Operational GHG Emissions Requirements for New Buildings and Energy Efficiency Requirements for Alterations to Existing Buildings

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Operational GHG Emissions Requirements for New Buildings and Energy Efficiency Requirements for Alterations to Existing Buildings

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Section 1 – Introduction, Application, Defined Terms

1. Introduction

This document describes the introduction of requirements to achieve low-carbon construction.

The text included below is a precursor to the publication of the 2025 editions of the National Model Codes. It reproduces selected proposed changes to Code requirements with regards to minimizing excessive operational GHG emissions (GHGe) in new *buildings* as well as improving energy performance of existing buildings when they are altered, as in a retrofit. Thereby, it supports the construction of net-zero operational emissions *building*s and energy efficient retrofits, that seek to align with the relevant national climate change objectives.

1.1 Application of this document

1) Except as provided in Sentence (3), Sections 1, 2, and 3 of this document apply to the design and construction of

   (i) all new *buildings* described in Sentence 1.3.3.2.(1) of Division A of the NBC-2020, and

   (ii) to *additions.*

2) Except as provided in Sentence (3), Sections 1 and 4 of this document apply to the *alteration* of all existing *building*s described in Sentence 1.3.3.2.(1) of Division A of the NBC-2020.

3) This document does not apply to *farm buildings*.

4) For the purposes of this document, the National *Building* Code (NBC 2020) Division B Sentence 9.36.1.3.(2) defines a Part 9 *building*. All other *building*s are Part 3 *building*s.
   For the purposes of this document, Part 9 buildings are:
   a) *buildings* of *residential occupancy* to which Part 9 applies,
   b) *buildings* containing *business and personal services*, *mercantile* or *low-hazard industrial occupancies* to which Part 9 applies whose combined total *floor area* does not exceed 300 m^2, excluding parking garages that serve *residential occupancies*, and
   c) *buildings* containing a mix of the *residential* and non-*residential occupancies* described in Clauses (a) and (b).

   All other *building*s are Part 3 *building*s.

1.2 Definitions

1) Words that appear in italics are defined in this document, and taken from either the NBC 2020 or NECB 2020.

Access to exit means that part of a *means of egress* within a *floor area* that provides access to an *exit* serving the *floor area*. (NBC 2020)

Addition means any *conditioned space* that is added to an existing *building* and that increases the *building's floor surface area* by more than 10 m^2. (NECB 2020)

Agricultural occupancy (Group G) means the *occupancy* of a *building* or part thereof that is located on land that is associated with and devoted to the practice of farming, and is used for the purpose of producing crops, raising farm animals, or preparing, marketing, storing or processing agricultural products. (See Note A-1.4.1.2.(1). NBC 2020) (NBC 2020)

Agricultural occupancy with no human occupants (Group G, Division 4) means an *agricultural occupancy* that is not intended to be occupied by persons under normal use and is generally used for the storage of agricultural materials and by-products. (See Note A-1.4.1.2.(1). NBC 2020) (NBC 2020)

Air barrier system means the assembly installed to provide a continuous barrier to the movement of air. (NBC 2020)

Air-supported structure means a structure consisting of a pliable membrane that achieves and maintains its shape and support by internal air pressure. (NBC 2020)

Alteration means a change or extension to any matter or thing or to any *occupancy* regulated by the NBC 2020. (NBC 2020)

Appliance means a device to convert fuel into energy and includes all components, controls, wiring and piping required to be part of the device by the applicable standard referred to in the NBC 2020. (NBC 2020)

Annual energy consumption means the annual sum of the lighting, *service water* heating and space-conditioning energy consumption of the proposed *building* design, as calculated in accordance with the requirements of Part 8 of Division B, NECB 2020. (NECB 2020)

Attic or roof space means the space between the roof and the ceiling of the top *storey* or between a dwarf wall and a sloping roof. (NBC 2020)

Authority having jurisdiction means the governmental body responsible for the enforcement of any part *building* code or the official or agency designated by that body to exercise such a function. (NBC and NECB 2020)

Basement means a *storey* or *storeys* of a *building* located below the *first storey*. (NBC 2020)

Building means any structure used or intended for supporting or sheltering any use or *occupancy*. (NBC and NECB 2020)

Building area means the greatest horizontal area of a *building* above *grade* within the outside surface of exterior walls or within the outside surface of exterior walls and the centre line of *firewalls*. (NBC 2020)

Building energy target means the *annual energy consumption* of a hypothetical replica of the proposed *building*, using the same energy sources for the same functions and having the same environmental requirements, *occupancy*, climatic data and operation schedules as the proposed *building*, but made to comply with all applicable prescriptive requirements of the NECB 2020. (NECB 2020)

Building envelope means the collection of components that separate *conditioned space* from unconditioned space, the exterior air or the ground, or that separate *conditioned spaces* intended to be conditioned to temperatures differing by more than 10°C at design conditions. (See Note A-1.4.1.2.(1)., NECB for Buildings 2020) (NECB 2020)

Boiler means an *appliance* intended to supply hot water or steam for space or *service water* heating purposes, except *storage-type service water heaters*. (NBC and NECB 2020)

Caisson (see Pile). (NBC 2020)

Care means the provision of services other than treatment by or through care facility management to residents who require these services because of cognitive, physical or behavioural limitations. (NBC 2020)

Chimney means a primarily vertical shaft enclosing at least one *flue* for conducting *flue* gases to the outdoors. (NBC 2020)

Conditioned space means any space within a *building*, the temperature of which is controlled to limit variation in response to the exterior ambient temperature by the provision, either directly or indirectly, of heating or cooling over substantial portions of the year. (NBC and NECB 2020)

Dead load means the weight of all permanent structural and non-structural components of a *building.* (NBC 2020)

