

Sharing What's Already Shared – Findings from Common Spaces in Multifamily Buildings

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ABSTRACT

California is currently updating energy multifamily standards for 2023. During the last code cycle, building shell data were used to inform insulation and roof code requirements (California Energy Commission 2020). The new codes for the 2023 cycle are still under consideration but will likely include a heavy emphasis on electrification and distributed energy resources (DERs).

This paper describes how codes and standards programs are using a new multifamily common area primary data source to inform market baselines, remaining potential for energy efficiency and distributed energy resources, and barriers to enacting aggressive codes including from an equity lens (e.g., electric equipment saturations by tenant income levels for disadvantaged communities, which may bear more of a burden with electrification requirements). The paper also summarizes key results by climate zone, building size, vintage, and income level.

Introduction

California is currently updating its Building Energy Efficiency Standards for 2022 in accordance with Title 24 requirements (California Energy Commission 2022). This effort is supported by the state's investor-owned utility statewide Codes and Standards program, for which Pacific Gas and Electric (PG&E) is the lead utility program administrator. In particular, the Codes and Standards Enhancement (CASE) Initiative provides data and recommendations to update the California Energy Code for new construction and retrofits. The Codes and Standards program requires market data to substantiate recommendations via CASE studies such as current equipment saturations and market conditions (e.g., shell and building characteristics).

Comprehensive data on the multifamily sector including common area HVAC, water heating, distributed energy resources (DERs), and laundry equipment have historically been less available than data at the tenant-unit level. As states seek to advance their energy codes to meet aggressive climate change goals through net zero and decarbonization strategies, they require comprehensive, current data on multifamily properties including the latest DER saturation combined with demographic information to ensure equity is considered. Equity concerns are necessary to ensure that disadvantaged residents or communities that may bear more of the burden of electrification requirements or other energy efficiency goals are supported with additional assistance or programs to decrease the burden.

To help inform other CASE studies, PG&E sponsored a primary on-site data collection effort across the state of California at 90 properties to capture detailed information on building characteristics, common spaces, and tenant units of multifamily properties. This data collection effort involved recruiting multifamily properties into the study, interviewing property managers,

and collecting data from all common areas and one to three tenant units via an all-day on-site energy audit at each property.

Methods

Evergreen Economics managed the study, and Michaels Energy auditors conducted site visits at 90 multifamily properties across California from December 2019 to February 2020. Table 1 shows the distribution of sites by EZ Building Climate Zone¹ and utility. The sample was developed based on a proprietary database of commercial and multifamily properties from CoStar (CoStar Group 2019). Newer buildings were intentionally over-sampled as they were of greater value to the 2022 Codes and Standards analysis.² Smaller climate zones were also oversampled to ensure sufficient sample for each climate zone. Each site visit was completed in one day, and one to three tenant units were audited per site.

Table 1. Site audits by California building zone, utility, and vintage

			Number of multifamily audits		
			Vintage		
EZ building climate zone	City	Electric utility	2013 or prior	2014+	Total
2	Santa Rosa	PG&E	3	2	5
3	Oakland	PG&E	6	3	9
4	San Jose	PG&E	4	2	6
6	Torrance	LADWP	2	1	3
6	Torrance	SCE	7	2	9
7	San Diego	SDG&E	6	3	9
8	Fullerton	LADWP	2	1	3
8	Fullerton	SCE	6	3	9
9	Burbank-Glendale	LADWP	7	3	10
9	Burbank-Glendale	SCE	3	2	5
10	Riverside	SCE	4	2	6
12	Sacramento	PG&E	1	1	2
12	Sacramento	SMUD	6	2	8
13	Fresno	PG&E	4	2	6
Total			61	29	90

Evergreen developed income classifications for the 90 audited sites using a combination of 2021 US Census data and proprietary CoStar data from 2019. Since income levels were not

¹ There are 16 EZ Building Climate Zones defined by the California Energy Commission that account for the diversity of climates within the state. See <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/climate-zone-tool-maps-and> for more information on the climate zones.

