Freddie Mac
MULTIFAMILY

Spotlight on
Underserved Markets

DUTY TO SERVE

2020 Analysis of Green Improvements in Workforce Housing

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Tenants of workforce housing are seeing a larger portion of their income going toward paying rent, leaving less to cover expenses, including utilities.[1] Reducing the utility consumption at multifamily properties through implementing energy and water improvements can play a part in helping to lower the associated utility expenses for tenants.

Our Green Advantage® suite of offerings seeks to make workforce housing more energy and water efficient. We do this primarily through the Green Up® and Green Up Plus® offerings that provide borrowers financing incentives for choosing to implement energy and water consumption reduction improvements at their properties and require monitoring and reporting on energy and water consumption over time. Since the program's inception, we have seen many properties complete their efficiency improvements and have collected enough consumption data to perform meaningful savings analysis.

In this paper, we provide an updated analysis[2] of our portfolio of Green Advantage loans including savings analysis results from a sample of properties. We also report associated property-level data tied to this analysis for loans funded from program inception, August 2016, through the end of the third quarter in 2020. The additional year of data collected builds on the prior year's data releases and serves as a source of information on energy and water efficiency improvements not readily available in the market. We seek to better understand the results of the savings analysis and the impacts of the green improvements made through the Green Advantage program.

Below are the key highlights from our analysis:

- Since program inception through the third quarter of 2020, Freddie Mac Multifamily Green Advantage provided over $60 billion in financing through loans purchased on nearly 600,000 units.
- Financed properties are garden-style apartments that are, on average, 35 years old with 85% of units being affordable to households making 100% of area median income (AMI) or less.
- The most commonly selected water-saving improvements continue to be the low-cost showerheads, kitchen aerators and bathroom aerators.
- The most commonly selected energy-saving improvements were exterior and common area LED lighting, closely followed by unit interior LED lighting and then HVAC thermostats.
- The projected average cost for improvements is $471 per unit with a total of $280 million of projected improvements as of the end of the third quarter of 2020.
- Properties have reported over 827 million gallons in actual cumulative consumption savings and over 152 million kBtu in actual cumulative consumption savings.
- The reported actual annual cost savings totals over $11 million, which averages roughly $40,500 per loan per year and $133 per unit per year.
- Tenants are saving, on average, $114 per year based on reported property data.

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[1] For more details on the rising cost-burden for most renters, particularly middle-income renters, see the Harvard Joint Center for Housing Studies, America's Rental Housing 2020 report: https://www.jchs.harvard.edu/cost-burdens-rise-middle-income-households-most-metros
[2] See the prior reports and data set released as part of the Spotlight on Underserved Markets: https://mf.freddiemac.com/docs/green-improvements-workforce-housing.pdf , https://mf.freddiemac.com/docs/insight_analysis_of_green_improvements.pdf and https://mf.freddiemac.com/docs/green_advantage_dataset_2019.xlsx

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 the installations 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 the 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 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.[5]

Properties submit their ongoing energy and water consumption data (Benchmarking Data) and Portfolio Manager generates performance metrics (Benchmarking Metrics) on an annual basis.[6] 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

Green Advantage loans have been an effective tool in driving market adoption of energy and water improvements. The total Green Advantage purchase volume through September 2020 is $60.68 billion from 2,183 loans across 596,058 units. Volume totals decelerated over 2020 due to various factors, including adjustments in both a regulatory and business focus and market uncertainties due to COVID-19.

Exhibit 1: Green Loan Totals through 3Q2020

Freddie Mac Green Loans	Totals
Loan Count	2,183
Total Loan Amount	$60,685,884,544
Average Loan Amount	$27,799,306
Total Unit Count	596,058
Average Unit Count	273

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[3] Appendix A: Green Assessment and Green Assessment Plus Standards provide more details about each standard.
[4] See Appendix B: Data Collection Methodology for details about the data collected and used for analysis.
[5] See Appendix B: Data Collection Methodology for details about the data collected and used for analysis.
[6] See Appendix B: Data Collection Methodology for details about the data collected and used for analysis.

In previous years, the program had the benefit of having a favorable treatment relative to the multifamily volume cap, which is set by our regulator, the Federal Housing Finance Agency (FHFA). The structure of this volume cap was changed in October 2019, removing green loans from the volume cap, requiring adjustments in not just our green loan strategy, but to our overall production focus.

Green Bonds Issuance

Since the program launch, we have used the knowledge gained in driving green practices to the multifamily market to more fully align our front-end production with our capital markets execution. Since the inception of the program, Green Advantage loans were integrated into each of our K-Deal® executions. To drive deeper change, we designed targeted impact bonds to help investors focus on overcoming housing challenges and provide support for environmental, social and sustainability goals.[7]

In 2019, we built a Green Bonds Framework to drive more private capital in support of green improvements in workforce housing. Through 2020, we have issued $2.2 billion in Green Bonds.

Focus on Workforce Housing

Our primary focus for Green Advantage loans is to serve workforce housing and affordable properties. Through the first several years of the Green Advantage program, we focused on improving aging multifamily housing stock, which was often affordable to tenants making low or moderate incomes. Exhibit 2 provides characteristics of all Green Advantage properties.

Exhibit 2: Green Loan Characteristics through 3Q2020

Freddie Mac Green Loans	Totals
Average Year Built	1985
Property Type	
Garden (1-3 story, townhome, walkup)	92.4%
Mid-Rise (Multistory with elevator)	5.2%
High Rise (9 or more floors, elevator)	2.4%
Unit Affordability	
100% AMI	85%
80% AMI	62%
50% AMI	3%

The average age of properties utilizing Green Advantage financing remains unchanged from prior years and is, on average, 35 years old. The vast majority of all Green Advantage properties are garden-style apartments. When looking at unit affordability, 85% of all Green Advantage units are affordable to households making 100% AMI, with 62% of units affordable at 80% AMI.