Deep foundation means a *foundation unit* that provides support for a *building* by transferring loads either by end-bearing to *soil* or *rock* at considerable depth below the *building*, or by adhesion or friction, or both, in the *soil* or *rock* in which it is placed. *Piles* are the most common type of *deep foundation*. (NBC 2020)

Designer means the person responsible for the design. (NBC 2020)

Effective thermal resistance," or RSI value means the inverse of the *overall thermal transmittance* of an assembly, in (m^2×K)/W. (See Note A-9.36.1.2.(3)., n NBC 2020) (NBC 2020)

Exit means that part of a *means of egress*, including doorways, that leads from the *floor area* it serves to a separate *building*, an open public thoroughfare, or an exterior open space protected from fire exposure from the *building* and having access to an open public thoroughfare. (See Note A-1.4.1.2.(1)., NBC 2020) (NBC and NECB 2020)

Exterior entrance means a doorway used for entering, or for entering and exiting, a *building*, that leads from an exterior space to a space provided with *interior lighting.* (NECB 2020)

Exterior exit means a doorway used only for exiting from an area provided with *interior lighting* to an exterior space. (NECB 2020)

Exterior lighting means lighting other than *interior lighting*. (NECB 2020)

Farm building means a *building* or part thereof that contains an *agricultural occupancy*. (See Note A-1.4.1.2.(1)., NBC 2020) (NBC and NECB 2020)

Fenestration means all *building envelope* assemblies, including their *frames*, that transfer visible light, such as windows, clerestories, *skylights*, translucent wall panels, glass block assemblies, transoms, sidelights, sliding, overhead or swinging glass doors, and glazed inserts in doors, etc. (NECB 2020)

Fire-resistance rating means the time in minutes or hours that a material or assembly of materials will withstand the passage of flame and the transmission of heat when exposed to fire under specified conditions of test and performance criteria, or as determined by extension or interpretation of information derived therefrom as prescribed in this Code. (See Sentence D-1.2.1.(2) in Appendix D of Division B., NBC 2020) (NBC 2020)

Fire separation means a construction assembly that acts as a barrier against the spread of fire. (See Note A-1.4.1.2.(1)., NBC 2020) (NBC 2020)

Firewall means a type of *fire separation* of *noncombustible construction* that subdivides a *building* or separates adjoining *buildings* to resist the spread of fire and that has a *fire-resistance rating* as prescribed in the NBC or NFC and has structural stability to remain intact under fire conditions for the required fire-rated time. (NBC 2020)

First storey means the uppermost *storey* having its floor level not more than 2 m above *grade*. (NBC 2020)

Floor surface area means the area of a floor surface, including heated garages, measured from the interior surface of the perimeter walls at or near floor level, including the area occupied by columns, interior walls and openings in the floor. (NBC 2020)

Floor area means the space on any *storey* of a *building* between exterior walls and required *firewalls*, including the space occupied by interior walls and *partitions*, but not including *exits*, *vertical service spaces*, and their enclosing assemblies. (NBC 2020)

Flue means an enclosed passageway for conveying *flue* gases. (NBC 2020)

Foundation means a system or arrangement of *foundation units* through which the loads from a *building* are transferred to supporting *soil* or *rock*. (NBC 2020)

Foundation unit means one of the structural members of the *foundation* of a *building* such as a footing, raft or *pile*. (NBC & NECB 2020)

Frame in a door, window or other glazed area means the associated head, jambs, sill and, where applicable, mullions which, when assembled, house the door, *sash* or fixed glazing. (NECB 2020)

Grade means the lowest of the average levels of finished ground adjoining each exterior wall of a *building*, except that localized depressions need not be considered in the determination of average levels of finished ground. (See *First storey* and Note A-1.4.1.2.(1)., NBC 2020) (NBC and NECB 2020)

Gross lighted area means the total area served by *interior lighting*, including the areas occupied by *partitions* but excluding areas occupied by exterior enclosing assemblies and by elevator and service shafts. (See Note A-1.4.1.2.(1)., NECB 2020) (NECB 2020)

Heat trap means an energy-conserving arrangement of the water piping entering or leaving a *service water heater* constructed to counteract the convective forces of the hot water (thermosyphoning) during standby periods. (NECB 2020)

Installed interior lighting power means the power, in watts, used by all the lighting systems that are part of the complete *interior lighting* design. (NECB 2020)

Interior lighting means

(a) lighting installed in spaces that are within the *building envelope*, and

(b) lighting installed in unconditioned or *conditioned spaces* that are sheltered from

the outdoor environment and intended to light only those spaces, except for lighting at *exterior entrances* and *exterior exits*. (See Note A-1.4.1.2.(1)., NECB 2020)(NECB 2020)

Interior lighting power allowance means the maximum lighting power allowed to be provided to illuminate the interior of a *building*. (NECB 2020)

Loadbearing (as applying to a *building* element) means subjected to or designed to carry loads in addition to its own *dead load*, excepting a wall element subjected only to wind or earthquake loads in addition to its own *dead load*. (NBC 2020)

Means of egress means a continuous path of travel provided for the escape of persons from any point in a *building* or contained open space to a separate *building*, an open public thoroughfare, or an exterior open space protected from fire exposure from the *building* and having access to an open public thoroughfare. *Means of egress* includes *exits* and *access to exits*. (NBC 2020)

Noncombustible construction means that type of construction in which a degree of fire safety is attained by the use of *noncombustible* materials for structural members and other *building* assemblies. (NBC 2020)

Occupancy means the use or intended use of a *building* or part thereof for the shelter or support of persons, animals or property. (NBC and NECB 2020)

Opaque building assembly means a *building* assembly that is part of the *building envelope*, other than doors, and does not admit light. (NECB 2020)