² Results for sites built in 2014 or later are presented separately than for sites built in 2013 or before for most analysis where vintage may be an influence in the field.

collected at sites for any tenants, income classifications were developed using an Area Median Income (AMI) metric that compares 1-mile radius median income data for each site from CoStar to the census median income level of the county in which the site is located.

The US Department of Housing and Urban Development provides guidance for what income levels are extremely low income, very low income, low income, moderate income, and high income based on the ratio of a household's median income to the broader AMI for their household size.³ Using the median income of a site's block group from the census with the average household size and comparing this estimate to the site's AMI, we estimated the income level of a site, ranging from extremely low income to high income.⁴ We use these AMI income classifications to help inform the burden low-income customers may face given changes to codes and electrification requirements (e.g., comparing saturations of natural gas equipment by income category).

Results

This section provides highlights from the HVAC, water heating, laundry equipment, and DER data.

HVAC

Heating data were collected for 126 of the 127 audited tenant units. Of the sampled units, furnaces, zonal heat, and electric baseboards were much more prevalent as heating sources for sites built before 2013. All sampled tenant units contained a primary heating source. Air source heat pumps were more common as a primary heating source for sites built after 2013.

Table 2. Primary heating systems in sampled units

		2013 or before (n=83 tenant audits)	2014 or later (n=43 tenant audits)	All vintage
Central heating	Furnace	46%	33%	41%
	Boiler	5%	16%	9%
In-unit heating	Air source heat pump	16%	40%	24%
	Zonal heat	19%	2%	13%
	Electric baseboard heater	11%	0%	7%
	Mini split heat pump	0%	9%	3%
	Packaged heat pump	4%	0%	2%

³ The geographies for which AMI estimates are provided are metropolitan areas and non-metropolitan counties. See Office of Economic Affairs, Housing and Urban Development (HUD). 2018. *Assessment of Small Area Median Family Income Estimates*. <https://www.huduser.gov/portal/sites/default/files/pdf/Assessment-of-Small-Area-Median-Family-Income-Estimates.pdf>

⁴ Note that for one of our 90 sites, the census did not provide a median income estimate for that site's block group. As a result, this one site cannot be considered in our income-based saturations, and some estimates may not sum to 100 percent when a given appliance is located at this site.

Cooling data were collected for all 127 audited tenant units. Of the units sampled, central AC, air source heat pumps, and packaged AC units were the most common types of cooling. Units in multifamily sites built in 2014 or later were more likely to have AC than units in multifamily sites built before 2014. Air source heat pumps were more common as a cooling source for units in multifamily sites built after 2013.

Table 3. Primary cooling systems in sampled units

		2013 or before (n=84 tenant audits)	2014 or later (n=43 tenant audits)	All vintage
Central AC		27%	35%	30%
In-unit AC	Air source heat pump	15%	40%	24%
	Packaged AC	24%	0%	16%
	Mini split heat pump	0%	9%	3%
	Evaporative cooler	2%	5%	3%
	Packaged heat pump	4%	0%	2%
No AC		27%	12%	22%

Water Heating

Data on all water heaters serving tenant units were collected at each site and are summarized in Table 4 and Table 5. Over a third of sampled sites had individual water heaters in tenant units, with low-rise sites having the highest percentage of tenant unit water heaters (44%). At high-rise sites, there were no tenant unit water heaters observed. Thirty-six percent of sampled sites built in 2013 or earlier had tenant unit water heaters, and 29 percent of sampled sites built in 2014 or later had tenant unit water heating.

Table 4. Residential site water heater types by building rise (n=89 sites)

	Tenant unit	Central
Low-rise sites	44%	56%
Mid-rise sites	27%	73%
High-rise sites	0%	100%
All heights	34%	66%

Table 5. Residential site water heaters by building vintage (n=89 sites)

	Tenant unit	Central
2013 or before	36%	64%
2014 or later	29%	71%
All vintage	34%	66%

The primary fuel types of water heaters that serve tenant units were also recorded for each site. Natural gas, electric, solar, and propane-fueled water heaters were observed in the sample, with natural gas being most prevalent across the sample.

