Evaluating Multifamily Building Responses to the California Drought

A WegoWise Study

August 18, 2015

Abstract

In response to the ongoing drought in California, Governor Brown has ordered a 25% reduction in city water use. The growing WegoWise database of utility bills from the state can be used to track the progress of multifamily buildings towards this goal. By examining usage from over 700 buildings, we confirm a reduction in usage in 2015 compared to 2013, but only an average of 6%. May and June saw greater savings of 10% and 12%, respectively, than earlier in the year. Buildings that recorded retrofits saved much more water, on average, than others in the multifamily category: a reduction of 25%. Our findings indicate that while savings in this building segment are lagging, there is ample opportunity to achieve greater savings, and trends are moving in a positive direction.

Introduction and Findings

The ongoing drought in California has drawn attention to the water usage of businesses, farms, and residents of the state. Governor Jerry Brown proclaimed a state of emergency in April of 2014, and a year later issued an executive order to reduce urban potable water usage by 25% relative to 2013.

WegoWise, a building efficiency software provider, tracks utility data for over 2600 multifamily buildings in California, for both fuel and water. Past monthly water usage from 2013 onward is available for over one-fourth of these buildings, affording the opportunity for a large-scale investigation into changing patterns of consumption.

Looking at changes in total gallons, we see a 6% decrease in water use from the first 6 months of 2015 with respect to the same time frame in 2013. The early summer months see larger decreases: 10% in May 2015, and 12% in June. When the data is normalized to gallons per bedroom per day for a direct comparison across buildings that vary in size, the savings are higher: the median building decreased water usage 9% in the first 6 months of 2015, with May and June seeing 14% and 16% (all relative to the same time frames in 2013). This discrepancy between the total decrease and the normalized decrease is due to the influence of large buildings, and is discussed below.

The stock of buildings in this study (mostly affordable housing) seemed to demonstrate a willingness to reduce water consumption, but the aggregate efforts of the population fall far below the Governor's goal of 25% reduction.

Some additional trends are apparent. First, the upper quartile of consumption—the highest water users—tend to show the largest reductions. This is especially noteworthy in buildings constructed before 2000: for the first half of 2015, these older buildings reduced the upper quartile by 16%. These inefficient (and older) buildings are good targets for reduction. Second, for the few buildings with tenant-paid water (only about 20 of the 700), the decreases in usage are higher: a 9% median decrease in 2014, leading to a 13% decrease in 2015 over 2013 usage. Cost incentives seem to motivate further savings, although it cannot be confirmed within the scope of this study, with the small sample size.

Analysis Details

Monthly water utility bills were examined for multifamily buildings in California, from January 2013 through June 2015. All bills were 'calendarized' to align with the first of the month, via summation or pro-rating where required, for easier comparison across buildings and across time. Extreme values (below 10 or above 250 gallons/bedroom/day) were removed from consideration. Only buildings with full, contiguous data for the time period above were included in the analysis, to be sure that the stock of buildings remained consistent through time, so that any changes in the usage distribution could not arise from buildings entering or leaving the stock. In the end, 718 buildings contributed to this analysis, comprising over 25,000 units, over 38,000 bedrooms, and 2.6 billion gallons of water usage over this time period.

Figure 1 shows how the distribution of usage changed over the past two and a half years. (The longer baseline in the plot, through June 2015, restricted the number of buildings with contiguous data to 403.) The visible drop in usage in 2014 is corroborated by the calculated percent changes for each of the quartiles, which hover around 5%. The savings flatten out at the start of 2015, before accelerating into the summer months. Usage in 2012 was similar to 2013, on average.

Weather did not have any significant effect on the usage; the mean monthly temperature and the daily average gallons per bedroom are uncorrelated. While certain subgroups use less water to begin with (newer construction uses ~15% less than older, green-certified uses ~10% less than non-certified, marine climate use ~5% more than hot/dry climate), all subgroups showed similar performance improvements. Table 1 summarizes the average changes for each quartile of such subgroups for 2014 versus 2013, and Table 2 shows the performance in the first 6 months in 2015. These 2015 values are drawn from the smaller subset of buildings with contiguous data for all 30 months.

