SPOTLIGHT ON UNDERSERVED MARKETS

Green Improvements in Workforce Housing

Freddie Mac MULTIFAMILY

DUTY TO SERVE

Green Improvements in Workforce Housing

The multifamily housing stock across the country is aging; of the 20.8 million units, over 77 percent were built prior to 2000[1]. As such, these units are likely to be using more energy or water than is reasonably necessary, and the tenants living in them are, on balance, paying more in utility costs than they need to. A typical 100-unit multifamily apartment requires over 7,400,000 kBtu of energy per year and consumes nearly 6,000,000 gallons of water per year, costing tenants roughly $1,150 in energy and $700 in water per unit annually[2]. The opportunity to improve this housing stock by implementing energy and water efficiency improvements is great, with real opportunities for savings for property owners and tenants.

In August 2016, Freddie Mac Multifamily introduced our Green Advantage® suite of energy and water efficiency financing offerings to the marketplace with an objective to lower expenses for workforce housing tenants. Through our flagship offerings, known as Green Up® and Green Up Plus®, we have done much work to meet this objective. The offerings provide financing incentives for borrowers who choose to make energy and water consumption reduction improvements at their properties, and require the borrowers to monitor and report on energy and water consumption over time. The offerings have been extremely well received in the market. From the inception through the end of the third quarter of 2018, nearly 367,000 units across nearly 1,300 properties have been financed with Green Up or Green Up Plus loans for a total of over $36 billion. In addition to the energy and water savings they project to generate, these loans generate valuable data for study.

In this paper, we analyze our portfolio of loans where borrowers elected to pursue green improvements and we provide property level data on improvements made. Our intention is to fill a gap in the current lack of energy and water efficiency data in the market, strengthen and improve green practices in the broader multifamily market, and provide broad insights into the types of improvements that can cost-effectively reduce both consumption and tenant expenses.

Below are key highlights from our analysis:

- Market adoption of Freddie Mac Green Advantage has been strong, with over $36 billion in loans purchased financing nearly 367,000 units.
- The properties financed are typically workforce housing, garden-style apartments. They are an average of 33 years old with 89 percent of units being affordable to households making 100 percent of area median income (AMI) or less.
- Borrowers have overwhelmingly focused on water-savings improvements. Borrowers met program requirements by pursuing water improvements on 77 percent of loans.
- The most common water-saving improvements are showerheads, bathroom aerators, kitchen aerators and toilets.

[1] See the 2017 Characteristics of Rental Apartment Units available at https://www.nmhc.org/research-insight/quick-facts-figures/quick-facts-apartment-stock/

[2] Figures are based on an analysis of Green Advantage portfolio data.

- The most common energy-saving improvements are LED lighting for interior, exterior and common areas and HVAC thermostats.
- The projected average cost for improvements was $470 per unit.
- Properties are projected to save on average $220 per unit per year.
- Water improvements across all loans are projected to save 3.6 billion gallons in water per year, and energy improvements are projected to save 1.4 billion kBtu per year.

Efficiency Improvement Data from Green Reports

To perform our analysis, we combined loan level information with the data collected from energy and water efficiency property assessments. We are also beginning to collect borrower-reported ongoing utility consumption data but as this data is incomplete, it was not included in the current analysis. An additional analysis was performed to better understand the quality of data received from the Green Reports.

Loan Level Information

Basic property level information provided to Freddie Mac by the Freddie Mac Seller during loan origination is housed in several internal systems. Examples of this data include:

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

Green Reports

Borrowers interested in pursuing a Green Up or Green Up Plus loan must first receive a Green Assessment® or a Green Assessment Plus® (both, Green Reports) respectively[3]. 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 or water consumption by a minimum required savings threshold and, in return, receive better loan pricing and potential additional loan proceeds.

The Green Reports are prepared by Green Consultants who meet Freddie Mac's qualification requirements. Green Consultants collect historical utility consumption data for the whole property (common and individual tenant areas) from the property owner[4], assess the building conditions and the performance of equipment, fixtures and systems on the energy and water consumption at the property.

[3] **Appendix A: Green Assessment or Green Assessment Plus Standards** gives more details about each standard.
[4] See **Appendix B: Data Collection Methodology** for data collection methods for the historical utility consumption data collected for the Green Reports.

Green Consultants deliver completed Green Reports to Sellers 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:

- Type of savings pursued (energy, water, or both)
- Green improvement measures recommended and pursued
- Projected savings of measures
- Estimated costs of measures

Utility Consumption Data in Portfolio Manager®

Green Consultants producing a Green Report are also responsible for inputting the collected historical and estimated property consumption data into ENERGY STAR® Portfolio Manager® (Portfolio Manager), a free online tool maintained by the Environmental Protection Agency (EPA). The data inputted into Portfolio Manager establishes baseline periods for energy and water consumption for the property and can be used by the borrowers for future utility consumption benchmarking[4]. By collecting and measuring the energy and water consumption, property owners are better equipped to understand and demonstrate the positive effects of their green improvements by comparing the energy or water reduction with the baseline set in Portfolio Manager. They will also be able to manage utility usage, make operational adjustments to improve performance and reduce operating costs to realize increased value at the property.

