

# ENERGY STAR NextGen™ Direct GHGi Targets

This document presents details on the development of the values for Direct GHGi Targets for ENERGY STAR NextGen certification.

## Overview

The ENERGY STAR NextGen certification is available to existing U.S. commercial and multifamily buildings that are eligible for an ENERGY STAR Score. The objective of the ENERGY STAR NextGen

certification is to encourage top energy performance, increased procurement and use of renewable energy, and reductions in on-site emissions. One eligibility requirement is that a building's direct (i.e., onsite) greenhouse gas emissions intensity (GHGi) is at or below a specified target level. To determine equitable targets for buildings across the country, EPA conducted statistical analysis of the emissions from each building type's population of ENERGY STAR certified properties.

Each building using the ENERGY STAR Portfolio Manager® tool will have a unique direct GHGi target – called the “NextGen Direct GHGi Target” – which is normalized for both the type of building and climate/weather. Because direct GHG emissions in buildings are primarily related to heating needs, every building's NextGen Direct GHGi Target will be normalized based on the number of Heating Degree Days (HDD) experienced by the building. The normalization process also accounts for the fact that buildings using fuels for hot water and cooking have a baseload level of fuel consumption, regardless of HDD. The results are presented as a list of normalized property type-specific equations used to calculate NextGen Direct GHGi Targets for an individual building.

**Property Types.** The ENERGY STAR NextGen certification applies to existing U.S. commercial and multifamily buildings that are eligible for an ENERGY STAR Score.

- **Reference Data.** The analysis for development of the NextGen Direct GHGi Targets is based on data from buildings that earned ENERGY STAR certification between 2015 and 2023.
- **Adjustments for Weather and Business Activity.** The analysis includes adjustments for:
  - Heating Degree Days
  - Property Type
- **Release Date.** The ENERGY STAR NextGen certification is set for launch in Fall 2024.

## Learn More



Visit the ENERGY STAR website for more information on [ENERGY STAR NextGen certification](#).

## Reference Data & Filters

For development of the ENERGY STAR NextGen Direct GHGi Targets, the reference data used is from buildings that have earned ENERGY STAR certification. These buildings have earned an ENERGY STAR score of 75 or higher on EPA’s 1 – 100 scale, indicating that they perform better than at least 75 percent of similar buildings nationwide. The energy data of all ENERGY STAR certified buildings is verified by a Professional Engineer or Registered Architect. Visit the ENERGY STAR website for a more complete description of [ENERGY STAR certification requirements](#).

Four filters were used to further refine the sample of buildings used and to overcome technical limitations in the data. *Figure 1* presents a summary of each filter applied, the rationale behind the filter, and the resulting number of properties in the data set after the filter is applied. While the initial data set included 63,590 properties, after all filters are applied the final data set has 16,274 properties.

**Figure 1: Summary of Filters for the ENERGY STAR NextGen Direct GHGi Target Calculations**

| Condition for Including an Observation in the Analysis                                     | Rationale  | Number Remaining |
|--|--|------------------|
| <b>Must be a building certified between 2015 and 2023, inclusive.</b>                      | Only verified energy data should be used for this analysis. The reference data was limited to the selected years because 2015 was the first year of ENERGY STAR's modern certification process and database systems and 2023 is the most current year of certified data available. | 63,590           |
| <b>For buildings that certified in multiple years, only include the most current year.</b> | Including only the most current year removes duplicate building entries from the analysis.   | 24,053           |
| <b>Direct GHGi must be greater than 0</b>  | A building with a GHGi of 0 automatically passes the requirement. Only buildings with a GHGi greater than 0 were included in the analysis.   | 16,284           |
| <b>Outlier buildings removed.</b>  | Buildings with extreme Direct GHGi values were excluded as they were determined to not be representative of typical buildings.   | 16,274           |

## Variables Analyzed

The NextGen Direct GHGi Target calculations account for both the reference data's baseline onsite fuel needs and the climate/weather by property type. Each property type is analyzed separately using a linear regression to identify and evaluate a building type-specific relationship between Direct GHGi and HDD. This linear regression yields an equation that enables calculation of a Direct GHGi Target (also called the dependent variable) based on HDD (also called the independent variable).

