area Median Income (AMI). We also broke out the results by cooling and non-cooling end uses to better understand the impacts of electrification in instances where the air conditioning was not included in the existing building characteristics. "Cooling" values refer to the portion of energy costs associated with meeting the building's cooling load, while "non-cooling" includes all other electric and gas end uses (e.g., space heating, water heating, lighting, and appliances). These values are estimated by first calculating the energy costs attributed to cooling through simulation outputs, then subtracting those from total building energy costs to estimate the non-cooling portion. Due to interactions between end uses and limitations in simulation granularity, these estimates should be interpreted directionally rather than as precise disaggregation.

Our findings indicate that, after implementing the electrification measures, annual utility costs for residents on Regular rates increased by approximately 1% for packages that excluded cooling and by 4–5% when cooling was included. CARE rate customers saw slightly higher percentage increases, about 3–4% without cooling and 7–8% with cooling, though the absolute dollar changes in monthly bills were similar due to lower baseline rates. This difference is primarily due to how the CARE discount is applied. Specifically, under the E-ELEC rate schedule used post-electrification, the CARE discount does not apply to the base service charge, which limits the potential savings compared to the pre-electrification E-TOU-C rate schedule, where the CARE discount covers a larger share of the bill.

Table 2. Impact of Electrification on Annual Energy Costs per building by End Use and Vintage

End Use	Regular Rates	CARE Rates

[2] Clean Power SF (CPSF) is San Francisco's publicly managed Community Choice Aggregation (CCA) program, run by the San Francisco Public Utilities Commission. CPSF sets the generation rates applicable to enrolled customers, such as tiered rates (e.g., E-1/E-1L), time-of-use plans (e.g., E-TOU-C), and electrification-focused rates like E-ELEC.

	Pre 1950s	1950-1980	1980s	1990-Present	Pre 1950s	1950-1980	1980s	1990-Present
Baseline Non-Cooling Energy Cost	$232,000 - $230,000				$148,000 - $146,000			
Baseline Cooling Energy Cost	$0			$8,000	$0			$5,000
Electrified Non-Cooling Energy Cost	$234,000 - $233,000				$153,000 - $152,000			
Electrified Cooling Energy Cost	$8,000 - $7,000				$5,000 - $4,000			
Percentage Increase in Annual Energy Cost (Non-Cooling)	**1%**				**3% - 4%**			
Percentage Increase in Annual Energy Cost (Total)	**4% - 5%**			**1%**	**7% - 8%**			**4%**

We then performed the cashflow calculations by taking into account the incremental costs, energy efficiency rebate amounts, and project financing costs associated with the electrification packages. TRC estimated the incremental costs for the different measures included in the packages based on secondary data sources and prior research we had conducted. We estimated the rebate amounts that building owners can leverage by using offerings from BayREN's Bay Area Multifamily Building Enhancements (BAMBE) program. We used historical data from GoGreen Home Energy Financing Program[3] to determine the terms for financing electrification upgrades. The analysis assumed a 15-year loan term at a 4.99% interest rate. It should be noted that these terms vary over time and can be different for each building owner.

Table 3 below shows the results of the cashflow analysis. A negative value in the Monthly Energy Cost Savings rows indicates an increase in monthly energy costs post electrification while a positive value indicates cost savings. The total monthly cashflow values are the sum of monthly energy cost savings and the equipment debt service costs. A negative value implies that the total loan payment is greater than any energy cost savings associated with electrification. The monthly cashflow payments are associated with the entire term of the loan, which is 15 years or 180 months. The monthly energy cost associated with non-cooling loads are expected to increase by $1-$4 post-electrification and the newly installed cooling is expected to increase monthly energy costs $4-$6 when averaged over the year. For buildings that already have AC (1990-Present), the costs associated with cooling energy for residents on Regular rates is expected to reduce by $1 and not change for residents on CARE rates.

The equipment debt service costs make up majority of the monthly costs associated with electrification and are expected to impact the landlord or the residents (if the building owner were to pass through the costs of the upgrades onto the tenants). These costs range from $0-$79 per month and vary based on the vintage and income group. This analysis assumes that the residents on CARE rates will also be eligible for the higher equity rebate amounts that will offset the equipment costs more. Therefore, the debt service costs for residents on CARE rates are expected to be lower. The analysis assumes that for the 1990-Present vintage a like-for-like upgrade of the baseline equipment would include an update of the existing AC unit which would effectively eliminate the incremental costs associated with purchasing the heat pumps for space conditioning. The combination of higher rebate amounts and the lower incremental costs for the 1990-Present vintage completely offsets the total incremental costs for residents on CARE rates, and there is no equipment debt service cost for them.