As we begin to receive more of the ongoing consumption data reported by borrowers in Portfolio Manager, we will incorporate it into our analysis to understand realized efficiencies at the properties in relation to the upfront projections. Our ability to better understand the impacts and benefits of the program to owners and tenants, the multifamily market, and the environment will be dependent on the quality of the pre- and post-retrofit data received.

Data Quality Assessment

To better understand the quality of the data received from the Green Reports, we engaged a third-party consultant, WegoWise by AppFolio (WegoWise), to perform an analysis of a sample of the loans in our portfolio. This analysis focused solely on historical consumption data provided by the borrowers and entered into Portfolio Manager by the consultants and did not include actual ongoing consumption data. The analysis was focused on developing an understanding, at both a property and a portfolio level, of our ability to measure and report on energy and water savings based on the data received.

Freddie Mac Multifamily provided WegoWise with a sample set of 80 properties[5] from our overall portfolio, which were randomly selected based on a proportionate representation of Green Consultants, retrofit types (energy/water) and the property geography. 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, which included the following criteria:

1. Tracking all utility types (electric, gas, water, etc.)[6]
2. Twelve months of pre-loan data available
3. Continuous data with no gaps in time
4. Monthly data entries
5. Energy Use Intensity (EUI) and Water Use Intensity (WUI) available
6. ENERGY STAR Score and Water Score available
7. Cost data (billing structure)
8. Metering structure
9. Estimated consumption
10. Heating and domestic hot water fuels

Findings from the data quality assessment[7] include the following:

- Overall, when data was available, the baseline data quality was acceptable for further analysis, given the two-week turnaround allocated for the Green Reports.
- One hundred percent of properties tracked electric data and 70 percent tracked gas data. When properties tracked consumption data, it included 12 months of continuous pre-improvement data with no gaps, although this data was not entered monthly.
- The majority of energy data did not distinguish between owner- and tenant-paid utilities.
- Water data was only tracked in 51 percent of properties. When water was tracked, the data was more complete than energy data.
- In general, the metrics generated by Portfolio Manager that measure building performance, the ENERGY STAR Score, Water Score, EUI and WUI, were reasonably distributed within industry averages.

[5] At the time of the analysis, this equated to roughly 10 percent of the overall portfolio.
[6] Tracking all utility types was not required until 3Q 2017. Previously borrowers were only required to track consumption based on the intended category (energy or water) to which improvements were made.
[7] Refer to **Appendix C: Data Quality Assessment** for more detailed findings.

The data quality assessment found the data quality acceptable for ongoing analysis. Our understanding of realized energy and water savings will be limited due to the current data collected so analysis of savings is based only on projected savings. As we begin to gather more ongoing utility consumption, particularly after borrowers complete their improvements, we will perform additional analysis on the impacts of the improvements to the property, tenant and owner. We intend to continue assessing the data quality and will make program improvements wherever possible to better our understanding of results and impact.

Program Parameters

The Green Advantage program parameters have undergone two separate evolutions based on how the Federal Housing Finance Agency (FHFA) permitted green loans to be excluded from the multifamily lending cap annually set for the two Government Sponsored Enterprises (GSEs). The initial consumption savings threshold was set at 15 percent and could be achieved via owner-paid, tenant-paid, or whole property consumption reduction. Freddie Mac set up program parameters to target workforce housing, including a "good fit" criteria for properties built in 2000 or earlier and a required per unit dollar spend[8]. In 2018, FHFA increased the savings threshold requirement for both GSEs to be 25 percent of whole property consumption in order to be considered uncapped volume. As a result, Freddie Mac removed the age and dollar per unit requirements and increased the consumption savings threshold. The evolution of the program parameters had an impact on borrower decisions, as will be seen in the data below.

Some of the data used in the analysis – such as total loan count, loan amount and unit count – can be aggregated across the portfolio, but the shifts in the program parameters call for separating the savings estimates into two sets: one with the current 2018 requirement of 25 percent whole property savings threshold and the other set using the prior 15 percent savings threshold.

[8] The initial requirement was $250/unit and was increased to $350/unit in March 2017.

Portfolio Analysis

Prior to the launch of Green Advantage, there was general market interest in financing to support energy and water improvements for multifamily properties, but limited market adoption. Since the launch of Green Advantage in August 2016 through September 2018, Freddie Mac has purchased $36.09 billion in 1,302 green financings across nearly 367,000 units. This extensive market adoption has created and established the market for energy and water efficiency improvements for multifamily properties.