### Dependent Variable

The dependent variable is what is predicted with the regression equation. For the GHGi regression analysis, the dependent variable is Direct GHGi expressed in kg CO<sub>2</sub>e/ft<sup>2</sup>. This is equal to the emissions resulting from the burning of fuels on-site, such as natural gas, propane, fuel oil, and others, for space heating, water heating, cooking, and miscellaneous uses. The regression analyzes each property type's relationship between HDD and Direct GHGi to find a line of best fit. This line of best fit's equation enables calculation of a building's predicted Direct GHGi using its actual HDD.

More information on the rationale behind using Direct GHGi and HDD for NextGen target setting is available in the final NextGen criteria document, available [here](#).

### Independent Variables

The following variables were analyzed and included in the final regression equation:

- HDD65 – Heating degree days (base 65)

NOTE: In this analysis and in the final target calculations, thousand HDD is used rather than HDD so the resulting statistics have fewer decimal places with leading zeros. This simplifies the analysis and display of trends in the reference data and results in statistically equivalent regressions. Throughout the remainder of this document, the term HDD is used to refer to thousand HDD.

## Regression Equation Results

The set of final regression equations are property type-specific linear regressions with Direct GHGi as the dependent variable, HDD as the independent variable, and an intercept term. The intercept accounts for the property type-specific onsite fuel needs that are not dependent on heating needs and can be referred to as the property type-specific "baseload" GHGi value. The coefficient on the HDD variable estimates the relationship between Direct GHGi and weather/climate.

The Property type-specific regression equations are used to calculate an individual building's NextGen Direct GHGi Target. An individual property's target is calculated by adding the baseload value (intercept) to the product of the GHGi/HDD coefficient and the property's actual HDD value for the 12-month period being evaluated. The target represents the average Direct GHGi emissions for ENERGY STAR certified

buildings, accounting for variations in heating needs. A value of 0.10 kg CO<sub>2</sub>e/ft<sup>2</sup> will be used as the minimum NextGen Direct GHGi Target for all buildings. This means that in instances where the target equation returns a value below 0.10 kg CO<sub>2</sub>e/ft<sup>2</sup>, the target is set to 0.10 kg CO<sub>2</sub>e/ft<sup>2</sup>.

Each property type eligible for NextGen certification is presented in *Figure 2*, along with the final equation which will be used to calculate the NextGen Direct GHGi Target for buildings of that type.<sup>1</sup>

**Figure 2 – Equations for Calculating NextGen Direct GHGi Targets**

| Parent Property     | Target Equation                      |
|---------------------|--------------------------------------|
| Data Center         | $0.60 + 0.06 * \text{Thousand HDD}$  |
| Hospital            | $4.02 + 0.22 * \text{Thousand HDD}$  |
| Hotel               | $1.23 + 0.06 * \text{Thousand HDD}$  |
| K-12 School         | $-0.08 + 0.27 * \text{Thousand HDD}$ |
| Medical Office      | $0.49 + 0.15 * \text{Thousand HDD}$  |
| Multifamily Housing | $0.63 + 0.13 * \text{Thousand HDD}$  |
| Office              | $0.40 + 0.15 * \text{Thousand HDD}$  |
| Retail Store        | $-0.08 + 0.18 * \text{Thousand HDD}$ |
| Senior Living       | $0.71 + 0.17 * \text{Thousand HDD}$  |
| Supermarket         | $0.09 + 0.48 * \text{Thousand HDD}$  |
| Warehouse           | $-0.24 + 0.24 * \text{Thousand HDD}$ |
| Worship Facility    | $0.16 + 0.23 * \text{Thousand HDD}$  |
| Vehicle Dealerships | TBD <sup>2</sup>                     |
| Convenience Stores  | TBD <sup>2</sup>                     |

<sup>1</sup> All variables in the regression equations were determined to be statistically significant.

