

Greenhouse Gas Intensity Limits Reference Manual

Reference Manual

This manual is for office and retail building owners with buildings subject to GHGI limits under the City of Vancouver By-law No. 13472. It is a technical document intended to provide clarity on calculations related to GHGI and energy adjustments.

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INTRODUCTION

The [Annual Greenhouse Gas \(GHG\) and Energy Limits By-Law](#) (No. 13472) adopted by City Council in 2022 establishes reporting rules for and limits on greenhouse gas emissions and heat energy use in the largest office and retail buildings. Heat energy refers to the total gas used in a building operation plus district heat that is consumed inside the building (excluding the electricity portion), while greenhouse gas emissions refer to the carbon dioxide equivalent (CO_{2e}), gases emitted as a result of energy consumption in a building. The City of Vancouver developed this Reference Manual (Manual) to assist building owners and their representatives in understanding and complying with the requirements of the By-Law.

This Manual is a companion to the *Greenhouse Gas Intensity Limits How-To Guide*, which offers in-depth guidance for the submittal of required forms and reports.

SECTION OVERVIEW

- **BUILDINGS COVERED BY GHGI AND HEAT ENERGY LIMITS** Section describes which building types and building sizes are subject to which requirements in the By-Law and when those requirements go into effect. It also identifies any exemptions from those requirements.
- The **COMPLIANCE AND REPORTING** Section provides a brief overview of the compliance and reporting pathways.
- The **Calculating GHG Emissions and Heat Energy Use** Section describes the calculations necessary to determine the GHG emissions and heat energy intensity of a building. This includes:
 - How to calculate the gross floor area of a building
 - How to calculate the GHG emissions and heat energy intensity of a building, including how to handle qualified purchase of RNG.
 - How to make allowable adjustments to the GHG emissions and heat energy intensity of buildings for special circumstances such as process loads and restaurants.
 - How to calculate a custom GHG emissions limit for buildings that include both office and retail occupancies.
 - The process for calculating the GHG emissions and heat energy use of mixed-use buildings that include residential occupancies.
- The **Weather Normalization** Section describes the process that the City will use to adjust GHG emissions and heat energy limits in years with abnormally cold winters.

- The [Appendix](#) Section includes information such as definitions of terms used in the By-Law and this Manual and standard conversion factors for use in the calculations.

BUILDINGS COVERED BY GHGI AND HEAT ENERGY LIMITS

The gross floor area of a building and its major occupancy type, as it appears in the Annual Greenhouse Gas and Energy Limits By-law ([GHG By-law](#)) determines whether a building may be subject to the GHG By-law.

The requirements cover:

- A building that is equal to or exceeds 9,290 m² of gross floor area and has one of the following major occupancy uses:
 - Group D major occupancy use, or
 - Group E major occupancy use, or
 - A mixed-use building with greater than 50% of the floor area as Group D and or E, or
 - A mixed-use building with floor area of Group D and or E occupancy that exceeds 9,290 m² of gross floor area.

Table 1 provides a description of the major occupancy types from the Vancouver Building Bylaw and corresponding Major Use Type from ENERGY STAR Portfolio Manager. This table is provided for convenience to aid building owners and managers in determining if their buildings are covered by the GHGI and Heat Energy Limits in the [GHG By-law](#).

TABLE 1: BUILDING TYPES UNDER GHGI AND HEAT ENERGY LIMITS

Group	Division	Description of Major Occupancy	Major Use Type from Portfolio Manager
D and MUB*	-	Business and personal services occupancies.	Office (Office refers to buildings used to conduct commercial or governmental business activities. This includes administrative and professional offices.) <ul style="list-style-type: none"> Medical Office Office Veterinary Office

			<ul style="list-style-type: none"> • <u>Radio Station (benchmark as Office in ESPM)</u> <p>Banking/Financial services</p> <ul style="list-style-type: none"> • Bank Branch • Financial Office <p><u>Personal Services</u></p> <ul style="list-style-type: none"> • <u>Barber and hairdressing shops</u> • <u>Beauty parlours</u> <p><u>Dry cleaning, laundromats and other process loads are excluded from GHGI calculations. Please refer the GHGI reference manual for further details.</u></p>
E and MUB*	-	Mercantile occupancies	<p>Retail</p> <ul style="list-style-type: none"> • Automobile Dealership • Convenience Store without Gas Station • Enclosed Mall • Lifestyle Center • Retail Store • Strip Mall • Wholesale Club/Supercenter <p><u>Supermarket/Grocery Store building use type is excluded from buildings covered by GHGI limits</u></p>

* MUBs in which the sum of the floor area of the included occupancies is 50% or greater of the building gross floor area. For more information, refer to the "MIXED USE BUILDINGS" section below.