Low-rise sites were observed to have more electric water heaters than sites with high-rise buildings. Solar was the least observed primary fuel type of water heater in the sample, with only 1 percent of sites in the full sample having solar as the primary fuel type.⁵ Sampled high-rise sites across the full sample were only observed to have natural gas as the primary fuel type.

Table 6. Fuel types of residential water heaters by building rise (n=88 sites)

	Natural gas	Electric	Solar	Propane
Low-rise sites	90%	10%	0%	0%
Mid-rise sites	89%	7%	2%	2%
High-rise sites	100%	0%	0%	0%
All heights	90%	8%	1%	1%

Clothes Dryers

Figure 1 displays access to dryers for the sampled sites. Overall, 92 percent of sampled sites provided dryers to tenants. Most sampled sites (54%) had dryers located only in common areas. Thirty percent of sites had in-unit dryers only, and 8 percent of sites had both common area and in-unit dryers.

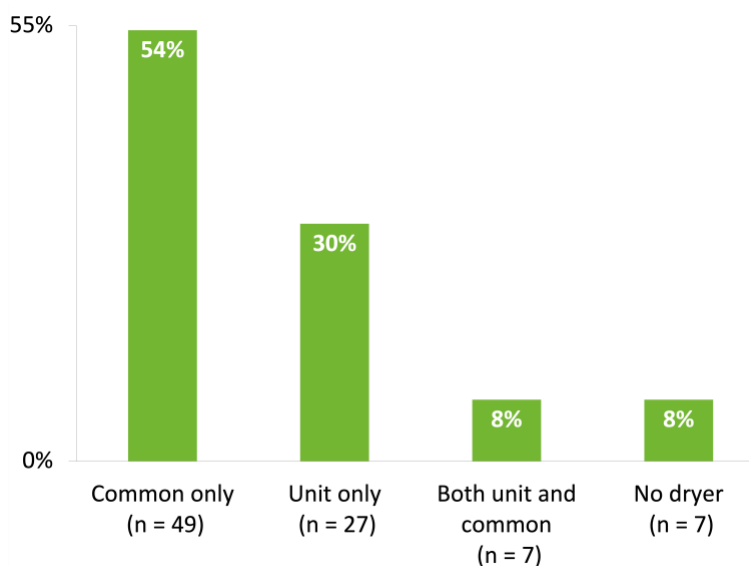


Figure 1. Unit and common dryer presence across sites (n=90)

⁵ Electric heat pump water heaters paired with a solar panel system would still be considered as using electric as a primary fuel source. Solar water heaters use a different technology; more information can be found at <https://www.energy.gov/energysaver/solar-water-heaters>

Figure 2 displays dryer access for sites by income level. High-income sites had the highest percentage of in-unit dryers, with 54 percent of sites having in-unit dryers and 12 percent having both in-unit and common area dryers. There were no in-unit dryers at very low and extremely low-income sites.