Exhibit 1: Green Loan Totals through 3Q2018

Freddie Mac Green Loans	Totals
Loan Count	1,302
Total Loan Amount	$36,088,621,532
Average Loan Amount	$27,717,835
Total Unit Count	366,976
Average Unit Count	282

Green Advantage Loans Serve Workforce and Affordable Housing

Green Advantage loans upgrade and improve workforce housing and affordable properties that average 33 years of age and are overwhelmingly garden-style apartments. We analyzed our Green Advantage portfolio to determine what percentage of units are affordable to households making 100, 80, or 50 percent of AMI. Overall, 89 percent of units are affordable to households at 100 percent AMI or less.

Exhibit 2: Green Loan Characteristics through 3Q2018

Freddie Mac Green Loans	Totals
Average Year Built	1985
Property Type	
Garden (1-3 story, townhome, walkup)	93.2%
Mid Rise (Multistory with elevator)	4.3%
High Rise (9 or more floors, elevator)	2.5%
Unit Affordability	
100% Median Income	89%
80% Median Income	65%
50% Median Income	4%

Green Improvement Recommendations and Selections

Primary drivers for borrower selections of green improvements include meeting the consumption savings threshold, the cost of improvements and the return on investment. Other motivations for selections include improved property performance, potential for reduced expenses and increased

property value, tenant satisfaction, and a commitment to more efficient use of resources. Exhibits 3 and 4 list the most common water and energy improvements and the affected utility. Some improvements achieve both energy and water savings, but we have categorized the improvements based on the intended savings category.

Exhibit 3: Percentage of Loans Selecting Water Improvements

Green Improvements	Utility	% Selected
Showerheads	Water	79.3%
Aerators/Faucet (bathroom)	Water	66.7%
Aerators/Faucet (kitchen)	Water	64.7%
Toilets	Water	41.7%
Irrigation (xeriscaping, weather sensors, drip, etc.)	Water	8.5%
Appliances (washing machines)	Water	6.1%
Pool cover installation	Water	3.6%

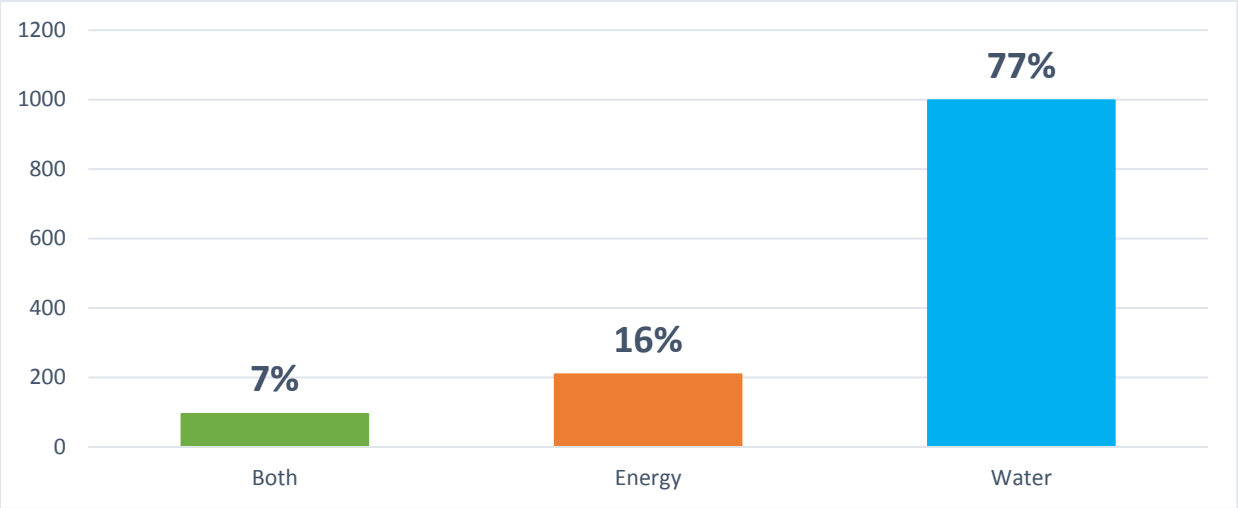
Exhibit 4: Percentage of Loans Selecting Energy Improvements

Green Improvements	Utility	% Selected
LED Lighting (exteriors and/or common areas)	Energy	23.1%
LED Lighting (unit interiors)	Energy	15.7%
Appliances (dishwashers)	Energy	8.2%
HVAC (thermostats, system replacement)	Energy	7.0%
Appliances (refrigerators)	Energy	5.7%
Central mechanical (Domestic Hot Water Heater)	Energy	4.1%
Windows	Energy	2.3%
Insulation (building)	Energy	1.9%

The most commonly selected improvements are replacements for showerheads, kitchen aerators and bathroom aerators. On the energy side, the most common improvements selected are exterior and common area LED lighting followed by unit interior LED lighting, HVAC related improvements – including thermostats and system replacements, and dishwashers.