COMPLIANCE AND REPORTING

OVERVIEW

Along with submitting annual operational energy use data, building owners will also be required to submit additional data to calculate both the GHGI and Heat Energy Intensity.

- **Determining Building Gross Floor Area:** All buildings will need to determine their Gross Floor Area (GFA). This is used to determine definitively if and when a building is subject to the different requirements in the By-Law. It is also used to calculate the GHG emissions and heat energy intensities of the building for compliance with the GHG emissions and heat energy limits in the By-Law.
- **Mixed Use Office & Retail Buildings:** Buildings with both retail and office occupancies will use this section to calculate a custom GHG emissions limit that reflects that building's unique blend of retail and office are.
-
- **Mixed Use Office and Retail Buildings with Residential Occupancies:** Buildings with separately metered residential occupancies will use this section to calculate the non-residential energy use and non-residential GFA of the building to be used in all calculations for compliance with the GHG emissions and heat energy limits.

DETERMINING BUILDING GROSS FLOOR AREA

All buildings will need to have their GFA calculated and verified as part of reporting under the GHGI limits in 2027 (owners are encouraged to report a calculated GFA in 2024 but is it not a requirement). This will be a one-time process for most buildings and will only need to be repeated if a building adds or subtracts floor area, if building area is converted to or from unconditioned space, or there is a change in major occupancy. GFA can be determined from onsite measurements, or permit documents for the building.

The GFA is defined as the sum of the area of every floor in a building, measured between the outside surface of the exterior walls; it excludes unconditioned areas of the building (i.e., those areas that do not include space heating other than freeze protection), parking areas, partial height spaces (e.g., crawl spaces and accessible plenums), and exterior spaces such as balconies, patios, and covered walkways. It is measured in square meters (m²).

Building owners can calculate the GFA as per the definition above or use the formula below.

Equation 1: Calculation of Gross Floor Area

$$\text{GFA} = \text{FPA} - \text{PA} - \text{UA}$$

Where:

- GFA: Gross Floor Area:** The sum of the conditioned area of every floor in a building, measured between the outside surface of the exterior walls.
- FPA: Floor Plate Area:** All areas of a floor in a building, measured between the outside surface of the exterior walls. Does not include partial height spaces
- PA: Parking Area:** All structured vehicle parking area within a building's footprint. Does not include surface parking, or covered parking, outside of the building.
- UA: Unconditioned Area:** Area of all building spaces, other than parking, that are not provided with space heating other than freeze protection. This includes, but is not limited to, vertical shafts used for vertical transportation and chases used for building infrastructure.

Error! Reference source not found. is an example of how GFA can be calculated and documented by recording measurements of specific spaces within a building.

Building Floor Label ¹ (1, 2, 3...) (M1, M2...) (B1, B2, B3...) (P1, P2, P3...)	Floor Plate Area (FPA) per floor (m ²)	Parking Area (PA) per floor (m ²)	Unconditioned Area (UA) per floor (<i>other than parking</i>) (m ²)	Gross Floor Area (GFA) per floor (m ²)
Totals (m²)				

DETERMINING BUILDING GROSS FLOOR AREA

The GFA is defined as the sum of the area of every floor in a building, measured between the outside surface of the exterior walls; it excludes unconditioned areas of the building (i.e., those areas that do not include space heating other than freeze protection), parking areas, partial height spaces (e.g., crawl spaces and accessible plenums), and exterior spaces such as balconies, patios, and covered walkways. It is measured in square meters (m²).

- 1 Numbers for numbered floors (1, 2, 3...)
- M prefix for mezzanines (M1, M2...)
- B prefix for basement or subterranean floors (B1, B2...)
- P for any floors designated specifically as parking (P1, P2...)

Building owners can calculate the GFA as per the definition above or use the formula below.

