



Fannie Mae Green Bond Impact Methodology



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Green Bond Impact Methodology

There have been minor changes to the impact methodology from year to year; please refer to [previous Fannie Mae Green Bond Impact Reports](#) for methodology details for bonds issued in those years. Impacts in cumulative figures have not been recalculated for prior-year issuances, as some inputs and conversion factors change over time.

For all Green Bond impact metrics, projected impacts are reported for the year in which the security was issued by Fannie Mae. Fannie Mae reports impact as a one-year impact occurring in the first year of the Green Bond, even though, in reality, many of the benefits of Green Mortgage Loans may be realized later in the life of the loan and to some degree will continue to provide impacts in subsequent years. We report single-year impacts because impacts may change over time or may not be realized until a later date when property improvements have been completed and because Fannie Mae cannot predict the duration of each loan or security.

Projected energy savings represent the estimated amount of energy savings in kBtu ascribed to the property's underlying Green MBS. For Green Rewards Mortgage Loans, this represents the difference between the property's energy usage prior to the energy-saving improvements associated with the loan and the projected energy usage after those improvements are completed. For properties with Green Building Certifications (GBCs), this represents the estimated difference in energy usage between the certified property and a building built to the state's baseline energy code.¹ Energy includes electricity, natural gas, propane, steam, and fuel oil, whether metered or delivered.

Projected water savings represents the estimated amount of water in kgal ascribed to properties underlying Green MBS. For Green Rewards Mortgage Loans, this represents the difference between the property's water usage prior to the water-saving improvements associated with the Green Rewards Mortgage Loan and the projected water usage after those improvements are completed.

Projected greenhouse gas (GHG) emissions avoided are reported in mtCO₂e associated with the energy savings ascribed to the properties underlying Green MBS. See the subsections below for specific methodologies by loan product.

Projected renter cost savings are the estimated utility cost savings expected to reach tenants of a property with a Green Rewards Mortgage Loan due to the installation of energy- and water-saving improvements. These may represent reductions in direct billing or utility expenses for which tenants reimburse property owners for utility costs through Ratio Utility Billing or flat fees. Tenant cost savings are not calculated for mortgage loans on properties with GBCs.

Projected homeowner utility cost savings are estimated based on the energy savings and the residential rates for electricity at the state level, using cost data from the U.S. Energy Information Administration (EIA). Average annual utility cost savings per single-family home is calculated as the sum of utility cost savings for single-family GBC homes divided by the number of homes.

¹ Please refer to the section titled 'Data Sources: Multifamily Green building Certification Mortgage Loans' for additional details.



Data Sources: Multifamily Green Rewards Mortgage Loans

Single-year impacts for Multifamily Green Rewards Mortgage Loans are based on the type and installation cost of energy- and water-saving capital improvements selected for each property and those improvements' projected annual energy and water savings compared to the property's historical 12-month consumption, regardless of whether those improvements were completed by the end of the reporting year.

The primary data source for a Green Rewards Mortgage Loan analysis is our High Performance Building (HPB) Report, which includes an American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Level 2-equivalent energy audit. This report is prepared by third-party HPB consultants who are engaged by the lender. As part of the energy and water audit, the HPB consultants:

- Gather cost data for the property, including historic utility consumption.
- Establish a baseline of 12-month energy and water consumption.
- Conduct a site visit.
- Model energy and water usage, if applicable.
- Identify and quantify energy and water efficiency measures (EWEMs), as well as investment opportunities based on the property's equipment age, energy or water efficiency, or other factors.

The HPB consultants generally recommend 10 to 20 EWEMs. All recommended EWEMs must be capital investments that require the installation of equipment, fixtures, or appliances.² For each recommended EWEM, the consultant assesses environmental and cost metrics, including:

- Total implementation cost to install the improvements.
- Annual estimated energy and water cost savings for the borrower.
- Annual estimated energy and water cost savings for the tenants.
- Annual estimated energy and water consumption savings for the property.

Baseline energy and water consumption data, recommendations for improvements, and cost and consumption savings data from the HPB consultants' analyses are input into Fannie Mae's Form 4099.H, an Excel workbook. Form 4099.H is a required part of the HPB Report and has been developed with support from Bright Power, an independent energy management consulting firm. The Form 4099.H calculates metrics such as:

- Source energy baseline and estimated savings from site energy inputs.
- Projected energy and water consumption savings as a percentage of the whole-property annual historical baseline consumption.
- Projected GHG emissions reductions using the ENERGY STAR methodology, based on the annual estimated source energy consumption savings for the property as determined by the HPB consultants.

