

Green Improvements in Workforce Housing

December 2021



Introduction

Green Up[®] and Green Up Plus[®] are the primary offerings of [Green Advantage[®]](#) and have been effective tools in reducing energy and water consumption in workforce housing properties. Nearly 10,000 green improvements have been made to over 2,300 properties since 2016. These energy and water upgrades have contributed to substantial utility consumption reductions, as demonstrated in our analysis discussed below. Given that average national residential energy¹ and water costs have steadily increased since the first Green Up loan was originated, the reduced consumption has helped relieve some of the cost burden on tenants associated with utility expenses.

For the past three years, we have provided an annual analysis of our portfolio of Green Up and Green Up Plus (both, Green Up) loans² and now include an additional year of data and analysis, including a combined review of realized property savings in this paper. We are also releasing associated property-level data tied to this analysis for loans funded from program inception through the end of the third quarter in 2021. By releasing this data, we seek to provide the market with transparency into Green Up loans and their performance. We continue to better understand the results of the savings analysis, the challenges that remain with obtaining multifamily utility data and the impacts of the green improvements made through the Green Advantage program.

Below are the key highlights from our analysis:

- Since Green Advantage program inception in 2016 through the third quarter of 2021, the Freddie Mac Multifamily Green Up program was utilized on loans totaling over \$64 billion and impacting nearly 630,000 units.
- Financed properties are typically garden-style apartments that are, on average, 36 years old with 86% of units being affordable to households making 100% of area median income (AMI) or less.
- Showerheads and kitchen and bathroom aerators have remained the top water selections due to their low cost and dual energy and water savings potential.
- The top four energy improvements are exterior and common area LED lighting, unit interior LED lighting, HVAC thermostats and insulation. We have seen a 6-fold increase in the selection of these improvements since requiring energy savings on all loans.
- The projected average cost for improvements is \$478 per unit with a total of nearly \$300 million of projected improvements as of the end of the third quarter of 2021.
- Properties have reported over 1.2 billion gallons in actual cumulative consumption savings and over 579 million kBtu in actual cumulative consumption savings.
- The reported actual annual cost savings averages roughly \$48,900 per loan per year and \$191 per unit per year.

¹ For more details on energy costs, see the Electricity Data Browser from EIA, <https://tinyurl.com/uwrze8l>. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_03. See water cost details at <https://www.circleofblue.org/waterpricing/>

² See the prior reports and data set released: <https://mf.freddie.mac.com/docs/green-improvements-workforce-housing.pdf>; https://mf.freddie.mac.com/docs/insight_analysis_of_green_improvements.pdf; <https://mf.freddie.mac.com/docs/2020-green-improvements-workforce-housing.pdf> and <https://mf.freddie.mac.com/docs/green-advantage-dataset-2020.xlsx>

- Tenants are saving, on average, \$129 per year based on reported property data.
- Almost 50% of properties are experiencing more than 15% energy savings, including properties with a required 15% energy reduction.
- We created many benchmarking tools and resources that are free to the public, available even for benchmarking efforts not associated with the Green Advantage program.
- Obtaining whole building data from utilities remains a challenge but sufficient tenant energy data to calculate tenant savings was obtained on 39% of properties receiving an energy savings analysis report, a 25% increase over 2020.

Efficiency Improvement Data from Green Reports and Portfolio Manager

The analysis of projected energy and water savings was performed by pulling together basic loan level information with data from the Green Assessment[®] or Green Assessment Plus[®] (both, Green Reports)³ received when a borrower pursues a Green Up or Green Up Plus loan. The report also includes an analysis of actual savings based on received ongoing utility consumption data collected after installation of the efficiency improvements.⁴

Green Reports

The Green Report provides the borrower with the specifications, quantities, costs, savings, and payback calculations necessary to decide which improvements they can implement to achieve increased energy and water efficiency at their property in a cost-effective way. Borrowers commit to reducing their energy and/or water consumption by the minimum required savings threshold and, in return, receive better loan pricing and potential additional loan proceeds. The Green Reports are prepared by consultants who meet Freddie Mac's qualification requirements (Green Consultants). Green Consultants collect historical utility consumption data for the whole property (common and individual tenant areas) from the property owner and evaluate the building conditions and the performance of equipment, fixtures, and systems on the energy and water consumption at the property.

Utility Consumption Data in Portfolio Manager

Green Consultants input at least 12 months of historical utility consumption data into ENERGY STAR[®] Portfolio Manager[®] (Portfolio Manager), a free online tool maintained by the Environmental Protection Agency (EPA), and provide Freddie Mac with access to this data. The Green Consultants will delineate the utility consumption data as owner- or tenant-paid based on who is ultimately responsible for paying the consumption according to the billing arrangements of the property. The data inputted into Portfolio Manager establishes baseline periods for energy and water consumption for the property and can be used for future utility consumption benchmarking.

We require the submission of ongoing energy and water consumption data (Benchmarking Data) and Portfolio Manager generates performance metrics (Benchmarking Metrics) on an

³ Appendix A: Green Assessment and Green Assessment Plus Standards provides more details about each standard.

⁴ See Appendix B: Data Collection Methodology for details about the data collected and used for analysis.

annual basis. This data is used to compare against the baseline periods to better understand realized savings at the properties resulting from the efficiency improvements. Findings of this analysis are discussed in a later section.

Portfolio Analysis

The multifamily market has seen more workforce housing properties increase in energy and water efficiency because of Green Up loans originated under the Green Advantage program. The total purchase volume through September 2021 is \$64.39 billion from 2,309 loans across 627,895 units.

Exhibit 1: Green Up Loan Totals through 3Q2021

Freddie Mac Green Up Loans	Totals
Loan Count	2,309
Total Loan Amount	\$64,391,612,044
Average Loan Amount	\$27,887,229
Total Unit Count	627,895
Average Unit Count	272

Focus on Workforce Housing

Our primary focus for Green Up loans is to serve workforce housing and affordable properties. Green Up loans have contributed to improving aging multifamily housing stock that often is affordable to tenants making low or moderate incomes. These properties tend to be less efficient overall and stand to benefit from efficiency improvements more than newer properties. Properties must meet specific workforce housing affordability levels; at least half of the units must be affordable at up to and including 80% AMI in standard markets, 100% AMI in cost-burdened markets, 120% AMI in very cost-burdened markets and 150% AMI in extremely cost-burdened markets.⁵ Exhibit 2 provides characteristics of all Green Up properties.

Exhibit 2: Green Up Loan Characteristics through 3Q2021

Freddie Mac Green Up Loans	Totals
Average Year Built	1985
Property Type	
<i>Garden (1-3 story, townhome, walkup)</i>	92.6%
<i>Mid-Rise (Multistory with elevator)</i>	5%
<i>High Rise (9 or more floors, elevator)</i>	2.4%
Unit Affordability	
<i>100% AMI</i>	86%
<i>80% AMI</i>	63%
<i>50% AMI</i>	3%

⁵ https://mf.freddiemac.com/docs/product/green_advantage_term_sheet.pdf

The average age of properties utilizing Green Up financing remains unchanged from prior years and is, on average, 36 years old. The vast majority of all Green Up properties are garden-style apartments. When looking at unit affordability, 86% of all Green Up units are affordable to households making 100% AMI, with 63% of units affordable at 80% AMI.

Green Bonds Issuance

In 2019 we introduced Green Bonds to help drive more private capital to support efficiency improvements in workforce housing. Green Bonds are collateralized by Green Up loans. Through 2021, we have issued \$4.6 billion in Green Bonds. We have also published an annual Impact Bonds Report summarizing the effects of the efficiency improvements implemented from that financing.⁶

Evolution of Green Up Program Requirements

Requirements for Green Up loans evolved to their current parameters of 30% projected whole property consumption reduction (a minimum 15% of which must be energy reduction) and have had no changes made from the prior reporting period.⁷ The implementation of the minimum energy reduction requirement was driven by a focus on finding more ways to benefit tenants using the green improvements. Tenants typically pay for in-unit energy consumption, so green improvements that reduce energy consumption can be an effective way to provide savings to the tenants.

Exhibit 3 provides the Green Up loan totals by program requirement through the third quarter of 2021. 882 loans for \$24.7 billion were funded under the 15% requirement. The count decreased slightly to 822 loans for approximately \$22.2 billion for the 25% requirement. Through the third quarter of 2021, 605 loans have been funded under the 30% consumption requirement for a total volume of over \$17.4 billion. See Appendix C for further discussion regarding the history of the Green Up programs and minimum requirements.

Exhibit 3: Green Up Loan Totals by Program Requirement through 3Q2021

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under Current 30% Requirement*	Totals
Loan Count	882	822	605	2,309
Total Loan Amount	\$24,732,154,182	\$22,196,778,182	\$17,462,679,679	\$64,391,612,044
Average Loan Amount	\$28,040,991	\$27,003,380	\$28,863,933	\$27,887,229
Average Year Built	1984	1987	1985	1985
Total Unit Count	252,538	219,962	155,395	627,895
Average Unit Count	286	268	257	272

⁶ For more information about Impact offerings including Green, Social and Sustainability Bonds, see <https://mf.freddiemac.com/investors/impact-bonds.html>

⁷ Details about the Green Up program requirements are found in Appendix C: Evolution of Program Requirements

Analysis of Improvements

Green Improvement Recommendation and Selections

Program requirements have played a role in the types of improvements that have been selected. Prior to the implementation of the current requirements which became effective at the beginning of 2019, borrowers have selected water improvements almost two and a half times as often as energy improvements. However, with the 30% savings requirement and a minimum required 15% energy reduction, there is now a more even split of borrowers choosing energy improvements along with water improvements.

