



Spotlight on Underserved Markets

# 2019 Analysis of Green Improvements in Workforce Housing



## 2019 Analysis of Green Improvements in Workforce Housing

Green improvements<sup>1</sup> have the potential to play an important role in preserving the affordability of workforce housing. Energy and water utility costs have increased across the country each year for the previous decade.<sup>2</sup> This is particularly poignant for families in rental housing. Almost one-third (31%) of multifamily households report some type of energy insecurity, such as forgoing or reducing necessities like food and medicine to pay an energy bill or keeping their home at an unhealthy or unsafe temperature.<sup>3</sup> By reducing energy and water consumption, green improvements can lessen energy insecurity by helping to reduce tenants' utility costs.

The Green Advantage<sup>®</sup> suite of offerings focuses on implementing energy and water efficiency improvements to multifamily housing with an objective of lowering tenant expenses to help address affordability challenges nationwide. To meet this objective, the program requirements were adjusted in 2019 to focus more heavily on implementing energy improvements. Our primary offerings, Green Up<sup>®</sup> and Green Up Plus<sup>®</sup>, provide borrowers with financing incentives for making energy and water consumption reduction improvements at their properties, and monitoring and reporting their energy and water consumption over time. Borrowers were able to meet the increased consumption savings requirements by selecting a mix of cost-effective energy- and water-saving improvements. Across our portfolio, cost savings projections have been significant, with nearly \$132 million across over 2,100 loans, and tenants projected to save \$291 per unit per year.

In this paper, we provide an updated analysis<sup>4</sup> of our portfolio of Green Advantage loans and release associated property-level data on improvements made. With an additional year of data, we are continuing to fill a gap in energy and water efficiency data that is lacking in the market. We seek to gain new insights into the types of improvements that can reduce tenant costs and make multifamily housing stock more efficient.

Below are the key highlights from our analysis:

- Since program inception through the third quarter of 2019, Freddie Mac Multifamily Green Advantage provided over \$59 billion in financing through loans purchased on 583,000 units.
- Financed properties are garden-style apartments that are, on average, 34 years old with 85 percent 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 \$464 per unit with a total of \$270 million of projected improvements as of the end of the third quarter of 2019.

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<sup>1</sup> Improvements to a building or unit that improves its energy and/or water efficiency.

<sup>2</sup> For more details on energy costs, see the Electricity Data Browser from EIA, <https://tinyurl.com/uwrze8l>, and for water costs see, <https://www.circleofblue.org/waterpricing/>

<sup>3</sup> We looked at the Residential Energy Consumption Survey and the reported energy insecure households from the number of apartments in buildings with five or more units:

<https://www.eia.gov/consumption/residential/data/2015/hc/php/hc11.1.php>

<sup>4</sup> See the prior report 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/green-improvements-workforce-housing.pdf> and

<https://mf.freddiemac.com/docs/green-advantage-dataset.xlsx>

- The cost to meet the 30% consumption savings threshold with a minimum 15% from energy was on average \$519 per unit. Of these properties, 67% spent \$500 per unit or less, with half of the properties projected to spend only \$360 per unit or less.
- Annual cost savings projections total over \$132 million, which averages roughly \$62,800 per loan per year and \$233 per unit per year.
- Under the 30% consumption savings threshold, owners are projected to save \$80 per unit per year, which is an almost \$23 per unit per year increase from the prior requirements. Tenants saw an even larger increase as they are projected to save \$291 per unit per year, an increase of over \$76 per unit per year.
- Water improvements are projected to save 6.1 billion gallons in water per year, and energy improvements are projected to save almost 2.8 billion kBtu per year.

### *Efficiency Improvement Data from Green Reports*

Our portfolio analysis was performed by pulling together basic loan level information with data from the Green Assessment<sup>®</sup> or Green Assessment Plus<sup>®</sup> (both, Green Reports)<sup>5</sup> received when a borrower pursues a Green Up or Green Up Plus loan.<sup>6</sup>

#### **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<sup>®</sup> Portfolio Manager<sup>®</sup> (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.<sup>7</sup>

We have begun to receive ongoing consumption data on a small number of properties and expect to receive more in the future. We performed a preliminary evaluation of this data and will discuss findings in a later section. 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.

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<sup>5</sup> Appendix A: Green Assessment and Green Assessment Plus Standards provides more details about each standard.

<sup>6</sup> See Appendix B: Data Collection Methodology for details about the data collected and used for analysis.

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### Portfolio Analysis

Market adoption of energy and water improvements for multifamily properties continued in 2019 with over \$14.7 billion in loans purchased. Total Green Advantage purchase volume through September 2019 is \$59.55 billion from 2,131 loans across over 582,000 units.