Out of the 1,302 Green Advantage loans funded through September 2018, over 1,000, or 77 percent, have met program requirements through water-saving improvements (Water Qualified Loans). Approximately 200, or 16 percent, of loans met the program requirements through energy-saving improvements (Energy Qualified Loans) while the nearly 100, or 7 percent, of remaining loans met the program requirements through both water and energy improvements.

Exhibit 5: Savings Type Pursued through 3Q2018



Comparison of Borrower Selections under the 15 Percent and 25 Percent Requirements

Prior to 2018, Borrowers could qualify for a green loan by selecting improvements that met the 15 percent savings threshold and the minimum spend per unit. The minimum spend per unit was a proxy designed to drive borrowers towards higher impact improvements, which would typically benefit tenants. In general, the percentage savings threshold was calculated using owner-paid consumption. Owners are typically responsible to pay for all water consumption, which meant for water improvements, the percentage savings calculations were based on the water consumption of the whole property. In contrast, owners typically only pay for common area energy consumption so consumption savings calculations for energy improvements only included owner-paid, or common area, energy consumption and not in-unit, tenant consumption.

Exhibit 6: Comparison of 15 Percent and 25 Percent Requirements

	Qualified Under 15% Requirement	%	Qualified Under 25% Requirement	%	Overall Total	%
Energy Qualified Loans	187	21.3%	17	4.0%	204	15.7%
Water Qualified Loans	598	68.0%	405	95.7%	1,003	77.0%
Energy AND Water Qualified Loans	94	10.7%	1	0.3%	95	7.3%
TOTAL	879		423		1,302	

Under the 15 percent requirement, the majority of borrowers, 68 percent, met the requirements by selecting water improvements, while 22 percent selected energy improvements and nearly 11 percent met program requirements through both energy and water.

When the savings threshold increased to 25 percent in 2018, almost 96 percent of loans met the savings requirements by selecting water improvements. Energy improvement selections went from a combined 33 percent of all loans down to only 4 percent. Less than half of 1 percent of loans met the requirements through both energy and water.

Energy improvement volumes were challenged by the 2018 program change on two fronts; the increase from 15 to 25 percent and the percentage savings calculations requiring whole-property consumption. It was more expensive for borrowers to meet this higher standard by selecting only energy improvements and as a result, borrowers overwhelmingly selected water saving measures.

Analysis of Improvements

Cost of Improvements

The total projected cost[9] of all selected improvements from August 2016 through the end of the third quarter of 2018 amounted to $173.4 million. This averages out to $133,212 per loan or $470 per unit.

Exhibit 7: Comparison of 15 percent and 25 percent average cost per unit

	Qualified Under 15% Requirement		Qualified Under 25% Requirement		Overall Count	Overall Total
	Count	Total	Count	Total		
Projected Average Cost per unit via Energy Qualified Loans	187	$501	17	$836	204	$529
Projected Average Cost per unit via Water Qualified loans	598	$442	405	$312	1003	$389
Projected Average Cost per unit via Energy AND Water Qualified Loans	94	$1,173	1	$2,567	95	$1,187
TOTAL	879	$532	423	$339	1302	$470

The cost of improvements depends on the type of improvements selected to meet the required savings threshold. The projected cost per unit is lowest for Water Qualified Loans and increases by nearly 40 percent for Energy Qualified Loans. Loans qualifying either through energy or water are projected to cost nearly $1,200 per unit. This clearly illustrates the high cost of selecting improvements that meet the savings thresholds on both water and energy concurrently. Under the 2018 standard, the average cost per unit on Energy Qualified Loans in 2018 was $836, while water was at a lower cost of only $312.

Water Improvements

Showerhead replacements, kitchen aerators and bathroom aerators make up the majority of all improvements selected. In large measure, these selections are being made due to their relatively high consumption and cost-saving projections combined with their low cost. At a cost of about $100 per unit, this combination of improvements on average has a projected water consumption savings of almost 22

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

percent, with showerheads on average projected to save 12.7 percent and kitchen and bathroom aerators on average projected to save 5 percent and 4.1 percent respectively.

Showerheads and aerators provide residual energy savings as well. For example, if a unit uses less water by installing more efficient showerheads and aerators, the water heater usage will be lower, thereby lowering energy consumption. When the water and energy savings are combined, the average annual cost savings per unit is over $212 allowing for a very quick payback relative to their per-unit cost.