In addition to the change in quartiles per month, we can examine water reduction through a couple of additional lenses. First, instead of the average change in gallons per bedroom per day, we can look at the change in the *sum* of this median value from year to year. This is akin to following the yearly usage of an imaginary building that takes on the median values of the group. This sum is performed over monthly values, in units of gallons per bedroom, having multiplied the quartile by the days in the month. For this sum of median values, the results are similar to Tables 1 and 2: a 5% decrease from 2013 to 2014, and a 10% decrease from the first half of 2013 to the first half of 2015.

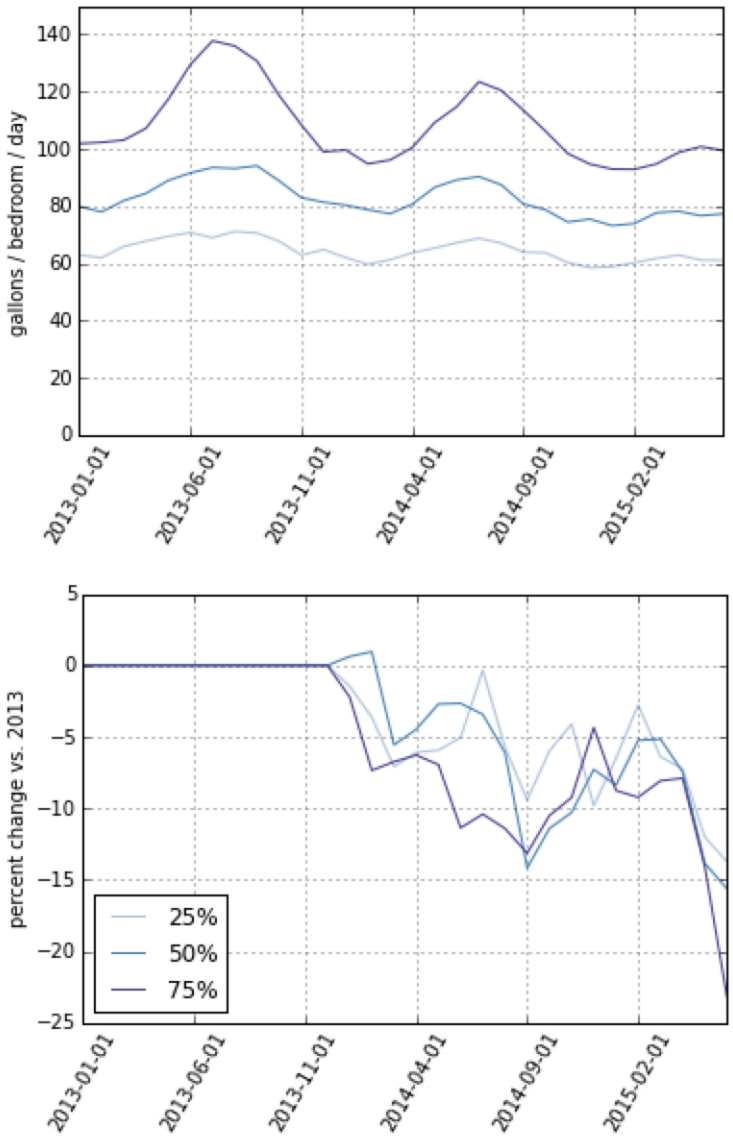

***Figure 1*:** The 25th, 50th, and 75th quartiles visibly decrease in 2014 (top panel). The monthly distributions are calculated from the same set of California multifamily buildings. The percent changes, shown in the bottom panel, are relative to the same calendar months in 2013, for each quartile. In 2014, the median decreased by an average of 5% relative to the same months in 2013. By May of 2015, the average savings surpassed 13%.

	Average change in daily usage from 2013 to 2014, as a percentage			
	25th percentile	50th percentile	75th percentile	Percent of 718 buildings
All	-5	-5	-7	100
Green-certified	-4	-6	-6	8
Low-income	-5	-5	-7	95
Public	+1	-4	-2	4
New construction (2000 onwards)	-6	-4	-6	37
Old construction (pre-2000)	-6	-5	-8	63
Hot climate	-4	-4	-4	64
Marine climate	-6	-7	-9	36
Tenant-paid water	+3	-9	-11	3
Savers	-13	-11	-14	60

Table 1: The reduction in usage for this stock of buildings is around 5% for 2014 compared to 2013. The 'savers' group includes all buildings that demonstrated a negative average monthly change from 2013 to 2014.