**Exhibit 1: Green Loan Totals through 3Q2019**

Freddie Mac Green Loans	Totals
<b>Loan Count</b>	2,131
<b>Total Loan Amount</b>	\$59,550,452,655
<b>Average Loan Amount</b>	\$27,944,839
<b>Total Unit Count</b>	583,729
<b>Average Unit Count</b>	274

### 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 3Q2019**

Freddie Mac Green Loans	Totals
<b>Average Year Built</b>	1985
<b>Property Type</b>	
<i>Garden (1-3 story, townhome, walkup)</i>	92.4%
<i>Mid-Rise (Multistory with elevator)</i>	5.2%
<i>High Rise (9 or more floors, elevator)</i>	2.3%
<b>Unit Affordability</b>	
<i>100% AMI</i>	85%
<i>80% AMI</i>	62%
<i>50% AMI</i>	3%

The average age of properties utilizing Green Advantage financing remains unchanged from prior years and is on average 34 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.<sup>8</sup>

<sup>8</sup> [https://mf.freddie.com/docs/product/green\\_advantage\\_term\\_sheet.pdf](https://mf.freddie.com/docs/product/green_advantage_term_sheet.pdf)

**2019 Program Parameters**

The Green Advantage program parameters have evolved each year to meet the requirements set by the Federal Housing Finance Agency (FHFA) for green loan treatment related to the multifamily lending cap. Exhibit 3 provides details of the program requirement by year. For 2019, the consumption savings threshold was increased to require a total of 30% whole property savings, with a required minimum of 15% coming from energy consumption reduction and the remaining 15% coming from either energy or water consumption reduction.

**Exhibit 3: Evolution of Requirements**

Requirements	2016-2017	2018	2019
<b>Consumption Savings Threshold</b>	15% owner-paid, tenant-paid or whole property energy OR water reduction	25% <u>whole property</u> energy OR water reduction	30% <u>whole property</u> reduction from a MINIMUM 15% energy and 15% energy AND/OR water
<b>Benchmarking Data Consultant</b>	Not required – borrower or third party could enter Benchmarking Data	Not required – borrower or third party could enter Benchmarking Data	Required – borrower must engage prior to loan origination

The shift to require a minimum of 15% energy reduction out of the overall 30% whole property consumption reduction requirement was driven by a focus on finding more ways to benefit tenants using the green improvements. Tenants typically pay for in-unit energy consumption, so green improvements that reduce energy consumption may be an effective way to provide meaningful savings to tenants.

Additionally, a requirement was added for data collection and reporting for 2019. A third-party consultant (Benchmarking Data Consultant) qualified<sup>9</sup> to collect, input and monitor energy and water consumption usage (Benchmarking Data) in Portfolio Manager must be engaged by the borrower prior to the origination of the loan. We expect this requirement will improve the quality and consistency of the reported utility consumption data received.

<sup>9</sup> For requirements of a Benchmarking Data Consultant, see <https://mf.freddiemac.com/docs/benchmarking-data-consultant-requirements.pdf>.

### Comparison between Program Requirements

Exhibit 4 provides the green loan totals by program requirement through the third quarter of 2019. Total loan count for the 15% requirement was at 881 for \$24.7 billion and decreased slightly to 823 loans for \$22.2 billion for the 25% requirement. Through the third quarter of 2019, 427 loans have been funded under the 30% requirement for a total volume of \$12.6 billion.

#### Exhibit 4: Green Loan Totals by Program Requirement through 3Q2019

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement*	Totals
Loan Count	881	823	427	2,131
Total Loan Amount	\$24,718,380,182	\$22,218,640,182	\$12,613,432,291	\$59,550,452,655
Average Loan Amount	\$28,057,185	\$26,997,133	\$29,539,654	\$27,944,839
Average Year Built	1984	1987	1986	1985
Total Unit Count	252,451	220,086	111,192	583,729
Average Unit Count	287	267	260	274

\* Figures are through 3Q 2019

### Green Improvement Recommendation and Selections

With the shift in program requirements requiring a minimum of 15% energy consumption reduction, energy-saving improvements were selected at a higher rate than the prior years. Exhibits 5 and 6 list the most common water and energy improvements. It also includes the percentage change from the prior reporting period of program inception through third quarter of 2018 to the third quarter of 2019.