To calculate GHG reductions, energy savings projections provided by consultants in the HPB Reports are converted from native units (e.g., kWh, therms) into source energy (kBtu) and associated GHG emissions reductions in

² Improvements that require solely changing operations and maintenance procedures or plans cannot be an EWEM that counts toward Green Rewards Mortgage Loan eligibility. Measures must capital improvements.



accordance with the [ENERGY STAR Portfolio Manager](#) methodology.³ Reductions calculations include conversion factors, which are included in Form 4099.H for each loan.⁴ Loans that used a Form 4099.H published before August 2018 use thermal conversion factors from the U.S. Environmental Protection Agency (EPA) Quick Converter tool.⁵

Data Sources: Multifamily Green Building Certification Mortgage Loans

The primary data source for the estimated impact of multifamily loans on properties with eligible GBCs is the Fannie Mae Green Building Certification Impact Calculator (Impact Calculator), developed by Introba, an engineering and green building consulting firm. The Impact Calculator uses property characteristics and the type, level, and version of each GBC to estimate energy and water savings and, in turn, cost and GHG savings for each GBC property.

The Impact Calculator is based on a detailed analysis conducted by Introba of the program requirements for each multifamily certification. Introba reviewed each GBC program to identify minimum requirements for each type of certification. For example, if a specific type of certification requires a minimum energy performance of 15% above code, then all loans on properties with that type of certification were assumed to meet that minimum performance level. Introba took the following approach to measure energy savings and GHG emission reductions:

1. Identify the applicable energy performance standard based on the property's location and age. The U.S. does not have a national building energy code; instead, most states have residential and commercial energy code requirements that specify which standard applies for new construction and renovations (e.g., ASHRAE 90.1-2010).
 - Properties constructed since 2012 use the U.S. Department of Energy determination of standard equivalency to the state energy code in effect at the time of construction.
 - Properties constructed prior to 2012 (the earliest year of our current database of energy codes) use the national median level of performance in multifamily buildings, ASHRAE 90.1-2004.
 - Properties in states where there is no statewide energy code use the national median level of performance in multifamily buildings, ASHRAE 90.1-2004.

³ "How Portfolio Manager Calculates Greenhouse Gas Emissions," energystar.gov, U.S. Environmental Protection Agency, and U.S. Department of Energy (accessed May 17, 2021).

⁴ See ENERGY STAR Portfolio Manager Technical Reference guides: "Portfolio Manager Technical Reference: Greenhouse Gas Emissions," "Portfolio Manager Technical Reference: Source Energy," and "Portfolio Manager Technical Reference: Thermal Conversion Factors."

⁵ "[ENERGY STAR Quick Converter](#)" (Excel file download), energystar.gov, U.S. Environmental Protection Agency, and U.S. Department of Energy (accessed May 17, 2021).



2. Estimate the property's site energy use if built to the applicable energy performance standard using reference energy models published by Pacific Northwest National Laboratory (PNNL). Using the PNNL reference energy models, Introba estimated the energy performance of different types of multifamily residential properties around the county by climate zone and by energy standard. All energy use estimates account for regional climate and property type/size (either gross floor area or, if not available, number of units) differences. This metric represents the property's baseline site energy use. Baseline site energy is then converted into baseline source energy, also known as "primary energy," using standard national factors published by the EPA.
3. Determine the minimum energy performance required by the property's GBC for the applicable performance standard.
4. Estimate the property's site energy use if built to the applicable GBC performance standard using reference energy models published by PNNL along with data from the EPA, the California Energy Commission, and/or PHIUS. Estimated site energy use is then converted into source energy use, using standard national factors published by the EPA.
5. Calculate estimated savings.
 - Site energy savings are estimated by subtracting the property's estimated site energy use from the property's baseline site energy use.
 - Source energy savings are estimated by subtracting the property's estimated source energy use from the property's baseline source energy use. All energy savings are reported as source energy savings.
 - Carbon emissions savings estimated based on the site energy savings combined with the EPA's Emissions and Generation Resource Integrated Database (eGRID), which contains grid electricity emissions factors by region (at the ZIP code level), derived from the fuels used for generation (e.g., coal, gas, nuclear). The emissions factors for natural gas also come from the EPA.
 - Utility cost savings estimated based on the site energy savings and the residential rates for energy at the state level, using cost data from the EIA.