Equation 1: Calculation of Gross Floor Area

$$\text{GFA} = \text{FPA} - \text{PA} - \text{UA}$$

Where:

- GFA: Gross Floor Area:** The sum of the conditioned area of every floor in a building, measured between the outside surface of the exterior walls.
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Table 1: Gross Floor Area

Building Floor Label (1, 2, 3...) (M1, M2...) (B1, B2, B3...) (P1, P2, P3...)	Floor Plate Area (FPA) per floor (m2)	Parking Area (PA) per floor (m2)	Unconditioned Area (UA) per floor (other than parking) (m2)	Gross Floor Area (GFA) per floor (m2)
Totals (m2)				

The major occupancy is the occupancy within a building that comprises more than 50% of the Gross Floor Area (GFA). When a single occupancy covered by the Bylaw exceeds 50% of the GFA, or the combination of two occupancies equals or exceeds the floor area threshold specified in the Bylaw, the building will be subject to the requirements.

Some buildings with multiple occupancies do not have a single occupancy that exceeds 50% of the GFA. The By-Law considers these “Mixed-Use Buildings” (MUBs). The real estate market generally considers any building with more than one occupancy to be a mixed-use building, so it is important to note this difference in usage. The By-Law has requirements and timeframes that apply specifically to MUBs, particularly MUBs where office and retail occupancies are more than 50% of the GFA when taken together, or when either office or retail occupancies exceed floor area thresholds for GHGi and HEL requirements.

Some GHG Limits established by the By-Law are specific to different occupancies. Additionally, both the GHG and Heat Energy Limits are not intended to apply to residential portions of buildings with multiple occupancies. Therefore, this Manual includes rules for calculating the GHG Limits for those particular buildings (see the “Buildings with Residential Occupancies” section below).

EXAMPLES

1. A 5-storey building with a gross floor area of 15,000 m², housing an arena of 6,000 m² and a wholesale club of 9,000 m² that has electric and natural gas utilities.

The building is over 9,290 m², the wholesale club is an E occupancy and comprises more than 50% of the GFA; therefore:

- the building will be subject to the energy and carbon reporting requirements in 2024.
- the building will be subject to the GHG limits for an E occupancy in 2026 and 2040

- the building will be subject to the heat energy limits for an E occupancy in 2040

2. *An 11,000 m² building with 4,000 m² of office, 4,000 m² of retail and a 3,000 m² theater, heated with a mix of gas and electricity.*

The building is over 9,290 m², neither the D or E occupancy comprises more than 50% of the GFA, but together they do comprise more than 50% of the GFA; therefore:

- the building is subject to the energy and carbon reporting requirements in 2024.
- the building will be subject to the GHG Limits for a mixed-use building in 2026 and 2040 (see [“MIXED USE OFFICE & RETAIL BUILDINGS”](#) section below for calculating GHG Limits for mixed use buildings).
- the building will be subject to the heat energy limits for a mixed-use building in 2040

3. *An 15,000 m² building with 5,000 m² of office, 5,000 m² of retail and 12,000 m² of residential, heated with a mix of gas and electricity.*

The building is over 9,290 m², neither the D or E occupancy comprises more than 50% of the GFA, but together they do comprise more than 9,290 m² in GFA; therefore:

- the building is subject to the energy and carbon reporting requirements in 2024.
- the building will be subject to the GHG Limits for a mixed-use building in 2026 and 2040 (see the [“MIXED USE OFFICE AND RETAIL BUILDINGS WITH RESIDENTIAL OCCUPANCIES”](#) section below for calculating GHG Limits for mixed use buildings).
- the building will be subject to the heat energy limits for a mixed-use building in 2040

MIXED USE OFFICE & RETAIL BUILDINGS

A building subject to GHG Limits may be a mix of D occupancies and E occupancies, which each have different targets. In this case, a custom GHG Limit needs to be calculated that reflects that mixed occupancy.² This is done by calculating a weighted average between the GHG Limits for each occupancy.