Overall thermal transmittance (U-value) means the rate, in $W/(m^2 \times K)$, at which heat is transferred through a *building* assembly that is subject to a temperature difference. It represents the amount of heat transferred through a unit area in a unit of time induced under steady-state conditions by a unit temperature difference between the environments on its two faces. The U-value reflects the capacity of all elements to transfer heat through the thickness of the assembly, as well as, for instance, through air films on both faces of above-ground components. Where heat is not transferred homogeneously across the area being considered, the *overall thermal transmittance* shall be determined. (See Note A-1.4.1.2.(1)., NECB 2020) (NECB 2020)

Owner means any person, firm or corporation controlling the property under consideration. (NBC 2020)

Partition means an interior wall 1 *storey* or part-*storey* in height that is not *loadbearing*. (NBC 2020)

Pile means a slender *deep foundation unit* made of materials such as wood, steel or concrete or a combination thereof, that is either premanufactured and placed by driving, jacking, jetting or screwing, or cast-in-place in a hole formed by driving, excavating or boring. (Cast-in-place bored *piles* are often referred to as *caissons* in Canada.) (NBC 2020)

Plenum means a chamber forming part of an air duct system. (NBC and NECB 2020)

Plumbing system means a drainage system, a venting system and a water system or parts thereof. (NBC 2020)

Residential occupancy (Group C) means the *occupancy* or use of a *building* or part thereof by persons for whom sleeping accommodation is provided but who are not harboured for the purpose of receiving *care* or *treatment* and are not involuntarily detained. (NBC 2020)

Rock means that portion of the earth's crust that is consolidated, coherent and relatively hard and is a naturally formed, solidly bonded, mass of mineral matter that cannot readily be broken by hand. (NBC 2020)

Sash means an assembly of secondary framing members that fits within the primary *frame* of a window and whose main purpose is to hold and support the glass in operable windows; however, a *sash* is often included in fixed windows to maintain a uniform appearance with operable windows. (NEBC 2020)

Service water means water for *plumbing system*s, but not water for systems used exclusively for space-heating or -cooling, or for processes. (NECB 2020)

Service water heater means a device for heating water for plumbing services. (NBC and NECB 2020)

Service space means space provided in a *building* to facilitate or conceal the installation of *building* service facilities such as chutes, ducts, pipes, shafts or wires. (NBC 2020)

Skylight means a form of *fenestration* that is inclined less than 60° from the horizontal. (NECB 2020)

Soil means that portion of the earth's crust that is fragmentary, or such that some individual particles of a dried sample may be readily separated by agitation in water; it includes boulders, cobbles, gravel, sand, silt, clay and organic matter. (NBC 2020)

Storage garage means a *building* or part thereof intended for the storage or parking of motor vehicles and containing no provision for the repair or servicing of such vehicles. (See Note A-1.4.1.2.(1)., NBC 2020) (NBC 2020)

Storage-type service water heater means a *service water heater* with an integral hot water storage tank. (NBC and NECB 2020)

Storey means that portion of a *building* that is situated between the top of any floor and the top of the floor next above it, and if there is no floor above it, that portion between the top of such floor and the ceiling above it. (NBC and NECB 2020)

Treatment means the provision of medical or other health-related intervention to persons, where the administration or lack of administration of these interventions may render them incapable of evacuating to a safe location without the assistance of another person. (See Note A-1.4.1.2.(1)., NBC 2020) (NBC 2020)

Vertical service space means a shaft oriented essentially vertically that is provided in a *building* to facilitate the installation of *building* services including mechanical, electrical and plumbing installations and facilities such as elevators, refuse chutes and linen chutes. (NBC 2020)

Section 2 – Energy Efficiency for New Buildings

2. Energy Efficiency for New Buildings

1) New Part 3 *buildings* are recommended to comply with the highest feasible Energy Performance Tier of Part 10 of Division B of the 2020 National Energy Code of Canada for *Buildings*.
2) New Part 9 *buildings* are recommended to comply with the highest feasible Energy Performance Tier of Subsection 9.36.7. of Division B of the 2020 National *Building* Code.

Section 3 – Operational GHGe for New Buildings

3. Operational Greenhouse Gas Emissions for New Buildings

3.1 Preamble

Approximately 13% of Canada's total greenhouse gas (GHG) emissions can be attributed to houses and buildings. This is primarily a result of using fossil fuels for space and water heating. Additionally, the combined impact of electricity consumption for cooling, lighting and running other appliances raises the overall contribution of buildings to GHG emissions to approximately 18%.[1] The 2020 GHG emissions from residential and building sectors are outlined in Table 1, which shows the sources and their percentage of electricity consumption.

Table 1. 2020 GHG Emissions in the Residential and Building Sectors (see Note A-3.1. below)

Sector	Source	Electricity Consumption, %
Residential	Space heating	64
	Water heating	20
	Running appliances	11
	Lighting	3
	Space cooling	2
Building	Space heating	65
	Running auxiliary equipment	12
	Lighting	10
	Water heating	7
	Space cooling	3
	Other	3

[1] https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/healthy-environment-healthy-economy/annex-homes-buildings.html

Note A-3.1.
https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm

There has been a growing recognition of the importance of addressing climate change and reducing GHG emissions from all sectors, including the built environment. However, the National Model Codes (the Codes) do not presently consider the type or quality of energy sources used by buildings and houses, nor do they address or regulate embodied and operational GHG emissions. As the industry moves towards higher energy efficiencies, the differences between energy sources must be examined because they contribute to GHG emissions differently. Historically, the Codes focused on design and construction requirements related to safety, structural integrity, accessibility and energy efficiency. With the latter, the emphasis was on reducing energy consumption during the construction and operational phases, but did not explicitly address operational GHG emissions. Furthermore, Canada is a large and diverse country with different climatic regions and building practices. This reality has led to regional variations in building codes and regulations, making it challenging to establish a unified approach to address operational GHG emissions at the national level.