In November of 2019, we published refined Green Advantage parameters that focus on improving properties with 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.[8]

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[7] For more information about Impact offerings including Green, Social and Sustainability Bonds, see https://mf.freddiemac.com/investors/impact-bonds.html
[8] https://mf.freddiemac.com/docs/product/green_advantage_term_sheet.pdf

Comparison between Program Requirements

Exhibit 3 provides the green loan totals by program requirement[9] through the third quarter of 2020. Total loan count for the 15% requirement was at 882 for $24.7 billion and decreased slightly to 822 loans for approximately $22.2 billion for the 25% requirement. Through the third quarter of 2020, 479 loans have been funded under the 30% requirement for a total volume of over $13.7 billion.

Exhibit 3: Green Loan Totals by Program Requirement through 3Q2020

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under Current 30% Requirement*	Totals
Loan Count	882	822	479	2,183
Total Loan Amount	$24,732,154,182	$22,196,778,182	$13,756,952,179	$60,685,884,544
Average Loan Amount	$28,040,991	$27,003,380	$29,022,444	$27,799,306
Average Year Built	1984	1987	1986	1985
Total Unit Count	252,538	219,962	123,558	596,058
Average Unit Count	286	268	258	273

* Figures are through 3Q 2020

Green Improvement Recommendation and Selections

Program requirements continue to require a minimum of 15% energy consumption reduction, which has helped to drive the selection of energy-saving improvements. Exhibits 4 and 5 list the most common water and energy improvements, which 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
Showerheads	87.4%
Aerators/Faucet (kitchen)	75.3%
Aerators/Faucet (bathroom)	74.7%
Toilets	38.7%
Irrigation (xeriscaping, weather sensors, drip, etc.)	11.3%
Appliances (washing machines)	6.9%
Pool cover installation	3.2%

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[9] Details about the program requirements are found in Appendix C: Evolution of Program Requirements

Exhibit 5: Percentage of Loans Selecting Energy Improvements

Green Improvements	% Selected
LED Lighting (exteriors and/or common areas)	27.9%
LED Lighting (unit interiors)	25.7%
HVAC (thermostats)	13.7%
Insulation (building/other)	9.6%
Appliances (dishwashers)	6.6%
HVAC (system replacement)	5.0%
Appliances (refrigerators)	4.5%
Central mechanical (domestic hot water heater)	4.2%
Windows	2.1%

The most commonly selected water improvements continue to be showerheads, kitchen aerators and bathroom aerators. Showerheads were selected on 87% of all loans. Bathroom and kitchen aerators were selected on nearly 75% of all loans. Although these improvements are primarily water-saving devices, they also provide residual energy savings, which contributed to the popularity of borrowers selecting these improvements.

During this reporting period, exterior and common area LED lighting was the second most selected overall improvement. Unit interior LED lighting was also very popular and has been selected on a quarter of all loans. HVAC thermostats were selected on 13% of all loans. Additionally, insulation was pursued on nearly 10% of loans. Borrowers continue to select these energy improvements as they are the most cost-effective method for reducing energy consumption

Analysis of Improvements

Cost of Improvements

The total projected cost[10] of all selected improvements from August 2016 through the end of the third quarter of 2020 amounted to $280.3 million. This averages out to $129,189 per loan or $471 per unit. Exhibit 6 provides a breakout of projected costs by program requirement.

Exhibit 6: Projected Cost of Improvements by Program Requirement through 3Q2020

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement*	Totals
Loan Count	882	822	479	2,183
Projected Cost of Improvements	$135,602,899	$77,070,649	$67,666,499	$280,340,048
Projected Average Cost per loan	$154,621	$93,874	$143,361	$129,189
Projected Average Cost per unit	$533.82	$360.42	$547.94	$471.29

* Figures are through 3Q 2020

The projected cost per unit to meet the 30% consumption reduction savings requirement is $548 and increased by 152% from the 25% requirement. To meet the 25% requirement, over 95% of loans selected the lower cost option of water improvements resulting in the lower cost-per-unit average. The increased cost per unit on loans qualifying under the 30% requirement is driven largely by the requirement that at

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[10] Cost projections include costs for materials and labor, according to industry standard references.

least 15% of the 30% reduction must be from energy improvements. Energy improvements remain more expensive than water improvements.

Despite this increase in cost, there were still many properties that met the higher consumption requirement in a cost-effective way. Of the 479 loans qualifying under the 30% requirement, 67% spent $500 per unit or less, with half of the properties projected to spend only $360 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 cost-savings measures. The top three selected energy improvements of LED lighting for both exterior/common area and unit interiors and HVAC thermostats projected an average consumption savings of 13.2% at an average cost of $367 per unit. The combination of these improvements nearly meets the required 15% energy reduction.

Exhibit 7: 2018-2020 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)	$407	$14	0.7%	28.8
Central mechanical (DHW)	$255	$32	5.3%	8.0
HVAC (system replacements)	$920	$94	5.5%	9.7
HVAC (thermostats)	$159	$67	4.7%	2.4
Insulation (building)	$581	$60	3.9%	9.6
Insulation (other)	$75	$26	2.3%	2.9
LED Lighting (exteriors and/or common areas)	$54	$26	2.4%	2.1
LED Lighting (unit interiors)	$154	$104	6.1%	1.5
Windows	$1,279	$123	7.5%	10.4
Totals	**$487**	**$138**	**3.9%**	**3.3**

Note that the figures above are only for 2018 through 2020 selected improvements as methods to standardize and collect the data were under development prior to the creation of the Green Advantage database.

Another popular energy improvement, due to its low cost and meaningful savings, is insulation, specifically insulation of domestic hot water lines and tanks. If a property added this selection to the other most commonly selected energy improvements, this would put the property over the required savings threshold with an average total cost of $442 per unit.

Water Improvements

Water improvement selections are typically driven by factors that include their projected cost relative to their payback and the associated consumption savings. Low-cost water improvement selections, combined with higher consumption and cost-saving projections (particularly water improvements that also obtain residual energy savings) are very popular among improvement selections. When a unit uses less water by using more efficient water fixtures, the water heater usage will be lower, thereby lowering energy consumption.

These water improvements with residual energy savings are often combined with energy improvements to meet the 30% consumption reduction savings targets. 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. The average projected energy consumption for these improvements is 7.6%, which helps meet nearly half of the required 15% energy-savings requirement. These improvements also project an average savings of 21.3% in water consumption. It is easy to see why these improvements are the

most selected for the program. Exhibit 8 provides more details about the average projected cost and savings figures for water improvements.