Exhibits 4 and 5 list the most common water and energy improvements selected through 3Q 2021, showing the overall program and highlighting the differences between the current and historical requirements. The improvements are categorized by the intended savings category, even if the improvement can achieve both energy and water savings.

Exhibit 4: Percentage of Loans Selecting Water Improvements

Green Improvements	% Selected Overall	% Selected in 15 and 25% loans	% Selected Under 30% Requirement
Showerheads	88%	86%	92%
Aerators/Faucet (kitchen)	76%	71%	73%
Aerators/Faucet (bathroom)	75%	73%	73%
Toilets	37%	47%	9%
Irrigation (xeriscaping, weather sensors, etc.)	11%	12%	7%
Appliances (washing machines)	7%	7%	6%
Pool cover installation	3%	4%	2%

Exhibit 5: Percentage of Loans Selecting Energy Improvements

Green Improvements	% Selected Overall	% Selected in 15 and 25% loans	% Selected Under 30% Requirement
LED Lighting (exteriors and/or common areas)	30%	19%	62%
LED Lighting (unit interiors)	27%	13%	67%
HVAC (thermostats)	17%	4%	54%
Insulation (building/other)	13%	2%	34%
Appliances (dishwashers)	6%	7%	5%
HVAC (system replacement)	5%	4%	7%
Appliances (refrigerators)	4%	5%	4%
Central mechanical (domestic hot water heater)	4%	4%	6%
Windows	2%	2%	3%

Showerheads, kitchen aerators and bathroom aerators have remained the top water selections throughout the Green Up program, even when the savings requirement shifted to a required minimum 15% energy savings. Borrowers continue to choose these improvements because they offer energy savings in addition to water savings. When a unit uses less water by using more efficient water fixtures, the water heater usage will be lower, thereby lowering energy consumption. Predictably, improvements that reduce only water with no residual energy savings, such as toilets and irrigation, have been selected less frequently since the minimum 15% energy saving requirement was introduced.

During this reporting period, exterior and common area LED lighting was the most selected energy improvement, chosen on nearly a third of all loans. Unit interior LED lighting was also popular and has been selected on about 27% of all loans. The top four energy improvements have seen a 6-fold increase from the earlier savings requirement to the current 30% savings requirement. Although energy-saving water improvements have increased, borrowers continue to select these energy improvements as they are the most cost-effective method for reducing energy consumption.

Cost of Improvements

The total projected cost⁸ of all selected improvements from August 2016 through the end of the third quarter of 2021 amounted to almost \$300 million. This averages out to \$129,558 per loan or \$478 per unit. Exhibit 6 provides a breakout of projected costs by program requirement.

Exhibit 6: Projected Cost of Improvements by Program Requirement through 3Q2021

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement*	Totals
Loan Count	882	822	605	2,309
Projected Cost of Improvements	\$135,602,899	\$77,070,649	\$86,474,806	\$299,148,354
Projected Average Cost per loan	\$154,621	\$93,874	\$144,365	\$129,558
Projected Average Cost per unit	\$533.82	\$360.42	\$558.09	\$478.17

The requirement that at least 15% of the 30% reduction must come from energy improvements has certainly been effective in driving more improvements to reduce energy consumption but has also increased the cost per unit on these loans. The projected cost per unit to meet the 30% consumption reduction savings requirement is \$558 as compared to the \$360 spent to meet the 25% requirement. This difference is largely due to over 95% of loans meeting the 25% requirement selecting the lower cost option of water improvements. In our portfolio, energy improvement costs per unit are slightly more than double the amount of water improvements. This difference is heavily influenced by the extremely low costs of showerheads and aerators and the high volume of loans selecting these improvements relative to the moderately more expensive energy improvements being selected at a lower rate.

⁸ Cost projections include costs for materials and labor, according to industry standard references.

Despite this increase in cost, there were still many properties that met the increased consumption requirement in a cost-effective way. Of the 605 loans qualifying under the 30% requirement, 65% spent \$500 per unit or less, with half of the properties projected to spend only \$375 per unit or less.

Energy Improvements

Exhibit 7 provides the average projected cost and savings figures for energy improvements. Most energy improvement selections were made for low-cost, high consumption and short payback periods. The top three selected energy improvements of (i) LED lighting for exterior/common area, (ii) LED lighting for unit interiors, and (iii) HVAC thermostats projected an average consumption savings of 12.2% with an estimated average payback period of just over 2 years. In fact, of the 605 loans required to meet the 15% energy consumption savings requirement, only 10% did not choose at least one of these three improvements. The other improvement with an estimated payback under 3 years is insulation, specifically insulation of domestic hot water lines and tanks. The combination of these four improvements nearly meets the required 15% energy reduction, all while ensuring the borrower will recover their initial investment in the shortest amount of time.

Exhibit 7: 2018-2021 Energy Improvement Cost and Savings

	Average Cost of Improvement (\$/unit)	Average Annual Energy Cost Savings (\$/unit/yr)	Average Energy Consumption Percentage Savings (%)	Estimated Simple Payback (years)
Appliances (refrigerators)	\$392	\$14	0.7%	27.5
Central mechanical (DHW)	\$242	\$32	5.2%	7.6
HVAC (system replacements)	\$929	\$91	5.4%	10.2
HVAC (thermostats)	\$165	\$61	4.4%	2.7
Insulation (building)	\$581	\$60	3.9%	9.6
Insulation (other)	\$69	\$24	2.2%	2.8
LED Lighting (exteriors and/or common areas)	\$49	\$23	2.1%	2.1
LED Lighting (unit interiors)	\$149	\$96	5.7%	1.5
Windows	\$1,243	\$103	6.6%	12.0
Totals	\$483	\$132	3.6%	3.7%

Note that the figures above are only for 2018 through Q3 2021 selected improvements as methods to standardize and collect the data were under development prior to the creation of the Green Up database.

Water Improvements

Water improvement selections are typically driven by factors that include their projected cost relative to their payback and the associated consumption savings.

Water improvements with residual energy savings are often combined with energy improvements to meet the 30% consumption reduction savings targets. As with energy improvements, borrowers are looking for short payback periods in addition to meeting the savings target. The three most common water improvements of showerheads and kitchen and bathroom aerators each have residual energy savings in addition to their high-water savings and have an estimated average payback of less than 6 months. Given the high water savings and residual energy savings, it is easy to see why these improvements are the most selected for the Green Up program. In fact, 98% of loans under the 30% requirement chose at least one of these improvements, and only 9% of loans did not select showerheads as one of their improvements. Exhibit 8 provides more details about the average projected cost and savings figures for water improvements

Exhibit 8: 2018-2021 Water Improvement Cost and Savings

	Average Cost of Improvement (\$/unit)	Average Annual Water Cost Savings (\$/unit/yr)	Average Water Consumption Percentage Savings (%)	Average Annual Energy Cost Savings (\$/unit/yr)	Average Energy Consumption Percentage Savings (%)	Estimated Simple Payback (years)
Aerators (kitchen)	\$17	\$28	5.3%	\$21	1.9%	0.3
Aerators (bathroom)	\$20	\$21	4.0%	\$16	1.5%	0.5
Appliances (dishwashers)	\$301	\$5	0.7%	\$21	1.0%	11.8
Appliances (washing machines)	\$292	\$25	5.1%	\$19	1.6%	6.6
Faucet (complete fixture - bathroom)	\$121	\$27	3.9%	\$16	1.3%	2.8
Faucet (complete fixture - kitchen)	\$131	\$28	5.3%	\$41	1.9%	1.9
Water Features (irrigation)	\$69	\$27	5.7%	\$0	2.0%	2.6
Showerheads (replace)	\$65	\$63	11.8%	\$50	4.3%	0.6
Showerheads (other)	\$84	\$21	4.5%	\$21	1.8%	2.0
Toilets	\$300	\$45	7.8%	\$0	0.0%	6.6
Totals	\$323	\$122	7.0%	\$82	2.2%	1.2

Note that the figures are only for 2018 through Q3 2021 selected improvements as methods to standardize and collect the data were under development prior to the creation of the Green Up database.

Actual Portfolio Savings

Measurement and Verification – Quantifying Consumption and Cost Savings

Measurement and verification (M&V) analysis is the process for quantifying consumption reduction and cost savings attributed to the energy and water efficiency improvements made at a property. Our ability to perform M&V analysis to better understand the impacts and benefits of the Green Up program to owners and tenants, the multifamily market, and the environment is dependent on the quality and completeness of the pre- and post-retrofit data received. Gathering tenant-specific and aggregate energy data remain a challenge, mainly due to utility companies being unwilling or unable to provide this data. Additionally, the COVID-19 pandemic has caused people to spend more time in their homes, impacting consumption levels at properties. These various data challenges make it difficult to fully understand the impacts of the efficiency improvements to the properties and to the tenants.