<sup>2</sup> The Direct GHGi Target Equation will be provided when there is enough certified building data for this property type to reliably complete the analysis.

## Example Calculation

There are 3 steps to calculating a NextGen Direct GHGi target and determining if a building meets the direct emissions criteria. The following is an example for a senior living facility, with an additional example for multi-use properties.

### Step 1: Identify the Building's HDD and Convert the Metric

- An example senior living facility in Ohio experiences HDD of 4,840 for a 12-month period between February 01, 2022 - January 31, 2023.
- The HDD is converted to thousand HDD by dividing by 1,000.

#### Senior Living Facility Metrics

HDD: 4,840

Thousand HDD (tHDD): **4.84**

### Step 2a: Use the Property-Type Equation to Calculate a Direct GHGi Target for a Single Use Property

- The thousand HDD value is entered in the equation specific to the property type to calculate the Direct GHGi Target.

| Senior Living Facility Equation for Direct GHGi Target                      |             |
|---|-------------|
| $= 0.71 + 0.17 * \text{tHDD}$   |             |
| $= 0.71 + 0.17 (4.84)$  |             |
| <b>Senior Living Direct GHGi Target (kg CO<sub>2</sub>e/ft<sup>2</sup>)</b> | <b>1.53</b> |

### Step 2b: Use the Property-Type Equations to Calculate a Direct GHGi Target for a Mixed-Use Property

- If the example building has both a Senior Living space of 100,000 ft<sup>2</sup> and Office space of 30,000 ft<sup>2</sup>, it would need two equations specific to its property types to calculate the Direct GHGi Target.
- First, the Senior Living and Office equations are used to calculate two separate Direct GHGi Targets using the converted HDD.

| Senior Living Facility Equation for Direct GHGi Target           |             | Office Equation for Direct GHGi Target                    |             |
|--|-------------|---|-------------|
| $= 0.71 + 0.17 * \text{tHDD}$                                    |             | $= 0.40 + 0.15 * \text{tHDD}$                             |             |
| $= 0.71 + 0.17 (4.84)$   |             | $= 0.40 + 0.15 (4.84)$                                    |             |
| <b>Senior Living Direct GHGi Target (kg CO2e/ft<sup>2</sup>)</b> | <b>1.53</b> | <b>Office Direct GHGi Target (kg CO2e/ft<sup>2</sup>)</b> | <b>1.13</b> |

- Then, each property type’s Direct GHGi Target is multiplied by its floor area. The resulting values are summed and divided by the building’s total floor area to yield an aggregate target.

| Senior Living Facility and Office Equation for Direct GHGi Target |   |
|---|---|
| $= 1.53 * 100,000 \text{ ft}^2$                                   |   |
| $= 1.13 * 30,000 \text{ ft}^2$                                    |   |
| <b>Aggregate Direct GHGi Target (kg CO2e/ft<sup>2</sup>)</b>      | $= (153,000 + 33,900) / 130,000 \text{ total ft}^2$ |
|   | <b>= 1.44</b>                                       |

### Step 3: Compare the Direct GHGi Target to the Actual GHGi

- The building’s actual Direct GHGi (as calculated based on energy data entered into Portfolio Manager) and its Direct GHGi Target are compared.
- The actual Direct GHGi should be **less than or equal to** the Direct GHGi Target to meet the NextGen direct emissions criteria.
- The example below uses the data from 2A above (single-use building), but the process would be identical for single-use or mixed-use buildings.

**Actual Direct GHGi: 1.21 kg of CO2e/ft<sup>2</sup> vs. Direct GHGi Target: 1.53 kg of CO2e/ft<sup>2</sup>**

- Because this building’s actual Direct GHGi value is less than or equal to its target, it **would meet** the NextGen direct emissions criteria.

#### Learn More

More details on how Portfolio Manager calculates Direct GHGi is available in our FAQ:

[How are Total GHG Emissions calculated?](#)