Exhibit 8: 2018-2019 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	1.8%	0.3
Aerators (bathroom)	$20	$21	4.1%	$17	1.5%	0.5
Appliances (dishwashers)	$313	$5	0.6%	$21	1.0%	12.2
Appliances (washing machines)	$290	$24	5.2%	$19	1.5%	6.7
Faucet (complete fixture - bathroom)	$119	$27	3.9%	$16	1.3%	2.8
Faucet (complete fixture - kitchen)	$128	$28	5.3%	$43	1.9%	1.8
Water Features (irrigation)	$70	$27	5.8%	$0	0.0%	2.6
Showerheads (replace)	$65	$64	11.9%	$51	4.3%	0.6
Showerheads (other)	$76	$20	3.8%	$21	1.6%	1.9
Toilets	$303	$46	7.8%	$0	0.0%	6.6
Totals	**$244**	**$124**	**7.1%**	**$83**	**2.1%**	**1.2**

Note that the figures above are only for 2018 through 2020 selected improvements as methods to standardize and collect the data were under development prior to the creation of the Green Advantage database.

Actual Portfolio Savings

Evolution of Utility Data Collection and Reporting

Our ability to better understand the impacts and benefits of the 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. 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. While progress has been made to implement data quality and reporting best practices, we are continuing to look for opportunities for improvement.

Data Quality Framework

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[11] and provided recommendations for data quality improvements.

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[11] For more details regarding the data quality assessment, see the prior report released as part of the Spotlight on Underserved Markets, https://mf.freddiemac.com/docs/green-improvements-workforce-housing.pdf

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[12] 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 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 Optigo® servicers along with resources for the annual reporting process. We do expect the implementation of these best practices to improve the data quality and accuracy of the measurement and verification (M&V) analyses, but its impact will likely be delayed given these practices will only be fully realized on future green loans.

Measurement and Verification – Quantifying Consumption and Cost Savings

With this data collection foundation in place, Freddie Mac Multifamily engaged WegoWise to perform M&V analysis. 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.[13] The initial M&V analysis was performed in 2019 to evaluate the submission of 2018 Benchmarking Data on a small set of 16 properties.[14] The results showed positive water savings, on average, for the sample but did have varying results at a property level. The sample size limited our ability to apply the results across the portfolio but did help lay the groundwork for future analysis.

With an additional year of data collection and reporting, WegoWise was engaged in 2020 to perform M&V analysis on a larger pool of properties. The properties available for analysis consisted of properties financed in 2016, 2017 and 2018. The properties were under either the 15% consumption reduction threshold and the earlier reporting requirements or the 25% whole property consumption reduction threshold and the more recent reporting requirements.[15]

In order for M&V analysis to be performed, a property must have reported their efficiency improvements as complete by mid-2019 as well as submitted enough Benchmarking Data from 2019 for meaningful savings comparison. After evaluating our green loan population, 305 properties meet these criteria and were available for potential M&V analysis.

The M&V process included gathering the pre-retrofit or baseline data, the post-retrofit or Benchmarking Data, building characteristics, and applicable loan reporting requirements. WegoWise performed an assessment of the data quality and completeness to determine suitability for further M&V analysis. Given our requirements for data collection and reporting have evolved over time as well as the need for a larger analysis sample size, the quality of the Benchmarking Data varied but still had to meet our quality and completeness threshold. This data evolution limited our ability to fully understand the impacts of the efficiency improvements at the property. WegoWise evaluated all data received and worked with the servicers and borrowers to rectify any discrepancies or anomalies, including outliers. All data shown received confirmation from those sources as being correctly represented. See Appendix D for greater detail regarding our M&V approach.

Of the 305 properties evaluated, 275 meet 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.

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[12] The Benchmarking Data Collection Best Practices Guide is available at:
https://mf.freddiemac.com/docs/benchmarking-data-collection-guide.pdf
[13] See Appendix D: Measurement and Verification Methodology for more details on our M&V approach.
[14] For more details regarding the initial M&V analysis, see the prior report,
https://mf.freddiemac.com/docs/insight_analysis_of_green_improvements.pdf
[15] See the "Benchmarking Data – Portfolio Manager" section in Appendix B for reporting details.

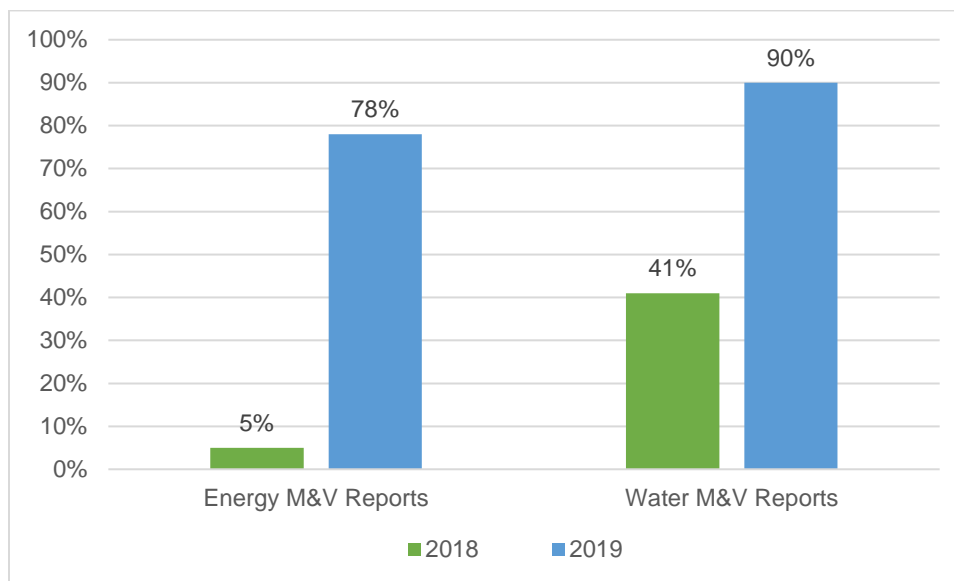**Exhibit 9: Benchmarking Data Quality and Completeness Comparison**

Exhibit 9 highlights the positive improvements in the quality and completeness of Benchmarking Data from 2018 to 2019. WegoWise was able to run 90% of requested water and 78% of energy M&V analyses as compared with 41% of requested water and only 5% of energy M&V analyses in the previous year's M&V population. The efforts made to refine our reporting requirements, release the Benchmarking Data Collection Best Practices Guide, and provide training and resources to servicers earlier in the process contributed to the improved results.