To help combat these challenges, Freddie Mac Multifamily has worked with WegoWise by Appfolio (“WegoWise”) to create a strong data collection foundation to better enable M&V analysis to be performed on the Green loan population.⁹

Annual M&V analysis is performed on our portfolio with the latest M&V analysis being completed in 2021, evaluating the submission of 2020 Benchmarking data.¹⁰ This analysis was for loans originated under all three savings requirements, including the 30% savings requirement.

The M&V process included gathering the 12 months of pre-retrofit or baseline data from the Green Report, the available post-retrofit, or Benchmarking Data, building characteristics and applicable loan reporting requirements.¹¹ In order for M&V analysis to be performed, a property must have reported their efficiency improvements as complete by mid-2020 as well as submitted a minimum of 6 months of Benchmarking Data from 2020 to allow for meaningful savings comparison. After identifying loans that met these initial hurdles, data quality indicators were used in a preliminary data quality screening to further narrow down the potential M&V population. This was a new process added for this year’s M&V analysis. Properties that submitted 2020 Benchmarking Data meeting Portfolio Manager data checks, indicated there was no estimated data, and that did not have outlier performance metrics such as an Energy Star or Water Score of 1 or 100 were prioritized for inclusion in the potential population. 296 properties met our criteria and were chosen to be evaluated by WegoWise for a potential M&V analysis.

⁹ See Appendix D: Data Quality Framework for more details about creating the Data Quality Framework

¹⁰ For more details regarding the prior M&V analysis performed in 2019 and 2020, see the prior report, <https://mf.freddiemac.com/research/duty-to-serve/2020-analysis-green-improvements-in-workforce-housing.html>

¹¹ See Appendix E: Measurement and Verification Methodology for more details on our M&V approach.

WegoWise performed a second, more in-depth assessment of the data quality and completeness to determine suitability for further M&V analysis. Given that our requirements for data collection and reporting have evolved over time, the quality of the Benchmarking Data varied. This data evolution paired with the lack of whole building data from utility companies limited our ability to fully understand the impacts of the efficiency improvements at all properties. Despite this, there was a marked increase over prior years due to our more rigorous standards and wider availability of eligible loans.

WegoWise evaluated all data received and worked with the servicers and borrowers to rectify any discrepancies or anomalies, including outliers. Data provided in monthly intervals allowed for regression analysis to be used to correlate energy or water usage with weather and allowed for adjustments to be made for seasonal variations. Data provided in a yearly interval prevented weather normalization, but analysis was still made through a year-over-year comparison. All data shown received confirmation from those sources as being correctly represented. See Appendix E for greater detail regarding our M&V approach.

Of the 296 properties evaluated for 2020, 282 met the data quality thresholds established through our prior engagements with WegoWise. These properties received either an energy, water or combined M&V analysis depending on the improvements made at the property.

Exhibit 9: Benchmarking Data Quality and Completeness Comparison

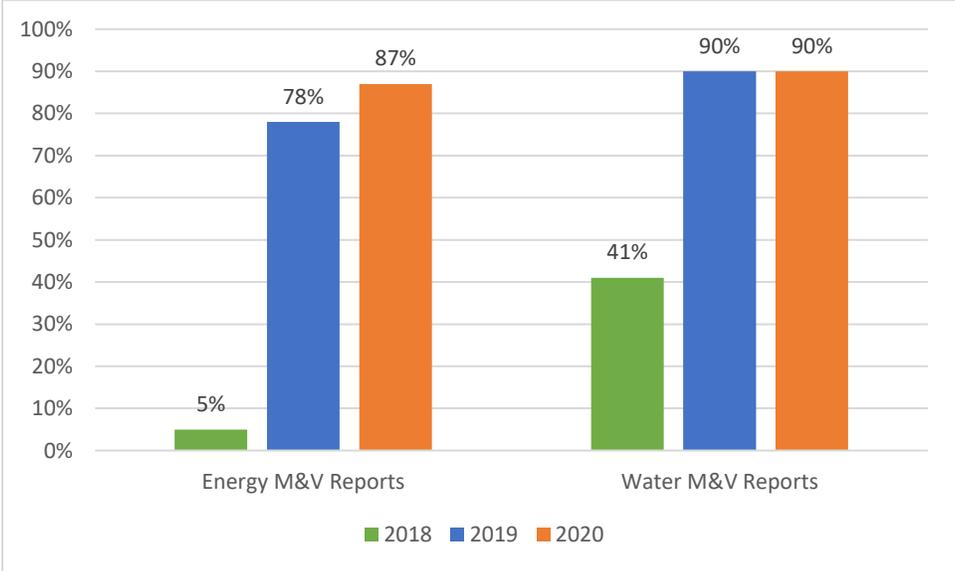


Exhibit 9 highlights the positive improvements in the quality and completeness of Benchmarking Data from 2018 to 2020. WegoWise was able to run 90% of requested water and 87% of energy M&V analyses on 2020 data, as compared to 41% of requested water and only 5% of energy M&V analyses in the 2018 M&V population.

The efforts made to refine our reporting requirements, release the Benchmarking Data Collection Best Practices Guide¹² and provide training and resources to Optigo servicers earlier

¹² The Benchmarking Data Collection Best Practices Guide is available at: <https://mf.freddiemac.com/docs/benchmarking-data-collection-guide.pdf>

in the process contributed to the improved results. Resources included providing on-demand instruction videos demonstrating the process for submitting data. These resources are available for public use, accessible even for benchmarking efforts not associated with the Green Advantage program. We also saw an increase in the number of third-party Benchmarking Data Consultants hired to collect and submit the Benchmarking Data this year. Engagement of a Benchmarking Data consultant became a requirement for loans originated in 2019 and beyond. We believe data quality will continue to improve as more third-party consultants are engaged in collecting, inputting, and monitoring Benchmarking Data.

Breakout of Combined Measurement and Verification Population

The standardization of our data collection, reporting and M&V analysis allows us to now combine data from prior M&V analyses for deeper evaluation. The combined population totals 527 properties, 275 from the 2019 analysis and 282 from 2020. We also included 30 properties from the 2019 population to receive a second M&V analysis in 2020. Exhibit 10 provides a breakout of the combined 2019 and 2020 population of loans receiving a M&V analysis by program requirement. The sample size for the loans under the 15% and 25% requirement is higher than the loans under the 30% requirement given they had more time to complete their efficiency improvements, which allowed for more post-retrofit data available for analysis.

Exhibit 10: M&V Population by Program Requirement

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement	Totals
Count of M&V Analyses	298	200	29	527
Energy only	53	9	3	65
Energy and Water	79	93	24	196
Water only	166	98	2	266

M&V analysis can be performed to understand energy, water or savings from both depending on the improvements selected at the property and the data received. Given the popularity of water savings improvements, water M&V analysis has been performed on 87% of the combined population. However, the number of energy M&Vs have increased, from less than 37% in 2019 to 61% in 2020. We can attribute this increase to the introduction of 15% energy reduction minimum for loans qualifying under the 30% requirement. Over time, we anticipate being able to do a larger number of M&V analyses on the 30% loans. We believe this will allow for a better understanding of the impacts of the efficiency improvements made at the properties, particularly for energy improvements.

Actual Cost Savings

WegoWise used all available post-retrofit data to determine cumulative savings for the Green Up program.¹³ Across the 527 properties receiving M&V analyses, the data ranged from a minimum of six months to a maximum of 47 months with an average savings period of 15

¹³ Refer to Appendix E: Measurement and Verification Methodology for details for determining cost savings.

months for energy and 16 months for water. Given properties had varying savings periods, WegoWise also calculated the average annual savings by applying the cumulative monthly savings average to a 12-month period.

The reported post-retrofit data allocated usage and cost based on who pays for the utility, the owner or the tenants. WegoWise completed energy M&V analyses on a combination of owner-paid, tenant-paid, or whole building data depending on the data provided to Freddie Mac at each property. Post-retrofit tenant data was available for 99 of 261 properties that received an M&V analysis, allowing tenant energy cost savings to be calculated.¹⁴ When tenant data was not provided, tenant savings could not be calculated.

For water M&V analysis, the data received was generally whole-building data as most properties are master-metered, which prevents understanding the usage and cost allocations between the owner and tenants. Water costs arrangements can vary, but an industry standard ratio utility billing system (RUBS) was used by WegoWise to allocate cost savings between owner and tenants.¹⁵

Cumulative cost savings from the M&V population includes savings accumulated since the installation of the improvements. Exhibit 11 shows the total of over \$35,700,000 which averages to about \$126,600 per loan and \$245 per unit. The owner cost savings amounted to \$2,866,300 while the tenant savings was \$22,340,888. The cumulative savings will continue to benefit both owners and tenants as savings will accrue each year the improvements remain in place.