This calculation is made with Equation . The equation is a standard weighted average calculation. The area of the building subject to each occupancy is divided by the area of both D and E occupancies to establish the weighting for that occupancy. Each occupancy area weighting is

² The Heat Energy Limit is the same for Office and Retail occupancies, so there is no need to calculate a weighted average Heat Energy Limit for buildings with both Office and Retail occupancies.

then multiplied by the associated GHG Limit. Finally, the results are added together to create the weighted average of the two Limits.³

Equation 2: Mixed Occupancy GHGI Limit Calculation

$$MUB_{GHGL} = D_{GHGL} \times (D_A / (D_A + E_A)) + E_{GHGL} \times (E_A / (D_A + E_A))$$

Where:

MUB_{GHGL} = The weighted average GHG Emissions Limit applicable to the mixed-use building.

D_{GHGL} = GHG limit for Group D Occupancies

D_A = Total area of Group D Occupancies in m²

E_{GHGL} = GHG limit for Group E Occupancies

E_A = Total area of Group E Occupancies in m²

The example below provides an illustration.

EXAMPLE

A 10,000 m² building has nine storeys of office occupancy (Group D) above one storey of retail (Group E). The office has an area of 9,000 m² and the retail area is 1,000 m². In 2026, the GHG limit for Group D occupancies (D_{GHGL}) is 25 kg CO₂e/m² and the limit for Group E occupancies (E_{GHGL}) is 14 kg CO₂e/m².

For this building, the equation above would look like this:

$$MUB_{GHGL} = D_{GHGL} \times (D_A / (D_A + E_A)) + E_{GHGL} \times (E_A / (D_A + E_A))$$

$$MUB_{GHGL} = 25 \text{ kg CO}_2\text{e/m}^2 \times (9,000 / (9,000 + 1,000)) + 14 \text{ kg CO}_2\text{e/m}^2 \times (1,000 / (9,000 + 1,000))$$

$$MUB_{GHGL} = 25 \text{ kg CO}_2\text{e/m}^2 \times 0.9 + 14 \text{ kg CO}_2\text{e/m}^2 \times 0.1$$

$$MUB_{GHGL} = 22.5 \text{ kg CO}_2\text{e/m}^2 + 1.4 \text{ kg CO}_2\text{e/m}^2$$

$$MUB_{GHGL} = 23.9 \text{ kg CO}_2\text{e/m}^2$$

MIXED USE OFFICE AND RETAIL BUILDINGS WITH RESIDENTIAL OCCUPANCIES

Some buildings subject to the GHGI and Heat Energy Limits may include residential occupancies, with very different emissions and heat energy profiles. The intent of the established limits is to only regulate commercial (non-residential) buildings. Therefore, any residential portions of a

³ Note that the building areas of all other occupancies are ignored in this equation.

covered building may be excluded from the calculations for GHG and heat energy, provided the natural gas and district energy for the residential occupancies are metered separately from the rest of the building. Residential areas can include amenity, corridor, and service spaces exclusively serving the residential portions of the building.

Residential portions of a covered building can be excluded by subtracting the residential natural gas and district energy usage from the total energy calculation, and the residential area from the GFA calculation in accordance with the equations 3, 4 and 5 below. If energy consumption is reported in different units by the energy provider than those used in the equation below, use the CONVERSIONS FACTORS section to obtain the units in the equation.

Note: If the residential section of the building is not separately metered, then the entire building will be subjected to the GHG emissions and heat energy limits for the major occupancy of the building and will use the total building GFA for these calculations.

NON-RESIDENTIAL NATURAL GAS USE

The equation below shows how non-residential natural gas (NG_{NR}) usage is separated from residential gas usage for the purpose of calculating regulated GHG emissions and heat energy use.

Equation 3: Non-Residential Natural Gas Use

$$NG_{NR} = NG_M - NG_R$$

Where:

NG_{NR} = The natural gas usage (in GJ) attributable to the non-residential portion of the building.

NG_M = Total annual natural gas usage (in GJ) of the building as measured at the utility meter.

NG_R = The measured natural gas usage (in GJ) attributable to the residential portion of the building.

Note: If your building does not have a master meter and non-residential and residential meters are separate, you should enter your metered non-residential natural gas consumption for energy adjustment in your BPRS profile for GHGI calculation.

If your utility does not allow you to enter multiple/separate meters for auto upload on ESPM, you can either manually create and enter separate non-residential and residential meter on ESPM or get building level automatic data upload and claim adjustment for residential gas use on BPRS.

NON-RESIDENTIAL DISTRICT ENERGY USE

The equation below shows how non-residential District Energy (NG_{NR}) usage is separated from residential gas usage for the purpose of calculating regulated GHG emissions and heat energy use.

