Market and Technical Evaluation of Combination Washer-Dryer Units for Multifamily Buildings

Final Report

ET25SWE0009

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Executive Summary

Laundry is a difficult to decarbonize end-use in multifamily buildings in California, with limited adoption of high efficiency electric equipment, especially heat pump clothes dryers. The recent market entrance of 120-volt combination washer and heat pump dryer technology introduces new potential opportunities for decarbonizing laundry in multifamily buildings. Prior research indicates that most multifamily buildings have shared laundry facilities, with most dryers fueled by gas. This CalNEXT market study evaluated the opportunity for the adoption of in-unit 120-volt combination washer/heat pump dryer units within the California multifamily housing market to accelerate laundry decarbonization.

Key Findings

- **Technology Overview and Features:** There are three manufacturers producing ENERGY STAR® certified units, and they average $3,000. There are several features of the technology that differ from standard electric stand-alone washer/dryer sets, and even stand-alone heat pump dryers, that collectively deliver flexibility and position themselves well for the multifamily market, including: 120-volt plug in, ventless moisture removal, smaller drum size, and user flexibility stemming from the elimination of switching laundry loads.
- **Heat Pump Drying Performance and Perceptions:** While heat pump drying technology is significantly more efficient than conventional electric, it also takes longer to complete a drying cycle, contributing to reduced market uptake. Across the market there is low familiarity, negative perception, and low user satisfaction rates. Prior research indicates that limited firsthand experience with, and low awareness of heat pump drying technology remain significant barriers to adoption.
- **California Multifamily Housing Laundry Landscape:** Laundry configurations in multifamily buildings vary widely among vintage, size, and resident income levels. Generally, instances of in-unit laundry, or at least hook ups, in new construction have been increasing over time. Additionally, as resident income levels increase, the skew towards in-unit laundry increases, leading to affordable housing more often having on-site shared facilities while the market rate multifamily housing and the condo market are more likely to have in-unit configurations by default. Residents of multifamily affordable housing shared mixed preferences for in-unit versus shared facilities, highlighting the accessibility and convenience of in-unit appliances but emphasizing the cost savings of shared facilities.
- **Market Barriers and Opportunities:** This technology presents an opportunity to provide laundry appliances in space-constrained locations, increase accessibility, and bolster heat pump drying technology adoption in multifamily buildings. Meanwhile, barriers to in-unit adoption across the current multifamily market, particularly in affordable housing, include third-party appliance ownership, existing central laundry facilities, and the risk of resident energy cost increases or cost-shifting issues stemming from resident-paid utility meters in buildings where owners currently pay for laundry energy use.

Recommendations

- **Improve Education and Increase Awareness of the Technology**
  Invest in education and marketing regarding combination units and the specific features that make them a favorable solution for the multifamily market.

- **Provide Robust Equipment Warranties to Ensure User Satisfaction and Reduce Ownership Hesitancy**
  Provide robust equipment warranties, clear routine maintenance instructions, and installation support to instill confidence in the quality and longevity of the appliances and incentivize building owners to provide these units in residences.

- **Design Future Demonstration Projects to Target Resident and Building Ownership Models**
  Within a future technology demonstration project, both resident and building owner ownership models should be tested to better inform additional barriers, realizations, and incentive program design.

- **Integrate Combination Washer/Heat Pump Dryer Units into California Incentive Programs**
  Facilitating the technology's inclusion in the California Technical Reference Manual will enable program eligibility, which will therefore accelerate adoption and reduce upfront costs.

Abbreviations and Acronyms

Acronym	Meaning
Amp	Ampere
CARB	California Air Resource Board
CBO	Community-based organization
CEF	Combined energy factor
CO2e	Carbon dioxide equivalent
CPUC	California Public Utility Commission
EPA	U.S. Environmental Protection Agency
GHG	Greenhouse gas
IMEF	Integrated modified energy factor
IOU	Investor-owned utility
IWF	Integrated water factor
kWh	Kilowatt-hour
LMI	Low- to moderate-income
MMBtu	Million British thermal units
NEEA	Northwest Energy Efficiency Alliance
NLR	National Lab of the Rockies
NREL	National Renewable Energy Laboratory
PG&E	Pacific Gas & Electric
RECS	Residential Energy Consumption Survey
TRM	Technical reference manual
TSB	Total system benefit

Acronym	Meaning
V	Volt

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Introduction

Laundry is a difficult to decarbonize end-use in multifamily buildings in California, with limited adoption of high efficiency electric equipment, especially heat pump clothes dryers. Laundry is often overlooked or deprioritized during upgrades and projects compared to other end uses, such as space or water heating, due to smaller cost savings and energy usage impact, creating a barrier to whole building electrification efforts. In addition, most low- to moderate-income (LMI) households living in multifamily buildings lack in-unit laundry, increasing barriers to equitable access to cost- and energy-efficient laundry. The recent market entrance of 120-volt (V) combination washer and heat pump dryers has introduced new opportunities for decarbonizing laundry in multifamily buildings.

Penetration of combination units is low in the US and California markets, although they are commercially available at most larger retailers such as Home Depot, Lowe's, and Best Buy. These combination units provide compact, in-unit convenience with all-electric, ventless models available. Recently, manufacturers such as LG, Samsung, and GE have introduced 120V ENERGY STAR® certified combination washer and ventless heat pump dryers, which offer a significant potential opportunity for multifamily building owners to avoid expensive ventilation and electrical upgrades while offering the flexibility of in-unit laundry. These combination units are most appropriate for small dwellings where space is limited, considering they are often priced comparably to (or higher than) separate washer and dryer units, and drying times can be considerably longer than with a standalone dryer. Additionally, shifting to in-unit models has the potential to simplify the laundry decarbonization progress. In the current multifamily market, the equipment in most shared laundry facilities is leased from third party operators, with buildings paying the utility bills. While some commercial-scale heat pump dryer models do exist, they come at a significant cost premium. Bringing equipment in-unit and under the ownership of either building owners or occupants could help remove the split incentive to reduce energy costs and create a clearer path for outreach and incentive program delivery. While this technology is on the market and readily available for purchase, combination units are not a part of the California Electronic Technical Reference Manual, excluding them from rebate eligibility though investor-owned utility (IOU)-funded energy efficiency incentive programs.

This market study aimed to determine whether the technology would be a feasible mechanism of electrification and useful to residents of multifamily buildings, and if so, what sort of outreach, engagement, and considerations for program delivery are needed. The project team focused outreach on LMI and disadvantage communities' multifamily residents and housing providers, manufacturers, program administrators, and additional market stakeholders to discuss if and how this technology could be optimally deployed to meet decarbonization and equity goals. The report includes a detailed review of the current market surrounding both laundry in multifamily housing, as well as the combination units the study is focused on, results from energy modeling and analysis of market potential, and an overview and analysis of stakeholder feedback. While there are 120V combination units on the market that utilize condensing dryer technology as well, for the purposes of this study, when combination units are referenced, it can be assumed that the project team is referring specifically to models with heat pump technology.