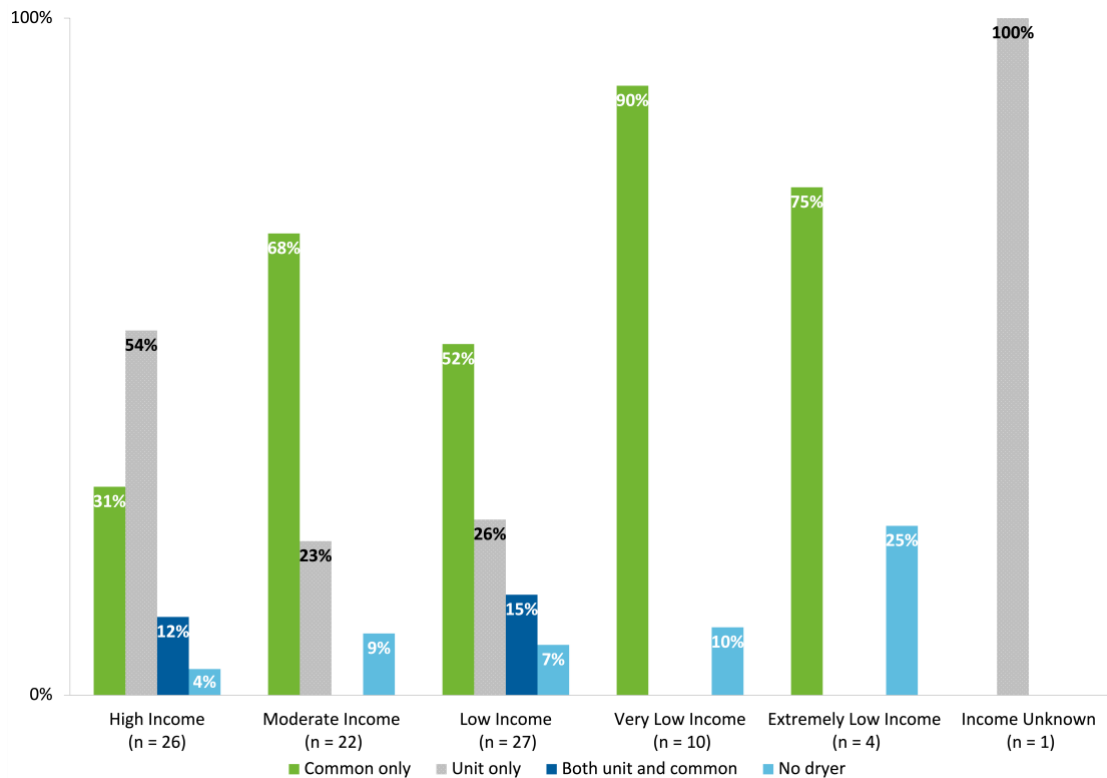


Figure 2. Unit and common dryer presence across income status

DERs

Multifamily properties built after 2013 were slightly more likely to have solar panels and more likely to have electric vehicle chargers on site (Figure 3). Not only were EV chargers more prevalent at newer sites, newer sites with chargers also contained a higher quantity of chargers. Sites built after 2013 contained 11 EV charging stations on average, compared to 4 charging stations at sites built before 2013. Only 3 percent of sampled properties had battery storage.