Equation 4: Non-Residential Natural Gas Use

$$DE_{NR} = DE - DE_R$$

Where:

DE_{NR} = The district energy usage (in GJ) attributable to the non-residential portion of the building.

DE = Total annual district energy usage (in GJ) of the building as measured at the utility meter.

DE_R = The measured district energy usage (in GJ) attributable to the residential portion of the building.

Note: If your building does not have a master meter and non-residential and residential meters are separate, you should enter your metered non-residential district energy consumption for energy adjustment in your BPRS profile for GHGI calculation.

If your utility does not allow you to enter multiple/separate meters for auto-upload on ESPM, you can either manually create and enter separate non-residential and residential meter on ESPM or get building level automatic data upload and claim adjustment for residential district energy use on BPRS.

NON-RESIDENTIAL GROSS FLOOR AREA (GFA)

The equation below shows how non-residential Gross Floor Area (GFA_{NR}) is calculated.

Equation 5: Non-Residential Gross Floor Area (GFA)

$$GFA_{NR} = GFA - GFA_R$$

Where:

GFA_{NR} = Gross Floor Area of the non-residential occupancies of the building in m^2

GFA = Gross Floor Area of the whole building in m^2 as determined in accordance with Building owners can calculate the GFA as per the definition above or use the formula below.

Equation 1

GFA_R = Gross Floor Area of the residential occupancies of the building in m². This includes common areas and utility areas that serve the residential units themselves (such as hallways, lobbies, mechanical rooms, etc).

EXAMPLE

A 10,000 m² majority office building has 4,500 m² residential floor area. The total natural gas usage of the building is 848 GJ (with no steam usage) and the residential portion of the building is separately metered for natural gas and has an annual usage of 330 GJ.

Calculate Non-Residential Natural Gas:

$$\text{NG}_{\text{NR}} = \text{NG}_{\text{M}} - \text{NG}_{\text{R}}$$

$$\text{NG}_{\text{NR}} = 848 - 330$$

$$\text{NG}_{\text{NR}} = 518 \text{ GJ}$$

Calculate Non-Residential GFA:

$$\text{GFA}_{\text{NR}} = \text{GFA} - \text{GFA}_{\text{R}}$$

$$\text{GFA}_{\text{NR}} = 10,000 - 4,500$$

$$\text{GFA}_{\text{NR}} = 5,500 \text{ m}^2$$

This building would then use a value of 518 GJ for the NG_M variable in Equation and 5,500 m² for the GFA variable in Equation and Equation .

CALCULATING GHG EMISSIONS AND HEAT ENERGY USE

Greenhouse gas and heat energy use intensities are both calculated using basic information about a building's energy usage and the building's floor area. This section describes the procedures for calculating and adjusting those values in special situations.

DETERMINING ENERGY USE

Both the GHG Emission and Heat Energy Limits of Vancouver's Annual Greenhouse Gas and Energy Limits By-Law are calculated from the natural gas and district energy consumption of a building. While they are not included in the Limits, other energy sources (such as electricity, propane, diesel and biomass) are still required to be reported. This section details how to report the energy used in the building and provides a set of adjustments that are allowed to be made before converting those energy quantities into emissions or heat energy. For buildings that are only subject to the reporting requirements and not subject to the GHG emissions and heat energy limits, there is no need to make any adjustments before reporting.

ADJUSTMENTS FOR NATURAL GAS USAGE

The GHG Emission and Heat Energy Limits are intended to regulate energy and emissions from heat energy, that is, the energy used to heat spaces and water. However, energy from natural gas might be used for other purposes in a covered building – such as process loads and certain food service loads – therefore buildings are allowed to adjust the natural gas use of the building to exclude these loads as detailed below. If no adjustments are claimed, the City will use the utility data submitted through Portfolio Manager to calculate the heat energy and GHG emissions of the building automatically.

Available adjustments consist of:

1. Exclusion of energy consumption from separately metered process loads.
2. Exclusion of energy consumption from separately metered food service loads.