Exhibit 11: Actual Cumulative Cost Savings by Program Requirement

Actual Savings - Cumulative	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement	Totals
Loan Count	298	200	29	527
Cumulative Cost Savings*	\$20,594,734	\$13,305,645	\$1,805,692	\$35,706,071
Cumulative Owner Cost Savings*	\$1,778,248	\$985,143	\$102,979	\$2,866,371
Cumulative Tenant Cost Savings*	\$11,043,643	\$10,859,801	\$437,443	\$22,340,888

*Cumulative savings includes all post-retrofit data available for analysis at each property. Data limitations may prevent allocation of savings between owner and tenants resulting in variation from total cost savings.

¹⁴ Tenants typically pay for in-unit energy consumption while property owners typically pay for all common area energy consumption.

¹⁵ Water costs are typically billed to property owners with various arrangements made for passing costs on to tenants. In some instances, property owners pay for the costs of the water utilities and then adjust rents. Other scenarios include a RUBS where property owners bill back to the tenants the costs of the water consumption. Various RUBS arrangements exist, including allocating a percentage of the bill to tenants according to unit size (ft²), number of tenants in the unit, or using a flat fee structure. Water cost savings realized from water improvements could potentially be passed on to tenants in any of these arrangements, but tenant savings can be inconsistent due to billing variations. As a result, WegoWise used an industry standard RUBS split of 15% allocated to the owner and the remaining 85% allocated to the tenants.

Exhibit 12 summarizes the annualized cost savings by program requirement. Annual cost savings realized almost \$28 million in savings which is \$53,000 per loan and \$190 per unit per year. Tenants saw on average a savings of \$129 per year.

Exhibit 12: Average Annual Cost Savings by Program Requirement

Actual Savings - Annual	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement	Totals
Loan Count	298	200	29	527
Average Annual Cost Savings	\$14,166,178	\$11,969,795	\$1,797,855	\$27,933,828
Average Annual Savings per loan	\$47,538	\$59,849	\$61,995	\$53,005
Average Annual Savings per unit	\$170.55	\$211.54	\$258.17	\$190.93
Average Annual Owner Cost Savings	\$1,222,201	\$809,738	\$97,633	\$2,129,572
Average Annual Owner Savings per unit	\$16.38	\$15.48	\$14.23	\$15.91
Average Annual Tenant Cost Savings	\$7,638,202	\$9,864,172	\$457,702	\$17,960,076
Average Annual Tenant Savings per unit	\$104.42	\$172.49	\$62.72	\$129.47

Actual Consumption Savings

Consumption savings provides a more reliable datapoint for measuring the impacts of the green improvements made at a property as it is less dependent upon billing arrangements or fluctuations in utility costs. Exhibit 13 provides a summary of consumption savings based on the available data for properties receiving a M&V analysis.

Exhibit 13: Actual Cumulative and Average Annual Consumption Savings

Actual Savings*	Energy M&V	Water M&V
Count of M&V Analyses	261	462
Cumulative Total Consumption Savings (kBtu) / (Gal)	579,492,455	1,271,002,845
Cumulative Consumption Savings per loan (kBtu) / (Gal)	2,220,278	2,751,088
Cumulative Consumption Savings per unit (kBtu) / (Gal)	8,143	10,264
Average Energy Savings Period	15	
Average Water Savings Period		16
Average Annual Total Consumption Savings	452,733,312	867,318,361
Average Annual Total Consumption Savings per loan	1,734,610	1,877,312
Average Annual Total Consumption Savings per unit	6,203	7,138

*Cumulative savings includes all post-retrofit data available for analysis at each property

The cumulative realized energy savings based on the energy M&V analysis is over 579 million kBtu, equating to enough annual power for nearly 16,000 homes across America¹⁶. These properties saw an average annual savings of 1.7 million kBtu per year and 6,200 kBtu per unit. These realized savings exceeded the projected savings of 1.4 million kBtu per year and 5,100 kBtu per unit per year. When applied across the portfolio for this year as well as for future years, these results will deliver significant consumption savings for the property.

For the properties receiving a water M&V analysis, average savings of almost 1.9 million gallons of water per year were realized. Units on average saw 7,100 gallons of annual savings. These figures fell short of the initially projected savings, by about 53% (based on projected savings for these same M&V properties). The discrepancy between the projected and actual savings warrants an additional review of our consultants and baseline data. However, these are still very meaningful savings amounts as a result of the water saving measures implemented at the properties. In fact, the cumulative water consumption savings was determined to be over 1.2 billion gallons, which is equivalent to filling the Lincoln Memorial Reflecting Pool 188 times¹⁷, 1,925 Olympic-sized swimming pools¹⁸, or the equivalent of the annual water usage for over 13,800 households across America¹⁹.

Distribution of Savings

The consumption savings for the energy M&V population is comparable to the projections provided in aggregate. When looking at the savings at a property level, there is more variability. Exhibit 14 shows the distribution of the cumulative energy savings by percentage and by program requirement across all properties receiving an energy M&V analysis. The dark orange represents the distribution of 15% loans, the orange represents the distribution of 25% loans, and the light yellow represents the distribution of 30% loans.

The shape of the distribution is a bell curve leaning more toward positive savings, suggesting a normal distribution with most properties realizing positive savings (i.e., a reduction in consumption from their baseline usage), as a result of the energy improvements made at the property. Of the 261 properties receiving an energy M&V analysis, 73% of properties achieved positive savings while 27% had negative savings (i.e., increased usage from the baseline period). About 45% of properties under the 30% requirement saved more than the minimum 15% required energy savings. Across all savings requirements, half of the properties saved over 15% in energy.

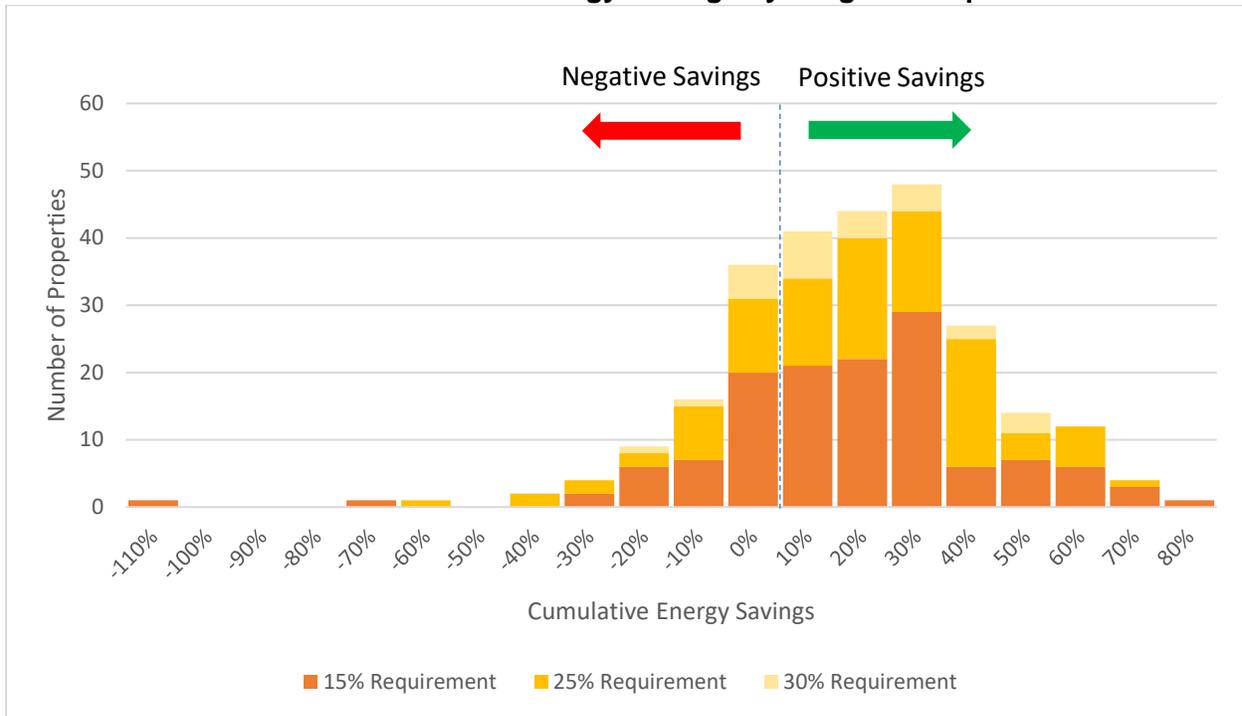
¹⁶ Average electricity usage for homes were based on data from the Energy Information Administration (EIA). See link for more details: <https://www.eia.gov/tools/faqs/faq.php?id=97&t=3>

¹⁷ The size of the Lincoln Memorial Reflecting Pool was based on references provided in the restoration of the pool. See link for more details: https://en.wikipedia.org/wiki/Lincoln_Memorial_Reflecting_Pool

¹⁸ Assumes volume of standard size Olympic pool is 660,000 gallons. See link for details: https://en.wikipedia.org/wiki/Olympic-size_swimming_pool

¹⁹ Annual water usage and the average household are based on figures provided by the US Geological Survey and the US Census. See links for more details: https://www.usgs.gov/special-topic/water-science-school/science/water-ga-how-much-water-do-i-use-home-each-day?qt-science_center_objects=0#qt-science_center_objects and <https://www.census.gov/data/tables/time-series/demo/families/households.html>, Table HH-4 for average household size