#### Exhibit 5: Percentage of Loans Selecting Water Improvements

Green Improvements	% Selected	% change from prior reporting period
Showerheads	87.3%	8.0%
Aerators/Faucet (kitchen)	74.9%	10.2%
Aerators/Faucet (bathroom)	74.5%	7.8%
Toilets	39.0%	-2.7%
Irrigation (xeriscaping, weather sensors, drip, etc.)	11.6%	3.1%
Appliances (washing machines)	6.8%	0.7%
Pool cover installation	3.2%	-0.4%

**Exhibit 6: Percentage of Loans Selecting Energy Improvements**

<b>Green Improvements</b>	<b>% Selected</b>	<b>% Change from prior reporting period</b>
LED Lighting (exteriors and/or common areas)	26.6%	3.5%
LED Lighting (unit interiors)	24.7%	9.0%
HVAC (thermostats)	13.0%	8.6%
Insulation (building/other)	8.2%	6.3%
Appliances (dishwashers)	6.5%	-1.7%
Central mechanical (domestic hot water heater)	5.0%	0.9%
Appliances (refrigerators)	4.5%	-1.2%
HVAC (system replacement)	4.2%	-0.7%
Windows	1.8%	-0.5%

The most commonly selected water improvements continue to be showerheads, kitchen aerators and bathroom aerators. Showerheads were selected on 87% of all loans, which is an increase of 8% from the prior reporting period. Bathroom and kitchen aerators were selected on nearly 75% of all loans and saw an even larger increase from the prior reporting period of nearly 8% and 10%, respectively. Although these improvements are primarily water-saving devices, they also provide residual energy savings, which contributed to the increase in borrowers selecting these improvements.

For energy improvements, the most commonly selected were exterior and common area LED lighting closely followed by unit interior LED lighting and then HVAC thermostats. Unit interior LED lighting saw a large increase from the prior reporting period, up 9% and selected on almost 25% of all loans. The HVAC thermostats increased by over 8% from the prior reporting period, being selected on 13% of all loans. Additionally, insulation<sup>10</sup> was pursued on 8% of loans, an increase of over 6% from the prior reporting period. These increases were largely driven by the improvements being the most cost-effective method for reducing energy consumption.

**Analysis of Improvements****Cost of Improvements**

The total projected cost<sup>11</sup> of all selected improvements from August 2016 through the end of the third quarter of 2019 amounted to \$270.3 million. This averages out to \$127,620 per loan or \$464 per unit.

<sup>10</sup> There were a variety of insulation improvements implemented, including insulation of attics, walls, domestic hot water lines and tanks, and foundations. This category also included weatherization efforts such as leakage sealing. Future enhancements to Green Reports will allow Green Consultants the option to select a specific conservation measure category for insulation.

<sup>11</sup> Cost projections include costs for materials and labor, according to industry standard references.

**Exhibit 7: Projected Cost of Improvements by Program Requirement through 3Q2019**

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement*	Totals
Loan Count	881	823	427	2,131
Projected Cost of Improvements	\$135,484,894	\$77,223,719	\$57,589,642	\$270,298,255
Projected Average Cost per unit	\$533.32	\$361.17	\$519.11	\$463.69

\* Figures are through 3Q 2019

The projected cost per unit to meet the 30% consumption reduction savings requirement is \$519 and increased by 144% 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 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 2019 increased consumption requirement in a cost-effective way. Of the 427 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**

There were multiple paths for borrowers to meet the 2019 program change requiring a minimum 15% energy consumption reduction. Most energy improvement selections were made for low-cost, high consumption and cost-savings measures. For example, a borrower could have selected interior and exterior LED lighting and made improvements to their insulation, such as insulating their domestic hot water lines. These improvements projected an average cost of \$283 per unit with projected consumption savings of 16.5% and an annual projected cost savings of \$157 per unit.

**Exhibit 8: 2018-2019 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)	\$385	\$13	0.4%	28.7
Central mechanical (DHW)	\$270	\$35	6.1%	7.7
HVAC (system replacements)	\$912	\$98	10.8%	9.1
HVAC (thermostats)	\$160	\$71	6.1%	2.3
Insulation (building)	\$468	\$69	6.2%	6.8
Insulation (other)	\$72	\$25	3.7%	2.8
LED Lighting (exteriors and/or common areas)	\$55	\$26	7.6%	2.1
LED Lighting (unit interiors)	\$156	\$105	5.1%	1.5
Windows	\$1,093	\$123	10.3%	8.9
<b>Totals</b>	<b>\$486</b>	<b>\$151</b>	<b>4.2%</b>	<b>3.2</b>

Note that the figures above are only for 2018 and 2019 selected improvements as methods to standardize and collect the data were under development prior to the creation of the Green Advantage database.