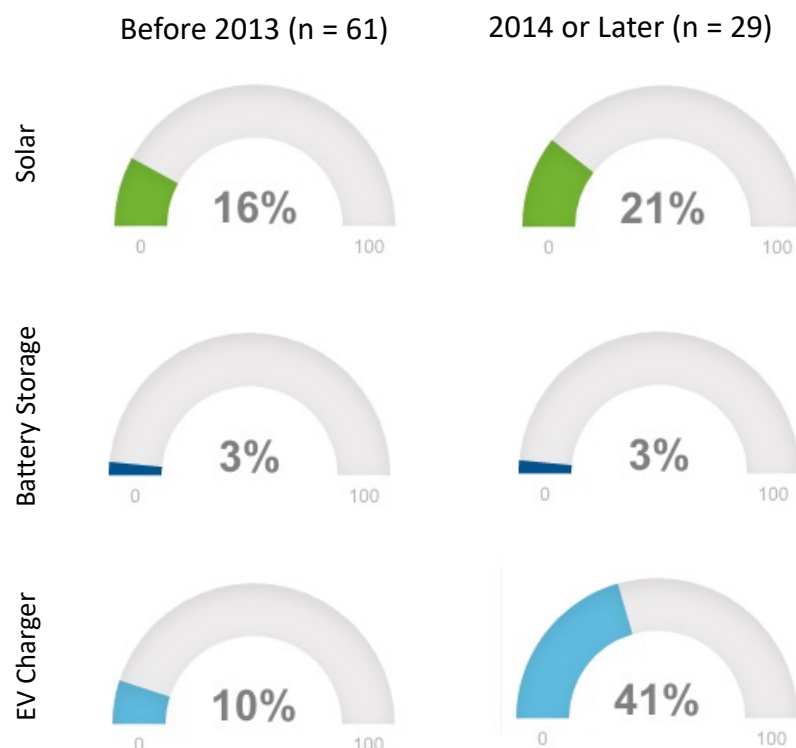


Figure 3. DERs at sites by vintage

As of 2016 new multifamily sites with 17 or more units must provide 3 percent of their parking to accommodate EV charging (UpCodes 2016). As of 2019, that mandate has increased to 10 percent of all parking (Code Publishing Co. 2019). Our sample contained eight sites built in 2018 or 2019; Table 7 shows the distribution of EV chargers across different vintages of sites.

Table 7. EVs and charging features at sites by vintage

Vintage	Sites	Sites with chargers	Number of EVs onsite	Charging listed in amenities
2018 or 2019	8 / 8.9%	3 / 37.5%	30	1 / 33.3%
2014 – 2017	21 / 23.3%	9 / 42.9%	114	3 / 33.3%
2013 or older	61 / 67.8%	6 / 9.8%	40	0 / 0%

Electrification

Electrification of gas-powered appliances helps reduce carbon emissions and improve air quality by replacing technologies relying on fossil fuels with appliances that use electricity as the source of energy. As California and other states reduce emissions generated by creating electricity through increased renewable energy, electricity becomes a source of reduced emissions.

We first look at the distribution variation of fuel types observed for in-unit dryers and stoves (Figure 1). Units with moderate-income residents with both appliances present were

observed to have at least one gas appliance in-unit. In the 60 percent of low-income sites and 50 percent of high-income sites with both a dryer and stove, both appliances were electric.

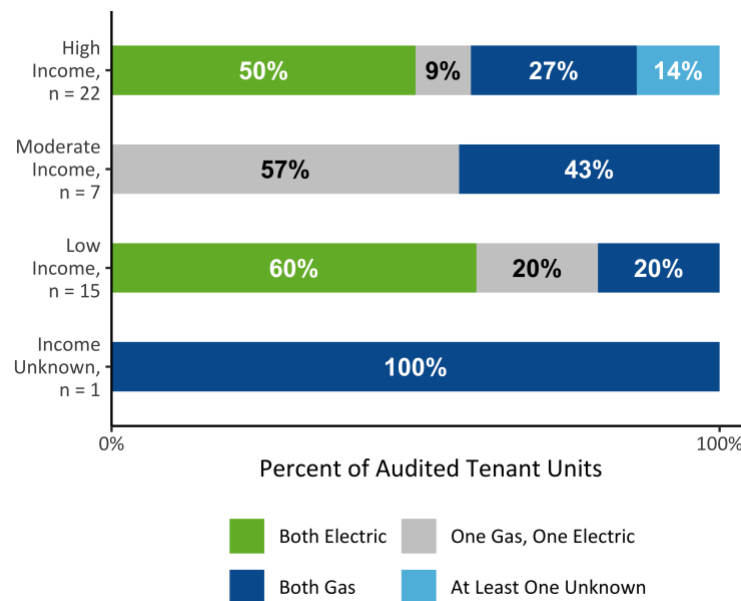


Figure 4. Percent of audited tenant units by income level

Figure 5 displays the fuel types of all tenant-unit stoves by vintage and income level of the sites. New sites are defined as having been built in 2014 or later and old sites as having been built in 2013 or earlier. For high-income, moderate-income, and low-income sites, newer sites were observed to have a higher percentage of electric stoves. Across all site vintages, moderate-income sites consistently had the highest percentage of stoves fueled by gas.