Separately Metered Process Loads

A process load is any energy use by a manufacturing, industrial, or commercial procedure or activity where the primary purpose is other than conditioning spaces and maintaining comfort and amenities for the occupants of a building.⁴ GHGI Limits do not aim to include process loads in the calculation of building GHG intensity. It is also unlikely that many building subject to the Vancouver

⁴ The National Building Code of Canada, BC Step Code and relevant Vancouver Codes make several references to process loads, but do not explicitly define the term. This definition of a process load is drawn from ASHRAE Standard 90.1.

Carbon Limits would include process loads since the Carbon Limits do not apply to industrial and manufacturing occupancies.⁵ However, it is possible that small process loads may be present in a covered building, therefore an allowance is made for that possibility. Examples might include a kiln in a pottery shop, a glass forge in a glass-blowing shop or a dry cleaner. Ventilation/air tempering is an example of a non-process load.

In cases where a process load's energy consumption is separately metered, the natural gas associated with that process load can be excluded from the building's total natural gas usage. This adjustment cannot be made if the load is not separately metered.

Food Service Gas Use Adjustment

Gas used for cooking in restaurants and other food service establishments is not the focus of the Annual GHG Limit By-Law. As such, when restaurants located within larger buildings that are subject to GHG intensity limits are metered separately for their gas use, this gas use and food service floor area can be excluded from the building's overall GHG intensity according to the following table:

Separate Gas Meter for Food Service Establishment		Separately metered gas includes space heating for the Food Service Establishment	
Yes	Exclude gas use from building GHGI calculation	Yes	Food Service floor area is excluded from the building GHGI calculation
No	Gas use included in GHGI calculation	No	Food Service floor area is included in the building GHGI calculation

Equation 1 is used to calculate the natural gas usage of the building with allowable adjustments.

⁵ Process loads are mostly found in industrial and manufacturing buildings and include loads directly related to such activities as product manufacturing, materials processing and large-scale food production. Therefore, process loads are rarely present in office and retail occupancies.

Equation 6: Adjusted Natural Gas Usage

$$\mathbf{NG_{adj} = NG_M - NG_{PL} - NG_{FL}}$$

Where:

NG_{adj} = Natural Gas Usage of the building (in GJ) as adjusted by allowable adjustments.

NG_M = Total annual natural gas usage (in GJ) of the building as measured at the utility meter. If residential energy use adjustment is being claimed, the value for non-residential natural gas (NG_{NR}) calculated in equation 3 should be used in place of metered natural gas (NG_M)

NG_{PL} = Annual Natural Gas usage (in GJ) for qualified process loads

NG_{FL} = Annual Natural Gas usage (in GJ) for qualified food service loads

PURCHASED RENEWABLE NATURAL GAS

An owner can purchase renewable natural gas (RNG) in order to lower the GHG emissions of their building.⁶

Since the gas meter at the building does not capture the purchase of RNG, it is necessary to separate RNG and fossil NG from the total NG usage of the building. This is done with the following equation:

Equation 7: Renewable Natural Gas and Fossil Natural Gas

$$\mathbf{FNG = NG_{adj} - RNG}$$

Where:

FNG = Fossil Natural Gas or the portion of the total annual Natural Gas usage (in GJ) of the building that is not attributable to the qualified purchase of RNG

RNG = Total annual qualified purchase of Renewable Natural Gas (in GJ).

⁶ It is important to remember that the fossil natural gas supplied by FortisBC may include some portion of RNG. This RNG has been introduced into the natural gas system to meet other climate and regulatory goals and cannot be credited to the building's emissions since it has been accounted for in the emissions factor for fossil natural gas. Only qualified purchases of RNG can be included in the emissions calculations of the building.

NG_{adj} = Natural Gas Usage of the building (in GJ) as adjusted by allowable adjustments (see Equation).

CALCULATING GHG EMISSIONS INTENSITY (GHGI)

The Vancouver GHG Limits regulate building emissions based on emissions intensity in the units of kilograms of carbon dioxide equivalent, per square meter of GFA, per year (kg CO_{2e}/m²/year). The GHG Limits cover emissions from the onsite combustion of natural gas (including any qualified purchases of RNG, see the PURCHASED RENEWABLE NATURAL GAS section above) and GHG emissions from the production of district energy that is used in the building. As noted above, other amounts of energy consumed such as electricity, propane, diesel, biomass, and others are required to be reported, but are not included in this emissions calculation.