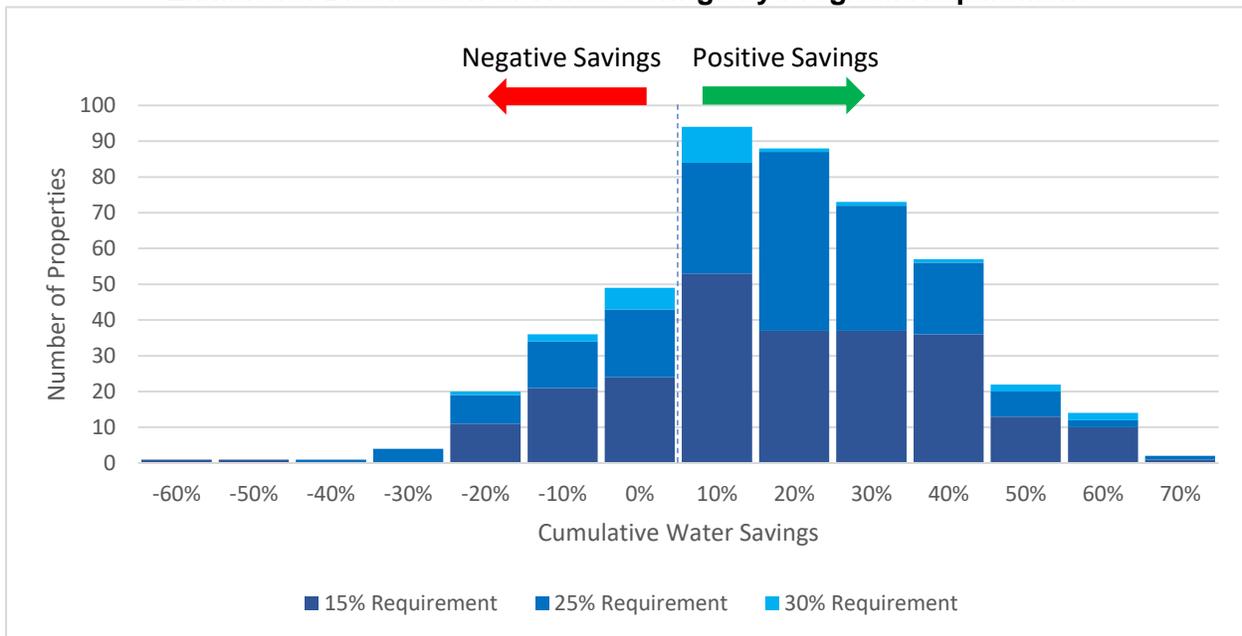
Exhibit 14: Distribution of Energy Savings by Program Requirement



There was more variability in the distribution of savings among properties under the 15% requirement even though the number of loans in the 15% and 25% group are relatively close, at 132 and 102, respectively. This variability could potentially be attributed to the difference in reported utility data between the three groups. All properties meeting the 30% savings requirement as well as 90% of properties under the 25% savings requirement provided whole property data. Only about three fourths of loans under the 15% savings requirement provided whole property data. It appears that when properties provide only owner-paid or tenant-paid data, the savings distribution for these properties varies more than properties with whole-building data, underscoring the need for improved data collection.

Exhibit 15 shows the distribution of the cumulative water savings by percentage and by program requirement across all properties receiving a water M&V analysis. The dark blue represents the distribution of 15% loans, the medium blue represents the distribution of 25% loans, and the light blue represents the distribution of 30% loans. This distribution has a normal bell-shaped pattern with a skew toward positive savings. Of the 462 properties receiving a water M&V, 46% reduced consumption by at least 15%, with 76% realizing positive savings. 24% of properties showed an increase in consumption despite the installed improvements.

Exhibit 15: Distribution of Water Savings by Program Requirement



There is less variability in water savings than in energy savings across the different program requirements, especially when looking at negative savings. This could potentially be attributed to the availability of whole building water utility data as opposed to the challenge of obtaining whole building energy data.

Data Challenges

The evaluation of savings occurred at a property level and are highly variable from property to property. The cumulative and annual savings above demonstrate real savings at the properties. The large majority of properties saw positive savings, but there were also properties that did not realize the expected savings based on their reported data. About 40% overall met or exceeded savings projections, reaching 50% on the energy side. For properties not meeting the projections or that had higher consumption than their baseline, results can vary based on many factors that may include:

1. Data challenges
 - a. Inaccurate estimated data (baseline or post-retrofit data) or single data point for annual energy or water usage
 - b. Difficulty obtaining whole property consumption data from utility companies.
2. Rate increases or fixed costs remain high
3. Equipment issues: Incorrectly installed, tenants' removal/tampering, etc.
4. Usage variations: Behavioral or occupancy changes at the property, new amenity installed, energy/water spikes
5. Impacts due to the COVID-19 pandemic

Many of these challenges are outside of the borrower's control. For instance, the occupancy density may have increased at a property or there has been a change in tenants' behavior. For

example, its likely more tenants were in their units for a longer duration in 2020 due to the COVID-19 pandemic, when the most recent data for analysis was collected, which would increase consumption. Additionally, utility costs continue to rise. Another challenge where borrowers can have a larger influence, but ultimately still rely on the responses of others, is in obtaining tenant data. Gathering this data is challenging in the best of environments and the difficulty has increased during the COVID-19 pandemic. We found sufficient tenant energy data was available for 39% of properties receiving an energy M&V in 2020, up from 31% in 2019.

The increase in available tenant energy data is promising, but estimated data is still necessary for the majority of post-retrofit analysis, which may lead to variability in the savings results. An area we expect to see improvement in is the access and availability of whole property consumption data from utility companies. This data, which includes tenant data, can generally only be provided by the utility company. The lack of awareness from utility providers around the need for energy and water consumption data directly impacts the quality of data available for consumption level analysis. Without whole property consumption data, our analysis is limited by either estimated data, or a lack of data, which lowers the confidence we could potentially have in our data and subsequent analysis, particularly in analyzing energy improvements that are intended to benefit the tenant. Widespread availability of whole property consumption data would give us more confidence in our data and analysis, allowing us to focus on other factors beyond the improvements made at the property that might be influencing the outcome of our analyses.

Several utility benchmarking programs exist around the country that require properties to report their annual utility data.²⁰ About 19% of our portfolio is located in these areas. Utility companies in these areas are generally more equipped to provide the required data necessary for property owners to fulfil their benchmarking obligations. By requiring borrowers to report their utility data for our program, more utilities will receive requests for whole property data. Our program can help in increasing the demand for this data, which may help serve as a driver of action from utility companies to make the necessary investments to provide whole property consumption data. In a landscape that is becoming more focused on environmental awareness, these changes can have beneficial impacts. We could add this improved data to the green data set we provide to the market.

As explained above, we have worked to improve the challenges inherent in collecting and reporting the data. While we have seen improvements each year, we will continue evaluating and implementing ways in which we can improve these results. We have implemented adjustments to require the Green Consultants provide monthly usage upfront as well as post-closing to allow for a more accurate analysis that can include weather normalization. Additionally, we began a point of submission data review in order to more quickly correct deficiencies where possible, to ensure the data provided meets our high standards. Our M&V process now includes two data quality assessments. We also plan to continue educating all stakeholders on collecting high quality data, particularly energy data and tenant data.

²⁰For more information see:

https://www.energystar.gov/sites/default/files/tools/Benchmarking%20Programs%20and%20Policies%20Factsheet_Q2-2021v5.pdf

Impact of Location

With an understanding of the absolute benefits water and energy efficiency improvements will have on reducing consumption and cost at a property, each year we have looked to evaluate the impact these improvements have based on the location of the property. We looked at impact relative to water scarcity, energy costs and carbon reducing environmental impacts. While all properties will see benefits due to their efficiency improvements, they may see greater impacts depending on the location of the property.

The distribution of Green Up and Green Up Plus properties is generally consistent with the overall distribution of all Freddie Mac Multifamily loans. These properties are located in 45 states, with the highest concentrations in Texas, Florida, California and Georgia. These four states contain 46% of all green loan properties. Arizona, Colorado, North Carolina, Nevada, and Virginia have 23% of green loan properties with the remaining 30% coming from 36 states. This distribution has remained relatively consistent over the course of the Green Up program. The properties are spread over 191 metropolitan statistical areas (MSAs). Below is a chart of the Top 10 MSAs, which contain almost 40% of all Green Up loans.