[3] This is a state administered program that is funded by investor-owned utility rate payers and offers favorable terms for financing energy efficiency upgrades, solar and battery storage and EV chagrining

The total incremental monthly cashflow varies between $4-$86. Residents in 1990-Present buildings and on CARE rates are expected to see the lowest increase in monthly payments and those that in Pre-1990 buildings on Regular rates are expected to see the largest increase.

Table 3. Impact of electrification on Monthly Cashflow ($) and Monthly Energy Cost Savings by End Use and Vintage per dwelling unit – Regular and CARE Rates

End Use	Regular Rates				CARE Rates			
	Pre 1950s	**1950-1980**	**1980s**	**1990-Present**	**Pre 1950s**	**1950-1980**	**1980s**	**1990-Present**
Monthly Energy Cost Savings* (non- cooling)	($1)	($1)	($2)	($2)	($3)	($3)	($4)	($4)
Monthly Energy Cost Savings* (cooling)	($6)	($6)	($6)	$1	($4)	($4)	($4)	$0
Equipment Debt Service†	($79)	($76)	($76)	($28)	($44)	($42)	($42)	$0
Total Monthly Cashflow	**($86)**	**($84)**	**($84)**	**($29)**	**($52)**	**($49)**	**($50)**	**($4)**

* Typically borne by tenants in multifamily buildings.
† Typically borne by building owners in multifamily buildings.

Cashflow Extrapolation Citywide

To explore citywide implications, we extrapolated the pre-dwelling results across the multifamily housing stock in San Francisco. This extrapolation was based on a Replace on Burnout (ROB) assumption, meaning that all end uses were modeled as if they reached end of life were replaced simultaneously. While this is unlikely to occur in practice, it provides a consistent framework for scaling the analysis across the building stock. Under this assumption, the aggregate net present value (NPV) of costs over the 15-year loan period was estimated at $1.04 billion for Regular rate customers and $441 million for CARE rate customers. These values should not be interpreted as precise citywide cost outcomes, but rather as illustrative of the order of magnitude of impacts that could occur under an all-ROB scenario. In reality, building stock would experience a distribution of incremental measure costs depending on whether equipment is replaced at burnout or earlier in its useful life, which would affect results.

The strength of this methodology is that it can be adapted to reflect different replacement assumptions and distributions of increment costs, thereby offering program administrators and policy makers a flexible tool for testing scenarios and planning incentive levels.

Conclusion

The paper presents a customer-oriented methodology for assessing the financial impact of electrification projects using a cashflow based approach. By focusing on monthly cash obligations rather than traditional energy savings metrics alone, this method helps bridge the gap between technical performance and customer affordability, an increasingly important consideration as electrification becomes a more prominent strategy in decarbonization efforts. This approach enables stakeholders to better understand how electrification may influence a customer's day-to-day financial experience, and offers a practical tool for evaluating project-level outcomes, incentive design, and equity considerations.

This methodology has broad applicability and can be used to support planning-stage decisions for utility programs, evaluate affordability gaps across customer segments, or inform policy design in jurisdictions seeking to scale electrification equitably. The approach is particularly well suited for analysis at the building archetype level, where sufficient data can be collected to define high quality estimates of costs, rates, and operating characteristics. While not intended to provide highly granular forecasts for individual customers, it offers actionable insights when applied to portfolios of buildings or customer segments with similar characteristics. It should be noted that the results reflect incremental project costs rather than total installed costs. This choice aligns with how many programs define cost-effectiveness and rebate eligibility but also means that monthly cashflow results do not represent a customer's full out of pocket burden. As such, interpretation of these results should remain grounded in the context of the baseline scenario assumed, typically a like-for-like equipment replacement at end-of-life.

As utilities and regulators seek to accelerate electrification while maintaining affordability and equity, methods like the one presented here can help fill an important gap. By bringing customer cashflow into the evaluation process, this approach offers a tangible, transparent way to understand and communicate the real-world implications of electrification for both customers and program designers.

References

TRC and P2S Engineers, 2021. "2021 Reach Code Cost-Effectiveness Analysis: Non-Residential Alterations."