Exhibit 8 provides the average projected cost and savings figures for energy improvements. A popular energy improvement, with a large increase from the prior reporting period, was HVAC thermostat replacements. On average, the cost to replace an HVAC thermostat was \$160 per unit and projected to save \$71 per unit per year with a payback of just over 2 years. The projected energy consumption savings is a little over 6%. Borrowers selected this improvement on 13% of loans, an increase of 8.6% from the prior reporting period.

### Water Improvements

Water improvement selections were also impacted by the 2019 program requirement change. The factors driving the improvement selections include their projected cost relative to their payback and the associated consumption savings. Water improvement selections with a low cost combined with higher consumption and cost-saving projections increased from the prior reporting period. Of particular note is the increase in water improvements that also obtain residual energy savings. 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 were often combined with energy improvements to meet the 30% consumption reduction savings targets for 2019. Using the example from above, of a borrower selecting the interior and exterior LED lighting along with insulation improvements, a borrower could select showerheads and kitchen aerators to achieve the remaining consumption savings to hit the required overall 30% consumption reduction threshold. The total projected costs for the water improvements are \$82 per unit, bringing the total projected cost per unit for all improvements to \$365. The projected water consumption savings would be 17.6% and total combined projected energy consumption savings to 22.2%, for an overall energy and water consumption reduction of nearly 40%.

### Exhibit 9: 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)	\$18	\$28	5.1%	\$21	1.6%	0.4
Aerators (bathroom)	\$20	\$21	4.1%	\$17	1.4%	0.5
Appliances (dishwashers)	\$303	\$4	0.6%	\$19	0.8%	13.0
Appliances (washing machines)	\$295	\$25	5.8%	\$19	1.2%	6.7
Faucet (complete fixture - bathroom)	\$115	\$28	4.1%	\$18	1.4%	2.5
Faucet (complete fixture - kitchen)	\$121	\$26	4.8%	\$32	1.7%	2.1
Water Features (irrigation)	\$60	\$25	5.5%	\$0	0.0%	2.4
Showerheads (replace)	\$64	\$62	12.5%	\$51	4.2%	0.6
Showerheads (other)	\$76	\$20	5.7%	\$18	1.9%	2.0
Toilets	\$299	\$43	8.0%	\$0	0.0%	6.9
<b>Totals</b>	<b>\$270</b>	<b>\$124</b>	<b>7.1%</b>	<b>\$84</b>	<b>2.0%</b>	<b>1.3</b>

Note that the figures above are only for 2018 and 2019 selected improvements as methods to standardize and collect the data were under development prior to the creation of the Green Advantage database.

Exhibit 9 provides the average projected cost and savings figures for water improvements. Showerheads and aerators saw the largest increase from the prior reporting period. At a projected cost of only \$18 per unit, 75% of loans selected kitchen aerators, an increase of 10%. Kitchen aerators not only projected to save roughly 5% in water consumption, but also projected to save 1.5% in energy consumption. With the associated energy and water cost savings, the short payback of just under five months made this an attractive improvement for borrowers. Bathroom aerators and showerheads show similar cost, savings and payback projections, helping explain their roughly 8% increase in selections from the prior reporting period. When combining the energy consumption savings projections, showerheads and aerators had the potential to save about 6% to 7% of the required 15% energy consumption reduction. They played an integral role in borrower selections for 2019.

**Projected Portfolio Savings**

**Projected Consumption Savings**

The projected consumption savings benefits for energy and water across the portfolio are substantial. Water improvements are projected to save 6.1 billion gallons in water per year, which is the equivalent of filling the Tidal Basin in Washington, D.C., 24 times, filling 9,247 Olympic-sized swimming pools, or the equivalent water usage for nearly 199 million loads of laundry. On average, each Green Advantage loan is projected to reduce the property water usage by 2.8 million gallons of water per year and almost 10,500 gallons of water per unit per year.

The projected energy savings to date are just under 2.8 billion kBtu per year, almost 2 times the previous program total. This is enough energy to power roughly 76,000 homes across America or 16,400 football stadiums. Across each loan, this averages to 1.3 million kBtu and almost 4,800 kBtu per unit.

**Projected Cost Savings**

Annual cost savings projections total over \$132 million which averages to roughly \$62,800 per loan per year and \$233 per unit per year. The projected average savings per unit has steadily increased as the consumption savings requirements increased each year. The change from 25% whole property consumption reduction from water or energy to the 30% reduction with a minimum 15% coming from energy resulted in an additional projected savings of almost \$80 per unit per year.