The Codes currently contain an energy-efficiency objective and related requirements for the design and construction of new buildings and houses. In the 2020 editions of the National Energy Code of Canada for Buildings (NECB) and National Building Code of Canada (NBC), energy-efficiency tiers were introduced, containing measures that progressively increase energy efficiency and reduce the amount of energy needed to operate a building. These requirements play a crucial role in reducing GHG emissions by focusing on the amount of energy used. However, the Canadian Board for Harmonized Construction Codes (CBHCC) recognizes that energy savings alone will not lead to reducing emissions to meet the national goals stated in the Pan-Canadian Framework.

GHG emissions across Canadian provinces and territories exhibit substantial variations, influenced by factors such as population density, climate, energy sources and economic considerations.[2] Provinces and territories with larger populations, resource-based economies or heavy reliance on fossil fuels for electricity generation generally register higher emissions levels. This demonstrates a greatly varied energy landscape across Canada.

Ultimately, the goal is to reduce operational GHG emissions to zero or near zero across provinces and territories by 2050. Consequently, authorities having jurisdiction require a flexible framework to regulate GHG emissions due to building operation by using "levels" that move towards lower operational GHG emissions.

On the path to this goal, the requirements below describe how to minimize excessive operational greenhouse gas emissions (GHGe) for the construction of new *buildings*.

[2] https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions.html

3.1.1 Scope

Scope 1 GHGe are GHGs produced directly from sources that are produced directly from energy sources combusted on properties that are owned or controlled by the Government of Canada (for example, from heating *building*s). Scope 2 GHG emissions are those generated indirectly from the consumption of purchased energy (electricity, heating and cooling). Scope 3 GHG emissions are indirect emissions resulting from an organization's operations.

Since 2010, the NBC and NECB have included requirements to minimize excessive use of energy. Though these requirements have improved the energy efficiency of new houses and *building*s, the Codes have remained silent on the source of energy used and the GHG emissions associated with production, distribution and use. As a result, many new Code-compliant *building*s contribute GHG emissions through their year-over-year operation. Reducing these emissions is an important step to enable action towards national climate change goals. Climate change is the biggest challenge facing humanity today, consequently, it is vital that we address this gap to support Canada in reaching its emissions reduction target of 40% below 2005 levels by 2030 and net-zero emissions by 2050. Furthermore, achieving long-term climate change goals requires early action on operational GHG emissions. Failure to address this pivotal issue could impede Canada's progress towards its emissions-reduction targets, jeopardizing the ability to effectively combat climate change and protect the future well-being of the country. The commitment to a sustainable future demands that these emissions be addressed comprehensively and urgently.

3.2 Defined terms

3.2.1 Definitions

1) For the purpose of this document, the term "annual operational GHG emissions" shall mean the annual sum of GHG emissions to meet the annual energy demand loads that are produced on the *building* site or produced from energy sources that are generated offsite.
2) For the purpose of this document, the term "operational GHG emissions target" shall mean the annual operational GHG emissions produced by a hypothetical replica of the proposed *building* to meet the *building energy target* from energy sources that are produced on the *building* site or produced from energy sources that are generated offsite.

3.3 Performance requirements

3.3.1 Performance Compliance

1) Except as provided in Sentence (5), compliance with this Article shall be achieved by designing and constructing new *building*s in accordance with GHG emission performance level A specified in Table 3.3.3., which corresponds to the

a) annual operational GHG emissions of the proposed *building*, expressed as a percent *building* GHG emissions target, or
b) Percentage of improvement of the annual operational GHG emissions of the proposed *building* relative to the operational GHG emissions target of the reference *building*, expressed as a percent improvement.

2) Compliance of the proposed *building* with GHG emission level A specified in Table 3.3.1. shall be determined by
   a) dividing the annual operational GHG emissions of the proposed *building* by the operational GHG emissions target of the reference *building* to derive the percent *building* GHG emissions target, or
   b) subtracting the annual operational GHG emissions of the proposed *building* from the operational GHG emissions target of the reference *building* and dividing the result by the operational GHG emissions target of the reference *building* to derive the percent improvement.
3) The annual operational GHG emissions of the proposed *building* shall be determined in accordance with Article 3.5.1.
4) The operational GHG emissions target of the reference *building* shall be determined in accordance with Article 3.5.2.
5) Where the *building* cannot reasonably be connected to the provincial or territorial electricity power grid, compliance with this Article shall be achieved by reporting operational GHG emissions of the proposed *building* in accordance with Article 3.5.1.

Table 3.3.1.
GHG Emissions Performance Levels

GHG Emission Performance Level	Percent *Building* GHG Emissions Target	Percent Improvement
A – Net-Zero GHGe level	≤ 10%	≥ 90%
B	≤ 25%	≥ 75%
C	≤ 50%	≥ 50%
D	≤ 75%	≥ 25%
E	≤ 90%	≥ 10%
F – No improvement	≤ 100%	≥ 0%

3.4 Emission Factors

If operational GHG emissions are to be regulated, *designer*s, builders and enforcement officials need a consistent and accurate means to convert expected energy use into expected GHG emissions. For years, governments and industry have relied on emissions factors (also referred to as emissions intensity factors) for this task. Emissions factors describe the amount of GHG emissions (in kg CO_2 equivalent) per

unit of energy consumed, for instance, of electricity (in kWh), of natural gas (in m^3), and of heating oil (in L). Environment and Climate Change Canada compiles this data annually and publishes estimates as part of Canada's national greenhouse gas inventory report. Emissions factors reflect the carbon intensity of different fuels, as well as regional differences in energy production and distribution. As energy utilities are presently undergoing unprecedented transition, future-looking forecasts for utility emissions, averaged for the years 2031 to 2035, are referenced. Emissions factor forecasts for electricity are sourced from Environment and Climate Change Canada's most recent (as of June 2023) projections. While no similar projections are currently available for natural gas utilities, such projections are expected in future years and could be incorporated at a later date.

3.4.1. Sources

1) The GHG emission factors used to calculate total GHG emissions by energy source shall be in conformance with Tables 3.4.1.- A— and 3.4.1.-B.