Energy consumption is converted into GHG emissions intensity according to the equation below. If energy consumption is reported in different units by the energy provider than those used in the equation below, use the conversion factors in the

CONVERSIONS FACTORS section to obtain the units in the equation. Current emissions factors will be published on the [Energize Vancouver webpage](#).

Equation 8: Total Annual Onsite GHG Emissions Calculation

$$\text{GHGI} = \frac{[(\text{FNG} \times \text{FNG}_{\text{ef}}) + (\text{RNG} \times \text{RNG}_{\text{ef}}) + (\text{DE} \times \text{DE}_{\text{EF}})]}{\text{GFA}}$$

Where:

GHGI = Total Annual Onsite GHG emissions intensity of the building in (kg CO_{2e}/m²/yr).

FNG = Total Annual Onsite Fossil Natural Gas Usage for the building in gigajoules (GJ) (see Equation).

FNG_{EF} = Emissions factor for Fossil Natural Gas (FNG).

RNG = Total Annual Onsite Renewable Natural Gas Usage for the building in gigajoules (GJ) (see Equation).

RNG_{EF} = Emissions factor for Renewable Natural Gas (RNG).

DE = Total annual metered energy use for the building from district energy system in gigajoules (GJ). If residential energy use adjustment is being claimed, the value for non-residential district energy (DE_{NR}) calculated in equation 4 should be used in place of metered district (DE).

DE_{EF} = Emissions factor for District Energy (DE). Different emission factors may be associated with individual buildings based on the rates offered by the DE provider.

GFA = Gross Floor Area (see Building owners can calculate the GFA as per the definition above or use the formula below.

Equation 1). If residential energy use adjustment is being claimed, the value for non-residential gross floor area (GFA_{NR}) calculated in equation 5 should be used in place of gross floor area (GFA)

CALCULATING HEAT ENERGY INTENSITY

The Vancouver Heat Energy Limits regulate the amount of heat energy from natural gas and district energy that is used by covered buildings. These limits are expressed in terms of the total heat energy in gigajoules per square meter per year (GJ/m²/year). Although fossil natural gas and renewable natural gas may have different emissions factors, they have the same heat energy and therefore the purchase of RNG does not provide a benefit for compliance with the Heat Energy Limits. As noted above, other amounts of energy consumed – such as electricity, propane, diesel, biomass, and others – are required to be disclosed, but are not included in this emissions calculation. Heating energy from electricity is excluded from the heat energy limit. Although parkade floor area is excluded from other calculations, parkade heating is included in this calculation.

The relevant energy consumption is converted into heat energy intensity according to the equation below. If energy consumption is reported in different units by the energy provider than those used in the equation below, use the conversion factors in the

CONVERSIONS FACTORS section to obtain the units in the equation.

Equation 9: Total Annual Onsite Heat Energy Intensity Calculation

$$\text{HEI} = (\text{FNG} + \text{RNG} + \text{DE}) / \text{GFA}$$

Where:

HEI = Total Annual Onsite heat energy intensity of the building in (GJ/m²/yr).

FNG = Total Annual Onsite Fossil Natural Gas Usage for the building in gigajoules (GJ) (see Equation).

RNG = Total Annual Onsite Renewable Natural Gas Usage for the building in gigajoules (GJ) (see Equation).

DE = Total annual metered energy use for the building from district energy system in gigajoules (GJ). If residential energy use adjustment is being claimed, the value for non-residential district energy (DE_{NR})

calculated in equation 4 should be used in place of metered district (DE).

GFA = Gross Floor Area (see Building owners can calculate the GFA as per the definition above or use the formula below.

Equation 1). If residential energy use adjustment is being claimed, the value for non-residential gross floor area (GFA_{NR}) calculated in equation 5 should be used in place of gross floor area (GFA)

WEATHER NORMALIZATION

The Vancouver GHG and Heat Energy Limits are based on typical weather patterns. In years with abnormally cold winters, buildings will likely be required to use more heating energy than they will under typical weather conditions. In those years, the City of Vancouver will make an adjustment to the Carbon and Heat Energy Limits accordingly. A year with an abnormally cold winter will be defined as any year where the Heating Degree Days (HDD) deviate from the median by more than 5%. Since 1998, the HDD have ranged from 2,497 to 3,043 with a median HDD of 2,844.⁷ The coldest winter during this period only deviated from the median HDD by 7% and the HDD has deviated from the median by 5% or more (colder) twice. These weather normalized GHG and Heat Energy Limits will be calculated and published by the City with no need for any additional action from building owners.