Breakout of Measurement and Verification Population

Exhibit 10 provides a breakout of the population of loans receiving a M&V analysis by program requirement. The sample size for the loans under the 15% requirement is higher than the loans under the 25% requirement given the earlier loans have had more time to complete their efficiency improvements, which allowed for more post-retrofit data available for analysis. Additionally, water M&V analysis was performed on over 84% of the M&V population as compared with nearly 37% of the population receiving an energy M&V analysis. Over time, we anticipate being able to do additional M&V analysis on the overall green loan population, including loans under the 30% requirement. We believe this will allow for more robust results and a better understanding of the impacts of the efficiency improvements made at the properties, particularly for energy improvements.

Exhibit 10: M&V Population by Program Requirement

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Totals
Count of M&V Analyses	188	87	275
Energy only	40	3	43
Energy and Water	31	27	58
Water only	117	57	174

Actual Cost Savings

All available post-retrofit data was used to determine cost savings both cumulatively and annually. Determination of cost savings is dependent upon having utility data allocated for who is responsible for the costs, either the owner or the tenants. This allocation can be inconsistent due to challenges in obtaining tenant data and varying billing arrangements at properties. Our methodology accounted for these possible limitations, allowing for cost-savings analysis to occur where possible. The limitations may

also result in variances between the actual cost savings and the split between owner and tenant cost savings as well as variances with the baseline projections.[16]

Cumulative cost savings totaled nearly $13,750,000, which averages to just under $50,000 per loan and $159 per unit. The owner cost savings amounted to $1,680,500 while the tenant savings was $10,629,393. 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	Totals
Loan Count	188	87	275
Cumulative Cost Savings*	$10,196,435	$3,552,443	$13,748,878
Cumulative Owner Cost Savings*	$1,317,315	$363,185	$1,680,500
Cumulative Tenant Cost Savings*	$7,919,102	$2,710,291	$10,629,393

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

Exhibit 12 summarizes the annualized cost savings by program requirement. Annual cost savings realized over $11 million in savings, which is over $40,500 per loan and $133 per unit per year. Tenants saw on average a savings of $114 per year.

Exhibit 12: Average Annual Cost Savings by Program Requirement

Actual Savings - Annual	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Totals
Loan Count	188	87	275
Average Annual Cost Savings	$7,360,233	$3,795,644	$11,155,877
Average Annual Savings per loan	$39,150	$43,628	$40,567
Average Annual Savings per unit	$130.37	$138.55	$132.96
Average Annual Owner Cost Savings	$1,006,528	$377,241	$1,383,768
Average Annual Owner Savings per unit	$19.31	$13.79	$17.50
Average Annual Tenant Cost Savings	$5,602,889	$2,938,799	$8,541,688
Average Annual Tenant Savings per unit	$116.31	$109.36	$113.97

Actual Consumption Savings

Consumption savings provides a more reliable datapoint for measuring the impacts of the green improvements made at the property as it is less dependent upon billing arrangements or fluctuations in utility costs. WegoWise used all available post-retrofit data to determine cumulative savings for the program. Across the 275 properties receiving M&V analyses, the data ranged from a minimum of six months to a maximum of 37 months with an average savings period of 14 months for energy and 15 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. Exhibit 13 provides a summary of consumption savings based on the available data for properties receiving a M&V analysis.

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[16] Refer to Appendix D: Measurement and Verification Methodology for details for determining cost savings.

Exhibit 13: Actual Cumulative and Average Annual Consumption Savings

Actual Savings*	Energy M&V	Water M&V
Count of M&V Analyses	101	232
Cumulative Total Consumption Savings (kBtu) / (Gal)	152,334,458	827,544,927
Cumulative Consumption Savings per loan (kBtu) / (Gal)	1,508,262	3,567,004
Cumulative Consumption Savings per unit (kBtu) / (Gal)	4,086	11,595
Average Energy Savings Period	14	
Average Water Savings Period		15
Average Annual Total Consumption Savings	132,000,382	629,035,367
Average Annual Total Consumption Savings per loan	1,306,934	2,711,359
Average Annual Total Consumption Savings per unit	3,968	9,235

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

For the properties receiving a water M&V analysis, the cumulative water consumption savings was determined to be over 827 million gallons, which is the equivalent to filing the Tidal Basin in Washington, D.C., over three times, more than 1,250 Olympic-sized swimming pools, or the equivalent water usage for nearly 27 million loads of laundry.

These savings figures are comparable to the projections made across the entire portfolio. On average, these properties showed savings of over 2.7 million gallons of water per year as compared with the projected 2.8 million gallons of water per property per year. The average gallons of water per unit per year saved is over 9,200 gallons, with the projections at almost 10,500 gallons of water per unit per year — a difference of 5%. These are meaningful savings resulting from the water-saving measures implemented at the properties.

The cumulative realized energy savings based on the energy M&V analysis is over 152 million kBtu, equating to roughly enough power for over 4,100 homes across America. These properties saw an average annual savings of 1.3 million kBtu per year and almost 4,000 kBtu per unit. Again, these realized savings were nearly equivalent, or showed a difference of only 0.5%, to the 1.3 million kBtu and almost 4,800 kBtu per unit per year of projected savings. When multiplied across the portfolio for this year as well as for future years, these results deliver significant savings for the property and for the environment.

Distribution of Savings

The consumption savings for the M&V population is comparable with 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 water savings by percentage across all properties receiving a water M&V analysis. The shape of the distribution is a bell curve leaning more toward positive savings, suggesting a normal distribution, with most properties realizing positive savings as a result of the water improvements made at the property. Of the 232 properties receiving a water M&V, 53% met or exceeded at least 15% savings with 77% realizing positive savings. There was 23% of properties with negative savings (i.e. increased usage and cost from the baseline period).