Table 3.4.1. -A
GHG Emission Factors for Energy Sources by Province or Territory
Forming Part of Sentence 3.4.1.

Province or Territory	GHG Emission Factor by Energy Source	
	Electricity ($g\ CO_2e\ /kWh$)[1]	Utility Gas ($g\ CO_2e\ /kWh$)[2]
Alberta	181.86	189
British Columbia	1.32	190
Manitoba	0	185
New Brunswick	77.88	185
Newfoundland and Labrador	11.08	185
Northwest Territories	6.82	185
Nova Scotia	161.64	190
Nunavut	465.16	190
Ontario	57.9	185
Prince Edward Island	80.42	185
Quebec	0.38	186
Saskatchewan	146.6	185
Yukon	25	190

Table notes:

1) Emissions factors for electricity are an average of the 2031-2035 values from Environment and Climate Change Canada's (ECCC) "Canada's Greenhouse Gas Emissions Projections - Environment and Climate Change Canada Data" as of June 2023.
2) GHG emission factors for utility gas values based on estimates from the 2022 National Inventory Report of Greenhouse Gas emissions, Environment and Climate Change Canada.

Table 3.4.1.-B.

GHG Emissions Factors for Other Energy Sources

Forming Part of Sentence 3.4.1.

Energy Source	Unit	GHG Emission Factor ($g\ CO_2\ e/unit$)	GHG Emission Factor ($g\ CO_2\ e/kWh$)
Propane[1]	L	1548	218
Heating Oil/Light Fuel Oil[1]	L	2755	270
Heavy Fuel Oil[1]	L	3176	274
Diesel[1]	L	2690	250

Table notes:

1) National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 2023, Table A6.6-1 of the NEC

2) For energy sources supplied by district energy plants, GHG emission factors used to calculate total operational GHG emissions by energy service shall be

a) as provided in Table 3.4.2., or

b) determined by a qualified person representing the district plant operator.

Note: Qualified Person

A qualified person is a trained person with expertise in *building* energy analysis, which includes:

a. a certified GHG verifier, certified in accordance with ISO-17024 by an ISO 17024 accredited body, demonstrating competence with use of ISO-14064 (2018/2019) or verifiers accredited as defined by ISO-14065:2020 and ISO-14066:2023, or

b. a person qualified by the *authority having jurisdiction*.

Table 3.4.2.

GHG Emissions Factors for district energy sources

Forming Part of Sentence 3.4.2.

Energy Service	Unit	Emissions Factor
Steam	$g\ CO_2e/\ kWh$	383
Hot Water	$g\ CO_2e/\ kWh$	362
Chilled Water	$g\ CO_2e/\ kWh$	128

Table notes:

1) ANSI/ASHRAE Standard 228-2023: Standard Method of Evaluating Zero Net Energy and Zero Net Carbon *Building* Performance

3) For energy sources not provided in Sentences (1) and (2), emission factors shall be obtained from a qualified person.

Note: Unit Conversions

A volumetric quantity of a fuel can be converted to an equivalent amount of energy, expressed in kWh, using the following table:

Energy Source	Unit	Equivalent Energy (kWh)[1]
Natural Gas	1.0 m^3	10.36
Propane	1.0 L	7.09
Heating Oil/Light Fuel Oil	1.0 L	10.20
Heavy Fuel Oil	1.0 L	11.59
Diesel	1.0 L	10.74

[1]Table note: Approximate energy content of various fuels from https://apps.cer-rec.gc.ca/Conversion/conversion-tables.aspx#2

One Gigajoule (GJ) is equivalent to 277.7778 kWh.

1) See Section 3.5. for calculation methodology

3.5 Methodology

3.5.1 Annual Operational GHG Emissions of the Proposed Building

1) The annual operational GHG emissions of the proposed *building* shall be as calculated in this Article.

2) The annual operational GHG emissions of the proposed *building*, $CO_2e, proposed,$ in kg CO_2e, shall be determined using the following equation:

$$CO_2e, proposed = \sum_{ES} (Regulated\ Energy\ Use_{ES} \times GEF_{ES}) / 1000$$

where

$CO_2e,$proposed is the total annual GHG emissions of all regulated loads, in kg CO_2e, for the proposed *building*,

$Regulated\ Energy\ Use_{ES}$ is the *annual energy consumption* of all regulated loads in the proposed *building*, in kWh by energy source.

For Part 3 *building*s, the regulated energy use is determined by modeling the proposed *building* in accordance with Part 8 of the National Energy Code of Canada for *Building*s to establish the total annual energy use, in kWh, for each energy source

of all regulated loads including lights, fans, pumps, *service water* systems, heating and cooling equipment in the proposed *building.*

For Part 9 *building*s, the regulated energy use is determined by modeling the proposed house in accordance with Article 9.36.5.9. of the National Building Code to establish the total annual energy use, in kWh, for each energy source of all regulated loads including fans, pumps, *service water* systems, and heating and cooling equipment in the proposed house.

GEF_{es} is the GHG Emissions Factor of the corresponding energy source as provided in Section 3.4., in g CO_2e/kWh.

3.5.2 Operational GHG Emissions Target of the Reference *Building*

1) The operational GHG emissions target of the reference *building* shall be as calculated in this Article.
2) The operational GHG emissions of the reference *building*, $CO_2e, target$, in kg CO_2e, shall be determined using the following equation:

$$CO_2e, target = CO_2e, other\ regloads + CO_2e, SH + CO_2e, SWH$$

where

$CO_2e, other\ regloads$ is the total annual GHG emissions of all non-heating regulated loads as determined in Sentence (3), in kg CO_2e, for the reference *building*

CO_2e, SH is the total annual GHG emissions from space heating as determined in Sentence (4), in kg CO_2e, for the reference *building*, and

CO_2e, SWH is the total annual GHG emissions from *service water* heating as determined in Sentence (5), in kg CO_2e for the reference *building*.