Figure 6 displays the fuel types of in-unit and common area dryers located at the 90 sites. Sites with both natural gas and electric dryers are labeled as having both fuel types. Dryers at sampled high-income sites were most observed to be electric, with 46 percent of sites having only electric dryers observed, and 8 percent having both natural gas and electric observed. Natural gas dryers were more prevalent at moderate-income, low-income, and very low-income sites.

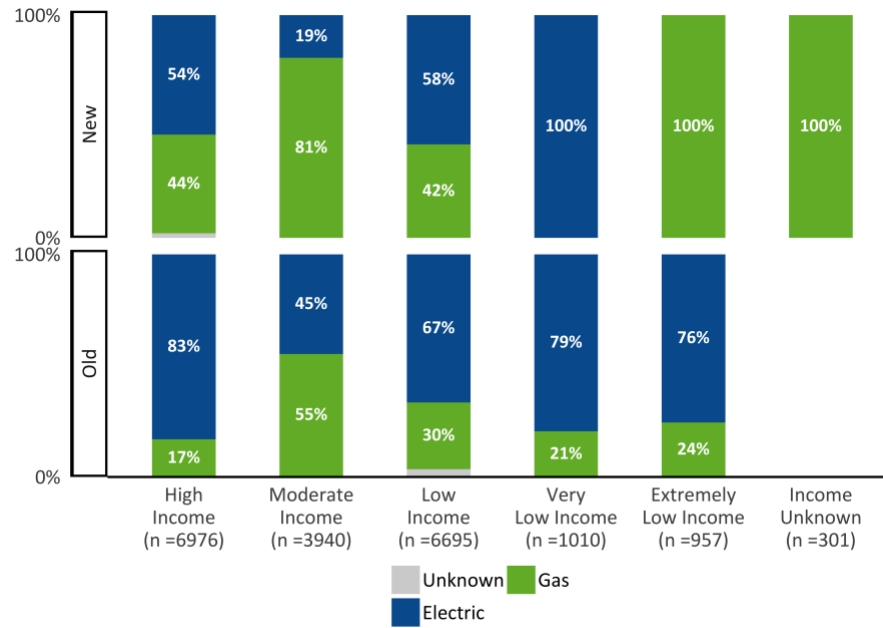


Figure 5. Total number of stoves by building vintage

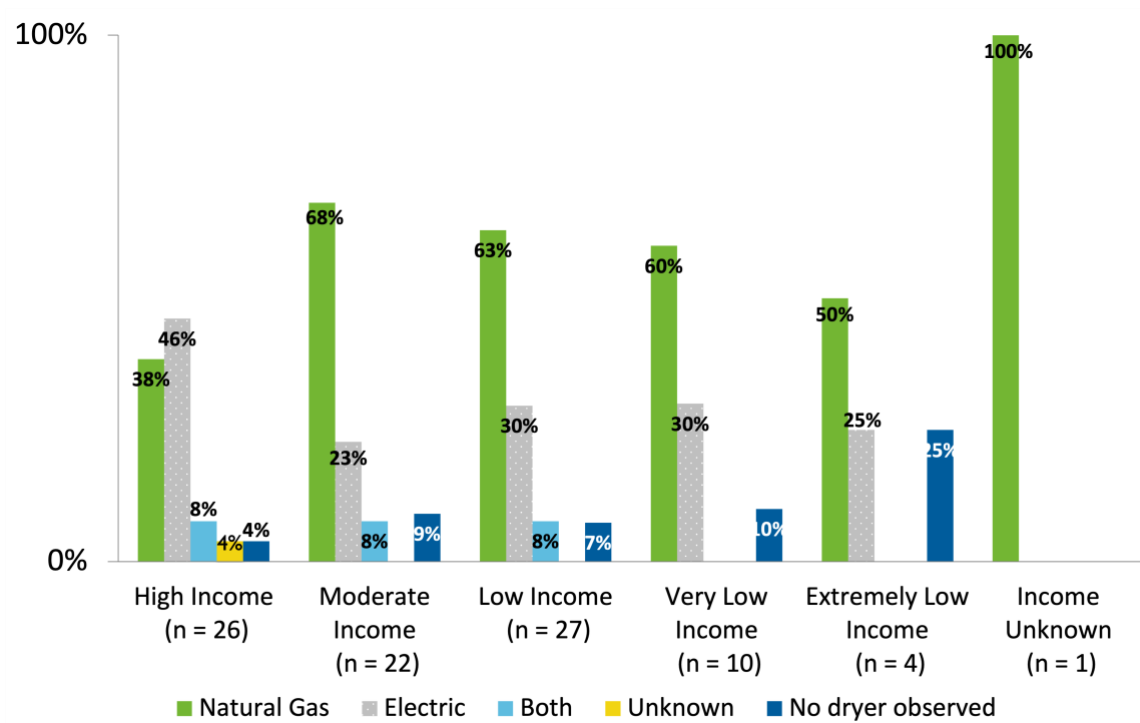


Figure 6. Unit and common dryer fuel types across income status

Conclusions

California is currently updating energy multifamily standards for 2023. During the last code cycle, building shell data were used to inform insulation and roof code requirements (California Energy Commission 2020). The new codes for the 2023 cycle are still under consideration but will likely include a heavy emphasis on electrification and DERs.

The DER data such as electric vehicle charging and solar data collected by PG&E's multifamily study are useful to understand market saturations, what potential exists for uptake of DER such as solar, battery storage, and electric vehicle charging at sites, and what technical constraints may exist at sites. As the demand for electric vehicles, solar, and battery storage increases as states aim to encourage less use of gas-fueled cars and an uptake in renewable energy, data collection efforts can help inform the potential that existing sites have for these DER units as well as what barriers sites may face in uptake of these measures. From our study, we observe that multifamily sites built in 2014 or later offer more electric vehicle charging and solar. Retroactively installing electric vehicle charging at sites after they are developed can be very costly depending on both existing electrical at the sites and how parking at sites is designed. As we have shown for multifamily properties within our sample, there were more sites that had electric vehicles parked at the site than sites that had electric vehicle chargers. This illustrates how the push for consumers purchasing electric vehicles is outpacing the supply of electric vehicle chargers' offered by multifamily sites. Although sites built in 2014 or later had more solar in our sample, this was by a much smaller margin than the percentage difference of sites with EV charging by vintage. Both solar and EV charging require a large upfront cost to install, but solar at a site may not be as attractive an amenity to tenants as electric vehicle charging.