Exhibit 8: 2018 Water Improvement Cost and Savings

Selected Improvements	Average Cost of Improvements ($/unit)	Average Annual Water Cost Savings ($/unit/year)	Average Water Consumption Percentage Savings (%)	Average Annual Energy Cost Savings ($/unit/year)	Average Energy Consumption Percentage Savings (%)	Estimated Simple Payback (yrs)
Showerheads	$64.85	$67.31	12.7	$58.47	4.3	0.5
Aerators (kitchen)	$16.56	$27.13	5.0	$20.81	1.6	0.4
Aerators (bathroom)	$19.53	$21.61	4.1	$17.52	1.4	0.5
Toilets	$310.03	$43.91	8.1	$0.00	0.0	7.1
Irrigation (xeriscaping, sensors, etc.)	$47.46	$25.59	5.5	$0.00	0.0	1.9
Appliances (washing machines)	$280.26	$26.65	5.6	$13.49	1.1	7.0
Appliances (dishwashers)	$334.76	$5.35	0.5	$20.19	0.8	13.1
Faucet (complete fixture - kitchen)	$73.04	$28.28	4.7	$63.60	1.7	0.8
Faucet (complete fixture - bathroom)	$101.25	$33.67	4.1	$29.30	1.5	1.6
Totals	**$297.69**	**$132.42**	**7.2**	**$91.09**	**1.9**	**1.3**

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

When considering benefits from water saving improvements, it is important to understand the methods of billing. 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 utilities and then adjust rents. Other scenarios include a ratio utility billing system (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 (ft^2), 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 are inconsistent due to billing variations.

Energy Improvements

The selected energy retrofits and upgrades tend to be a mix of lower cost projects (such as installing LED lighting or replacing thermostats in HVAC systems), medium cost projects (such as insulating walls and/or roofs, replacing domestic hot water heaters, or replacing appliances like refrigerators) and higher cost projects (such as HVAC system replacements and installing new windows). The average cost of energy improvements is much higher than water improvements; energy improvements average over $680 per unit, which is more than twice as expensive than the average cost of water improvements at $300 per unit. This helps explains the significant gap between the number of loans selecting energy improvements versus water improvements.

Exhibit 9: 2018 Energy Improvement Cost and Savings

Selected Improvements - 2018	Average Cost of Improvements ($/unit)	Average Annual Energy Cost Savings ($/unit/year)	Average Energy Consumption Percentage Savings (%)	Estimated Simple Payback (yrs)
LED Lighting (unit interiors)	$233.92	$73.43	5.2	3.2
HVAC (thermostats)	$191.56	$129.53	6.1	1.5
LED Lighting (exteriors and/or common areas)	$170.25	$39.22	7.8	4.3
Insulation (building)	$515.13	$117.75	6.2	4.4
Windows	$1,639.95	$230.85	9.8	7.1
HVAC (system replacements)	$1,437.93	$199.33	10.8	7.2
Appliances (refrigerators)	$446.49	$11.74	0.4	38.0
Central mechanical (DHW)	$569.93	$41.72	6.9	13.7
Totals	**$682.30**	**$104.65**	**4.6**	**6.5**

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

While energy savings measures can be more expensive than water savings measures, energy improvements have a larger and more direct benefit to tenants. One of the most direct ways to benefit tenants is by reducing the in-unit energy consumption for which tenants typically pay. Energy improvements project to produce an average annual savings of $105 per unit. High-cost energy improvements can be subsidized when combined with lower cost energy improvements and water measures with residual energy savings. The combination of these improvements can be a more cost-effective way to increase in-unit energy improvements and provide meaningful savings to tenants.

Projected Portfolio Savings

Given the extent of market adoption, we anticipate the Green Advantage program will have a large impact across the country on overall consumption and savings to both owners and tenants.

Projected Consumption Savings

Based on the improvements selected at the properties across the portfolio, the overall projections for consumption savings are significant. Over the entire portfolio, water improvements are projected to save 3.6 billion gallons in water per year. For perspective, this is enough water to fill 5,500 Olympic-sized swimming pools or the equivalent water usage for over 119 million loads of laundry. When spread across each Green Advantage loan, this averages out to 2.8 million gallons of water per loan per year and nearly 10,000 gallons of water per unit per year.

Energy savings are projected to save 1.478 billion kBtu per year. This is enough energy to power roughly 40,000 homes across America or enough power for 8,600 football stadiums. This translates to over 1.1 million kBtu per loan and almost 4,030 kBtu per unit.

Projected Cost Savings

Across the portfolio of loans, the annual projected cost savings totals over $79 million. Loans average almost $61,500 of savings per year or $220 per unit.

Projected cost savings vary depending on the type of improvements selected and the required program savings threshold. With the increase from 15 to 25 percent for the savings threshold, projected cost savings on Water Qualified Loans have only a modest increase of $29 per unit per year from $211 to $240. Energy Qualified Loans have a much greater increase of $414 per unit per year from $131 to $545. This increase in cost savings associated with energy improvements is significant as the savings are anticipated to largely benefit tenants.