3) The total annual GHG emissions of all non-heating regulated loads shall be determined using the following equation:

$$CO_2e, other\ regloads = Other\ regloads\ Energy\ Use_{ES} \times GEF_{electricity} / 1000$$

where

Other regloads Energy Use$_{ES}$ is the annual energy use of all non-heating regulated loads in the reference *building*, in kWh

For Part 3 *buildings*, *Other regloads Energy Use*$_{ES}$, in kWh, shall be determined by modeling the reference *building* in accordance with Part 8 of the National Energy Code of Canada for *Buildings* to establish the total annual energy use, in kWh, of all non-heating regulated loads including lights, fans, pumps, and cooling equipment in the reference *building*.

For Part 9 *buildings*, *Other regloads Energy Use*$_{ES}$ in kWh, shall be determined by modeling the reference house in accordance with NBC-2020 Article 9.36.5.13. to establish *annual energy consumption* of all non-heating regulated loads including fans, pumps, and cooling equipment in the reference house, in kWh.

$GEF_{electricity}$ is the Emissions Factor for electricity as provided in Section 1.2.4., in g CO_2e/kWh

4) The total annual GHG emissions from space-heating, CO_2e, SH, in kg CO_2e, shall be determined using the following equation:

$$CO_2e, SH = TED_{SH} \times GEF_{SH} \quad /1000$$

where

TED_{SH} is the total annual thermal energy demand of the space-heating system in the reference *building*, in kWh

For Part 3 *buildings*, TED_{SH} is determined by modeling the reference *building* in accordance with Part 8 of the National Energy Code of Canada for *Buildings* to establish the total annual thermal energy demand, in kWh, of the space-heating system, including baseboard heating, in the reference *building*.

For Part 3 *buildings*, GEF_{SH}, the reference GHG emissions factor for space heating, is 265 g CO_2e/kWh,.

For Part 9 *buildings*, TED_{SH} is determined by modeling the reference house in accordance with Article 9.36.5.13. of the National Building Code to establish the total annual thermal energy demand, in kWh, of the space-heating system, including baseboard heating, in the reference house.

For Part 9 *buildings*, GEF_{SH}, the reference GHG emissions factor for space heating, is 235 g CO_2e/kWh.

5) The total annual GHG emissions from *service water* heating, CO_2e, SWH , in kg CO_2e, shall be determined using the following equation:

$$CO_2e, SWH = TED_{SWH} \times GEF_{SWH} / 1000$$

where

TED_{SWH} is the total annual thermal energy demand of the *service water* heating system in the reference *building,* in kWh.

For Part 3 *building*s, TED_{SWH} is determined by modeling the reference *building* in accordance with Part 8 of the National Energy Code of Canada for *Building*s to establish the total annual thermal energy demand, in kWh, of the *service water* heating system in the reference *building*.

For Part 3 *building*s, GEF_{SWH}, the reference GHG emissions factor for *service water* heating, is 240 g CO_2e/kWh,.

For Part 9 *building*s, TED_{SWH} is determined by modeling the reference house in accordance with NBC-2020 Article 9.36.5.13. to establish the total annual thermal energy demand, in kWh, of the *service water* heating system in the reference house.

For Part 9 *building*s, GEF_{SWH}, the reference GHG emissions factor for *service water* heating, is 260 g CO_2e/kWh.

Note: Thermal Energy Demand

This is the amount of heating energy that is output from any and all types of heating equipment.

For space heating, heating equipment includes electric, gas, hot water, or DX heating coils of central air systems (e.g., make-up air units, air handling units, etc.), terminal equipment (e.g., baseboards, fan coils, heat pumps, reheat coils, etc.), or any other equipment used for the purposes of space heating and ventilation. Heating output of any equipment whose source of energy is not directly provided by a utility (electricity, gas or district) must still be counted towards the TED_{sh}.

For *service water* heating, heating equipment includes the electric resistances or gas heaters/burners of hot water storage tanks or instantaneous/tankless water heaters, heat pump water heaters, or any other equipment used for the purposes of *service water* heating. Heating output of any equipment whose source of energy is not directly provided by a utility (electricity, gas or district) must still be counted towards the TED_{swh}.

Section 4 – Alterations of Existing Buildings

4. Alteration of Existing Buildings

4.1 Preamble

Requirements applicable to *alteration* of existing *buildings* provided in this document are intended to improve the energy performance of existing *buildings* (without worsening performance in other areas) at the time of *alteration*, and thereby potentially reducing the operational GHG emissions of *the building* by using energy as a proxy.

The voluntary *alteration* of an existing *building* represents an opportunity to upgrade the *building*'s energy performance. When significant repairs or *alterations* need to be made, it is the ideal time to also consider upgrading energy performance where it is cost-effective to do so, thereby minimizing the incremental cost of the upgrade.

4.2 General

4.2.1 Scope

Section 4 of this document is concerned with the energy performance of existing *buildings* or parts thereof subjected to *alteration*. (See Note A-4.2.1.)

4.2.2 Application

1) Except as provided in Sentences (2) and (3), Section 4 of this document applies to *alteration* of existing *buildings*, or parts of existing *buildings*.

2) Section 4 of this document does not apply to

a) *farm buildings*
b) tents,
c) *air-supported structures*,
d) relocatable *buildings*,
e) open-air *storage garages*,
f) garages or carports, or
g) construction camps.

3) Section 4 of this document does not apply to heritage *buildings* or to parts of a *building* that have been formally recognized by a federal, provincial, territorial or municipal authority as having heritage value.