Equation 2 will be used by the City to calculate the weather normalization ratio. This is done by creating a ratio between the HDD of the cold year and the HDD median to establish the magnitude of the adjustment. The City will apply this ratio to the GHG and Heat Energy Limits for the applicable year.

Equation 2: Weather Normalization Ratio

$$\text{WNR} = (\text{HDD}_x / \text{HDD}_B)$$

Where:

WNR: The weather normalization ratio that will be applied to the GHG and Heat Energy Limits for years with abnormally cold winters. Limits will not be adjusted down for warmer years.

HDD_x: The Heating Degree Days (HDD) for the year with extreme weather.

HDD_B: The baseline Heating Degree Days (HDD), which is 2844.

EXAMPLE

The HDD in 2008 were 3043. If Vancouver were to experience another year with these heating degree days, which should happen rarely, the equation would look like this:

$$\text{WNR} = \text{HDD}_x / \text{HDD}_B$$

$$\text{WNR} = 3043 / 2844$$

⁷ <https://vancouver.weatherstats.ca/metrics/hdd.html>

WNR = 1.07

In this example, both the GHG and Heat Energy Limits for that year would be multiplied by 1.07.

APPENDIX

DEFINITIONS

“Building” means any structure with a gross floor area equal to or larger than 4,645 m² used or intended to support or shelter any use or occupancy that is listed in Table 2.

“Building By-law” means the Building By-law of the City.

“City” means the City of Vancouver.

“Director of Planning” means the person appointed by Council under section 560 of the Vancouver Charter and any person authorized to act on behalf of the Director of Planning.

“Energy and carbon reporting” means providing to the City the total energy consumed, separated by fuel type, for the previous calendar year and other descriptive information for a building in a form established by the Director of Planning for an ongoing review of a building’s energy and greenhouse gas emissions performance.

“Existing buildings” means buildings lawfully constructed and completed under a building permit, if a building permit was required.

“Greenhouse gas (GHG) emissions” means carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) gases emitted as a result of energy consumption in a building, and expressed in carbon dioxide equivalent (CO₂e), a unit of measure that combines the three gases by multiplying each by their global warming potential and adding them together.

“Gross floor area” or **“GFA”** means the sum of the area of every floor in a building, measured between the outside surface of the exterior walls, including all areas inside a building, other than crawl spaces or exterior spaces such as balconies, patios, parking and covered walkways.

“Heat energy” means the total gas used in a building operation plus district heat that is consumed inside the building (excluding the electricity portion), measured in gigajoules of energy equivalent per square meter of gross floor area per year (GJ/ m²/year).

“Lessee” means a person or organization occupying a building, or part of a building or premises under a rental or lease agreement.

“Major occupancy” means the principal occupancy for which a building or part thereof is used or intended to be used as classified in Table 1, and must comprise at least 50% of the building GFA to be considered the major occupancy.

“Mixed Use Building” or **“MUB”** means a building that contains multiple occupancies set out in Table 1, none of which are greater than 50% of the total GFA, including parking GFA.

“Owner” means a registered owner, a holder of an agreement for sale and purchase and, in the case of Crown-owned lands, owner shall mean the occupier.

A “**process load**” is any energy use by a manufacturing, industrial, or commercial procedure or activity where the primary purpose is other than conditioning spaces and maintaining comfort and amenities for the occupants of a building.⁸

“**Site energy**” means electricity, natural gas, steam, or other fuel types including renewable on-site electricity generation that are used directly by the building and reflected on the utility bills.

“**Utility provider**” means a person or organization that distributes or sells natural gas, electric, water, district heating and cooling or thermal energy services for buildings.

CONVERSIONS FACTORS

Area:

- 0.092903 m² / ft²

Fossil Natural Gas:

- 0.106 GJ / therm

Renewable Natural Gas:

- 0.106 GJ / therm

Steam:

- 2000 lbs / ton

GHG Emissions:

- See the [Energize Vancouver webpage](#) for the current GHG emissions factors.

⁸ The National Building Code of Canada, BC Step Code and relevant Vancouver Codes make reference to process loads, but do not explicitly define them. This definition of a process load is drawn from ASHRAE Standard 90.1.