Background

In 2023, VEIC completed the CalNEXT Low Income Multifamily Housing Characteristics Study (ET22SWE0033), which summarized laundry access and fuel type for the market. The study found that based on the 2020 Residential Energy Consumption Survey, 76% of low- to moderate-income (LMI) households residing in 5+ unit multifamily housing in California do not have access to an in-unit dryer. Although estimates of fuel type for shared laundry facilities are not available statewide, the report presents a field study of 50 affordable multifamily buildings: most buildings have shared laundry facilities and most shared facilities utilize natural gas as the fuel type for clothes dryers.

Looking only at more urban areas of the state, access to in-unit laundry varies across California, according to the 2021 American Housing Survey. By metropolitan statistical area, only 52% of LMI households in the Riverside-San Bernadino-Ontario metropolitan statistical area do not have access to in-unit dryers, while 73% of LMI households in the Los Angeles-Long Beach-Anaheim metropolitan statistical area lack in-unit dryers. Further, a sizable portion of LMI households do have electric dryers, in-unit: 33% in San Jose-Sunnyvale-Santa Clara, and 25% in both San Francisco-Oakland-Hayward and Riverside-San Bernadino-Ontario. Relatively high rates of electric dryers in some areas of the state and low rates of in-unit dryers of any type in others show that market landscape varies by region (VEIC 2023).

California Energy Commission's Multifamily Ready Requirements

The California Energy Commission's 2022 Building Energy Efficiency Standards introduced "electric-ready" requirements for newly constructed multifamily buildings. These standards aim to facilitate a future transition from gas-powered to electric appliances, aligning with California's decarbonization goals (California Energy Commission 2022).

The 2022 Energy Code mandates that when gas or propane appliances are installed—such as for space heating, water heating, cooking, or clothes drying—certain electrical infrastructure must be in place to support future electric replacements. Specific provisions include:

Dedicated 240V Branch Circuits: For future electric appliances, including clothes dryers, a dedicated 240V branch circuit with a minimum 30-ampere (amp) conductor must be installed within three feet of the appliance location.

Reserved Panel Space: A reserved space in the main electrical panel for a double-pole circuit breaker for future electric appliance installations, labeled "For Future 240V Use."

Common Area Laundry Facilities: For common area clothes dryers, the code specifies that electrical conductors or raceways must be installed from the main electrical panel to within three feet of each gas outlet. These conductors must be labeled "Future 240V Use" and sized to meet future electrical load requirements.

This foresight ensures that new multifamily buildings can transition to electric appliances without significant retrofitting, aligning with California's broader environmental and energy efficiency objectives. While these regulations are pertinent to common area laundry facilities in multifamily residences, they do not apply to individual units, leaving the potential for a laundry hookup to be installed without the 240V outlet necessary for an electric dryer.

Heat Pump Clothes Dryer Background, Performance, and Perceptions

As shown in Figure 1, electric resistance clothes dryer efficiency has historically been slow to progress, especially in comparison to other home appliances. Recent heat pump dryer technology is significantly more efficient than electric resistance alternatives, unlocking several benefits beyond decarbonization. While conventional electric dryers can dry around three pounds of laundry per kilowatt-hour (kWh) expended, heat pump dryers can dry at least double that amount using the same amount of energy (Northwest Energy Efficiency Alliance 2018).

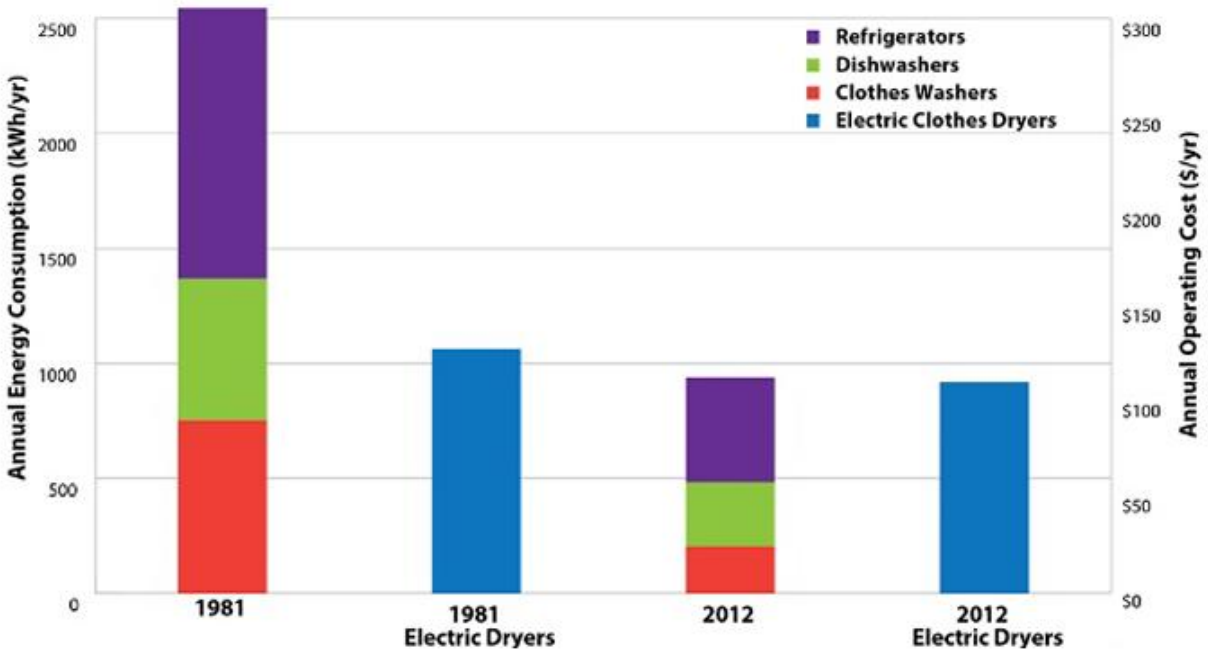

Figure 1: Annual energy consumption of electric clothes dryers vs. other major appliances.

Source: (Northwest Energy Efficiency Alliance 2018)

While heat pump dryers are significantly more efficient than conventional electric models, they also take more time to dry the same amount of laundry. Heat pump dryers operate at lower temperatures than conventional models and remove moisture via a closed-loop system, contributing to longer drying times. A study looking at whether heat pump clothes drying reduced clothing wear relative to conventional electric resistance drying, in part informed by testing effects of temperature, found that the maximum fabric temperatures in a heat pump dryer came to an average of approximately 115 degrees, while those in a conventional electric dryer came to approximately 155 degrees. (Northwest Energy Efficiency Alliance 2017) Longer dry times were confirmed in a field and market assessment of heat pump dryers, which found the appliances taking an average of 129 minutes to dry a load, compared to an average of 76 minutes for conventional dryers. While the heat pump drying times were substantially longer, the study also found that back-to-back dryer loads, where longer drying times could present an issue or inconvenience, were uncommon among the participant households. (Slipstream 2021)

According to the *California Zero-Emission Appliance Awareness Study*, both building owners and landlords are generally open to adopting appliances that are more energy-efficient and cost-effective. However, limited firsthand experience with heat pump dryers and low awareness remain significant barriers to adoption. Safety concerns also influence decision-making, with a clear preference for electric systems over gas. The study suggests that educational outreach—combined with incentives or rebates—would be an effective strategy to encourage adoption among these groups (California Air Resources Board 2023).