**Exhibit 10: Projected Cost Savings by Program Requirement**

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement	Totals
Loan Count	881	823	427	2,131
Projected Cost Savings	\$45,094,929	\$52,837,542	\$34,908,583	\$132,841,054
Projected Average Savings per unit	\$183.43	\$241.95	\$321.45	\$233.61
Projected Owner Cost Savings	\$22,869,188	\$8,197,955	\$5,445,350	\$36,512,492
Projected Average Owner Savings per unit	\$101.31	\$57.85	\$80.53	\$81.75
Projected Tenant Cost Savings	\$22,244,983	\$44,639,587	\$29,463,233	\$96,347,803
Projected Average Tenant Savings per unit	\$122.15	\$214.39	\$291.00	\$197.23

Green Consultants further allocated projected savings to either owners or tenants based on who was ultimately responsible for paying the consumption according to the billing arrangements of the property. The adjustment to require 30% consumption reduction with a minimum of 15% coming from energy increased the projected savings to both owners and tenants. Owners are projected to save \$80 per unit per year, which is an almost \$23 per unit per year increase from the prior requirements. Tenants saw an even larger increase as they are projected to save \$291 per unit per year, an increase of over \$76 per unit per year. Although the change requiring a minimum consumption savings to come from energy increased the average projected costs, the associated savings increased in a meaningful way, particularly for tenants.

**Exhibit 11: Water Improvement Projected Cost Savings**

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement	Totals
Projected Owner Cost Savings	\$14,229,707	\$6,691,114	\$2,157,464	\$23,078,286
Projected Average Owner Savings per unit	\$83.37	\$49.93	\$65.47	\$67.20
Projected Tenant Cost Savings	\$3,645,256	\$23,468,665	\$8,796,314	\$35,910,235
Projected Average Tenant Savings per unit	\$78.16	\$132.10	\$95.58	\$113.50

Exhibit 11 looks at the savings associated with water improvements. The projected tenant cost savings decreased from over \$23 million under the 25% requirement to \$8.8 million with the 30% requirement. This is driven in part by the difference in loan volume but also due to water improvements generally only targeting savings at 15% or less. Borrowers would first look to meet the minimum 15% energy requirement, and then could select water improvements to achieve the remaining 15% savings to hit the 30% overall requirement. Under the 30% requirement, water improvements would generally not exceed 15% as compared with the 25% threshold from last year. These factors contributed to the decrease in tenant savings from water improvements between program requirements. While water savings measures such as showerheads and aerators can help meet the energy requirements, additional energy selections needed to be made to hit the savings targets.

**Exhibit 12: Energy Improvement Projected Cost Savings**

	Qualified Under 15% Requirement	Qualified Under 25% Requirement	Qualified Under 30% Requirement	Totals
Projected Owner Cost Savings	\$8,639,481	\$1,506,841	\$3,287,885	\$13,434,206
Projected Average Owner Savings per unit	\$50.10	\$17.60	\$52.43	\$39.32
Projected Tenant Cost Savings	\$18,599,728	\$21,170,922	\$20,666,919	\$60,437,568
Projected Average Tenant Savings per unit	\$108.74	\$107.78	\$208.65	\$130.55

Exhibit 12 looks at the projected savings from energy improvements. Tenant cost savings under the 30% requirement of \$20.66 million was close to the \$21.17 million tenant cost savings for the prior 25% requirement, even though there were nearly 400 fewer loans. The increased tenant cost savings can be attributed to the focus on implementing energy improvements, which typically will directly benefit the tenant due to the billing arrangement. On average, tenants are projected to save over \$208 per unit on energy improvements.

## Measurement and Verification – Quantifying Consumption and Cost Savings

The process for quantifying consumption reduction and cost savings resulting from the energy and water efficiency improvements is called measurement and verification (M&V). Freddie Mac Multifamily engaged WegoWise by AppFolio (WegoWise) to evaluate a sample of loans to determine if an M&V analysis could be performed.<sup>12</sup> The properties analyzed were financed in 2016 or 2017. These properties were under the original 15% consumption reduction threshold and earlier reporting requirements.<sup>13</sup>

Properties included in this analysis had completed their energy efficiency improvements by the end of 2017 — which was ahead of the completion date required by the program allowing properties up to two years to complete the work. The M&V analysis also required collecting all historical consumption data provided with the Green Report and the reported actual energy and water usage (Benchmarking Data). The data had to meet a level of completeness and quality in order to produce reliable and accurate M&V reports. This resulted in a sample of 16 properties with completed improvements and acceptable Benchmarking Data available for M&V analysis.

As part of the M&V analysis, we wanted to be able to understand tenant and property impacts resulting from the improvements implemented at the property. Of high importance, we wanted to focus on any cost savings realized by tenants as well as savings overall to the property both in dollar figures and in consumption reduction. The ability for Freddie Mac to report on these outcomes is dependent upon the quality of the historical and post-retrofit data collected.