Exhibit 16: Top 10 MSAs Containing Green Up Loans

MSA	% of Green UP Loans
Atlanta	7.2%
Dallas	4.8%
Phoenix-Mesa	4.5%
Houston	4.4%
Denver	4.0%
Tampa-St. Petersburg	3.7%
Las Vegas	3.5%
Los Angeles-Long Beach	2.5%
Orlando	2.4%
Baltimore	2.1%

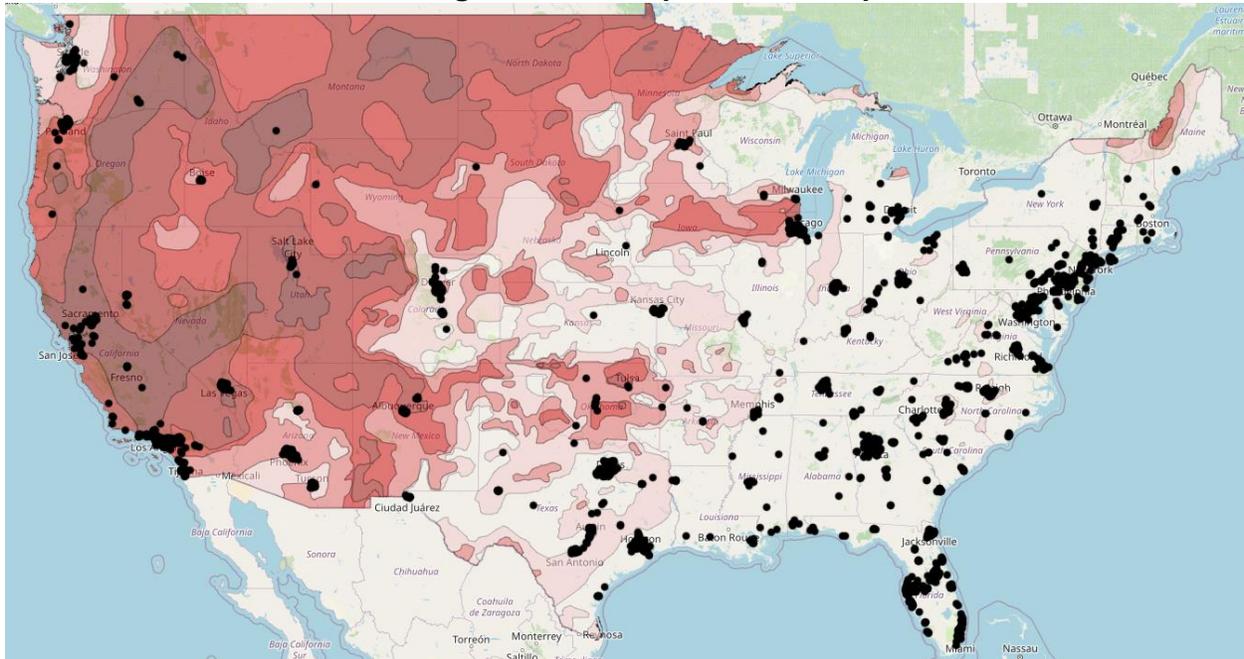
Green Up Loan Impacts in Areas Experiencing Drought

Water-saving improvements have played an important role of reducing water consumption since the beginning of the Green Up program. As properties become more efficient, this becomes even more important in areas experiencing water scarcity. Exhibit 17 is a map showing location and intensity of areas experiencing drought relative to Green Up loans as of the end of the third quarter of 2021.

We found 826 Green Up loans, or 36%, are in areas that were experiencing drought or were abnormally dry. We have consistently seen about this same amount in each of the past 3 years of analysis. Green Up loans installing water conservation improvements in these areas are projected to save over 2.3 billion gallons of water, or 12,000 gallons per unit. In fact, we analyzed post-retrofit water data from 181 properties in these areas and found they saved 506

million gallons since implementing their green improvements. These properties saved 12,000 gallons of water per unit, meeting the average projected savings per unit of the overall program. Properties with water-savings improvements in these locations help in water conservation efforts and lessen the water demand in these water-constrained areas. These efforts are not only important in drought or abnormally dry areas but in the many states that have water supply issues, aging infrastructure and are expecting water shortages to occur over the next several years.²¹ Green Up properties can play a role in reducing water consumption in many of these areas.

Exhibit 17: U.S. Drought Monitor Map and Green Up Loan Location



Source: U.S. Drought Monitor provided by the National Integrated Drought Information System, <https://droughtmonitor.unl.edu/Maps/MapArchive.aspx>

Green Loan Impacts in Areas of High Electric Utility Costs

One of our primary objectives of the Green Advantage offerings was to improve affordability through lower utility expenses. Given the requirement for all properties to reduce energy consumption by 15%, we evaluated the impact of implementing energy-saving improvements in high utility cost areas. Exhibit 18 is a map showing the average monthly electric utility bills by state in 2020 relative to the location of Green Up properties. States with the most expensive electric bill are dark red and states with the least expensive bill are light yellow. The national average monthly electric utility bill is \$117, up almost \$6 since our first full year of green loan funding in 2017. The average monthly electric utility bill for states with the most expensive electric bill is \$137, 17% more than the national average.

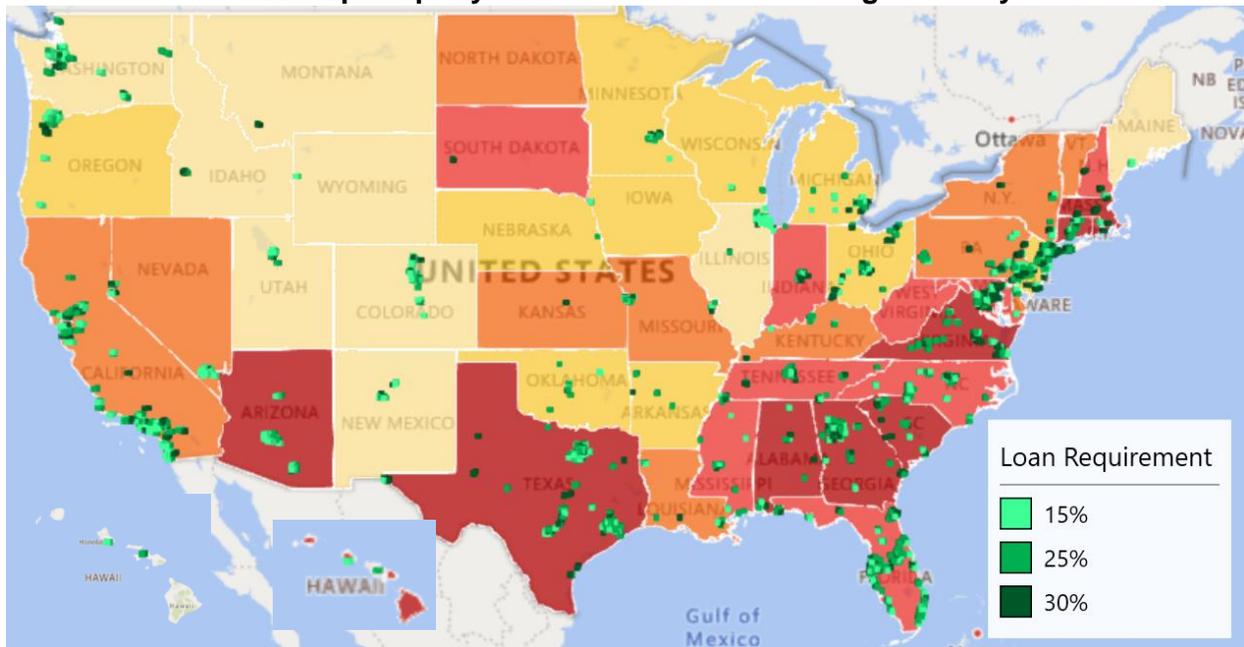
We found 51%, or 306 Green Up loans qualifying under the 30% consumption reduction requirement, are located in states with the most expensive electric bills. In fact, 165 properties in

²¹ Reference the Water Use facts on the WaterSense EPA website: [About WaterSense | US EPA](https://www.epa.gov/watersense/about-water-sense-us-e-p-a)

these states received an M&V analysis and have saved on average over \$92,000 annually and \$301 per unit, which lowers the monthly electric bill \$25, which is more in line with the national average.

Regardless of the location of the Green Up loans, the expected savings will have a meaningful impact, particularly given the rising energy costs: energy bills have increased from 12.88 cents per kWh in August 2016, when the first Green Up loan was originated to 14.19 cents in September 2021.²² Energy improvements made as a result of the minimum 15% energy consumption reduction requirement will serve to combat these rising costs. This is particularly important for tenants, since they pay for their energy usage, either directly, or via a RUBS system, which is found in roughly two thirds of Green Up loans. This is the first year that we were able to analyze loans under the 30% savings requirement. In an analysis of 27 properties, we found a cumulative savings of almost 35 million kBtu, which averages to over 5,200 kBtu per unit. The cumulative energy cost savings totaled \$1.4 million, or an average of \$234 per unit.