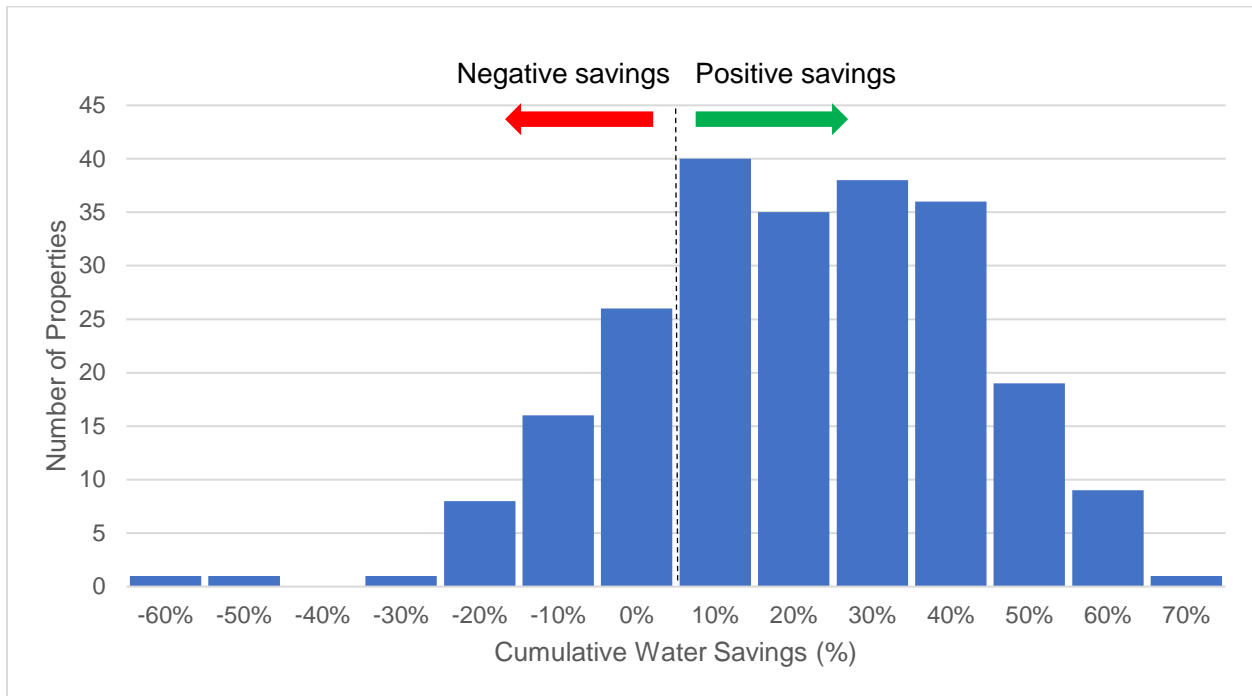**Exhibit 14: Distribution of Water Savings**

Exhibit 15 shows the distribution of the cumulative energy savings by percentage across all properties receiving an energy M&V analysis. This distribution has a normal bell-shaped pattern with a skew toward positive savings. Of the 101 properties receiving an energy M&V analysis, 47% exceeded the program's required savings threshold of 15% or 25% consumption savings with half of the population exceeding 15% savings. 67% of properties achieved positive savings while 33% had negative savings.

Exhibit 15: Distribution of Energy Savings
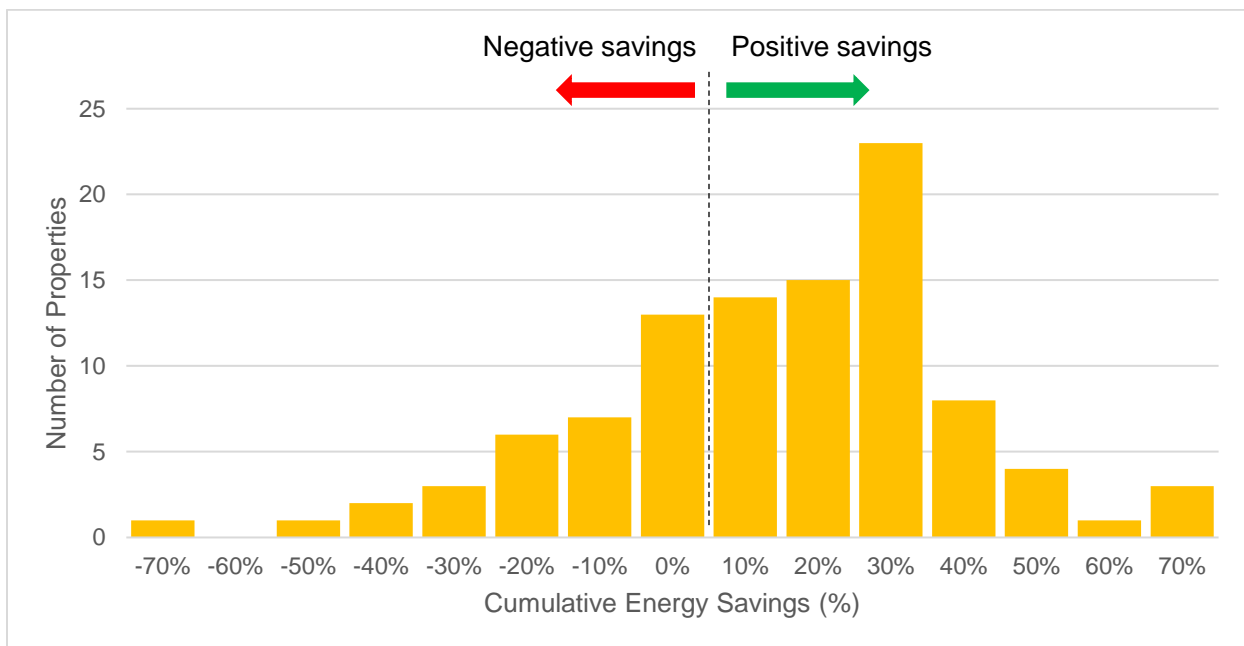
The evaluation of savings occurred at a property level and are highly variable from property to property. The cumulative and annual savings above demonstrate real savings at the properties, but there were also some properties that did not realize the expected savings based on their reported data. The large majority of properties saw positive savings with a little more than half meeting or exceeding savings projections.