Based on the sample of loans that were able to receive an M&V analysis, the average actual water savings was 20%, which exceeded the 15% consumption savings program minimum. We also found the median projected savings from Green Consultants were on target with the program requirements. Given the limited number of properties receiving an M&V analysis, we cannot apply these preliminary results across the portfolio, however, they indicate that for water-efficiency improvements there is a likelihood of meeting projections. As we continue reviewing our portfolio of loans, we expect to have a larger sample size available for additional M&V analysis. Additionally, these loans will also benefit from the program changes tied to improved data collection. With the larger sample size and improved requirements, we will explore these preliminary findings in more depth in a future report.

There were some encouraging preliminary findings, but there were also some properties that did not realize the expected savings based on their reported data. Additionally, various data challenges prevented a subset of properties in the sample from being able to produce an accurate, reliable M&V report. Challenges included:

1. Availability of tenant data
2. Lack of reported data
3. Not enough post-retrofit data
4. Large discrepancy between baseline data and post-retrofit data
5. Single data point for annual energy or water usage

We worked with WegoWise to develop a Benchmarking Data Collection Best Practices Guide<sup>14</sup> to help mitigate these data challenges. 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

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<sup>12</sup> See Appendix C: Measurement and Verification Methodology for more details on our M&V approach.

<sup>13</sup> See the “Benchmarking Data – Portfolio Manager” section in Appendix B for reporting details of loans originated prior to the third quarter of 2017.

<sup>14</sup> The Benchmarking Data Collection Best Practices Guide is available at:  
<https://mf.freddiemac.com/docs/benchmarking-data-collection-guide.pdf>

improvements (energy or water) being implemented at the property. We also require the collection of a minimum of 10% of tenant data. The 2019 change requiring a third-party data collection firm will also improve the data we collect. We are also working with our Optigo® servicers on our annual reporting process. We believe these adjustments will improve future data collection and reporting to allow for a more robust M&V analysis to help us better understand the impact of the green improvements at each property.

**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, Virginia and Nevada 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 185 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 13: Top 10 MSAs Containing Green Loans**

MSA	% of Green Loans
Atlanta	7.2%
Dallas	5.1%
Phoenix-Mesa	4.8%
Houston	4.7%
Denver	4.0%
Tampa-St. Petersburg	4.0%
Las Vegas	3.5%
Orlando	2.6%
Los Angeles-Long Beach	2.4%
Baltimore	2.2%

**Green Loan Impacts in Areas Experiencing Drought**

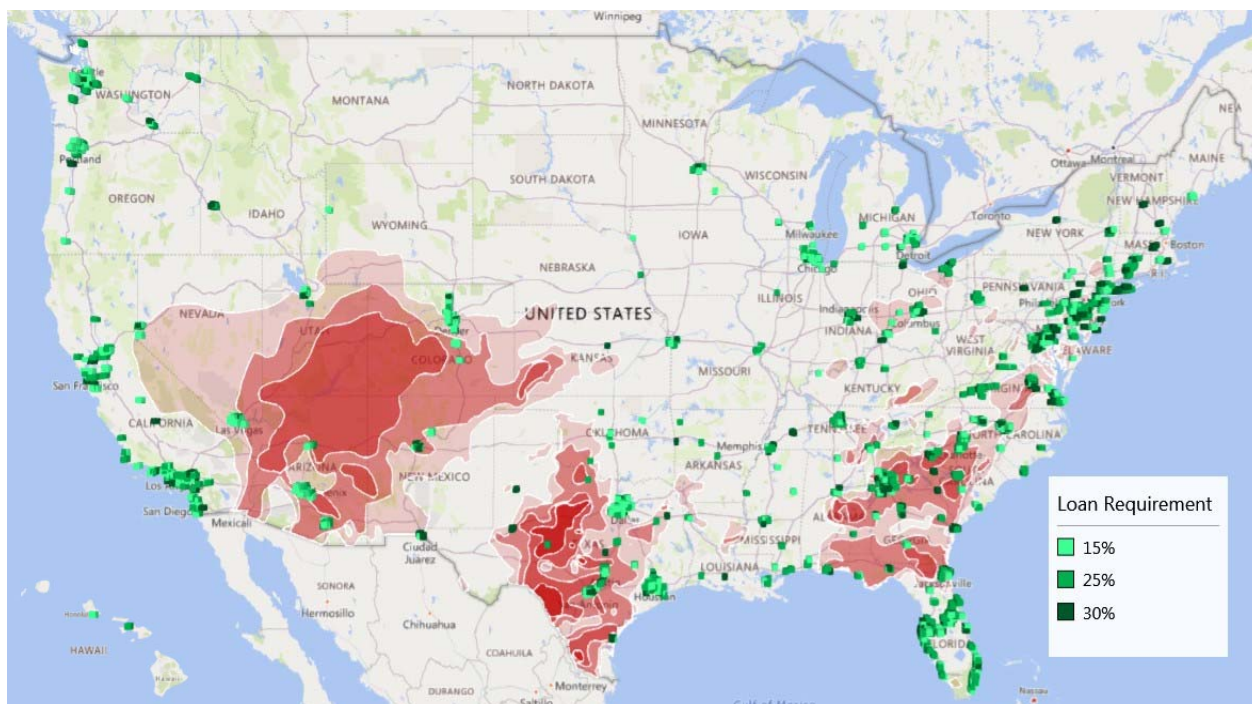
When we look more closely at these properties, we can see what additional impacts may result due to the increased efficiency of the improvements. Given the high percentage of water-saving improvements over the course of the program, we looked at the locational benefit of such improvements. Exhibit 14 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 2019.