	Average change in daily usage from 2013 to 2015, as a percentage (based on first 6 months of year)			
	25th percentile	50th percentile	75th percentile	Percent of 403 buildings
All	-8	-9	-12	100
Green-certified	-8	-5	-7	9
Low-income	-8	-10	-13	94
Public	-10	-10	-7	5
New construction (2000 onwards)	-10	-7	-7	37
Old construction (pre-2000)	-7	-11	-16	63
Hot climate	-10	-11	-7	66
Marine climate	-6	-7	-17	34
Tenant-paid water	-4	-13	-16	4
Savers	-16	-14	-19	67

Table 2: The reduction in usage for this stock of buildings increased to 9% in the first half of 2015, compared to 2013. The group of 403 buildings is a subset of the group comprising **Table 1**, for which contiguous data was available through June 2015. The 'savers' group includes all buildings that demonstrated a negative average monthly change from 2013 to 2014.

The second comparison we can make is a simple total of gallons used. We highlight this particular statistic in our top-level results above because it is easiest to interpret. Table 3 shows the changes in total usage: 6% reduction so far in 2015, but increasing to 12% in June. In this sample of buildings, the total usage shows less reduction that the median quartile (which is normalized by bedrooms and days). This discrepancy demonstrates the effect of long tails: there are some large, high-usage buildings that have not reduced usage along with the population, weighing the total savings numbers down with them. These buildings have reasonable *normalized* usage (gallons per bedroom per day), but high and unresponsive *total* usage (gallons). Figure 2 shows this difference graphically.

Finally, Figure 3 shows the usage of all buildings considered in this study, with quartiles shaded. The same overall usage trends are visible, while highlighting just how great of a discrepancy there is between usage in inefficient buildings and their efficient counterparts.

Percent changes in medians (from quartiles in gallons/bed/day)	
2014 vs. 2013 (average of 12 months)	-5
2015 vs. 2013 (average of 6 months)	-9
May 2015 vs. May 2013	-14
June 2015 vs. June 2013	-16
Percent changes in totals (from totals in gallons)	
2014 vs. 2013 (sum of 12 months)	-4
2015 vs. 2013 (sum of 6 months)	-6
May 2015 vs. May 2013	-10
June 2015 vs. June 2013	-12

***Table 3*:** The percent reductions are smaller when considering total usage, due to the influence of many-bedroom buildings which do not reduce their water consumption along with the other buildings.