Exhibit 10: Comparison of 15 Percent and 25 Percent Cost Savings

	Qualified Under 15% Requirement		Qualified Under 25% Requirement		Overall Count	Overall Total ($/unit/year)
	Count	Total ($/unit/year)	Count	Total ($/unit/year)		
Projected Cost Savings via Energy Qualified Loans	187	$131	17	$545	204	$165
Projected Cost Savings via Water Qualified Loans	598	$211	405	$240	1,003	$223
Projected Cost Savings via Energy AND Water Qualified Loans	94	$309	1	$910	95	$316
TOTAL	879	$204	423	$254	1,302	$220

Green Consultants further allocated projected savings to either owners or tenants based on who was ultimately responsible for paying for the consumption according to the billing arrangements of the

property. Overall, tenants are projected to save roughly $130 per unit per year, with property owners projected to save $90 per unit. With the shift in whole property consumption in 2018, these figures change to $215 per unit per year for tenants and $40 per unit for property owners.

Consumption Reduction Percentages

15 Percent Savings Threshold

For loans meeting the 15 percent savings threshold by selecting water improvements, the overall average projected water savings was 19.3 percent. For loans meeting the 15 percent savings threshold by selecting energy improvements, the overall average projected energy savings was 22.9 percent. Loans qualifying under a combination of water and energy had an overall average projected water savings of 20.6 percent and an overall average projected energy savings of 26.1 percent.

25 Percent Savings Threshold

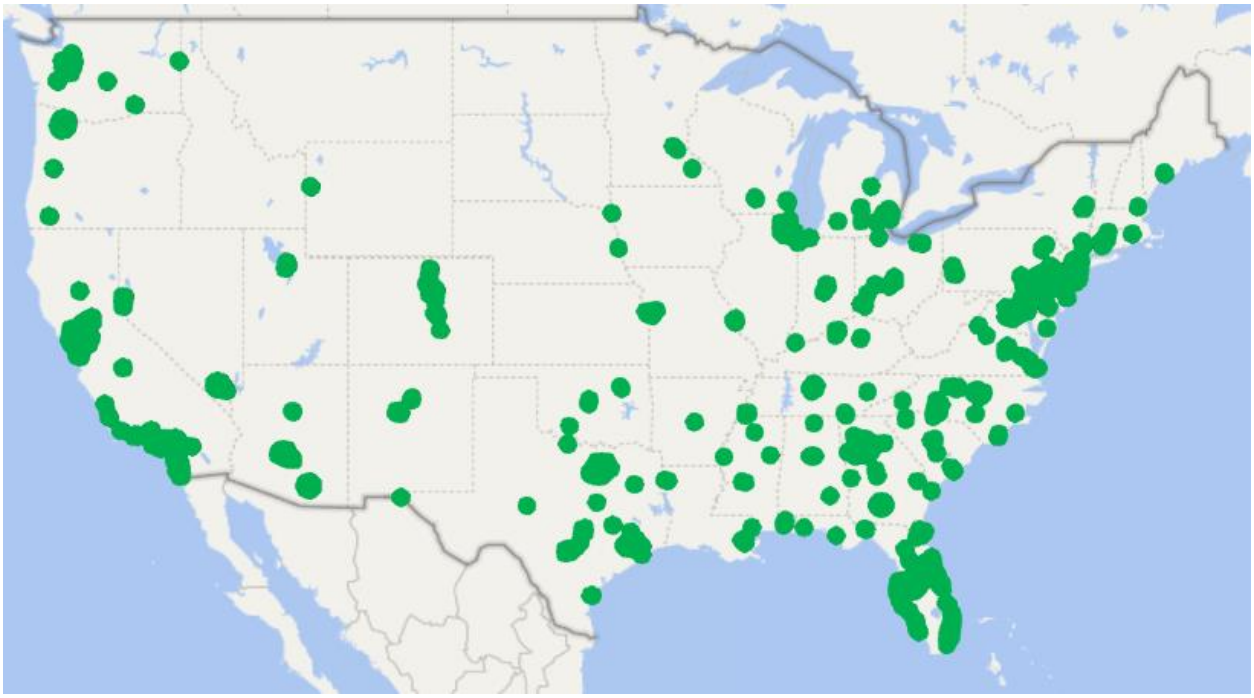
For loans meeting the 25 percent savings threshold by selecting water improvements, the overall average projected water savings was 26.7 percent. For loans meeting the 25 percent savings threshold by selecting energy improvements, the overall average projected energy savings was 26.1 percent. Only one loan qualified through a combination of water and energy, having an overall average projected water savings of 27.2 percent and an overall average projected energy savings of 32.2 percent.

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 42 states, with the highest concentrations in Texas, Florida, California and Georgia. These four states contain 49 percent of all green loan properties. Arizona, Colorado, North Carolina and Nevada have 21 percent of green loan properties with the remaining 30 percent coming from 34 states. This distribution is generally consistent with the overall distribution of all Freddie Mac Multifamily loans.

Exhibit 11: Freddie Mac Green Loans by Location



These properties are spread over 149 metropolitan statistical areas (MSAs). The top MSAs contain 33 percent of green loans in their respective MSAs and include Atlanta, Dallas, Phoenix-Mesa, Denver, Houston and Las Vegas. Below is a chart of the top 10 MSAs.