We found 832 Green Advantage loans, or 39%, 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 2.3 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. While not all Green Advantage loans were originated in drought areas, the water consumption savings will still provide positive impacts, particularly as many states are expected to have water shortages not related to drought<sup>15</sup>.

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<sup>16</sup> and will also save property owners and tenants money given water costs have steadily increased each year<sup>17</sup>.

**Exhibit 14: 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**

Given the 15% minimum energy-savings requirement implemented in 2019, we looked at which areas would benefit most from these improvements. Exhibit 15 is a map showing the average monthly electric utility bills by state in 2018 relative to the location of Green Advantage loans. States with the most expensive electric bill are dark red and states with the least expensive bill are light yellow. The national average electric utility bill is \$117, whereas the average electric utility bill for states with the most expensive electric bill is \$140, which is 20% more than the national average. We found 62%, or 265,

<sup>15</sup> Reference the Government Accountability Office (GAO) study, <https://www.gao.gov/assets/670/663344.pdf>, or more information at the following EPA website: <https://www.epa.gov/watersense/how-we-use-water>

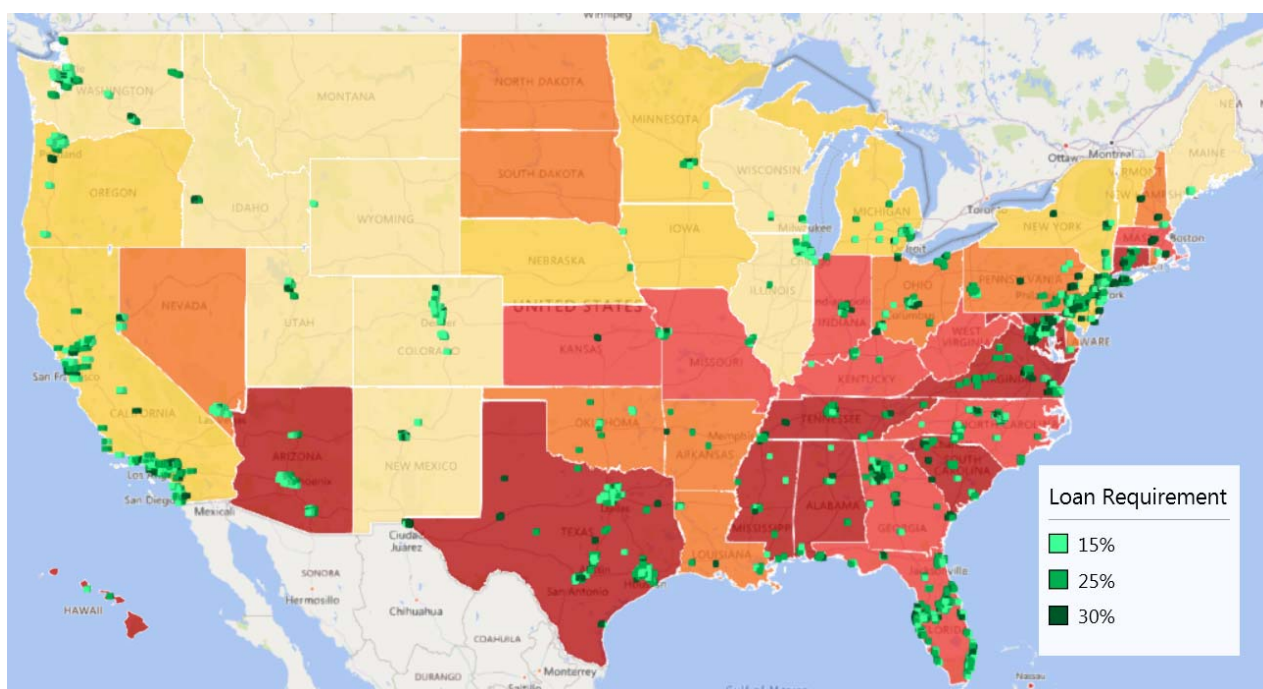
<sup>16</sup> See results from the EPA's 6th Drinking Water Infrastructure Needs Survey and Assessment available at <https://www.epa.gov/drinkingwatersrf/epas-6th-drinking-water-infrastructure-needs-survey-and-assessment>