For properties not meeting the projections or that had higher consumption and costs than their baseline, results can vary based on many factors that may include:

1. Data challenges: Inaccurate estimated data (baseline or post-retrofit data) or single datapoint for annual energy or water usage
2. Rate increases or fixed costs remain high
3. Equipment issues: Incorrectly installed, tenants' removal/tampering
4. Usage variations: Behavioral or occupancy changes at the property, new amenity installed, energy/water spikes

Many of these challenges are outside of the borrower's control. For instance, if the occupancy density has increased at a property, or as is likely for 2020, and more tenants are in their units for a longer duration, the consumption will increase. 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 31% of energy M&V analyses. As a result, estimated data was often necessary to use for post-retrofit analysis, which may lead to variability in the savings results. Despite these challenges, the consumption savings results still provide confidence that the improvements made are increasing the efficiency and may lessen the increased usage at the property.

As explained above, we have worked to improve the challenges inherent in collecting and reporting the data. While we saw improvements from the prior year to this year, we will continue implementing measures to 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 are exploring ways to more quickly review submitted data and correct deficiencies, where possible, to ensure the data provided meets our high standards. We also plan to continue educating all stakeholders on collecting high quality data, particularly energy data and tenant data. As our program matures and we continue to obtain additional data, we will look for other opportunities to improve our data collection and reporting process.

Impact of Location

While water and energy efficiency improvements have absolute benefits in terms of consumption reduction and cost savings wherever the property is located, there is the potential for greater impact based on location; water or energy may cost more in some markets than others, or properties may be located in a drought-prone area where water savings are especially important.

Green Advantage properties are located in 44 states, with the highest concentrations in Texas, Florida, California and Georgia. These four states contain 47% of all green loan properties. Arizona, Colorado, North Carolina, Nevada and Virginia have 23% of green loan properties with the remaining 30% coming from 35 states. This distribution is generally consistent with the overall distribution of all Freddie Mac Multifamily loans.

These properties are spread over 187 metropolitan statistical areas (MSAs). The top MSAs contain 30% of all green loans and include Atlanta, Dallas, Phoenix-Mesa, Houston, Denver and Tampa-St. Petersburg. Below is a chart of the Top 10 MSAs.

Exhibit 16: Top 10 MSAs Containing Green Loans

MSA	% of Green Loans
Atlanta	7.1%
Dallas	5.0%
Phoenix-Mesa	4.7%
Houston	4.6%
Denver	4.1%
Tampa-St. Petersburg	3.9%
Las Vegas	3.4%
Orlando	2.6%
Los Angeles-Long Beach	2.4%
Baltimore	2.1%

Green Loan Impacts in Areas Experiencing Drought

When we look more closely at these properties, we can see what additional impacts may result due to the increased efficiency of the improvements. Given the high percentage of water-saving improvements over the course of the program, we looked at the locational benefit of such improvements. Exhibit 17 is a map showing location and intensity of areas experiencing drought relative to our Green Advantage loans as of the end of the third quarter of 2020.

We found 807 Green Advantage loans, or 37%, are in areas that were experiencing drought or were abnormally dry. Green Advantage loans installing water conservation improvements in these areas are projected to save over 2.2 billion gallons of water. In fact, we analyzed post-retrofit water data from 94 properties in these areas and found they saved over 465 million gallons since implementing their green improvements. As more properties complete their improvements, we expect to see the water savings increase. The water conservation from the green improvements in these locations stands to have a greater impact than in areas where water is more abundant. While not all Green Advantage loans were originated in drought areas, the water consumption savings will still provide positive impacts, particularly since most states are expecting freshwater shortages in the next decade.[17]

The reduction in consumption will also help to reduce the strain on an aging water infrastructure that will require billions of dollars for future maintenance and improvements[18] and will also save property owners and tenants money given water costs have steadily increased each year.[19]

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[17] Reference the USDA website, https://www.usda.gov/media/blog/2020/04/28/uniting-combat-water-shortages-across-country, or more information at the following EPA website: https://www.epa.gov/watersense/how-we-use-water
[18] See results from the EPA's 6th Drinking Water Infrastructure Needs Survey and Assessment available at https://www.epa.gov/drinkingwatersrf/epas-6th-drinking-water-infrastructure-needs-survey-and-assessment
[19] For additional details see, https://www.circleofblue.org/waterpricing/

Exhibit 17: U.S. Drought Monitor Map and Green Advantage Loan Location
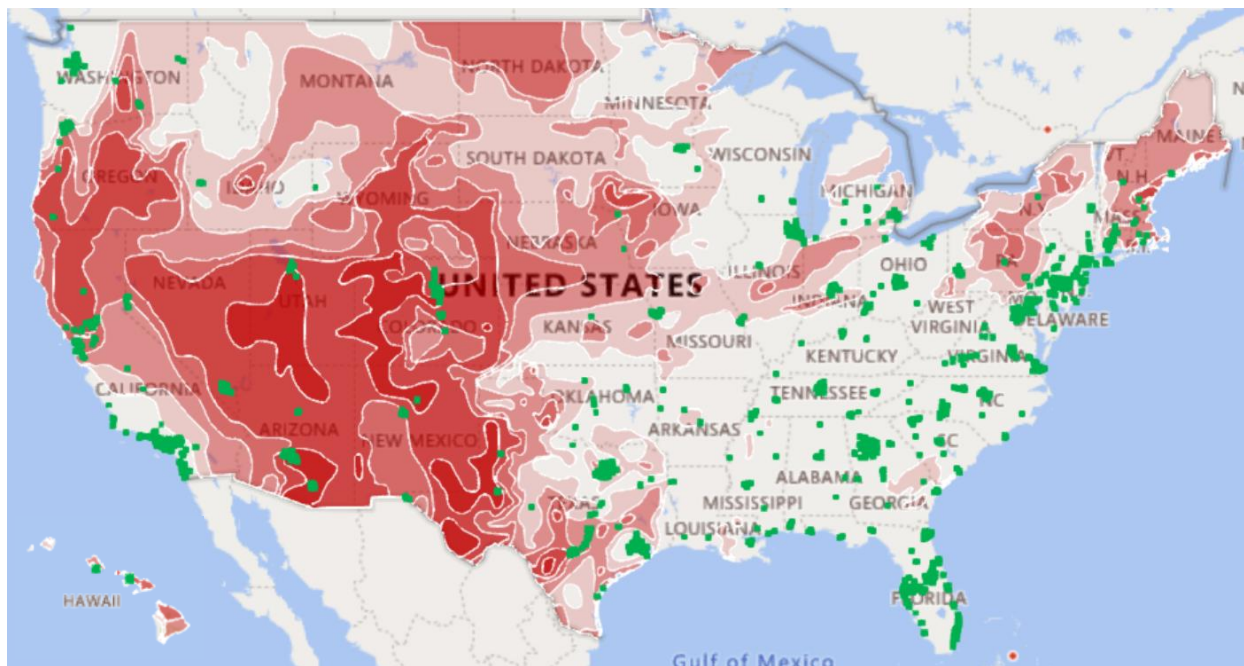
Source: U.S. Drought Monitor provided by the National Integrated Drought Information System, https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Green Loan Impacts in Areas of High Electric Utility Costs