To estimate projected water savings, Introba used a similar approach:

1. Estimate the property's baseline water use using an assumption of 30 kgal per 1,000 ft² per year.⁶
2. Determine the minimum water performance required by the property's GBC. Not all GBCs have water prerequisites; therefore, water savings from baseline was not assumed for all properties. For those GBCs that did have water saving requirements, savings were based on prescriptive fixture requirements, EPA Water Score, or modeled water savings. Introba converted all three of these methodologies to a percent savings reduction.
3. Estimate the property's water use by applying the applicable percent savings reduction to the property's estimated baseline water use.

⁶ This estimate was developed by Introba analyzing results from the Fannie Mae Multifamily Energy and Water Market Research Survey, a 2012 nationwide survey of over 1,000 multifamily properties, and comparing this to other models of multifamily water use, including Bright Power's EnergyScoreCards tool.



To ensure impact estimates are conservative, all calculations are based on the minimum energy and water savings requirements of each GBC. For example, many GBCs use a points-based scoring system and award points for non-energy- or water-related sustainability measures. For these GBCs, a building could theoretically achieve a higher level of certification (e.g., Gold, Platinum) without substantial improvements to energy or water efficiency. Therefore, the analysis only recognizes the minimum level of required energy or water savings of the program, regardless of the level of certification.⁷ In addition, if a GBC does not have a minimum performance threshold for energy or water, it is assumed that there was no energy or water impact for securities collateralized by loans on properties with that certification, and therefore none are reported. These are represented with a "-" in the "Environmental Impact per CUSIP" spreadsheet for securities backed by properties either located in a state where the state code matches the minimum performance standard of the Green Building Certification or holding a Green Building Certification that does not have a minimum performance threshold for energy or water. Fannie Mae no longer accepts GBCs that do not have minimum energy requirements.



Data Source: Single-family Green Building Certification Mortgage Loans

Impact calculations for single-family properties with green building certifications were also performed using a Fannie Mae Green Building Certification Impact Calculator for single-family properties developed by Introba, which uses the type, level, and version of each GBC to estimate energy savings and, in turn, cost and GHG savings for each single-family GBC property.

Each year, Introba conducts a comprehensive review of green building certifications for single-family homes and a comparison of their relative impacts on building energy performance.

1. Estimate the property's site energy use in each state subject to the applicable state code, likely to be IECC 2006, IECC 2009, IECC 2012, IECC 2015, IECC 2018, or IECC 2021. Site energy use for a single-family home in each climate zone subject to a given code is derived from outputs of the Pacific Northwest National Laboratory (PNNL) Prototype Building Models. Site energy use is then converted to source energy use, carbon emissions, and utility costs using standard national factors published by the EPA and EIA.
2. Estimate the property's site energy use after achieving green building certification. PNNL energy models are used to determine the site energy use of the property in a given state subject to the baseline code referenced in the certification's energy savings requirements (this could be a version of IECC, a different baseline energy reference, or an absolute energy target as is the case with PHIUS and PHI certifications). The percentage savings requirement associated with the certification is applied to the property's estimated baseline site energy use. Site energy use is then converted to source energy use, carbon emissions, and utility costs using standard national factors published by the EPA and EIA.
3. Calculate estimated savings.
 - Site energy savings are estimated by subtracting the property's estimated site energy use after achieving a green building certification from the property's state code baseline site energy use.
 - Source energy savings are estimated by subtracting the property's estimated source energy use from the property's baseline source energy use if it were built to the state's minimum energy code. All energy savings are reported as source energy savings.
 - Carbon emissions savings are estimated by subtracting the estimated emissions of a property achieving green building certification from the estimated emissions of property built to the state's baseline energy code. Carbon emissions are estimated based on the property's energy use combined with the EPA's eGRID grid electricity factors by region (at the ZIP code level), derived from the fuels used for generation (e.g., coal, gas, nuclear). The emissions factors for natural gas are provided by the EPA.
 - Utility cost savings are estimated by subtracting the estimated utility costs of a property achieving green building certification from the estimated utility costs of a property built to the state's baseline energy code, using cost data from the EIA.



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