Exhibit 18: Green Up Property Location Relative to Average Monthly Electric Bill



Source: Freddie Mac tabulation of 2020 U.S. Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS) data https://www.eia.gov/electricity/sales_revenue_price/xls/table5_a.xlsx

Environmental Impact based on Carbon-Intensity of Energy Supply

More municipalities are beginning to require buildings to reduce their carbon footprints, making it critical for properties to track their building performance. Our program started collecting additional datapoints from Green Reports at the end of 2019 to track carbon performance.²³ We

²² For more details on energy costs, see the Electricity Data Browser from EIA, <https://tinyurl.com/uwrze8l>. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_03

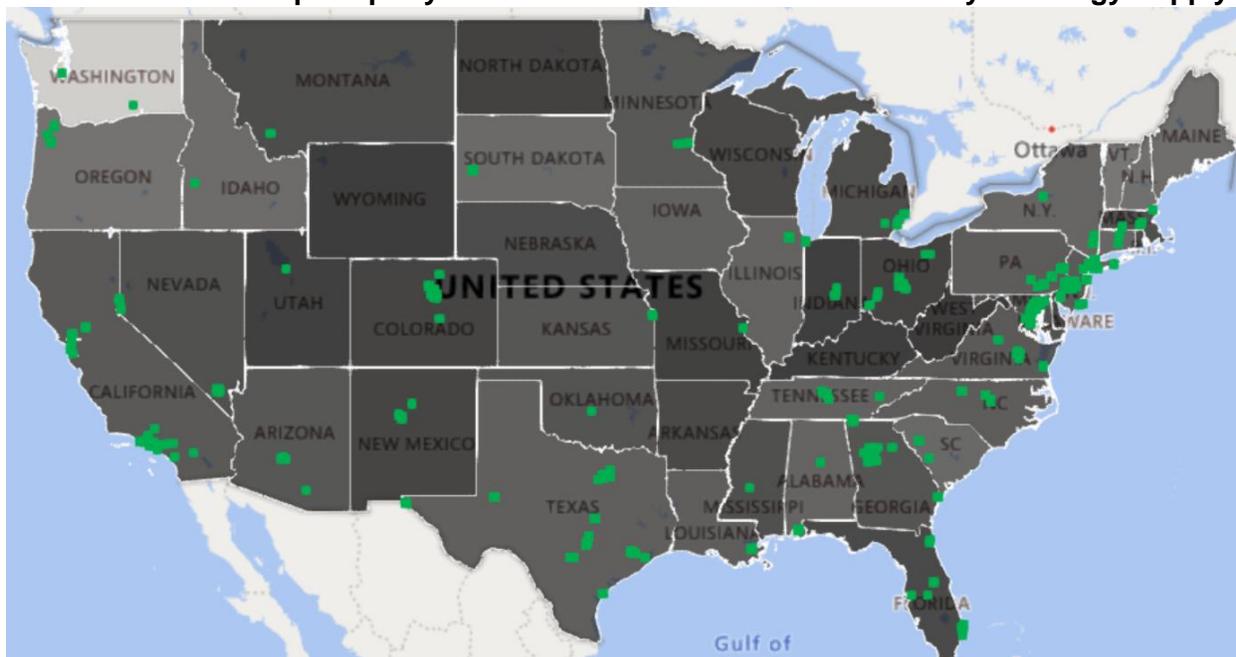
²³ The new datapoints collected allow us to determine the projected Greenhouse Gas (GHG) emissions savings (CO2 equivalent) based on the EPA Portfolio Manager Technical Reference for GHG emissions. Data is only available for a subset of the green loan population. We are tracking this information moving forward, but the data is unavailable on loans funded prior to the implementation of the GHG data collection enhancement.

want to better understand the impact Green Up improvements could make at properties in reducing their carbon footprint and potentially helping to meet these mandates.

We looked at a subset of Green Up loans where we have this new information and found that their green improvements will make a positive impact on carbon emissions savings. In Exhibit 19, the locations of this subset of properties are shown relative to the carbon intensity of the energy supply within that state.²⁴ States with a more carbon-intensive energy supply are shaded in dark grey, and states with a lower carbon-intensive energy supply are light grey. We found 77, or 34% of properties are located in states with an energy supply carbon intensity that is above the national average of 53.1 kilograms of CO₂ per million Mbtu (kg CO₂/MMbtu). These properties are projected to save 14,296 metric tons of CO₂ equivalent.

Regardless of the location of these properties, the projected savings will have a meaningful impact. Across the subset of Green Up loans with carbon emissions savings data, the implemented green improvements are projected to reduce annual greenhouse gas emissions by 39,813 metric tons of CO₂ equivalent. This is equivalent to the same amount of CO₂ as removing 8,659 cars off the road for a year or charging almost 5 billion smartphones.

Exhibit 19: Green Up Property Locations Relative to Carbon-Intensity of Energy Supply



Source: Freddie Mac tabulation of 2018 U.S. Energy Information Administration (EIA) Energy-Related Carbon Dioxide Emissions by State data <https://www.eia.gov/environment/emissions/state/excel/table7.xlsx>

²⁴ Each state has a unique profile of the types of fuel sources used to produce energy. Carbon-producing fuel sources such as coal, petroleum and natural gas, vary in the amount of carbon produced and will have a direct impact on the energy-related carbon dioxide (CO₂) emissions in that state.

Conclusion

Green Up has been an effective tool in upgrading workforce housing and preserving affordability for tenants. Properties are realizing consumption and cost savings due to the energy and water efficiency improvements implemented at these properties. Our analysis showed an average savings of 1.7 million kBtu of energy per year and almost 1.9 million gallons of water per year for properties receiving a Green Up loan. The majority of these properties realized positive savings as a result of the energy and water improvements made at the property.

These savings figures are especially critical when considering the average age of properties in our portfolio is 36 years old with 86% being affordable to tenants making 100% of AMI. On average, tenants have realized savings of \$129 per unit, which can make a significant difference for these residents.

We have built a solid foundation of data collection, reporting and M&V analysis that has contributed to building one of the largest multifamily datasets focused on green loan performance. We have focused on providing data transparency and clarity to the multifamily market. Looking closer at the property level, we see persistent data challenges, such as obtaining whole property utility data, that impacts our ability to understand impacts and benefits to owners, tenants, the multifamily market and the environment. Additionally, other factors can positively or negatively impact consumption and cost savings that are outside of the control of the borrower including occupancy and tenant behavior.

As our program has matured, we have worked to improve our processes to address these challenges. We are doing a point of submission reviews of Benchmarking Data and implementing two data quality assessments in the M&V process. We have also provided tools and resources including a Best Practices Data Collection Guide and on-demand videos explaining the reporting process. We believe these improvements will continue to increase the quality of data we receive, allowing us to demonstrate and quantify the meaningful savings happening at these properties.

Appendix A: Green Assessment and Green Assessment Plus Standards

In conjunction with Green Consultants, Freddie Mac Multifamily designed the Green Assessment and Green Assessment Plus to align with industry standards and to be completed within two weeks, which aligns with typical multifamily deal quote timelines and allows borrowers to make decisions about improvements early in the deal process. The two-week time frame required striking a balance between the level of due diligence and analysis needed to produce meaningful recommendations, and the need to deliver reports within the requisite period of time at a reasonable cost for real estate transactions.

Green Assessment

The resulting standard for the Green Assessment is a report meeting the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Level I standard with certain additional requirements. The additional requirements above the Level I standard include the analysis of water performance at the property, the reporting of Portfolio Manager metrics and documentation of existing property conditions. Green Consultants also provide cost and savings calculations through simplified modeling and the use of industry recognized formulas and standards. We also set rigorous inspection requirements. Borrowers receiving a Green Assessment who commit to improvements meeting the required savings threshold can receive financing through the Green Up offering.

Green Assessment Plus

The standard for the Green Assessment Plus report meets all the requirements of a Green Assessment but also aligns with the ASHRAE Level II protocol, which increases the level of due diligence and analysis required. This includes items such as inspecting more units and taking measurements such as heating and cooling cycles, water flow rates and toilet flush rates. The additional property and system measurements are used to feed into more sophisticated modeling software that can allow the consultant to determine possible interactions between improvement recommendations related to the conditions of current systems, climate and various other factors. Borrowers receiving a Green Assessment Plus who commit to improvements meeting the required savings threshold can receive financing through the Green Up Plus offering.

Green Consultants

The Green Assessment or Green Assessment Plus is to be completed by a qualified Green Consultant. General requirements set up by Freddie Mac include experience completing energy and water audits, understanding of the ASHRAE standards, and familiarity with Portfolio Manager. Green Consultants must also have an industry recognized professional certification demonstrating their proficiency in energy and water audits and analysis.

Appendix B: Data Collection Methodology

Loan Level Information

Basic property-level information provided by Optigo lenders during loan origination is collected by Freddie Mac and used for analysis and reporting. This type of data includes:

- Property state
- Property county
- Year built
- Number of units
- Property type (for example, garden, high rise, mid-rise)

Green Reports

Green Consultants deliver completed Green Reports to Optigo lenders who transmit them to Freddie Mac during the loan due diligence process. We collect the data contained within the reports through an automated process and store it in a database, which we then use for our analysis. Examples of this data include:

- Green improvement measures recommended and pursued
- Projected savings of measures (consumption, dollars, and percentage)
- Estimated costs of measures

Historical Utility Consumption Data

The collection of available historical utility consumption data for the whole property (common and individual tenant areas) provides the foundation for property performance and efficiency improvement recommendations. The availability of the utility consumption data will vary from property to property and will be dependent on multiple factors, such as metering structure at the property, billing arrangements between owner and tenants, availability of past data in an acquisition, and utility provider constraints.

Where properties are master-metered or if the owner pays for all utilities, property owners are more easily able to provide whole-property data. More typically, property owners will provide the owner-paid utility data which generally is made up of energy consumption in all common areas such as the leasing office, clubhouse, gym, laundry facilities, outside property lighting, and often include property wide water and sewer consumption. Property owners more often have difficulty providing tenant-paid utility data, which typically constitutes energy consumption within apartment units, since they do not readily have access to this information.