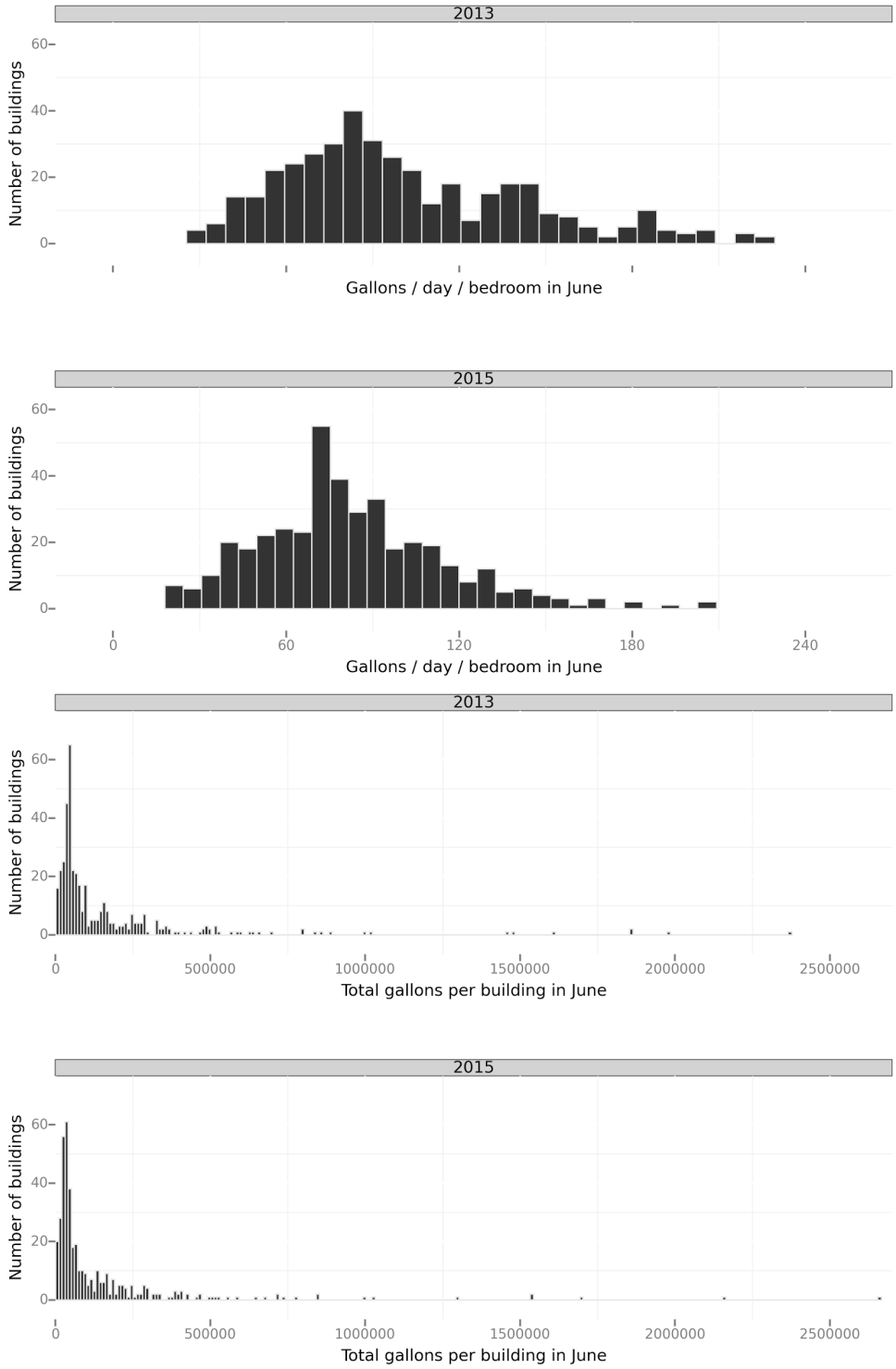

Figure 2: In the top panel, the median of the normalized distribution for June (i.e. usage in terms of gallons/bed/day) decreases by 16% between June 2013 and June 2015. This shift is also shown in **Figure 1**, along with the other months in the study. In the bottom panel, we can see the extreme long tails the total, non-normalized distribution. The buildings to the far right have many bedrooms, and thus dwarf the usage of other buildings, which may have a similar normalized usage.