Exhibit 12: Top 10 MSAs Containing Green Loans

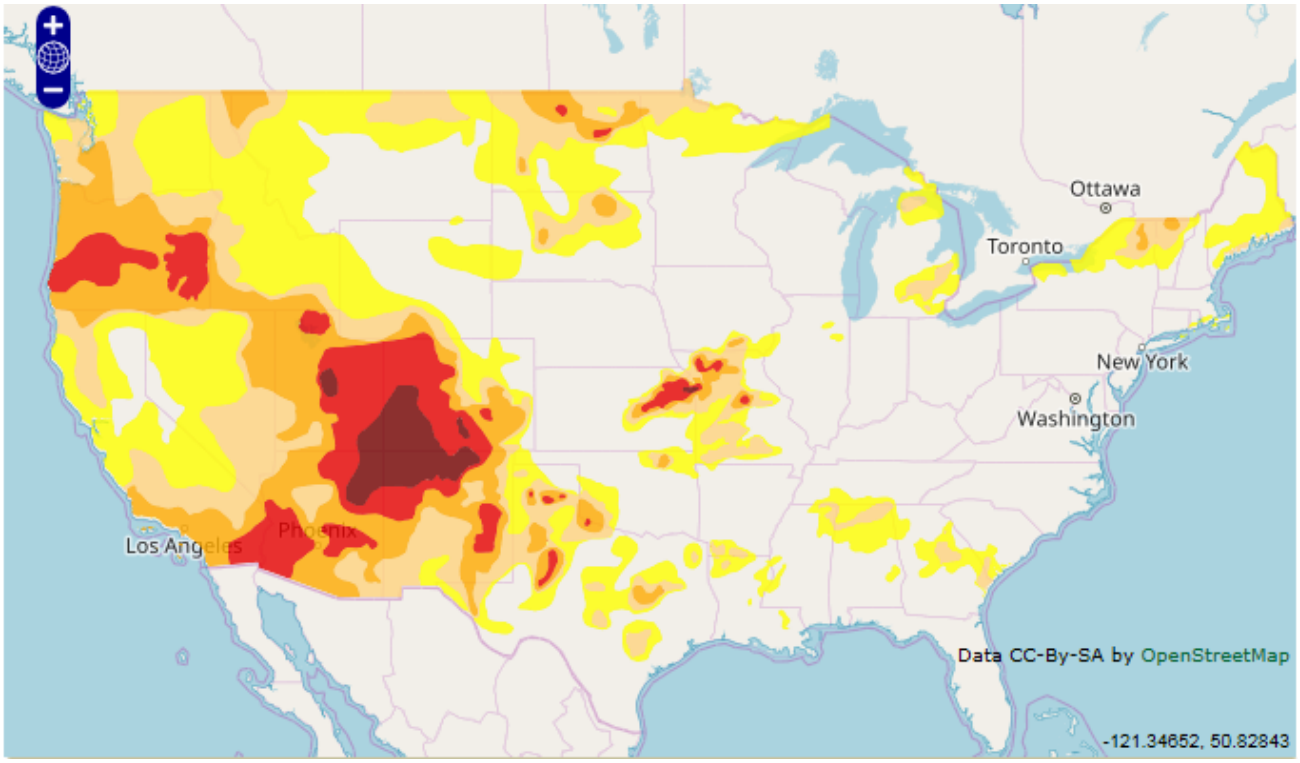
MSA	% of Green Loans
Atlanta	8.1%
Dallas	6.6%
Phoenix-Mesa, AZ	5.7%
Denver	4.5%
Houston	4.4%
Las Vegas	4.0%
Tampa-St. Petersburg, FL	3.3%
Orlando, FL	3.1%
Los Angeles-Long Beach	2.8%
Fort Worth-Arlington, TX	2.5%

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, we looked at the locational benefit of such improvements. Exhibit 11 is a map showing the location and intensity of areas experiencing drought as of the end of the third quarter of 2018.

Roughly 30 percent of Green Advantage loans qualifying via water improvements appeared to be in areas that were experiencing drought. Green Advantage loans installing water conservation improvements in these areas are projected to save 1.1 billion gallons of water. The water conservation from the green improvements in these locations stands to have a greater impact than in areas where water is more abundant. 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[10] and will also save property owners and tenants money given water costs have steadily increased each year[11].

Exhibit 13: U.S. Drought Monitor Map



Source: U.S. Drought Monitor provided by the National Integrated Drought Information System, https://www.drought.gov/drought/data-gallery/us-drought-monitor

[10] 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
[11] For additional details see https://www.circleofblue.org/waterpricing/

Conclusion

Green Improvements have benefits beyond the environmental impacts of reduced energy and water consumption. They can reduce tenant's utility costs and can play an important role in preserving the affordability of workforce housing.