Similarly, consumers, particularly younger and low-income Californians, tend to prefer electric dryers but are even less familiar with heat pump technology than landlords or builders. The experience and evidence that electric and heat pump dryers dry clothes more slowly than gas alternatives further hinders consumer interest. Complementing these findings, the *Heat Pump Dryer Impact on Clothing Life – Emerging Technologies Assessment Study* shows that heat pump dryers do not cause greater wear on clothing compared to conventional models, and some users even report preferring how their clothes feel after being dried in them—helping to counter concerns about performance and fabric care (PG&E 2016).

Technical Overview

ENERGY STAR® and Efficiency of Laundry Equipment

According to the EPA's ENERGY STAR® program, clothes washers certified by the program use about 20% less energy and about 30% less water than traditional washers, and certified dryers use about 20% less energy than standards models. The ENERGY STAR® certified product guide was reviewed to compare key efficiency metrics between stand-alone washers, stand-alone dryers, and combination washer/dryer units. Below are the metrics employed for this comparison:

- Dryers are evaluated by the combined energy factor (CEF). This is a measure of the energy consumption of clothes dryers in pounds per kWh. A higher CEF indicates better energy efficiency.
- Washers are evaluated by the integrated moderated energy factor (IMEF). This is a measure of the energy consumption of washers in cubic feet per kWh cycle. A higher IMEF indicates better energy efficiency.
- Washers are also evaluated by the integrated water factor (IWF), which measures the water consumption of the machine in gallons of water per cubic foot. A lower CEF indicates better water efficiency.

A filtered search on the ENERGY STAR® product list for the "Most Efficient" certified dryers revealed 36 different products with a drum capacity range of 3.9 to 7.8 cubic feet. All of these high-efficiency dryers employ heat pump technology and have CEFs in the range of 5.1 to 11 (ENERGY STAR 2025).

A filtered search on the ENERGY STAR® product list for the "Most Efficient" certified washers revealed 26 different products with drum capacities between 2.2 to 5.8 cubic feet. These high efficiency washers have IMEFs ranging between 2.2 to 3.2 and IWFs in the range of 2.6 to 3.7 (ENERGY STAR 2025).

Meanwhile, there are nine combination washer/dryer units listed on the product list, seven of which employ heat pump technology, and two of which are certified as “Most Efficient.” The IMEFs for the combination washer/dryers range between 2.76 and 2.92. The IWF ratings for the combination units range from 2.9 to 3.2 and the CEFs range from 3.93 to 7.5. These measures range across drum capacities of 4.5 to 5.3 cubic feet. Table 1 provides further details on the specifications of the combination units.

Overview of 120V Combination Unit Technology

There are at least nine manufacturers of 120V combination washer/dryer units servicing consumers in the United States. Between the manufactures, there are at least 12 different 120V models, five of which are certified and listed on the ENERGY STAR® website. They range from 1.62 to 5.3 cubic feet of capacity and come in vented or ventless designs, and four of the models employ heat pump technology. See Table 1 below for further details on ENERGY STAR® qualified units which employ heat pump technology.

Table 1: Manufacturers and specs of 120 combination units available in the U.S.

Manufacturer	Model	Capacity (cu. ft.)	Washer Energy Use (kWh/yr)	Dryer Energy Use (kWh/yr)	Water Use (gallons/ yr)	IMEF	IWF	Warranty (years)	Cost (as of April 2025)
GE	PFQ97HS PVDS	4.8	136	399	4,283	2.76	3	Parts and labor: 1 Sealed drying system: 5 Motor: 10	$2,999
GE	PFQ83HS LWWW	4.6	150	399	4,106	2.76	3	Parts and labor: 1 Sealed drying system: Motor: 10	$2,699
LG*	WM6998 H*A	5	99	380	4,235	2.92	2.9	Parts and labor: 1 Stainless steel drum: 3 Motor: 10	$3,299
Samsung*	WD53DB A900HZ	5.3	103	319	4,500	2.92	2.9	Parts and labor: 1 Stainless steel drum: 3 Motor: 20	$3,299

*Most Efficient

Source: Compiled by project team. Referenced: ENERGY STAR website, accessed April 2025; GE, LG, and Samsung websites.

As mentioned above, there are several characteristics of 120V combination units with heat pump technology that differ from standard electric stand-alone washer/dryer sets, and even stand-alone heat pump dryers, that collectively deliver flexibility and position themselves well for the multifamily market.

- **120V:** These models plug in to standard 15-amp electric outlets, unlike stand-alone electric dryers which have a higher voltage, requiring a 240V outlet and adequate electrical capacity. This feature allows for a simplified and more cost-effective installation in the case where an electrical upgrade would otherwise be needed. In cases where a 240V outlet already exists in the unit, this provides the flexibility to utilize that outlet and capacity for another demanding plug load, such as a heat pump water heater.
- **Ventless:** While traditional electric resistance clothes dryers are vented to the outside of buildings to exhaust moist air from the drying process, heat pump clothes dryers remove moisture through a condensate line, which is the same pipe as the main water supply for the washing cycle on combination units. This ventless feature provides flexibility of appliance location and removes the air barrier penetration(s) that would be required to install a stand-alone electric resistance dryer (Northwest Energy Efficiency Alliance 2018).
- **Smaller Drum Size:** Beyond the fact that the combination technology reduces laundry appliances from two to one, as noted above, the drum capacity of these units is often significantly smaller than those of both standard stand-alone washers and dryers. While this could be a barrier to the technology for some, it provides an opportunity for space-constrained spaces or smaller units where there would otherwise not be room for laundry appliances.
- **User Flexibility and DSM:** Not only does having access to in-unit laundry greatly decrease the time burden of doing laundry, but combination units also hold the ability to further decrease that burden by eliminating the need to switch loads from the washer to the dryer. This allows users to start laundry at any point in their day and return to a complete, dry load. This feature also helps to mitigate the longer dry time that comes with heat pump drying technology. This feature also provides potential for demand response, as users can run complete loads overnight or during the work day.

Objectives

The primary objectives of this study were to: 1) characterize the market opportunity of 120V combination washer and heat pump dryer units as an option for energy efficient electrification of multifamily housing throughout California, 2) determine technical performance and cost/energy savings of the units, 3) effectively engage stakeholders to identify the benefits and barriers of increasing in-unit laundry access for multifamily residents and reduced reliance on shared laundry facilities and laundromats, and 4) deliver actionable recommendations based on our findings.

This project includes a market characterization study, energy and cost modeling, and outreach to stakeholders, including multifamily building owners and community-based organizations working in disadvantaged communities.

Understanding Market Opportunity

The project team assessed the scale of the market opportunity for in-unit combination wash/dryers throughout the state by conducting a literature review, a market scan of the existing multifamily building landscape in relation to laundry, and stakeholder interviews. Specific markets of interest included new construction and multifamily buildings with the following laundry configurations: 1) those with in-unit washing/drying appliances, 2) those with shared laundry facilities, and 3) those without any laundry facilities. Opportunities were assessed for both market rate and affordable housing, with a particular focus on challenges faced by LMI households and those in DACs. Research focused on the technology's features (120V, ventless, sizing) that could make it a good fit for multifamily units.

Additionally, details gathered through stakeholder outreach and engagement regarding opportunities and barriers specific to the various markets were used to provide context to the market characterization and findings. This effort yielded qualitative and anecdotal data, and the geographic scope of the outreach was statewide. The team considered region-specific analyses, but there was not a wide enough variance from region to region to be significant. A variety of market actors, including residents and owners/managers of multifamily buildings, manufacturers, CBOs, and program administrators were engaged on the project. The project team contacted energy efficiency program administrators in California to understand how combination units could be integrated into utility programs. They also contacted current manufacturers of ENERGY STAR® combination units to better understand the multifamily market opportunity for their products.

Determine Technology Performance and Potential Cost/Energy Savings

The project team sought to understand the energy and greenhouse gas (GHG) savings potential of combination units, as well as cost implications, through energy and cost modeling. The modeling also considered the total system benefit of combination units.

Deliver Actionable Recommendations

Project findings are presented in this report summarizing the project team's learnings and providing clear recommendations and next steps to facilitate equitable electrification and decarbonization of multifamily housing.

The target audience includes affordable housing developers and the contractors who support them, the California IOUs, the California Emerging Technologies Coordinating Council, the California Technical Forum, and program administrators, especially those supporting programs that serve multifamily affordable housing.

Methodology and Approach

Findings include results from studies on the technology and on the California multifamily building laundry landscape, primary and secondary research from manufacturers, gaps identified to inform stakeholder outreach, and results from interviews and multifamily building energy modeling.

Market Characterization

The project assessed the scale of the market opportunity for in-unit combination wash/dryers using a literature review, energy savings calculations, and stakeholder interviews. Both market rate and affordable housing opportunities were assessed through literature review and robust stakeholder engagement, with a particular focus on challenges faced by LMI households and those in DACs. Data for the market characterization portion of this study were pulled from publicly available resources. The U.S. Census American Housing Survey, U.S. Energy Information Administration Residential Energy Consumption Survey (RECS), National Lab of the Rockies (NLR) (previously National Renewable Energy Laboratory (NREL)), and ResStock were the primary sources used to gather data pertaining to housing and laundry configuration in the California market. These data sources were synthesized to present relevant points for this study. Details from the cost-savings and stakeholder interviews below were incorporated into the literature review process to add context and guide the focus of research.

Technology Performance and Potential Cost/Energy Savings

To assess the performance of 120V combination units, this study quantified energy and GHG impacts and evaluated property owner and tenant cost impacts.

Energy modeling to assess costs, savings, and performance for the following scenarios was performed:

- Inefficient in-unit washer and dryer (electric and gas) vs. in-unit combination washer/heat pump dryer
- Shared laundry inefficient washer and dryer (electric and gas) vs. in-unit combination washer/heat pump dryer
- Laundromat inefficient washer and dryer (electric and gas) vs. in-unit combination washer/heat pump dryer

Initial energy savings were calculated using a methodology typical of a technical reference manual (TRM). The performance of assumed baseline equipment was compared to the performance of efficient equipment. An existing Illinois TRM measure characterization for combination in-unit washer/dryer equipment was leveraged for the calculations for this study, with input modifications to compare commercial equipment to residential equipment. Notable assumptions for the calculation include capacity, rated efficiency, number of cycles, and load size.

Stakeholder Outreach

A variety of market actors working to electrify the multifamily affordable housing market were engaged by the project team to gain initial insights into existing laundry configurations in the CA market, opportunities and barriers regarding the applicability of combination units for the multifamily market, and feedback on project approach. Stakeholders included residents and owners/managers of multifamily buildings, affordable housing agencies, manufacturers, consumer advocates, and program implementors and administrators. A list of stakeholder categories and purposes of engagement is displayed below in Table 2. This combination of qualitative and anecdotal data was synthesized into the market characterization and findings to provide further context.

Table 2: Summary of stakeholder engagement.

Stakeholder	Purpose of Status and Engagement
Consumer advocates	Interviewed for insights on the laundry market in multifamily affordable housing in California, opportunities and barriers of combination units as a solution for the market, and feedback on project approach
Program implementors	Interviewed for insights on the laundry market in multifamily housing in California, opportunities and barriers of combination units as a solution for the market, feedback on project approach, and potential connections for resident surveying effort
Manufacturers	Interviewed for insights on appliance/brand approach, applicability for the multifamily market, and market codes and regulations
Affordable multifamily housing providers	Interviewed to gain insights on the opportunities and barriers of in-unit laundry and combination units from an affordable housing provider, cost shifts and changes, and common laundry decarbonization methods
Affordable multifamily housing residents	Surveyed to gain insights on current laundry habits, priorities, costs, preferences, and concerns
Incentive program administrators	Interviewed for insights on the technology from a program perspective, potential rebate design and eligibility, and considerations regarding scaling this technology through integration in statewide/regional rebate programs

Findings

Overview of Existing California Multifamily Housing Market

This section provides an overview of the existing multifamily housing market in California to help inform the characterization of the multifamily laundry market that follows. The project team leveraged a combination of analyses from previous reports and new findings to portray the current market.

The CalNEXT Multifamily In-Unit Heat Pump Project (ET22SWE0035) provides an overview of the existing California Multifamily Housing Market. The study found multifamily apartments account for approximately 32 percent of the residential housing stock in the state by unit count and that multifamily units represent 50 percent of new housing stock (VEIC 2023).

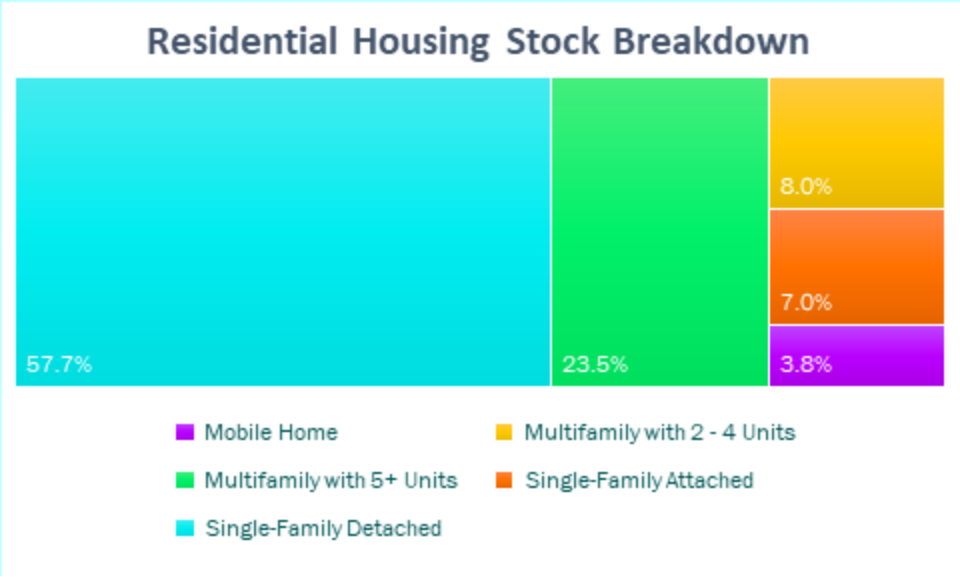

Figure 2: Estimated multifamily buildings in California.

Source: VEIC 2023.

Of the 32 percent of the residential housing stock noted above, Table 3 below shows a breakdown of multifamily housing stock in California by region and building size.

Table 3: Breakdown of the multifamily housing stock in California by region.

Building Size	Los Angeles - Long Beach - Anaheim	Riverside - San-Bernadino - Ontario	San Francisco - Oakland - Hayward	San Jose - Sunnyvale - Santa Clara
Multifamily 2–4 Units	145,675	17,882	80,186	15,306
Multifamily 5+ Units	90,630	13,327	31,675	12,109
5–9 Units	46,898	6,806	17,565	5,934
10–19 Units	25,218	4,722	8,722	4,121
20–49 Units	12,077	968	3,138	1,154
50+ Units	6,437	831	2,250	900

Building Size	Los Angeles - Long Beach - Anaheim	Riverside - San-Bernadino - Ontario	San Francisco - Oakland - Hayward	San Jose - Sunnyvale - Santa Clara
Total	236,305	31,209	111,861	27,415
Average Number of Units	17.58	15.89	16.62	17.23

Source: 2021 American Housing Survey.

Figure 3 below displays the vintage of the multifamily housing stock in California, the majority being built between 1960 and 1990.

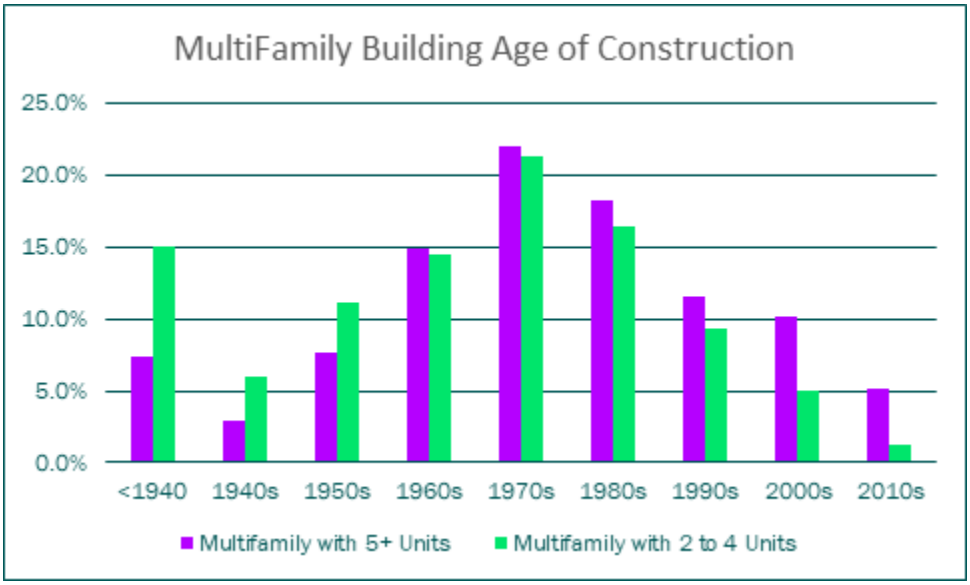

Figure 3: Vintage of multifamily buildings in California based on date of construction.

Source: VEIC 2023.

In terms of billing structure, most utilities in multifamily rental housing are resident-paid. Utilities are more frequently included in the rent, or owner-paid, in multifamily buildings with five or more units. Gas is slightly more likely to be included in rent, or master-metered, than electricity. The share of resident-paid utilities indicate that utility cost shifting will likely occur when moving laundry from common areas to in-unit. Particularly in affordable housing, cost shifting should be planned for and adequately addressed through existing mechanisms, such as utility allowance adjustments.

Table 4: Split of multifamily households with utilities included in rent.

RECS Building Type	Utilities Included in Rent	
	Electricity	Gas
Multifamily with 2–4 Units	4.6%	6.5%
Multifamily with 5+ Units	7.9%	15%

Source: NLR ResStock

Characterization of Existing Multifamily Laundry

Table 5 details the distribution of laundry locations in multifamily buildings for the state of California. The saturation of in-unit as opposed to shared or no laundry looks different for multifamily buildings with two to four units and multifamily buildings with five or more units. In multifamily buildings with two to four units built prior to 1940, in-unit laundry was present in 80 percent of units. The split between in-unit and shared or no laundry in multifamily buildings with two to four units was between 42 and 49 percent between 1940 and 2009. Since 2010, the share of in-unit laundry in multifamily buildings with two to four units has increased to 73 percent of units. Multifamily buildings with five or more units show a steady increase in the presence of in-unit laundry across vintage bins from 4 percent prior to 1940 to 60 percent since 2010. These estimates are sourced from the NLR ResStock model.

Table 5: In-unit vs shared or no laundry presence in multi-family residences in California.

Building Size	Vintage Bin	In-Unit Laundry	Shared or No Laundry
Multifamily with 2–4 Uits	<1940	80%	20%
	1940–1979	42%	58%
	1980–2009	49%	51%
	>2010	73%	27%
Multifamily with 5+ Units	<1940	4%	96%
	1940–1979	28%	72%
	1980–2009	44%	56%
	>2010	60%	40%

Source: NLR ResStock.

Distribution of laundry location when split out by income level shows similar trends between multifamily buildings with two to four units and multifamily buildings with five or more units. As income levels increase, the skew towards in-unit laundry increases. The increasing trend is consistent across all income bins. For both multifamily housing types, the highest saturation of units with shared or no laundry, at 62 and 82 percent respectively, corresponds to the lowest income bin of below $20,000. The highest saturation of in-unit laundry for both multifamily housing types, at 72 and 48 percent respectively, is in the highest income bin of greater than $150,000. These estimates are sourced from NLR's ResStock model.

Table 6: Distribution of in-unit laundry in multifamily buildings in California by income level.

Building Size	In-Unit Laundry	Income Level					
		<$20,000	$20,000 – $39,999	$40,000 – $59,999	$60,000 – $99,999	$100,000 – $149,999	$150,000 +
Multifamily with 2-4 Units	Yes	38%	40%	49%	57%	59%	72%
	No	62%	60%	51%	43%	41%	28%
Multifamily with 5+ Units	Yes	18%	23%	26%	33%	42%	48%
	No	82%	77%	74%	67%	58%	52%

Source: NLR ResStock.

In-Unit Laundry Characteristics

The majority of existing in-unit clothes dryers are fueled by electricity across both multifamily housing classifications. Multifamily buildings with five or more units skew particularly towards the electric fuel source with 92 percent of clothes dryers using electric fuel. The fuel splits are sourced from RECS Table HC3.1.

Table 7: Primary clothes dryer fuel in residences in California.

Building Size	Clothes Dryer Fuel	
	Electricity	Natural Gas
Multifamily with 2–4 Units	79%	21%
Multifamily with 5+ Units	92%	8%

Source: RECS.

The age of clothes washers and dryers is reported to be between less than two years and twenty years or older. The differences between clothes washer and clothes dryer reported age are negligible, with most equipment aging in tandem. There is also a negligible difference in equipment age across the different multifamily housing classifications of two- to four-unit and five- or more-unit buildings. The bulk of reported equipment falls between two and nine years old. Equipment age is sourced from RECS Table HC3.1.

Table 8: Primary clothes dryer age in residences in California.

Clothes Dryer Age	
Less than 2 years old	18%
2 to 4 years old	29%
5 to 9 years old	32%
10 to 14 years old	14%
15 to 19 years old	5%
20 or more years old	3%

Source: RECS.

Laundromat Characteristics

Laundromats are characterized as service buildings for the Commercial Buildings Energy Consumption Survey. Over half of commercial service buildings in the Pacific census region use electricity as their primary fuel source. It was interpolated for these market characterization purposes that laundromats follow the broader trend of commercial service buildings, but additional research would be needed to verify if this is true in commercial laundromats. Fuel splits are sourced from Commercial Buildings Energy Consumption Survey Table B4.

Table 9: Primary fuel source for commercial buildings in California.

Building Fuel Source	
Electricity	64%
Natural Gas	36%

Source: Commercial Buildings Energy Consumption Survey.

Gaps in Multifamily Building Market Data

LOCATION OF LAUNDRY EQUIPMENT

One gap identified in the characterization of laundry in multifamily buildings is the split between shared laundry and no laundry conditions. The NLR ResStock dataset only provided enough detail to determine whether there was in-unit laundry. It is not possible to break out the market for shared laundry compared to no laundry on site using the NLR ResStock data. A study by the U.S. Census on location of laundry in multifamily new construction units was identified to provide some insight to this data point, though it cannot be cleanly applied to the data in Table 4. According to the Census report using average data from 2010 through 2023 for the Western U.S., 67 percent of new construction multifamily buildings reported having shared laundry compared to 33 percent of new construction multifamily buildings with no laundry on site. In the absence of similar data for prior building vintage bins, a clear gap in market data exists.

Energy Consumption and Savings Potential

Combination 120V Washer and Heat Pump Dryer Units

Combination washer and heat pump dryer units are eligible for ENERGY STAR® certification. These units must meet the ENERGY STAR® requirements for both clothes washers and clothes dryers. The ENERGY STAR® program does offer an exemption from the cycle time requirement for the clothes dryer specification for this equipment due to expected lengthened cycles to cover both washing and drying laundry. ENERGY STAR® provides a separate qualified products list for combination clothes washer and dryer units.

Starting in the 2025 program year, Illinois utilities began claiming savings prescriptively for combination washer and dryer units through their technical reference manual (TRM). The characterization combines savings potential from an efficient clothes washer and clothes dryer and compares them against a baseline clothes washer and clothes dryer. Commonwealth Edison Company (ComEd) is offering rebates for this equipment set at $350 per unit.

Following the methodology of the Illinois TRM ENERGY STAR® All-in-One Clothes Washer-Dryer measure characterization as a basis, potential savings can be estimated for the California multifamily market. Potential greenhouse gas impacts were estimated using an Environmental Protection Agency (EPA) conversion factor between million British thermal units (MMBtu) of natural gas and pounds of carbon dioxide equivalent (CO_2e). There are a few notable algorithm input assumptions that were altered from the Illinois measure characterization with the intent on narrowing in on combination clothes washer and heat pump dryer equipment. The assumptions for capacity, IMEF, and CEF were updated in these calculations to include only equipment with the heat pump dryer type. These per-unit savings are a reflection of an ENERGY STAR® All-in-One Clothes Washer-Heat Pump Dryer when compared to a conventional clothes washer and dryer.

TOTAL SYSTEM BENEFIT

The project team also considered total system benefit (TSB) calculations in the modeling effort. The team followed the California Public Utility Commission's (CPUC) guidance and utilized E3's avoided cost calculator (Energy and Environmental Economics, Inc. (E3) 2024). The CPUC's definition of TSB is the following:

> *"TSB is an expression, in dollars, of the lifecycle energy, ancillary services, generation capacity, transmission and distribution capacity, and GHG benefits of energy efficiency activities, on an annual basis. The 2021 Energy Efficiency Potential and Goals study states that TSB represents the total benefits, or "avoided costs," that a measure provides to the electric and natural gas systems. The factors included in avoided costs are defined through the CPUC Integrated Distributed Energy Resources (IDER) proceeding."* (California Public Utilies Comission 2021)

As this technology does not operate with significant differences dependent on utility or climate zone, the project team has presented one TSB value for each measure that is intended to be broadly applicable across the state. The E3 avoided cost calculators for electric or gas utilities provided an annual estimate of avoided dollars per MWh or dollars per MMBtu, which has been applied to the savings calculated for each measure. To maintain consistency with CPUC guidance, the total resource cost test was utilized for the purpose of this project. Where a penalty is applied, the dollar value of the penalty is subtracted from that of the savings to provide a simplified overall impact estimate.

Table : Per-unit energy savings for comparable in-unit equipment.

In-Unit Stand-alone Washer and Dryer vs In-Unit Combination Washer and Heat Pump Dryer		
Baseline Fuel Source	**Per-Unit Energy Savings**	**Total System Benefit 2026 ($)**
Electric Baseline	459 kWh (0.1346 MMBtu, 15.7 lbs CO2e)	$43
Gas Baseline	1.92 MMBtu (223.83 lbs CO2e)	-$25
Per-Unit Water Savings		
3,298.75 Gallons		

Source: Project Team.

In the case where in-unit laundry is being added where there previously was none, there will not be energy savings for the occupant. In these cases, there will be penalties related to the increased load of new pieces of equipment. The full calculated usage of the ENERGY STAR® All-in-One Clothes Washer-Heat Pump Dryer should be considered a penalty in these cases.

Table 11: Per-unit energy penalty for new in-unit equipment.

No In-Unit Laundry vs In-Unit Combination Washer and Heat Pump Dryer		
Baseline Fuel Source	**Per-Unit Energy Penalty**	**Total System Benefit 2026 ($)**
Electric Baseline	-465 kWh (-0.1363 MMBtu, -15.9 lbs CO2e)	-$44

Source: Project Team

For a building-wide analysis, per-unit savings have been multiplied by the average number of units in a building. In addition, the assumption for number of cycles annually for baseline equipment in a multifamily shared application is aligned with the Department of Energy Technical Support Document for 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Commercial Clothes Washers. With shared laundry configuration, there are fewer units running more cycles annually in comparison to in-unit configuration with more units running fewer cycles annually. In addition to commercial units running more cycles, they also have a slightly larger capacity. The assumed capacity from a 2013 Commercial Clothes Dryers Codes and Standards Enhancement (CASE) initiative has been assumed for the purpose of this analysis. A ratio between the commercial and residential capacity was also applied to the load assumption for the baseline commercial clothes dryer.

Table 12: Building-wide energy savings for in-building shared laundry vs in-unit laundry.

Shared Laundry to In-Unit Combination Washer and Heat Pump Dryer			
RECS Building Type	Baseline Fuel Source	**Energy Savings**	**Total System Benefit 2026$**
Multifamily with 2-4 Units	**Electric Baseline**	6,024 kWh (1.766 MMBtu, 205. 95 lbs CO2e)	$562
	Gas Baseline	27.18 MMBtu (3,169.98 lbs CO2e)	$57
	Building-Wide Water Savings		

Shared Laundry to In-Unit Combination Washer and Heat Pump Dryer			
	108,976.21 Gallons		
Multifamily with 5+ Units	Electric Baseline	14,255 kWh (4.178 MMBtu, 487.35 lbs CO2e)	$1,330
	Gas Baseline	61.15 MMBtu (7,133.63 lbs CO2e)	$128
	Building-Wide Water Savings		
	299845.88 Gallons		

Savings between laundromat and in-unit laundry were calculated with a focus on one unit. To avoid overstating potential savings, the residential laundry number of cycles from the Illinois TRM characterization were used for both laundry configurations.

Table 13: Savings between laundromat and in-unit laundry.

Laundromat vs In-Unit Combination Washer and Heat Pump Dryer		
Baseline Fuel Source	Per-Unit Energy Savings	Total System Benefit 2026$
Electric Baseline	488 kWh (0.1431 MMBtu, 16.69 lbs CO2e)	$46
Gas Baseline	2.52 MMBtu (293.59 lbs CO2e)	$5
Water Savings		
11,167.24 Gallons		

Source: Project Team

Stakeholder Insights and Considerations

Conversations and interviews were conducted with stakeholders involved in decarbonization efforts within the multifamily housing market. These stakeholders included manufacturers, housing providers, and rebate program representatives. Various opportunities, challenges, and considerations regarding the use of combination unit technology throughout the market were flagged.

In addition to conversations and direct interviews, surveys were circulated to tenants at an affordable housing complex run by Self-Help Enterprises. Eleven responses were received. Survey questions can be found in Appendix A. Participating residents were asked about their unit and household size, their current laundry configuration and corresponding costs, their satisfaction with their laundry access, habits and usage rates, and experience with and interest regarding heat pump technology and combination units.

RESIDENT LAUNDRY ACCESS AND HABITS:

The majority of respondents reported living in a one bedroom unit, with three living in two or more bedroom units, and household sizes ranged from one to four people. While all respondents reported having access to shared laundry facilities on site, three also reported having in-unit laundry. Shared on site laundry was reported to cost between $4.25 and $7.50 per load. Five respondents reported utilizing a laundromat as well, with costs ranging from $2.25 to $8.50 per load. Responses were split between residents doing laundry weekly and a few times a week, and most reported doing their laundry in the morning.

Residents' main concerns regarding their laundry experience were accessibility and cost, with a few also prioritizing speed and energy efficiency. When asked whether they preferred in-unit or on site shared facilities, responses were mixed, with one resident citing the fixed, cheaper cost of shared facilities. In addition, when asked about what concerns they would have with using an all-in-one washer/dryer in their unit, respondents noted energy use/cost as the largest concern. Space, noise, drying time, and maintenance were also mentioned. The common benefits listed included accessibility and convenience. Finally, respondents were asked how much they would be able and willing to pay for an all-in-one in-unit laundry appliance assuming some cost was offset by a rebate. While some residents did not know or did not answer, the responses received ranged from $200 to$500. This is important to note since this technology retails for close to $3,000 per unit. These findings are explored futher in the sections below.

Across the project team’s stakeholder engagement efforts, the most relevant topics and considerations included: ownership and maintenance models, energy efficiency and resident energy burden, technology performance concerns, and consumer education.

Ownership and Maintenance Models

Insights from building owners highlighted that while different configurations of on-site laundry access do exist, shared facilities in common areas are by far the most common. In most cases, the laundry appliances are owned and maintained by third-party companies and not the housing provider. However, one affordable housing provider did highlight that they are exploring ownership of laundry appliances and how to leverage funds collected from residents operating the washers and dryers to reinvest in sustainability and efficiency opportunities on the property.

While not all types of affordable housing include on-site laundry as the default, interviewees also reported that various funding sources may mandate the inclusion of on-site laundry facilities. One housing provider shared that access to tax credits was a motivator for providing on-site laundry facilities. The California Tax Credit Allocation Committee regulations state that adequate laundry facilities must be available on the property premises in order to qualify for tax credits for several different housing types, such as large family, senior, special needs, or single room occupancy (California Code of Regulations 2024). This understanding of laundry ownership models helped the team better understand laundry configurations across the market—in particular, the split between laundry offered in common area facilities versus no on-site laundry requiring laundromat use—and therefore better target our recommendations.

In conversations with housing providers, some mentioned that while they have common area laundry facilities across their portfolio, some or all sites also include in-unit laundry hook-ups. While tenants must provide their own equipment, it is often allowable for them to install it, although this does vary among providers/leases, etc. Housing providers who allow tenants to install their own laundry equipment commented on the low levels of uptake, suggesting the upfront cost of laundry equipment was a barrier to ownership. Housing providers additionally expressed hesitancy in taking on the ownership of these in-unit appliances, describing them as technology that would see heavy use and therefore require routine and likely frequent maintenance. This suggests a need for flexibility regarding eligibility and/or inclusion in various types of programs when it comes to rebate design for these units to accommodate all types of owners/markets.

Energy Efficiency and Energy Burden

Affordable multifamily housing providers flagged the risk of increased energy use (and therefore cost) as a concern for in-unit laundry. While the combination units are significantly more efficient than existing baseline equipment, if usage rates rise significantly, energy savings may not be realized. Especially in affordable housing properties, adding tenant paid plug loads should be approached with caution to avoid increasing energy burden when not accommodated by utility allowances in subsidized affordable housing.

The responses from the Self-Help Enterprise tenant surveys echoed the concerns of property owners and managers, indicating increased laundry activity with in-unit appliances and concerns around cost are indeed factors for tenants. Of the eleven tenant responses received, energy use and cost were the most cited concerns around adopting in-unit laundry. Adding to this, 55% respondents answered “yes” when asked "If you currently use a shared laundry space, do you think you would do laundry more often if you had an in-unit appliance?” Five respondents reported doing laundry weekly, and six reported doing laundry a “few times a week” -- meaning laundry frequency would increase from these self-reported baselines.

Technology Performance Concerns

Most conversations across the portfolio of stakeholders with whom the team engaged illuminated a general hesitancy and dissatisfaction regarding heat pump drying technology. Housing providers pointed to tenant satisfaction as an important consideration when weighing building upgrades and technology replacements overall.

Primary concerns expressed by housing providers included damp clothing after drying and longer drying times, which could lead to tenant dissatisfaction. These concerns were derived from direct

experience with heat pump dryers, feedback from tenants, and general public perception of the technology and resulted in reluctance to install them, particularly as a replacement for existing operable appliances. In addition to housing providers, similar feedback was received from incentive program administrators. They described only wanting to rebate and advocate for technology they believe will achieve user satisfaction and improve residents' daily quality of life.

A single respondent from the Self-Help Enterprises tenant survey had previously used a heat pump dryer. This same respondent listed "drying time" and "noise" as their major concern with having a combination washer/heat pump dryer in their unit. This perception tracks concerns noted by multifamily housing providers regarding long trying times associated with heat pump technology.

Consumer Education

Manufacturer representatives cited the lack of consumer education among both residents/end users as well as contractors/installers as the largest barrier to heat pump dryer adoption overall. They also noted that the multifamily market is their ideal, target market for combination units for the US market as a whole.

Of the survey responses received from Self-Help Enterprises tenants, three of the eleven respondents answered "yes" to the question "Are you familiar with heat pump dryers?" Of these, one respondent confirmed having used a heat pump dryer and noted having a "good" experience with the technology and yet having concerns around the technology's drying time and noise.

While the sample size of respondents was small, it is worth noting that 72% of respondents had not heard of heat pump technology. This aligns with the manufacturers stating concern about insufficient consumer awareness about the technology.

Recommendations and Conclusion

This report concludes with actionable recommendations for manufacturers, policymakers, multifamily housing providers, and program implementors to support the adoption of combination washer/heat pump dryer units for the multifamily housing market. While the technology is a promising solution for a variety of housing models and configurations within the market, further research is needed to evaluate how to maximize accessibility across ownership models. Market analysis, modeling, and stakeholder feedback inform these recommendations.

1) **Improve education and increase awareness of the technology**
   Audience: manufacturers, distributors
   While combination units and their specific features hold potential for the multifamily market, many stakeholders are hesitant of heat pump drying technology in general, leading to rejection of combination washer/heat pump dryer technology in some cases. Manufacturers, distributors, and those influencing decision-makers should invest in education and marketing regarding combination units and the specific features that make them a favorable solution for the multifamily market. While they may have longer drying times than existing conventional dryers, features such as the elimination of switching loads from one machine to the next, or the increased accessibility of an in-unit appliance, may be favorable and a worthwhile tradeoff for end users.

2) **Provide robust equipment warranties to ensure user satisfaction and reduce ownership hesitancy**

Audience: manufacturers

To ensure a positive product owner experience, drive building owners to provide these units in residences, and encourage programs to support and incentivize the products, manufacturers should instill confidence in the quality and longevity of the appliances by providing robust equipment parts warranties extending beyond one year, clear routine maintenance instructions, and installation support. Given multifamily buildings are the manufacturer's target market for this technology, manufacturers should work to design specific repair and replacement agreements for bulk orders.

3) **Design future demonstration projects to target both resident-owned and building-owned models**

Audience: policymakers, program implementors

A demonstration project should be pursued as a next step in this research to test the technology's applicability and savings potential in California multifamily buildings. Findings from the market analysis as well as engagement with housing providers and incentive program implementers confirmed the wide scope of laundry configuration and ownership models among the multifamily housing laundry landscape. Within the technology demonstration, both resident- and building-owned appliance ownership models should be tested to better inform additional barriers, realizations, and incentive program design.

4) **Integrate combination washer/heat pump dryer units into California incentive programs**

Audience: program administrators, policymakers

The combination model offers an additional and unique opportunity to integrate heat pump drying technology into the market, providing additional features and benefits. Inclusion in California incentive programs would significantly reduce barriers to adoption by driving down costs. Pending results of a demonstration project testing ownership models, incentive design for these products should consider both resident and building owner purchasing models.

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Appendix A: Multifamily Building Resident Laundry Preferences Survey

Purpose: This survey is looking to gather feedback from residents of multifamily buildings regarding laundry habits and preferences to help inform the design of future rebate programs for in-unit laundry appliances.

Section 1: About You

1. What type of unit do you currently live in?
    a. Studio
    b. 1-bedroom
    c. 2-bedroom
    d. 3+ bedroom

2. How many people live in your household?

3. Do you currently have:
    a. In-unit laundry
        i. If so, what configuration?
    b. Shared laundry (e.g., building laundry room)
        i. If so, does it cost and how much?
    c. No laundry access on-site
        i. Do you go to a laundromat?
            1. How often?
            2. How do you get there/how far is it?
            3. How much does each load cost you?

Section 2: Laundry Habits

1. How often do you do laundry?
    a. Daily
    b. A few times a week
    c. Weekly
    d. Less than weekly

2. What time of day do you typically do laundry?
    a. Morning
    b. Afternoon
    c. Evening
    d. Overnight
3. Do you line-dry clothes (e.g., on a rack or outside)?
    a. Yes, regularly
    b. Occasionally
    c. No

Section 3: Preferences & Experiences

1. How satisfied are you with your current laundry setup?
    a. Very satisfied
    b. Somewhat satisfied
    c. Neutral
    d. Somewhat dissatisfied
    e. Very dissatisfied

2. What do you like about your current laundry setup?
3. What challenges do you face with your current laundry setup?
4. If you've used both shared and in-unit laundry, which do you prefer and why?
5. If it is/was allowable for you to install an all-in-one unit in your apartment, would you want to pursue the opportunity? Why or why not?
    a. How important are the following to you regarding your laundry experience? (Rate each on a scale from 1 = Not Important to 5 = Very Important)
        i. Accessibility (in-unit)
        ii. Speed
        iii. Cost to operate
        iv. Energy efficiency

v. Would you be willing to sacrifice one of these for another? (ex. sacrifice speed for accessibility to an in-unit appliance or vice versa)

b. How much would you be able/willing to pay for an all-in-one in-unit laundry appliance (assuming some cost was offset by a rebate)?

c. If you could only have one, would you prefer in-unit laundry or a dishwasher?

d. If you currently use a shared laundry space, do you think you would do laundry more often if you had an in-unit appliance?

Section 4: Combo Washer/Dryer Feedback

1. Have you ever used a 120V combination washer/dryer machine before?
   - Yes
   - No
   - Not sure
2. If yes, how would you rate your experience?
   - Excellent
   - Good
   - Fair
   - Poor
   - N/A
3. Are you familiar with heat pump dryers?
   - If so, have you used one?
4. If yes, how would you rate your experience?
   - Excellent
   - Good
   - Fair
   - Poor
   - N/A
5. What concerns would you have about using a 120V combo washer/dryer in your unit? Circle all that apply.

- Drying time
- Energy use
- Energy cost
- Space
- Noise
- Maintenance
- Other (please specify)

6. What benefits do you see in having an all-in-one laundry unit in your apartment?

Section 5: Social & Environmental Considerations

1. Do you think shared laundry spaces help build community?
   - Yes
   - No
   - Not sure
2. Would you be open to shared laundry if it meant lower costs or more space in your unit?
   - Yes
   - No
   - Maybe
3. How important are the following to you when it comes to laundry appliances? (Rate each on a scale from 1 = Not Important to 5 = Very Important)
   - Energy efficiency
   - Water conservation
   - Speed
   - Noise level
   - Space-saving
   - Cost to operate

Section 6: Final Thoughts

1. What would make laundry easier or more enjoyable for you?
2. Would you be interested in participating in a pilot project down the line? This could involve having an all-in-one unit installed in your unit free of cost.

3. Any other comments or suggestions?