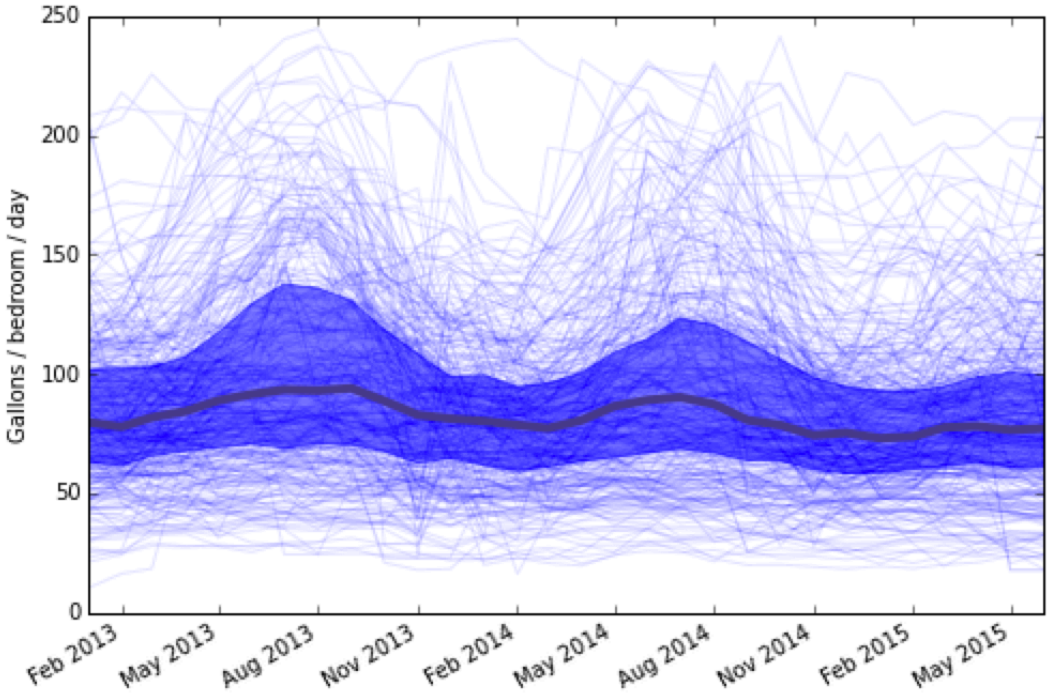

Figure 3: The quartiles, plotted over the usage curves of individual buildings. The range between the 25th and 75th quartiles is shaded, while the median is shown in darker blue. The largest consumers of water stand out; they use over twice the median value, and represent a large savings opportunity.

Performance by City

Performance may vary by local incentives or other regional factors. The table below shows how some cities performed disproportionately well (or poorly). For all buildings with 8 months or more of data after 2013, the mean percent savings (relative to 2013) was calculated. The first column shows the representation by city for this subset of data (of 1000 buildings); the second column shows the representation for buildings with greater than 10% curtailment (out of 140 buildings).

While this building stock is not a perfect sample of the geographic distribution of California's multifamily housing, it still reveals some striking trends. Large cities like Oakland and San Jose are underrepresented in the set of top-curtailing buildings. Morgan Hill, on the other hand, a small city south of San Jose, makes up only 7% of the subset, but comprises a third of the buildings that have displayed over 10% water savings. (The Morgan Hill buildings all fall in two developments, each served by a master water meter, demonstrating the positive influence a single developer can have in a city.) The city is reported to be using 7% less per capita than the statewide average, but still 20% more than the average of the rest of the Central Coast region.

	Percent of buildings in study	Percent of buildings that curtailed usage more than 10%
Los Angeles	18	17
Santa Monica	9	5
Rancho Cucamonga	7	3
Morgan Hill	6	23
Oakland	6	4
San Jose	5	3
Chico	3	-
Fresno	3	-
Berkeley	2	4
Sacramento	1	3

Table 4: Breakdown of savings recorded based on city.

Case Studies

The population-wide changes in the distribution of usage derive, of course, from the efforts of individual property managers, owners, and tenants. Over 100 buildings in the population maintained 15% year-over-year savings for 12 months. Some of the water curtailment coincided with retrofit events entered into WegoWise, though it is likely that not all buildings that underwent retrofits recorded these events in the software. Some buildings, however, did not undergo any physical upgrades and instead obtained savings through behavioral changes. Of the buildings that did record their upgrades in WegoWise, their savings in 2015 averaged to 25%, compared to 2013.

The list below is a sample of the 50 top performers:

- Multifamily apartment complex, Los Angeles: After a failed low-flow toilet upgrade in 2012 where usage more than doubled, the problem was fixed in 2013. The usage dropped further in 2014, sustaining 30% savings that year.
- Affordable housing complex, Santa Monica: A successful toilet upgrade in 2014 sustained 20% savings to below 50 gallons/bedroom/day.
- Affordable housing complex, Sacramento: Irrigation and landscaping changes during 2014 flattened peak summer water usage.
- Affordable housing for seniors, Whittier: Water usage reduced after a 'Healthy Homes Challenge Resident Services Event' in the spring of 2014.

Conclusions

California multifamily buildings in the WegoWise database have certainly decreased their usage in light of the drought, with the median building achieving an average savings of 5% in 2014 and an 9% in 2015, relative to the 2013 baseline. However, this effort pales in comparison to recent reports of a 29% decrease in residential usage in May of 2015 (compared to May 2013). This discrepancy could be due to a number of factors. For example, in multifamily buildings there are fewer square feet of lawn per apartment resident to 'go gold' by reducing irrigation, and less incentive for residents to reduce usage as long as the owner pays the water bill. However, there is hope: for the handful of buildings with recorded upgrades in WegoWise, they saved an average of 25% of their water usage. The multifamily sector has a way to go to pull its weight in the California water crisis, but the goal is not out of reach.

About WegoWise:

WegoWise provides software for more efficient buildings. By automatically integrating a broad range of energy and water data, WegoWise delivers a complete picture of utility use. The intuitive software helps building owners make smarter efficiency decisions that increase cash flow and boost asset value. More than a thousand real estate institutions have added millions to the bottom line with WegoWise. **Learn more at wegowise.com.**