Green Consultants try to gather this information within the requisite report timelines. If any of the whole-property data is unavailable, they have to collect all common area and at least 10% of tenant consumption data. Most commonly, the tenant-paid consumption is unavailable, and in these instances, Green Consultants will make every effort to obtain the data from local utilities, typically requesting aggregated data. If utility providers do not provide the requested data or do not provide it within the required timeline, Freddie Mac will allow Green Consultants to estimate

the missing consumption data based on their experience with other buildings of similar use, size, occupancy, construction, and location.

Benchmarking Data and Benchmarking Metrics – Portfolio Manager

As part of the requirements in the loan agreement, the collection of the actual energy and water usage (Benchmarking Data) at the property through Portfolio Manager is required and must be provided to Freddie Mac. The timing and details on what should be put into Portfolio Manager and by whom has evolved and been clarified in the loan agreement as the Green Up program has matured.

Prior to 2019, the collection of Benchmarking Data could be completed either by the borrower or a third party. For 2019 and beyond, this data must be collected, inputted, and monitored by a Benchmarking Data Consultant.

Prior to the third quarter of 2017, borrowers were not required to track energy and water data until after they completed their green improvements, which typically is up to two years. They also were only required to track consumption based on the intended category (energy or water) to which improvements were made and were to make best efforts to collect tenant data. As a result, the ongoing consumption data received for earlier loans will only include energy or water owner-paid consumption.

In 2018, we refined these requirements by requiring borrowers to track both energy and water consumption (regardless of the improvements selected) post-closing and to collect at a minimum 10% tenant data.

The inputting of Benchmarking Data will generate property performance metrics, known as Benchmarking Metrics. Freddie Mac requests submission of Benchmarking Metrics on an annual basis.

Appendix C: Evolution of Program Requirements

The Green Up program parameters have evolved to meet the requirements set by FHFA for green loan treatment related to the multifamily lending cap. Despite adjustments to the structure of the multifamily lending cap, the Green Up program parameters remain unchanged from 2019 to 2021. Borrowers must meet the consumption savings thresholds set at the 30% whole-property savings level, with a required minimum of 15% coming from energy consumption reduction and the remaining 15% coming from either energy or water consumption.

Near the end of 2019, Freddie Mac added a requirement that properties must also have at least half of the units affordable at workforce housing levels, which we define as up to and including 80% AMI in standard markets, 100% AMI in cost-burdened markets, 120% AMI in very cost-burdened markets and 150% AMI in extremely cost-burdened markets.

The requirement to engage a qualified third-party consultant (Benchmarking Data Consultant) who will collect, input and monitor Benchmarking Data in Portfolio Manager prior to the origination of the loan is still in place.

Evolution of Requirements

Program Year(s)	Consumption Savings Threshold	Benchmarking Data Consultant	Affordability at Workforce Housing Levels
2016-2017	15% owner-paid, tenant-paid or whole property energy OR water reduction	Not required – borrower or third party could enter Benchmarking Data	Not required
2018	25% <u>whole property</u> energy OR water reduction	Not required – borrower or third party could enter Benchmarking Data	Not required
2019	30% <u>whole property</u> reduction from a MINIMUM 15% energy and 15% energy AND/OR water	Required – borrower must engage prior to loan origination	Required – Changed in Nov 2019
2020-2021	30% <u>whole property</u> reduction from a MINIMUM 15% energy and 15% energy AND/OR water	Required – borrower must engage prior to loan origination	Required

Appendix D: Data Quality Framework

Beginning in 2018, Freddie Mac Multifamily engaged WegoWise by AppFolio (WegoWise) in a series of projects to create a framework for our data collection and reporting practices. These projects built the foundation for performing actual savings analysis on properties receiving the energy and water efficiency improvements.

Our initial engagement with WegoWise was set up to analyze, at the time, a 10% sample of the overall portfolio to understand the quality of the data received from the Green Reports. This analysis focused solely on historical consumption data provided by the borrowers and entered in Portfolio Manager by the Green Consultants. WegoWise used their own internal data collection practices, developed through its extensive experience benchmarking over 70,000 buildings, to create a data quality assessment framework. Using this framework to evaluate the sample set of properties, the data quality assessment found the data acceptable for ongoing savings analysis and provided recommendations for data quality improvements.

In response to the recommendations made from the initial data quality assessment, Freddie Mac Multifamily worked with WegoWise to develop a Benchmarking Data Collection Best Practices Guide to create more consistent data collection throughout the entire loan process and to produce higher quality data and reports. We have worked to implement these best practices through adjustments to our loan agreements, requiring the collection of both energy and water data, regardless of the type of improvements (energy or water) being implemented at the property. We also require the collection of a minimum of 10% of tenant data. For Green Up loans originated in 2019 and beyond, we require the borrower to engage a third-party data collection firm to collect, input and monitor the Benchmarking Data. We also provided general and individualized training to our servicers along with resources such as on-demand instructional videos for the annual reporting process.

The final aspect of our data quality framework was developed through our multiple engagements with WegoWise to perform measurement and verification (M&V) analysis. As part of the M&V analysis process, we evaluate the submitted Benchmarking Data against data quality indicators as an initial data quality assessment. WegoWise then performs an additional, more in-depth assessment of the data to ensure completeness and data quality to determine suitability for further M&V analysis.

Appendix E: Measurement and Verification Methodology

There are varying approaches for determining actual savings for energy or water projects. The most widely accepted framework is defined by the Efficiency Valuation Organization (EVO), which publishes the International Performance Measurement and Verification Protocol (IPMVP). IPMVP defines four M&V options (A-D) for determining savings depending on the property, project and reporting needs.

M&V Approach	Explanation	Savings Calculations
Retrofit Isolation – IPMVP Options A & B	Considers only the affected equipment or system independent of the rest of the property, through ongoing measurements taken at the equipment level	Engineering calculations of baseline and reporting-period utility usage based on measured and estimated values; ongoing utility benchmarking not required
Whole Facility – IPMVP Option C	Considers the total energy use and de-emphasizes specific equipment performance using continuous measurement of utility usage during baseline and post-retrofit periods	Analysis of baseline and reporting-period utility data using regression analysis to correlate usage with independent variables such as weather and occupancy
Simulation Software – IPMVP Option D	Builds simulation models showing energy performance of a whole facility calibrated with actual billing data and requiring engineering expertise	Comparison of simulation of the performance period to the period of the utility data

For the M&V analyses, WegoWise followed Option C of IPMVP along with the ASHRAE Guideline 14- 2014 by using the Whole-Building Performance Approach.²⁴ This approach compared pre-retrofit or baseline data with post-retrofit data. Our aim was to obtain the highest quality Benchmarking Data which will include at least 12 months of both pre- and post-retrofit whole-property consumption and cost data, provided in monthly increments for each utility type (electric, gas, water, etc.). The whole building data should also allocate usage and cost based on who pays for the utility, the owner or the tenants. Given our requirements for data collection and reporting have evolved over time as well as the need for a larger analysis sample size, not all data provided includes the above factors but still met the thresholds for inclusion in the savings analysis. Additionally, our Benchmarking Data Collection Guide provides the best practices for collecting the data and alternative approaches when the best practices cannot be followed.

The amount of post-retrofit property data available ranged from a minimum of six months to a maximum of 47 months. When the data was provided in monthly intervals, it allowed for regression analysis to be used to correlate energy or water use with weather and allowed for adjustments to be made for seasonal variations. Data provided in a yearly interval prevented weather normalization, but analysis was still made through a year-over-year comparison. WegoWise completed energy M&V analyses on a combination of owner-paid, tenant-paid or whole building data depending on the data provided to Freddie Mac at each property. The M&V analysis may not always represent the entire property's consumption and cost. For instance, if

owner-paid electric usage was only provided, the percentage savings calculated would only represent the owner-paid savings and not savings across the entire property. The accompanying dataset provides this property-level detail including the cost savings coverage (owner, tenant or whole building) as well as the type of utility (electric, gas, water, etc.) for which the M&V analysis was performed.

WegoWise used all available post-retrofit data for each property to determine both cumulative consumption and cost savings and also average annual savings. In cases where utility data was not reported, WegoWise estimated costs using billing rates provided in the baseline data or the Green Reports. If the cost data was unavailable from these sources, the costs were estimated using publicly available rate information for the property's utility company.

For water M&V analysis, the data received was generally whole-building data as most properties are master-metered. This is helpful in obtaining whole-building consumption data but prevents understanding the usage between the owner and tenant. Water costs arrangements can vary but an industry standard ratio utility billing system (RUBS) split between owner and tenants was used to allocate cost savings between owner and tenant. WegoWise used a split of 15% allocated to the owner and the remaining 85% allocated to the tenants.

Metered energy data (electric and gas) is typically tenant-paid, making it more challenging to obtain. As a result, the energy M&V analysis more often had tenant data missing. If tenant data was missing, tenant savings could not be calculated for the property. When tenant data was unavailable, the overall cost savings would still be calculated but the cost savings would not be allocated between owner and tenant. When tenant data was provided, this allowed for tenant-specific savings analysis to be performed.

Given these limitations, the actual cost savings can vary from the projections provided for the baseline figures.