<sup>17</sup> For additional details see <https://www.circleofblue.org/waterpricing/>

Green Advantage loans qualifying under the updated 2019 energy requirement are located in states with the most expensive bill. Improvements made on properties in these states will have a larger impact than loans where the electric utilities are less expensive. Regardless of the location of the Green Advantage loans, the projected savings will have a meaningful impact. The projected consumption for the 30% qualified loans is over 900,000 kBtu, with an average of almost 8,000 kBtu per unit with cost savings projected to be almost \$35 million or an average savings of \$321 per unit.

Cost savings are especially important due to rising energy costs: Energy bills have increased from 7.73 cents per kWh in 2001 to 13.3 cents in 2019.<sup>18</sup> The minimum 15% energy consumption reduction will serve to combat these rising costs, particularly for tenants. We found projected average tenant savings per unit have increased by 59%, from \$171 under the previous program requirements to \$291 under the 2019 requirements.

**Exhibit 15: Green Advantage Loan Location Relative to Average Monthly Electric Bill**



Source: Freddie Mac tabulation of 2018 U.S. Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS) data, [https://www.eia.gov/electricity/sales\\_revenue\\_price/xls/table5\\_a.xlsx](https://www.eia.gov/electricity/sales_revenue_price/xls/table5_a.xlsx).

<sup>18</sup> For more details on energy costs, see the Electricity Data Browser from EIA, <https://tinyurl.com/uwrze8l>

**Conclusion**

There are positive environmental benefits from the Green Advantage program. The improvements have primarily been implemented in units with an average year built at 1985 and that are affordable to low- and moderate-income renters. Aggregated consumption savings across our portfolio include 6.1 billion gallons of projected water savings per year and nearly 2.8 million gallons of water per year. The average 100-unit property participating in Green Advantage and receiving a Green Up loan is projected to save over 1.2 million gallons of water and over 580,000 kBtu per year. Over a 10-year term, projected savings are almost two and a half years of water consumption and over nine months of energy consumption.

The benefits are not limited just to environmental impacts but include real financial benefits to both owners and tenants of workforce housing. The demand for energy and water improvements offered as part of the Green Advantage program continued to be strong. Multifamily properties are implementing over \$270 million of green improvements, despite slightly higher costs to meet the increased minimum energy consumption savings requirement. To meet this requirement, we found borrowers are implementing more low-cost energy improvements in conjunction with water-saving improvements that also have residual energy savings; two-thirds project to spend \$500 per unit or less, and half project to spend \$360 per unit or less. These cost-effective solutions are being implemented and will make a difference for tenants of workforce housing by saving them a projected \$291 per unit per year. Owners are seeing projected savings of \$80 per unit per year.

The 2019 focus on implementing energy improvements has had a meaningful impact in helping to reduce tenant expense in workforce housing. Given the rising challenges in affordability, the savings associated with the green improvements can help to provide a measure of relief to workforce housing tenants.



## **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<sup>19</sup> 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 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.

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<sup>19</sup> 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 propertywide 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 – 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, 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 that will be 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. This requirement remained unchanged in 2019.

**Appendix C: 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).<sup>20</sup> IPMVP defines four measurement and verification (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

The Whole Facility – IPMVP Option C, approach was an appropriate option to use for M&V analysis based on our program setup. This approach requires gathering at least 12 months of pre-retrofit data for an accurate baseline model, along with post-retrofit data. An analysis is then performed of the full operating cycle by comparing the 12 months of baseline with 12 months of post-retrofit data to account for variations due to variables such as weather and occupancy.

Properties typically had up to two years to complete the improvements. The post-retrofit reporting would not occur until after the improvements were reported complete and needed preferably 12 months of post-retrofit data. Given these timing requirements, there were limited numbers of properties available for analysis. Properties not included in the initial analysis either had not reported the improvements completed or had not input the required utility consumption data in Portfolio Manager.

<sup>20</sup> IPMVP: <https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp>