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Driving Market Transformation

Ranking and Rewarding Certifications for Energy-Efficient and Healthy Multifamily Buildings

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Abstract

The Fannie Mae Green and Healthy Housing Financing program operates in every market across the United States, driving energy and water efficiency improvements and measures to improve resident health at multifamily properties. Fannie Mae's Green Building Certification (GBC) and Healthy Housing Rewards™ Healthy Design financing options provide preferential pricing for certified properties. However, not all certifications available on the market have requirements that are likely to result in meaningful energy savings or improvements in health outcomes for residents. To drive market transformation, Fannie Mae, Integral Group, and Elementa Engineering conducted an analysis of all certifications for green or healthy multifamily buildings available in the United States.[1] The analysis focused on certification program prerequisites. First, we analyzed the minimum energy savings expected from 44 green building certifications for new and existing multifamily buildings based on the projected energy performance of properties with each certification. Grouping green building certifications into different categories based on projected energy efficiency enables Fannie Mae to drive market transformation by offering lower mortgage rates to green-certified properties that comply with more stringent green building certification requirements. This may also encourage some organizations issuing green building certifications to raise their standards. In addition, green building certifications are now focusing more explicitly on measures aimed at creating healthier building environments for residents. To understand the scope of health-focused requirements across different certifications, we assessed green and healthy housing certifications against eight heathy building criteria. The results of our assessment of health criteria are being used to inform the Healthy Housing Rewards program.

1 This analysis is limited to all known certifications that are available to multifamily buildings nationwide; regional, state, and local certifications are not included.

Introduction

Fannie Mae's Green Financing program started as an initiative in 2010, and the first Fannie Mae Green Mortgaged-Backed Security (MBS) backed by a loan on a property with a Green Building Certification was issued in 2012. An interest rate discount for loans on properties with Green Building Certifications was introduced in 2015. For the past three years, we conducted an annual review with technical support from industry experts. To continue our focus on increasing the triple bottom line impact on the loans we finance, we add new certifications to the list of certifications that we recognize and remove certifications that no longer meet our defined standards.

Fannie Mae has developed invaluable relationships with many of the organizations that issue green building certifications. The work done by each certification organization to define, document, and verify their requirements was integral to our ability to develop the analysis described in this paper, resulting in greater market transformation through our Green Building and Healthy Housing programs.

Fannie Mae Green and Healthy Housing Financing Products and Goals

Fannie Mae's role in the market

Fannie Mae operates in the secondary mortgage market, providing a reliable, steady source of funding for housing in the United States. The company operates in two business lines — Single-Family and Multifamily. The Single-Family business provides financing to individuals and families for single-unit homes and properties that have four or fewer rental units, while the Multifamily business provides financing for commercially owned and operated apartment buildings with five or more rental units. Fannie Mae's Multifamily unit does not lend directly to consumers; instead, it provides financing through a national network of lenders that are authorized to underwrite, close, and sell loans to Fannie Mae through Fannie Mae's Delegated Underwriting and Servicing (DUS®) program. Fannie Mae then securitizes multifamily mortgage loans originated and delivered by lenders into Fannie Mae MBS. MBS are purchased by investors around the world, providing liquidity to the U.S. mortgage market.

Fannie Mae Multifamily Green and Healthy Housing Financing

The Fannie Mae Green and Healthy Housing Financing program serves Fannie Mae's multifamily business line, driving delivery of energy and water efficiency improvements, healthy housing improvements, and high-quality resident services at multifamily properties. Fannie Mae offers three distinct green and healthy housing financing options for multifamily borrowers to leverage when seeking permanent mortgage financing — Green Rewards, Green Building Certification, and Healthy Housing Rewards. Green Rewards incentivizes multifamily owners to renovate and retrofit existing multifamily properties with capital investments in energy efficiency, water efficiency, and/or renewable energy. Green Building Certification provides preferential pricing for multifamily buildings that have obtained select certifications. Lastly, the Healthy Housing Rewards program provides incentives for borrowers who incorporate health-promoting design features and practices (through the Healthy Design pathway) or resident services (through the Enhanced Resident Services™ pathway) in multifamily affordable housing. Due to the delegated nature of Fannie Mae's multifamily business, lender partners take a primary role in encouraging borrowers to leverage green and healthy housing financing options and in ensuring all program requirements set by Fannie Mae are met by borrowers. In short, Fannie Mae sets the green and healthy housing program requirements, and lenders execute the program in the market with limited individual deal-level review by Fannie Mae. All green and healthy housing financing options are designed to integrate into Fannie Mae's DUS model.

Loans that are backed by a Green Rewards property or a property with a Green Building Certification are securitized as Green MBS. As part of the standard multifamily securitization process, Fannie Mae discloses detailed information for each MBS, including the security, loan, and property-level information on its disclosure website, DUS Disclose®. For Green MBS, Fannie Mae additionally provides energy and water performance metrics to investors, including the property's ENERGY STAR® Score, WaterScore, Energy Use Intensity (EUI), and Water Use Intensity (WUI). Separately, as part of an annual impact report, Fannie Mae releases projected savings estimates for each MBS.

Green and Healthy Housing Certification analysis process

This paper focuses on the analyses underpinning Fannie Mae's Green Building Certification and Healthy Housing Rewards initiatives. Green Building Certification recognizes 35 certifications from 12 different organizations that are assigned to four different groups based on each certification's minimum percent energy improvement over a common baseline. Fannie Mae provides preferential mortgage interest rate pricing to borrowers that have a property with a recognized Green Building Certification. The preferential pricing is based on the certification group — receipt of a Green Building certification that requires higher energy savings results in a lower mortgage interest rate. Recognizing these leading multifamily borrowers is important. Recent analysis from CBRE Group, Inc. shows that, despite an increase in the market share of multifamily properties with a green building certification in the United States, such properties remain a relatively small subset of all multifamily properties. CBRE estimates that 3.3% of multifamily units within the top 30 multifamily markets have a green building certification (CBRE 2019).

Healthy Housing Rewards Healthy Design was launched with one certification serving as the qualifying mechanism. However, as the certification market develops an increasing focus on health, Fannie Mae is evaluating additional certifications that could qualify the loan for the preferential mortgage loan pricing of Healthy Housing Rewards.

To determine eligible green building certifications and develop the groupings, Fannie Mae conducts an annual market review and a technical evaluation. During this review, we first identify newly available certifications or newly released revisions to previously published certification standards for multifamily buildings.[2] In this year's analysis, 44 different certification standards were identified and reviewed. Next, we conduct a technical analysis to determine whether the certification requires energy and water savings as core criteria or minimum requirements to achieve the certification. We then compare the energy savings requirements of the various certifications to a common baseline, an analysis described in this paper. Green building certification programs use different energy codes and standards as baselines against which projected energy savings of a project are assessed, so comparing the energy and carbon emissions implications of the requirements of different certification programs can be challenging. This analysis enables Fannie Mae's Green Financing Business to organize green building certifications into different groups based on projected energy savings against a common baseline.

Next, we build upon the initial analysis, developing a calculator that provides estimates of the energy, carbon emission, and cost impacts of properties financed through Fannie Mae's Green Building Certification initiative. The calculator enables Fannie Mae to input basic data about a property (zip code, building type, building size, and the green building certification obtained) to get regionally specific estimates for building EUI, total energy use, greenhouse gas emissions, and energy costs, as well as savings relative to the base energy code of the state in which the property is located. The projected energy savings is disclosed publicly and to investors through Fannie Mae's annual *Green Bond Impact Report.*

Increasingly, green building certifications either require or incentivize improvements aimed at resident health through a points-based scoring system. Within the last few years, new certifications focused explicitly on resident health have entered the market, resulting in our incorporation of a comprehensive assessment of certification requirements around health-focused criteria for the first time in our annual review. This assessment serves to inform inclusion of health-focused criteria into the Green Building Certification program as well as the Healthy Design pathway of Healthy Housing Rewards, which currently relies on one certification (Fitwel®) as the qualifying mechanism for the program.

2 This analysis is limited to certifications that are available to multifamily buildings nationwide; regional, state, and local certifications are not included.

Green Building Certification Analyses

Technical approach: Comparing green building certifications to a common baseline

Most green building certifications require an improvement in energy and/or water use relative to either a stated code standard or the national median EUI. Some green building certifications use customized methodologies, but those too have average savings or EUI estimates that can be compared against a code model. To assess the energy requirements of different certifications and categorize them by projected energy savings, the methodology had to apply nationally and work for both newly constructed and existing buildings to align with Fannie Mae's Green Financing program, which operates in every market across the United States, serving newly constructed, renovated, and existing buildings.

Setting a national baseline

We used the ENERGY STAR Score for Multifamily to set a national baseline, as it uses a statistical model based on survey data from existing buildings that were collected by Fannie Mae (Fannie Mae 2014). ENERGY STAR estimates the median energy use of a building based on a variety of factors, such as building size, location, and use type. By comparing the actual energy use of a project to the predicted median energy use of similar projects, the ENERGY STAR Portfolio Manager generates a score from 1 – 100 that indicates how well the project performs compared to its peers. Based on the ENERGY STAR technical methodology, a multifamily building with a score of 75 (a benchmark that qualifies buildings for the ENERGY STAR for Existing Multifamily Certification) performs 18.5% better than a median building (score of 50) (ENERGY STAR 2018c).

For the purposes of this analysis, we used a simplified version of the ENERGY STAR methodology to generate a predicted EUI for each multifamily building type. Since the ENERGY STAR statistical model is not publicly available to generate a predicted median site EUI for a project, we approximated the median EUI in one thousand British thermal units per square foot (kBtu/ft2) by evaluating how closely the national averages for multifamily housing lined up with a database of commercial and residential prototype energy models published by Pacific Northwest National Laboratory (PNNL). Based on this analysis, we determined that the national median EUI for multifamily housing is approximately equivalent to the American Society for Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1-2004 (ENERGY STAR 2018d). Therefore, we used the results of the ASHRAE 90.1-2004 PNNL reference models as a baseline for predicted median EUI.

We selected ASHRAE 90.1-2004 as a national baseline for two primary reasons. First, the estimated performance of multifamily buildings that meet this code standard aligns with the national median EUI for multifamily properties, thereby serving as a common baseline for both new and existing buildings. Second, almost all new energy codes and certification systems are based on ASHRAE standards. ASHRAE 90.1 Appendix G requires that energy savings calculated under new codes be benchmarked against ASHRAE-90.1-2004 to create a common baseline over time (ASHRAE 90.1, Appendix G).

Assessing building energy code savings over baseline

The PNNL database contains results from energy models of low-rise, mid-rise, and high-rise multifamily residential buildings in each climate zone for ASHRAE 90.1-2004 to ASHRAE 90.1-2016 and IECC 2006 to IECC 2015.[3] By using model data from these major energy codes, we can estimate the energy performance of different types of multifamily residential properties around the county by climate zone. For establishing baseline comparisons and grouping analysis, we used nationwide average energy performance; however, for the impact analysis discussed later in this paper, we can estimate the energy performance of different types of multifamily residential properties for each county in the United States, resulting in a more accurate estimate of the program's impact at the project level. When creating the certification groups, we averaged the projected savings for each energy code standard across the entire country. In certain instances, the dataset from PNNL did not contain results for all ASHRAE 90.1 and International Energy Conservation Code (IECC) code standards. For example, the residential dataset, which include low-rise multifamily and single-family homes, only contains models for IECC standards, since ASHRAE 90.1 does not apply to single-family and low-rise multifamily buildings. In those instances, we interpolated the results for ASHRAE 90.1 models based on the relative differences between IECC and ASHRAE in each climate zone. By filling in this missing data, we developed a full set of results for each ASHRAE and IECC code standard, in each climate zone, for low-rise (three floors, 31,000 gross ft^2), mid-rise (four floors, 34,000 gross ft^2), and high-rise (10 floors, 85,000 gross ft^2) buildings (DOE2019a, DOE 2019b).

California Energy Codes: To calculate the Title 24-2016 baseline for projects in California, we used a recent California Energy Commission report comparing the standard to IECC 2015. The average performance increase (29%) over IECC 2015 was used as the basis for the Title 24-2016 baseline and the average performance increase of 3.2% over IECC 2009 as the basis for the Title 24-2008 baseline (Alatorre and Neumann 2017, Ware and Bozorgchami 2013). For the purposes of this analysis, we assumed that annual time dependent value (TDV) savings and total annual energy savings, expressed as percentage savings from an IECC 2015 baseline, are roughly equivalent.[4]

3 At the time of the initial analysis, PNNL had not yet published energy models for ASHRAE 90.1-2019 and IECC 2018; no green building certifications that were reviewed referenced either standard.

4 The possible effect of this assumption is that we have overestimated the savings attributable to Title-24 by 3 – 5%. Additional analysis is underway to verify this estimate.

ENERGY STAR Homes Savings: To determine savings projections for each version of the ENERGY STAR Homes certification, we relied on published studies that evaluated the impact of ENERGY STAR-certified homes relative to IECC Codes. We then developed EUI projections using a 2018 report on cost savings from the ENERGY STAR Homes certification program. The reference report provides energy savings projections for each version of the ENERGY STAR Homes Certification relative to the applicable code at the time; thus, the EUI of an ENERGY STAR v3 compliant single-family home is calculated from estimating savings relative to IECC 2009 and ENERGY STAR 3.1 relative to IECC 2012 (ENERGY STAR 2018a; ENERGY STAR 2018b). For ENERGY STAR 3.2-California (CA), the standard is 10% better than the latest Title 24 energy code (ENERGY STAR 2019). Detailed savings estimates were not available at the time of this paper for assigning savings to ENERGY STAR 3.1-Florida (FL), ENERGY STAR 3.0-Pacific (for Hawaii), or ENERGY STAR 3.2-Oregon/Washington (OR/WA).; thus 3.2-OR/WA and 3.1-FL were modeled identically to 3.1, and 3.0-Pacific was modeled identically to 3.0, after accounting for climate zone variation (Gamble 2019).

Passive House Energy Savings: The source EUI targets for Passive House Institute US (PHIUS)+ Certified residential buildings are primarily based on occupancy, with allowances for heating and cooling load that vary according to climate zone. To compare PHIUS+ Certified projects to ASHRAE, IECC, or ENERGY STAR baselines, we normalized the PHIUS source EUI targets by building area by first using the PHIUS+ calculation methodology to develop an energy target for each PNNL prototype model and, second, calculating an approximate site EUI based on the area of each model (PHIUS 2017, 2019). We assumed that high-rise multifamily buildings use heat pumps for space heating, as is required under most new building codes, and assumed a domestic hot water (DHW) gas heating allowance of 7.0 kBtu/ft^2.[5]

Results of baseline analysis

The baseline energy savings compared to ASHRAE 90.1-2004/national multifamily median EUI of all codes/standards referenced by the multifamily green building certifications we reviewed are summarized in Table 1. These savings are national averages and were used to support the grouping. Substantial variation exists across climate zones and between low-, medium-, and high-rise buildings; these variances were accounted for in the calculator, discussed below. To estimate savings on a per-unit basis, site EUI was calculated for electric and gas using the above methodology. This was then converted into a per unit metric using the default assumption for unit density from the ENERGY STAR Portfolio Manager multifamily model of 1.2 units per 1,000 ft^2, which was derived from Fannie Mae survey data (ENERGY STAR 2018c; Fannie Mae 2014).

5 Assumptions based on Integral Group field experience.

Table 1: National average energy savings for multifamily buildings, relative to the national median EUI/ASHRAE 90.1-2004

CODE STANDARD	IMPROVEMENT OVER BASELINE	AVERAGE ANNUAL SITE ENERGY USE PER UNIT (MMBTU)	AVERAGE ANNUAL SITE ENERGY SAVINGS PER UNIT (MMBTU)	CITATION FOR SOURCE OF ENERGY ESTIMATES
ASHRAE 90.1-2004/ U.S. National Median	0%	42.0	0.0	DOE 2019a, 2019b, ENERGY STAR 2018d
ASHRAE 90.1-2007	5%	39.7	2.3	DOE 2019a, 2019b
ASHRAE 90.1-2010	11%	37.5	4.4	DOE 2019a, 2019b
ASHRAE 90.1-2013	17%	34.8	7.2	DOE 2019a, 2019b
ASHRAE 90.1-2016	21%	33.1	8.8	DOE 2019a, 2019b; Liu et al. 2018
IECC 2006	3%	40.5	1.4	DOE 2019a, 2019b
IECC 2009	9%	38.4	3.6	DOE 2019a, 2019b
IECC 2012	16%	35.1	6.9	DOE 2019a, 2019b
IECC 2015	19%	34.0	8.0	DOE 2019a, 2019b
PHIUS 2015	56%	18.6	23.4	PHIUS 2017
PHIUS 2018	70%	12.5	29.4	PHIUS 2019
PHI	70%	12.5	29.4	PHIUS 2019
ENERGY STAR Existing Multifamily	19%	34.2	7.8	ENERGY STAR 2018c
ENERGY STAR Homes 3.0	29%	30.9	11.1	ENERGY STAR 2018a
ENERGY STAR Homes 3.1	44%	24.4	17.5	ENERGY STAR 2018b
ENERGY STAR Homes 3.2-OR/WA	44%	24.4	17.5	ENERGY STAR 2018b; Gamble 2019
ENERGY STAR Homes 3.2-CA	50%	21.1	20.9	ENERGY STAR 2019; Alatorre and Neumann 2017
Title 24-2001	9%	38.4	3.6	Ware and Bozorgchami 2013
Title 24-2008	11%	37.2	4.8	Ware and Bozorgchami 2013
Title 24-2013	21%	33.5	8.5	Alatorre and Neumann 2017
Title 24-2016	42%	24.1	17.8	Alatorre and Neumann 2017
Net Zero Energy	**100%**	**0.0**	**42.0**	**ILFI**

Certification energy savings and grouping

The energy savings in the table above were used to assess and then group all reviewed certifications. For example, if a certification requires 15% savings relative to ASHRAE 90.1-2007, which is 5% better than the national baseline of ASHRAE 90.1-2004, then that certification effectively requires 19% savings relative to the baseline. Some certifications measure savings against the more stringent of either (i) a specified code, or (ii) the local or state energy code. For evaluating a certification's minimum expected improvement, these "or better" provisions were disregarded. However, these specifications are accounted for in the regionally specific impact calculations discussed later in the paper.

In past years, the Green Building Certification initiative was limited to three groups based on performance. In recognition of the growth of certification programs targeting net-zero "ready" or net-zero energy (NZE) or carbon outcomes, we introduced a new group in 2019 called "Towards Zero." The four-group structure aligns with jurisdictions moving to zero energy/carbon requirements and enables Fannie Mae to support market transformation to confront climate change and other environmental challenges. Fannie Mae Form 4250 includes the full list of Fannie Mae-recognized Green Building Certifications as well as the group into which each certification falls (Fannie Mae 2019).

- ***"Towards Zero" Group:*** This group recognizes buildings aiming for NZE or water use, or energy use reductions at NZE-ready levels. An NZE-ready building is one that is sufficiently energy efficient such that if solar photovoltaic (PV) were added, it could operate at NZE.
- ***Group 1: High Performance + Ventilation Requirements:*** Group 1 is for green building certifications that require projected energy savings of at least 20% relative to the national baseline, plus ventilation requirements for new construction projects. Proper ventilation is a particularly important consideration in energy efficient buildings that typically have tight building envelopes and, thus, more limited outdoor air exchange.
- ***Group 2: High Efficiency Buildings:*** These certifications must require projected energy savings of more than 15% relative to the national baseline. This group does not have ventilation requirements.
- ***Group 3: Base Green Building Certifications:*** Group 3 certifications must require projected energy savings of 10% or more relative to the national baseline. This group does not have ventilation requirements.

Technical approach: Impact calculator

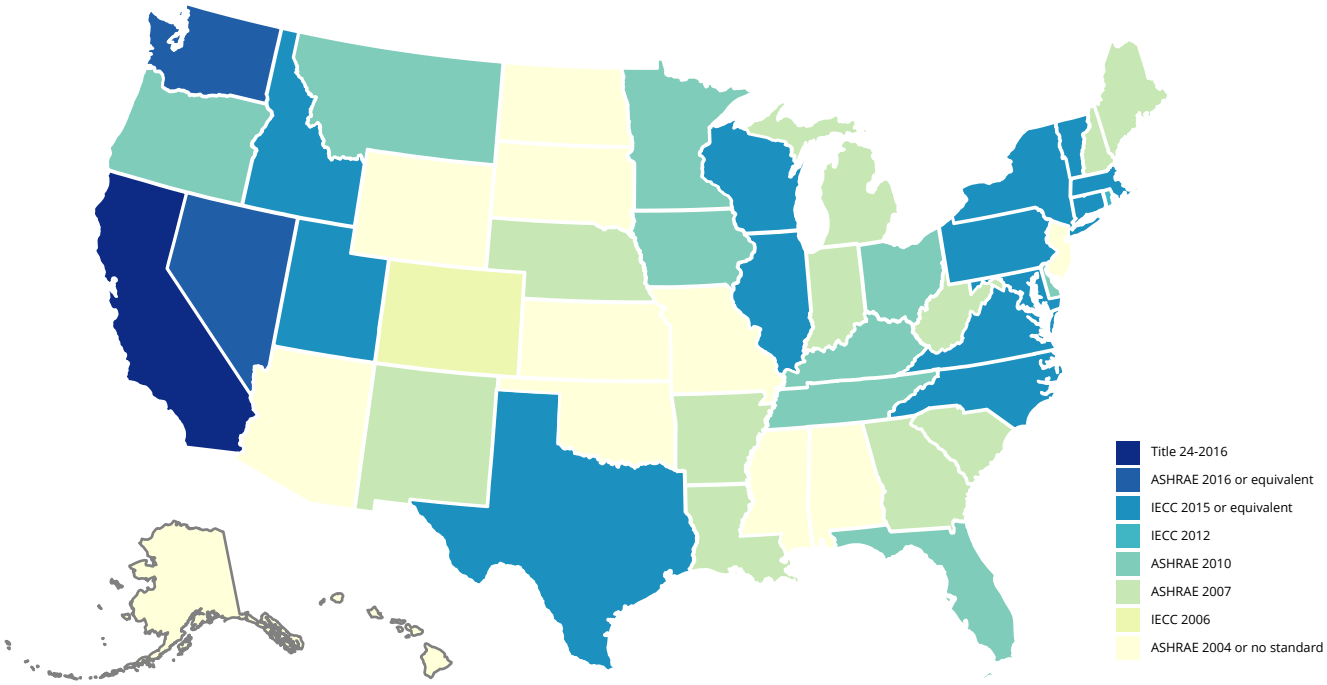
Building on the leveling analysis, we developed a calculator that allows Fannie Mae to combine the expected energy consumption of a building with the U.S. Environmental Protection Agency's (EPA) database of regional grid emissions factors to estimate: (i) energy consumption, (ii) carbon emissions, and (iii) energy and carbon emissions savings compared to an equivalent, non-certified property in the same location. The result of this approach is a system for calculating energy use and carbon emissions estimates that recognizes different building types within the multifamily portfolio as well as regional differences in energy consumption (weather/climate based) and carbon emissions (electric grid composition based).

Baseline energy code assumptions

To set a baseline for a property's projected energy consumption, we first determined which energy code would apply based on the applicable state code for the property's location. We relied on the U.S. Department of Energy's (DOE) regularly updated status of energy codes in each state (Figure 1) (DOE 2019c). Based on the types of properties most likely to leverage Fannie Mae's Green Building Certification pricing, we assumed that most properties would adhere to commercial energy codes. In states where there is no statewide energy code, we used ASHRAE 90.1-2004 as the baseline standard.

Some states allow local jurisdictions to set more stringent energy codes than required at the state level. Since there is no comprehensive, regularly updated database of applicable local code requirements, our calculation methodology does not factor in local jurisdiction requirements, instead assuming minimum state code requirements as a baseline. This may result in over-projecting energy savings from green building certification requirements in some areas. However, the state-level code approach is appropriate for obtaining an estimate of energy and carbon emissions savings over a baseline scenario with a limited set of building information.

Figure 1: Commercial energy code requirements by state in 2019



Calculating energy savings

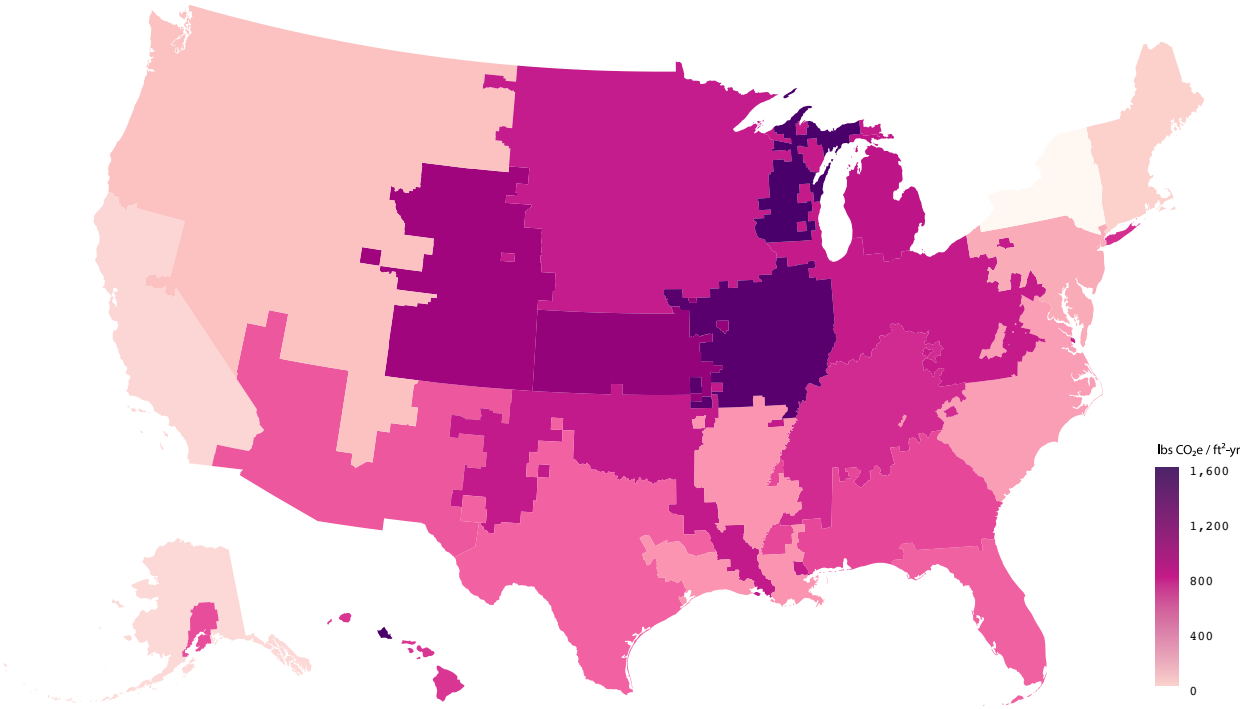
From the subset of PNNL prototype models discussed above, we determined the site energy use and site EUI for the ASHRAE 90.1-2004 model, the applicable state energy code model, and the applicable green building certification. The three values are compared, and the lowest value is used as the estimated site energy consumption of the building. The calculated site energy use is converted into source energy use using national source-to-site ratios of 2.80 for electricity and 1.05 for natural gas, as calculated by the EPA ENERGY STAR program, based on DOE data (ENERGY STAR 2019 — Source Energy).

Calculating carbon emissions savings

To calculate carbon emissions from electricity for a particular project, we rely on the EPA's Emissions & Generation Resource Integrated Database (eGRID), which contains grid emissions factors by region, types of fuels used for generation (e.g., coal, gas, nuclear), and generation capacities (EPA eGRID 2018). Other factors may influence carbon emissions from a building's energy consumption, such as time-of-day use. Although the eGRID does not account for these additional factors, it is the best available source of emissions data for annual emissions calculations.

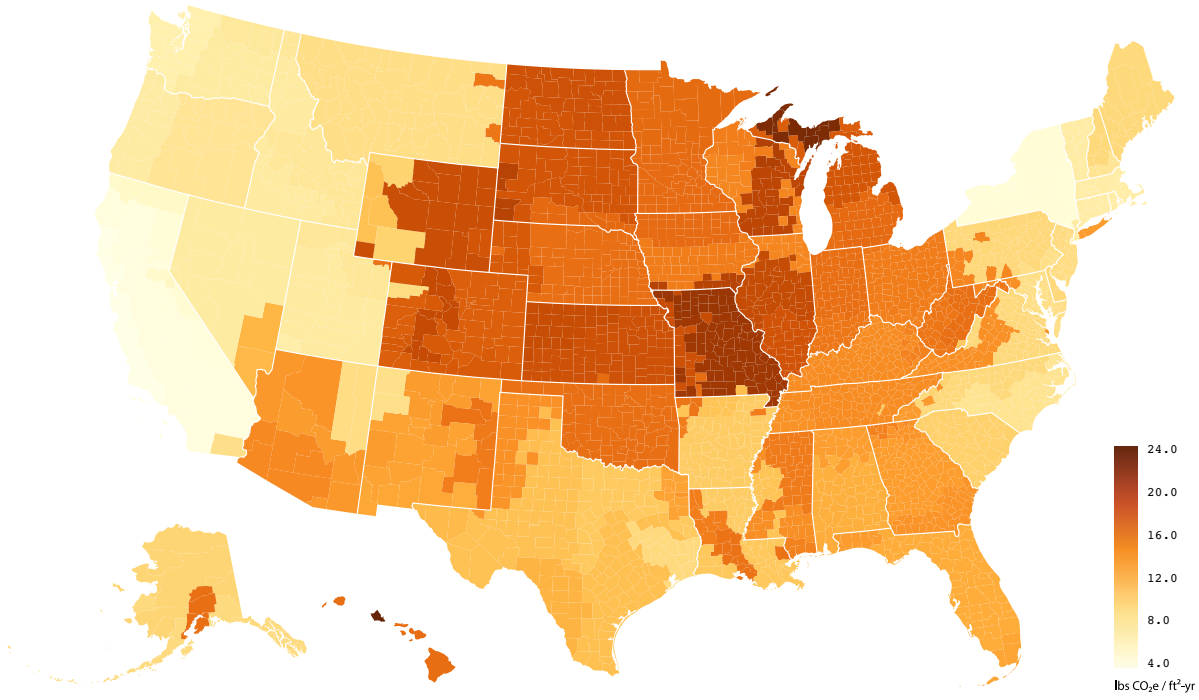
Figure 2 shows the geographic boundaries of each grid region. The map was developed by combining geographic county data with the EPA's eGRID region boundaries. Using county lines to demarcate eGRID regions enables us to overlay the PNNL energy model results, since they rely on county-level ASHRAE climate zones.

Figure 2: eGRID 2016 grid emissions factors (eGRID data), drawn by county



Emissions associated with onsite combustion of natural gas are calculated using an emissions factor of 117 pounds (lbs.) carbon dioxide equivalent per million Btu (CO2e/MMBtu) (EPA 2018 — Emission Factors). Emissions from electricity and natural gas consumption are combined, and savings are calculated relative to the applicable state code. By combining expected site-specific energy use with regional electricity emissions factors, we generated maps of how emissions intensities vary across the country for multifamily properties. Figure 3 indicates emissions intensity in CO_2e/ft^2 for mid-rise multifamily properties.

Figure 3: Estimated emissions (CO_2e/ft^2) for mid-rise multifamily buildings by county



Impact calculator

A user enters the ZIP code, property building type, and gross square footage or number of units. The property building type options are based on Fannie Mae's classifications; these are mapped to prototype models from PNNL for low-rise, mid-rise, and high-rise buildings. Based on Fannie Mae data, most of the buildings are garden-style apartments followed by mid-rise, high-rise, and low-rise. However, the garden-style typology is very similar to the PNNL low-rise prototype, so the three prototypes (low-rise, mid-rise, high-rise) cover 96% of the multifamily portfolio. The tool uses the low-rise prototype for townhouses, garden-style, and other properties. (The "other" category is for properties that do not fit cleanly in any property type, but which are predominately in a low-rise setting.) Because the size of the unit and the amount of common space vary, the tool uses the square footage if known. If the square footage is unknown, we estimate it based on the number of units in the building and an assumed ratio of 1.2 units to 1,000 gross ft^2 of floor area, which is the standard default assumed by ENERGY STAR (ENERGY STAR 2018c). The ZIP code is used to determine the applicable state code and regional greenhouse gas (GHG) intensity.

Certification details are also entered by the user, including certifying organization, green building certification, certification version, and certification level (e.g., Gold). Based on these inputs, the workbook identifies a set of prototype models to reference in the calculations and the relative minimum energy use improvement required under that certification. Some certifications, such as the ENERGY STAR New Construction standards, require a percentage improvement relative to ASHRAE 90.1-2007, or the state code if more stringent; for these certifications, the grouping assumes a baseline of 90.1-2007, but the calculator sets the more stringent code as the baseline, if applicable.

Health-Focused Certification Analysis

Overview

Next, we conducted a review to understand the scope of health-focused criteria across various green and healthy housing multifamily building certifications. As Fannie Mae's Healthy Housing business develops, we are using lessons learned from the rigor of our Green Building Certification analysis to inform our Healthy Housing analysis. We based the scope of this analysis on certification pre-requisites to determine what criteria health-focused building certifications require and for what building types. First, as a part of the green building certification analysis, we conducted an initial assessment of whether each certification had requirements in the following categories: ventilation, smoke-free housing, air filtration, low-emitting materials, air quality testing, thermal comfort, moisture minimization and mold prevention, integrated pest management, pollution source control, safety and security, hazardous materials, water quality testing, daylighting, lighting quality, biophilic design, acoustic design, and active design. Based on this initial review, we extracted a subset of certifications with a health focus (as defined by having minimum requirements in four or more of the categories above) and conducted a more comprehensive analysis to determine the particular requirements in each category. For this analysis, we also included certifications that are specifically focused on health that do not have minimum requirements around energy efficiency (WELL Building Standard and Fitwel).

Our initial review of green and healthy housing certifications found five certifications applicable to multifamily buildings that have an explicit focus on resident health — Enterprise Green Communities, Fitwel, WELL Building Standard, International Living Future Institute's Living Building Challenge, and EPA's Indoor airPLUS. Four of the five certifications have minimum requirements around health, while Fitwel operates with a minimum point threshold and does not have prerequisites. We evaluated these five certifications for a subset of the categories that we initially scanned for: ventilation, smoke-free housing, air quality, hazardous materials, pest management, mold and moisture management, and water quality. This subset of categories represents well-documented environmental exposures common in housing environments where multifamily housing interventions have been shown to be effective (Jacobs et al. 2014).
This review focused on the newest version of each certification available on the market at the time of analysis in July 2019 (Enterprise Green Communities 2015, Fitwel Version 2.1, WELL Building Standard Version 2, International Living Future Institute's Living Building Challenge Version 4.0, and EPA's Indoor airPLUS). One certification has since released an updated version (Enterprise Green Communities 2020) that is not reflected in this analysis.

Healthy building criteria

Ventilation. We assessed whether each certification specified minimum ventilation requirements at a standard equivalent to, or more stringent (e.g., more protective for human health) than, ASHRAE 62-2010. Four of the certifications have minimum ventilation requirements equivalent to ASHRAE 62-2010 or better. In addition, two certifications have additional required provisions for ventilation system verification testing. One certification has a pathway for moderate rehabilitation projects where ventilation is not mandatory but is a points-based optional measure. One certification did not reference ventilation at all.

Smoke-free housing. We assessed whether certifications require smoke-free housing policies that include multifamily common areas, individual resident units, and outdoor areas within a specified distance of building openings (25-foot minimum). Three of the certifications had mandatory smoke-free requirements, while two certifications provide optional points for smoke-free housing policies.

Performance Testing — Air Quality. We assessed whether the certifications require indoor air quality testing and for what parameters. Two certifications require annual indoor air quality testing after project completion for the following parameters: particulate matter 2.5 ($PM_{2.5}$), particulate matter 10 (PM_{10}), formaldehyde, total volatile organic compounds (TVOCs), carbon monoxide (CO), ozone, and radon. One certification provides optional points for air quality performance testing. Two certifications did not have performance testing requirements for air quality measures and tended to address air quality through prescriptive measures instead, as described next.

Prescriptive Measures — Air Quality. We assessed whether certifications have prescriptive requirements for a variety of materials/practices that can impact air quality, including:

- Low-emitting materials, including low/no VOC paints, coatings, primers, adhesives and sealants, and low/no formaldehyde composite wood products.
- Combustion safety, including requirements for any newly installed power- or direct-vented space and water heating combustion equipment, testing existing combustion equipment to ensure proper drafting and CO levels, and CO monitors in each sleeping zone for properties with combustion appliances.
- Radon risk reduction, including incorporating radon-resistant features in new construction, or one-time radon testing to verify levels below EPA action threshold.
- Green cleaning policies, including procurement and use of green cleaning products.

Four of the certifications had prescriptive requirements in all areas, including one certification that requires both prescriptive measures and performance testing air quality; one certification did not have any requirements or optional points for the prescriptive measures above.

Lead paint hazard assessment and remediation. We assessed whether certifications require risk assessment and inspection to identify lead hazards (as defined by U.S. Department of Housing and Urban Development [HUD]) and remediation of identified hazards for all buildings constructed before 1978, including clearance testing at the end of remediation to meet HUD dust lead clearance standards. Two certifications require lead remediation, one certification only requires it for a subset of certified buildings (substantial rehabs, but not moderate rehabs), and one certification only certifies new construction properties where lead hazards are not applicable. One certification offers optional points for lead remediation.

Asbestos abatement. We assessed whether certifications require asbestos abatement for renovations of buildings constructed prior to regulations banning/restricting asbestos and found that certification requirements aligned with federal requirements for renovation of buildings with asbestos (as defined in 40 CFR 61.141). Although this regulation applies to buildings with four or more residential units, certifications that included asbestos abatement requirements include all building sizes, thereby going above what is required in federal regulation.[6] Two certifications had asbestos hazard assessment and abatement requirements for certifications applying to existing buildings. One certification only certifies new buildings where asbestos abatement is not applicable. One certification offers optional points for asbestos abatement. One certification does not address asbestos abatement.

Pest Management. We assessed whether certifications address pest reduction in two primary ways — (1) through construction/renovation techniques that reduce the possibility of pest entry into the structure, and (2) through implementation of integrated pest management (IPM) plans that include limits on the type of pesticides eligible for outdoor use and a ban on the use of indoor pesticides. One certification addresses pest management through construction/renovation requirements, and three certifications require implementation of IPM plans that, at minimum, include a ban on use of indoor pesticides and limits on pesticides eligible for outdoor use. One certification goes further to include a ban on use of any outdoor pesticides, as well. One certification offers optional points for implementation of an IPM plan.

Mold prevention/moisture minimization. We assessed whether certifications address mold prevention and moisture minimization through materials specifications and through moisture management and inspection plans. Specifications around durable materials include one or more of the following: use of moisture-resistant backing materials behind tub/shower enclosures; use of materials with durable, cleanable surfaces throughout bathrooms, kitchens, and laundry rooms; use of advanced water management strategies for roof and wall systems; and adequate drainage for water heaters. Operations policies address moisture management and annual mold inspections. Two certifications had design and materials specifications to minimize moisture issues; two certifications provide optional points for moisture minimization measures; and one certification did not specifically address mold prevention or moisture minimization.

Water quality. We assessed whether certifications required water testing to demonstrate that water quality metrics are below EPA-defined maximum contaminant levels at the point of use. One certification has minimum requirements for water quality testing, and one certification provides optional points. Three certifications do not address water quality testing.

6 This is a federal requirement for buildings with four+ residential units. For residential buildings below that threshold, requirements would come from the state, and there is no uniform approach across the country.

Discussion

While the analytical methodology developed by Fannie Mae, Integral Group, and Elementa Engineering provides a first-of-its-kind roadmap to allow comparison of energy and health impacts across multifamily green and healthy building certifications, there are clear next steps that would enhance the results and drive greater market transformation.

Green building certification analysis

Ranking certifications by the minimum requirements of the lowest certification level does not allow us to distinguish between the energy implications of different levels of certification. For example, the Leadership in Energy and Environmental Design (LEED) Platinum and LEED Silver are deemed to have the same impact for the purpose of the certification groupings. Fannie Mae's decision to not differentiate between the different levels of a given certification stems from the nature of our delegated lending model: mortgage originators and underwriters responsible for determining that properties are eligible for Fannie Mae's Green Building Certification benefits often do not have green expertise, and the simplified process allows lenders to correctly identify qualifying certifications. As knowledge of green building certifications and mortgage delivery technology advances, opportunities to group certifications on a more granular level may be possible, which would enable Fannie Mae to offer higher incentives to borrowers whose properties achieve a higher level of certification than the base level.

Focusing on quantifying the impact of only the minimum requirements potentially undercounts the impact of some certifications. Quantifying the additional impact of points-based thresholds required by certifications, in addition to the minimum requirements, would present a more accurate picture of the impact of each certified property. While we can determine the type and level of certification, at present Fannie Mae does not have the ability to collect information pertaining to specific strategies used to qualify for certification, or how many points were achieved. In addition, the national scale of the program limits the level of review that could be conducted to identify specific strategies used in each project, making a "directed use" system to prioritize certain credit categories infeasible. Fannie Mae continues to work with the organizations that issue green building certifications to develop our ability to capture more granular data.

Given that modern energy codes such as ASHRAE 90.1-2016 are already 20% better than the national baseline, in some states and jurisdictions, Group 3 certifications may not yield savings over business-as-usual construction. While the impact calculations take the effect of location into consideration, the group designations do not. This means that a property with a Group 3 certification that was simply built to local code may be able to access the green building certification benefits even though no additional green design or equipment was included. As the buildings are still highly efficient and have other green features beyond energy efficiency, this is not a significant concern.

Healthy housing certification analysis

The mandatory health criteria included in multifamily green and healthy building certifications reflect an understanding that occupant health can be affected not only by physical building infrastructure (e.g., design, systems, and materials) but also by how the building is maintained and operated (e.g., smoke-free policies, integrated pest management, air quality testing of occupied buildings). Some certifications focus heavily on assessment of how the physical building infrastructure was built or renovated to support health while limiting their reach into how the building is operated and maintained over time; others have requirements related to both areas. Certifications that include a focus on ongoing operations tend to have re-certification requirements, in recognition that operational practices are more subject to change over short periods than physical building infrastructure. A growing emphasis is emerging on performance verification related to indoor environmental parameters, particularly air quality, to ensure that buildings are operated in a way that supports human health. Research has indicated that even buildings with proper ventilation can have pollution concentrations that are higher indoors than outdoors, and that regular maintenance of HVAC systems is critical to maintaining performance (Allen 2017). Ongoing real-time or periodic testing of key indoor environment parameters with performance targets is likely to become more widespread, particularly for certifications that are focused on certifying the ongoing performance of a building (versus point in time construction/renovation).

The current COVID-19 pandemic brings into focus the importance of building level controls and measures in controlling infectious disease spread. Historically, public health efforts around housing focused on reducing infectious disease spread by addressing poor sanitation, crowding, and ventilation, while more recent efforts have focused on a wider range of health impacts, including chronic conditions like asthma (Krieger 2002). Many of the heath criteria evaluated in this analysis focus on reducing environmental exposures associated with chronic and non-communicable disease; however, some of the criteria can also have an important role in minimizing infectious disease spread, such as building ventilation and filtration (Schoen 2020). Some of the certifications have recently issued guidance on optimizing buildings to better control infectious disease, and we are likely to see more certifications incorporate optional or required measures into certifications to better address infectious disease spread in the future. The focus will not only be on ventilation and filtration, but also on policies and practices that help limit infectious disease spread.

Conclusion

This analysis presents a national benchmarking and certification grouping based on projected energy savings and enables Fannie Mae to drive market transformation by offering preferential pricing to green building-certified properties that comply with more stringent requirements. The impact calculator described above allows Fannie Mae to calculate an estimate of the expected energy consumption and savings based on a property's location and building type, enabling Fannie Mae to summarize and evaluate projected impact of properties underlying green mortgage loans that are secured as Green MBS. Lastly, the analysis of minimum health requirements of green and healthy building certifications reveals the extent to which existing multifamily certifications are addressing resident health. These certifications provide a foundation for Fannie Mae to further incorporate specific health criteria into its programs to help drive increased focus on resident health in the multifamily sector.

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