Market adoption of energy and water efficiency improvements have been strong. Across the country, multifamily properties participating in the Green Advantage program are implementing over $173 million of energy and water efficiency improvements. Across our portfolio, projected water savings average 2.8 million gallons of water per loan per year and nearly 10,000 gallons of water per unit per year, and projected energy savings average over 1.1 million kBtu per loan and almost 4,030 kBtu per unit projected. The average 100-unit property that participates in Green Advantage and receives a Green Up loan, is projected to save over 1.3 million gallons of water and almost 500,000 kBtu per year, saving tenants roughly $250 per unit per year. Over a 10-year loan term, almost two and a half years of water consumption and almost nine months of energy consumption are projected to be saved.

The efficiency improvements are being implemented primarily in workforce housing with buildings' average year built at 1985. Water improvements are the preferred choice as they are smaller, lower cost projects and generally have a quick projected return on investment. They also can have a residual energy-savings benefit to further improve the savings of the improvement. Energy improvements are a mix of small, medium and large projects ranging in cost. In general, they are more expensive than water improvements but tend to provide more direct cost savings to tenants.

With each year of lending and property operations, we will continue to amass more data on green improvements and the effects they have on properties, and we will continue to publish and analyze this data. If projections hold true and market adoption continues to be strong, over a 10-year period averaging 170,000 units financed per year, there is the potential to save 16.8 billion gallons of water and 6.8 billion kBtu of energy, potentially equating to a projected $210 million of tenant utility cost savings.

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 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 need for a due diligence and analysis period for each report, which allowed the Green Consultants to provide meaningful recommendations, and the need to deliver reports within a reasonable period of time 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 plus additional specific and rigorous inspection and consumption data 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 is an 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 water flow rates and toilet flush rates. 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 setup 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

Historical Utility Consumption Data

When producing a Green Report, Green Consultants are expected to collect historical utility consumption data for the whole property (common and tenant areas) from the property owner. 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 percent 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 – Portfolio Manager

As part of the requirements in the loan agreement, borrowers are required to provide Freddie Mac with the actual energy and water usage (Benchmarking Data) at the property through Portfolio Manager. The timing and details on what should be put into Portfolio Manager has evolved and been clarified in the loan agreement as the program has matured. 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, we will not have immediate access to ongoing consumption data for earlier loans, and some of this data will only include energy or water owner-paid consumption. We have since refined these requirements, now requiring Borrowers to track both energy and water consumption (regardless of the improvements selected) post-closing and to collect at a minimum 10 percent tenant data.

Appendix C: Data Quality Assessment

Additional detailed findings from the data quality assessment performed on a sampling of green loans from the Freddie Mac Multifamily portfolio are below.

Water Data Quality Successes

- All available water data has an available WUI
- All available water data has at least 12 months of pre-retrofit data*
- All available water data is continuous, there are no gaps in data*

Water Data Quality Areas for Improvement

- 49 percent of sample is not tracking water data
- 45 percent of all available water data does have a Water Score available
- 20 percent of all available water data is not tracking cost
- 0 percent of all available water data distinguishes between owner and tenant utilities
- 10 percent of all available water data indicated estimated values
- 55 percent of all available water did not track monthly data points
- 22 percent of all available water data did not track cost

Electric Data Quality Successes

- All of the sample did track electric data
- All available electric data has at least 12 months of pre-retrofit data*
- All available electric data is continuous, no data gaps*

Electric Data Quality Areas for Improvement

- 55 percent of all available electric data did not track cost
- 22 percent of all available electric data did not track monthly data points*
- 61 percent of all available electric data did not distinguish between owner and tenant utilities

Gas Data Quality Successes

- All available gas data is continuous, no data gaps*
- All available gas data has at least 12 months of pre-retrofit data*

Gas Data Quality Areas for Improvement

- 30 percent of sample did not track any gas data
- 41 percent of all available gas data did not track cost
- 42 percent of all available gas data did not track monthly data points*
- 73 percent of all available gas dad did not distinguish between owner and tenant utilities

*Due to an error with Portfolio Manager, a subset of properties was not able to share some meter data. Due to unavailable meter-level data granularity, this data point only reflects the portion of the sample that was able to be shared.

Overall Areas for improvement

Water

- Stress importance of entering baseline data
- Investigate 49 percent of properties that do not have baseline data

Energy

- 43 percent of all available data was flagged as estimated
- 13 percent of properties did not have an ENERGY STAR score available

General Areas for Improvement

To address the main areas for improvement, WegoWise recommended:

- Data must be entered as monthly data points to improve data quality assessment and allow for weatherized verification
- Incorporate data quality assessments at time of submission to fix errors or omissions more quickly
- Establish guidelines for labeling actual, sampled and estimated consumption data
- Strive for full cost data to improve savings calculations
- Clarify what is tenant versus owner data