4.2.3. Compliance

1) Except as provided in Sentence (2), the *alteration* of existing *building*s or parts thereof shall comply with Section 4.1 to 4.6.
2) Except as provided in Sentence (3), the *alteration* of existing *building*s or parts thereof shall comply with Section 4.1 to 4.5 and 4.7. for
   a) *building*s of *residential occupancy* to which Part 9 of the National *Building* Code applies,
   b) *building*s containing *business and personal services*, mercantile or low-hazard industrial occupancies to which Part 9 applies whose combined total *floor area* does not exceed 300 m^2, excluding parking garages that serve residential occupancies, and
   c) *building*s containing a mix of the residential and non-residential occupancies described in Clauses (a) and (b).
3) For the purpose of determining whether which Sections of this document apply in Sentence (2), the existing *building*s shall be considered together with the *alteration*.

Note A-4.2.1. Extent of the Alteration.

Unless they state otherwise, the provisions provided in Section 4 of this document are not intended to require *building owner*s to undertake work beyond the planned extent of an *alteration*. Certain provisions do, however, expand the extent of an *alteration* where it is reasonable and cost effective to do so. Some examples of such an expansion of extent are the following:

- sealing ducts that are accessible,
- insulating piping that is being replaced,
- installing automatic temperature controls on *service water* heating systems with storage tanks,
- improving impacted or exposed portions of an *air barrier system*, and
- improving the thermal resistance of exposed wall framing, ceilings or floors.

The overarching principles for the application of the provisions of Section 4 of this document to an *alteration* are the following:

- to maintain or increase the overall *building* performance level,
- to avoid negative or unintended consequences and unrealistic expectations,
- to ensure that the *building* is left in a safe state during the *alteration*, and
- to encourage *alteration*s without placing an undue burden on *building owner*s.

4.3. Performance

An *alteration* to an existing *building* shall not adversely affect any aspect of *building* performance.

4.4. Extensions

1) Where an extension, including an *addition*, is being added to an existing *building*,
   a) the existing *building* shall comply with Section 4 of this document, and
   b) the extension shall comply with the National Model Codes and Sections 2 and 3 of this document.

Note A-4.4.(1) *Additions*

For the purpose of understanding the scope of this document, an *addition* can be thought of as a new *building* that happens to be built contiguous to an *existing building* or as a new portion of an *existing building*.

4.6. Requirements for alterations of existing Part 3 buildings

4.6.1. Building Envelope

4.6.1.1. General

1) Scope: This Section is concerned with the *building envelope* covered in NECB Part 3.

2) Application: This Section applies to existing building envelope subjected to alteration and new building envelope installed in existing buildings.

4.6.1.2. Requirements for compliance

1) Except as provided in Sentences (2) to (6), the *building envelope* shall comply with Part 3

2) The following need not comply with Sentence (1):

   a) repair and maintenance,

   b) the installation of storm windows or glazing panels over existing glazing,

   c) the replacement of glazing in existing *sash*es and *frame*s, provided the *overall thermal transmittance* of the replacement glazing is not more than that of the existing glazing (see Note A-4.6.1.2.(2)(c))

   d) the *alteration* of roof, wall or floor cavities that are insulated to full depth with insulation having a minimum nominal RSI value of 0.53 per 25 mm,

   e) the *alteration* of walls and floors, provided the existing wall or floor has no framing cavities and no new framing cavities are created, and

   f) the provision of continuity of insulation, where impractical because of structural or construction constraints.

3) Vestibules need not be installed, where impractical because of structural, construction or accessibility constraints.

4) Except as provided in Sentence (5), where the *alteration* of the *building envelope* reduces or does not change the vertical *fenestration* and door area to gross wall area ratio (FDWR) of the *building*, the FDWR need not comply with the maximum allowed by NECB Sentence 3.2.1.4.(1).

5) The existing FDWR and total *skylight* area are permitted to be increased by the minimum amount necessary to provide the functionality required as a result of a change of use within the altered area or in *building occupancy*. (See Note A-4.6.1.2.(5).)

6) The maximum normalized air leakage rate specified in NECB Sentence 3.2.4.2.(1) and the maximum air leakage rate specified in NECB Sentence 3.2.4.3.(1) are permitted to be increased to the minimum rates that will not adversely affect the performance or structural integrity of materials, components or assemblies of the environmental separators. (See Section 5.4. of Division B of the NBC-2020.)

Note A-4.6.1.2.(2)(c) Replacement of Existing Glazing.

The centre-of-glass U-value for the existing glazing provides an acceptable basis for comparison with the replacement glazing in order to demonstrate compliance with Clause 4.6.1.2.(2)(c), assuming the replacement glazing is provided with low conductivity spacers.

Note A-4.6.1.2.(5) Increase in FDWR.

Changes of use or *occupancy* may necessitate the addition of vertical *fenestration*, *skylight*s and/or doors to provide access to sufficient daylight, sufficient *means of egress*, or required functionality for the new use or *occupancy*.

4.6.2 Lighting

4.6.2.1. General

1) Scope: This Section is concerned with lighting components and systems covered in NECB Part 4.

2) Application: This Section applies to existing lighting components and systems subjected to *alteration* and new lighting components and systems installed in existing *building*s.

4.6.2.2. Requirements for compliance

1) Except for repair, maintenance and replacement, and except asprovided in Sentences (2) to (3), lighting components and systems shall comply with NECB Part 4.

2) Where the total wattage of all new and existing interior luminaires is 2000 W or less, the following requirements apply to *interior lighting alterations*:

a) the total wattage of the new and replaced luminaires shall not exceed

i) 50% of the total wattage of the removed luminaires, or

ii) the *interior lighting power allowances* specified in NECB Article 4.2.1.6., and

b) the *interior lighting* controls shall comply with Sentences NECB 4.2.2.1.(3), (16), (18) and (20).

3) Where 10 or fewer exterior luminaires are replaced, the following requirements apply to *exterior lighting alteration*s,

a) the total wattage of the replaced luminaires shall not exceed

(i) 50% of the total wattage of the removed luminaires, or

(ii) the *exterior lighting* power allowances specified in NECB Article 4.2.3.1., and

b) the *exterior lighting* controls shall comply with NECB Article 4.2.4.1.