As states set more ambitious emissions targets, electrification becomes an increasingly relevant avenue to achieve emissions reductions goals as electricity relies less on fossil fuels as utility scale and DERs rely more and more on renewable energy. While code can require new construction to be all-electric, the state must focus on existing construction to meet its goals. Understanding existing saturations of HVAC and water heating equipment can help policymakers understand how codes should be structured to address both the equipment in common areas that serve residential units and equipment within tenant-units serving the tenant. For example, understanding that high-rise sites tend to have central water heating instead of tenant-level water heating can help policy makers effectively target buildings for retrofits. As localities move toward mandating electrification, there are concerns of placing a burden on low-income customers. Sites classified as low and extremely low-income in our sample were more likely to have dryers (either in the tenant-unit or common areas) fueled by natural gas than electricity but were also more likely than other income levels to have no dryers at all located at the site. Changes to codes that would require gas-powered dryers to be replaced with electric dryers would likely impact these low-income sites more than higher income sites and may even cause more sites to stop having dryers altogether if they are too costly to replace. Supplemental information from the tenant-unit panels can help to inform how costly it would be for installing electric appliances since units without sufficient space or capacity in their panels would face high costs of upgrading the existing electrical infrastructure to electrify appliances.

This new robust data on the multifamily sector will be useful for code, DER, and energy efficiency program administrators and policymakers as they seek to develop strategies to decarbonize the built environment while also considering equity issues. These data can also help

policymakers define alternative metrics that incorporate both common and in-unit HVAC and appliances to better evaluate energy efficiency levels at multifamily properties.

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