With the program focused on implementing more energy-saving improvements, we looked at which locations would benefit most from these improvements. Exhibit 18 is a map showing the average monthly electric utility bills by state in 2019 relative to the location of Green Advantage 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 $115, whereas the average monthly electric utility bill for states with the most expensive electric bill is $141, 22% more than the national average. We found 59%, or 282 Green Advantage loans qualifying under the 30% consumption reduction requirement are located in states with the most expensive electric bills. Improvements made on properties in these states will have a greater impact than loans where the electric utilities are less expensive.

Regardless of the location of the Green Advantage loans, the expected savings will have a meaningful impact, particularly given the rising energy costs: Energy bills have increased from 7.73 cents per kWh in 2001 to 13.3 cents in 2019.[20] The minimum 15% energy consumption reduction will serve to combat these rising costs, particularly for tenants since they pay for their energy usage either directly or via a RUBS system, which is found in roughly two-thirds of our green loans. The projected consumption savings for the 30% qualified loans is over 1 billion kBtu, with an average of almost 7,900 kBtu per unit with cost savings projected to be almost $39 million or an average savings of $321 per unit. While we do not yet have sufficient data to analyze any of the loans under the 30% requirement, we did perform an analysis from a sample of loans under earlier requirements. Properties having six months or more of post-retrofit data showed a cumulative savings of over 152 million kBtu, which averages to 4,086 kBtu per unit. The cumulative energy cost savings totaled over $5.6 million, or an average of $158 per unit. These figures are less than the projections for the 30% qualified loans but are not comparable given the differing qualification requirements. As we obtain more data, we will be better able to determine the impact energy improvements are having at the properties.

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[20] For more details on energy costs, see the Electricity Data Browser from EIA, https://tinyurl.com/uwrze8l

Exhibit 18: Green Advantage Property Location Relative to Average Monthly Electric Bill
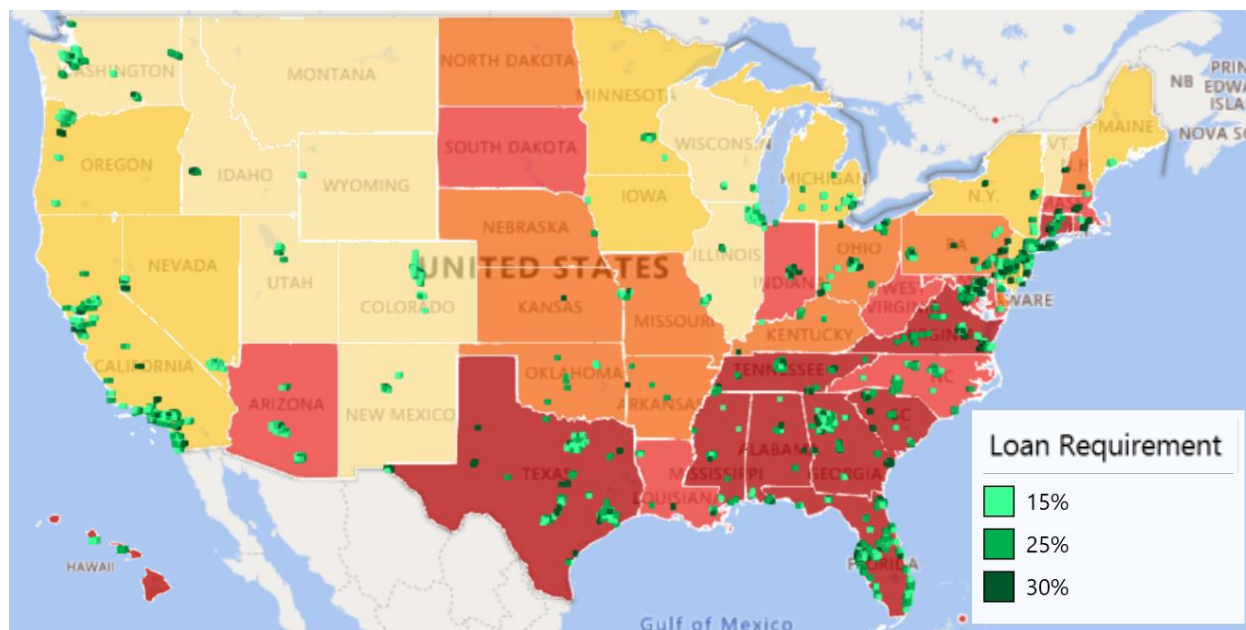
Source: Freddie Mac tabulation of 2019 U.S. Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS) data, https://www.eia.gov/electricity/sales_revenue_price/xls/table5_a.xlsx,

Environmental Impact Based on Carbon-Intensity of Energy Supply

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 (CO_2) emissions in that state.

At the end of 2019, we started collecting additional datapoints from our Green Reports to better understand the amount of carbon emissions savings as a result of the efficiency improvements installed at the property.[21] We looked at a subset of green 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. 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 19 properties in states with an energy supply carbon intensity that is above the national average of 54 kilograms of CO_2 per million Mbtu (kg CO_2/MMbtu). These properties are projected to save 3,782 metric tons of CO_2 equivalent.

Regardless of the location of these properties, the projected savings will have a meaningful impact. Across the subset of green loans with carbon emissions savings data, the implemented green improvements are projected to reduce annual greenhouse gas emissions by 17,353 metric tons of CO_2 equivalent. This is equivalent to the same amount of CO_2 as removing 3,749 cars off the road for a year.

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[21] The new datapoints collected allow us to determine the projected Greenhouse Gas (GHG) emissions savings (CO_2 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.

Exhibit 19: Green Advantage Property Locations Relative to Carbon-Intensity of Energy Supply
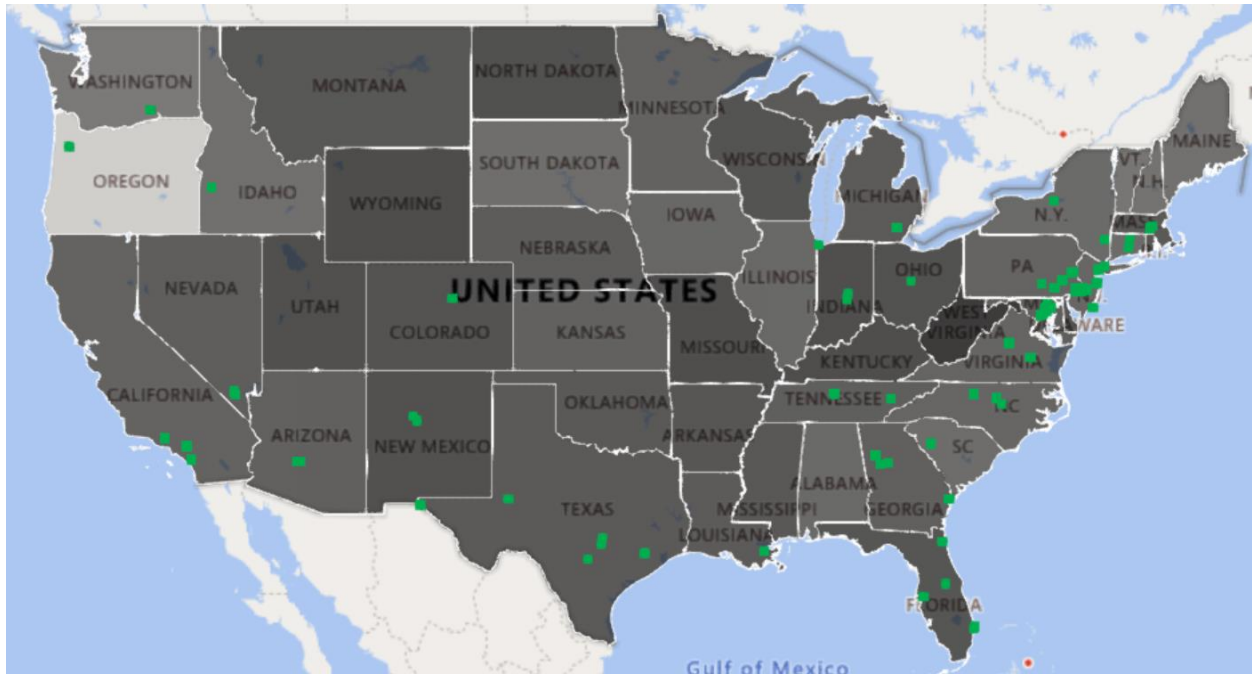
Source: Freddie Mac tabulation of 2017 U.S. Energy Information Administration (EIA) Energy-Related Carbon Dioxide Emissions by State data, https://www.eia.gov/environment/emissions/state/excel/table7.xlsx

Conclusion

Properties are realizing savings due to the energy and water efficiency improvements implemented as part of the Green Advantage program. As we were able to collect another year of utility consumption data, a savings analysis was performed across a subset of our portfolio to determine realized consumption and costs savings. While savings can vary across individual properties, the analysis showed an average savings of 2.7 million gallons of water per year and over 1.3 million kBtu of energy per year. Some properties have also shown savings beyond a one-year period, with cumulative savings accruing to both owners and tenants. What's more is the improvements are being made to workforce housing properties built on average 35 years ago. These critical upgrades help to improve the efficiency of aging multifamily housing.

Green Advantage properties primarily serve low- and moderate-income tenants and the realized savings have meaningful financial benefits. For the subset of properties receiving a savings analysis, cumulative cost savings amount to over $13.7 million dollars. This translates to average annual savings of $40,500 per loan with specific savings for tenants at $114 per unit. These savings are particularly poignant during the current pandemic where so many are experiencing financial hardship and economic turmoil.

While these are meaningful and important savings being seen across our portfolio, the realization of these savings varies property by property. The majority of properties are seeing positive savings as a result of the energy and water improvements installed at the properties. Many factors impacting consumption and cost savings are outside of the control of the borrower, but we know the improvements made to the properties can still positively impact utility consumption. Additionally, we are seeing evidence of improved data collection and reporting. With continued education to the market and coordination with data collection professionals, our ability to analyze impacts will continue to improve.

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[22] 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.

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[22] Each consultant must provide the following metrics for each Green Assessment or Green Assessment Plus: Energy Star Score, Water Score, Energy Use Intensity and Water Use Intensity

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 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 Advantage 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 program parameters remain unchanged from 2019 to 2020. 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)[23] 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% whole property energy OR water reduction	Not required – borrower or third party could enter Benchmarking Data	Not required
2019	30% whole property 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	30% whole property reduction from a MINIMUM 15% energy and 15% energy AND/OR water	Required – borrower must engage prior to loan origination	Required

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[23] For requirements of a Benchmarking Data Consultant, see https://mf.freddiemac.com/docs/benchmarking-data-consultant-requirements.pdf.

Appendix D: 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 37 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

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[24] IPMVP: https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp

Reports. If the costs 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.

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.

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