4.6.3 Service Water Systems

4.6.3.1. General

1) Scope: This Section is concerned with *service water* equipment and systems covered in NECB Part 6.

2) Application: This Section applies to existing *service water* equipment and systems subjected to *alteration* and new *service water* systems installed in existing *building*s.

4.6.3.2. Requirements for compliance (see Note A-4.6.3.2.)

1) Except for repair and maintenance, and except as provided in Sentences (2) to (5) below, *service water* equipment and systems shall comply with NECB Part 6.
2) Except as provided in Sentences (3) and (4), existing parts of hot *service* water distribution systems that are not subjected to *alteration* and existing distribution systems need not comply with NECB Article 6.2.3.1.
3) Existing non-circulating, uninsulated hot *service water* distribution systems shall be provided with *heat traps* in accordance withNECB Sentence 6.2.3.1.(5).
4) Except where impractical because of structural or construction constraints, existing uninsulated hot *service water* distributionsystems shall comply with Sentence (5) where
   a) the added *service water* heating load exceeds 60% of the hydraulic load served by the existing system, or
   b) the length of added and replacement piping exceeds 60% of the length of piping in the existing system. (See Note A-4.6.3.2.(4) and (5).)
5) The existing uninsulated hot *service water* distribution systems described in Sentence (4) shall comply with NECB Article 6.2.3.1., except that
   a) for circulating systems, only the supply and return piping runs where hot

service water circulates are required to be insulated, and

b) for non-circulating systems with electric heating elements, only the piping runs along which heating elements are installed are required to be insulated. (See Note A-4.6.3.2.(4) and (5).)

6) Where the *alteration* of a *service water* heating system with a design temperature not higher than 60°C results in flow at a design discharge temperature higher than 60°C in portions of the system, separate remote heaters or booster heaters shall be installed for those portions of the system with a design temperature higher than 60°C.

Note A-4.6.3.2. Extent of Alteration for *Service Water* Systems.

The requirements of NECB Subsection 13.6.2. target only to the subsystems subjected to *alteration* and not the "entire" *service water* system. The scope of the subsections in NECB Part 6 should be used as a guideline to identify the boundaries of these subsystems

Note A-4.6.3.2.(4) and (5) Insulation of Piping in Existing Hot Service Water Distribution Systems.

The *alteration* of an existing hot *service water* distribution system offers the opportunity to significantly reduce energy loss by insulating runs of uninsulated distribution piping where the temperature of the hot *service water* is maintained through recirculation or with heating elements. The requirement in Sentence 4.9.2.1.(5) to insulate these piping runs is triggered if at least one of two criteria is met as a result of the *alteration*.

The first criterion, as set out in Clause 4.9.2.1.(4)(a), applies where the *service water* heating load served by the system is significantly increased. This criterion may be evaluated, for example, by using the hydraulic loads, in fixture units, of the equipment and services supplied by the system (see Subsections 2.4.10. and 2.6.3. of Division B of the NPC-2020).

The second criterion, as set out in Clause 4.9.2.1.(4)(b), applies where a significant length of piping is added to or replaced in the system. This criterion may be evaluated using measurements on plans that are representative of the existing installation.

The intent of Sentence 4.9.2.1.(5) is to ensure that existing uninsulated piping is insulated where the effort involved is reasonable, without requiring overly onerous demolition or reconstruction to access the piping. For example, piping runs in cavities within or behind *masonry* walls may be exempted from the insulation requirement, as may be piping runs where the available space does not allow for the installation of the required thickness of insulation. However, the opening and closing of drywall and the provision of access to a large pipe shaft are considered to be reasonable efforts.

4.6.4 Heating, Ventilating and Air-conditioning Systems

4.6.4.1. General

1) Scope: This Section is concerned with HVAC systems covered in NECB Part 5.
2) Application: This Section applies to existing HVAC systems subject to *alteration*s and new HVAC systems installed in existing *building*s.

4.6.4.2. Requirements for compliance (See Note A-4.6.4.2.)

1) Except for repair, maintenance and as provided in Sentences (2) and (3) below, HVAC equipment and systems shall comply with the requirements of NECB Part 5.
2) Parts of existing HVAC systems subjected to *alteration*, and replacement components shall comply with the requirements of NECB Part 5, adjusted as follows: where leakage testing of air distribution systems is performed to comply with the requirements of Subsection 5.2.2 of NECB Part 5., the entirety of air distribution systems undergoing *alterations* must be tested for leakage according to NECB Article 5.2.2.4., and
   a) where NECB Subsection 5.2.3. applies, fan systems subjected to *alteration* need only comply with:
      (i) for variable-air-volume systems, NECB Sentences 5.2.3.3.(2) and (3) and
      (ii) NECB Article 5.2.3.4, and
   b) except where impractical because of structural or construction constraints, only replacement air-handling units need comply with NECB Article 5.2.2.7.
3) Parts of the existing HVAC system that are not subject to *alteration*, need not comply with NECB Part 5, where
   a) the added thermal loads does not exceed 60% of the peak design load supplied by the existing HVAC system, and
   b) the length of added and replacement ductwork or piping does not exceed 60% of the length of ductwork or piping in the existing distribution systems. (See Note A-4.6.4.2.(3)(b))

Note A-4.6.4.2. Extent of Alteration for HVAC Systems

The requirements of Subsection 4.6.4. target only the HVAC subsystems subjected to *alteration* and not the "entire" HVAC system. The scope of the subsections in NECB Part 5 should be used as a guideline to identify the boundaries of these subsystems.

Note A-4.6.4.2.(3)(b) Criteria for Upgrading Existing HVAC Systems.

The *alteration* of existing HVAC systems presents an opportunity to reduce the energy use of these systems by upgrading them to meet the requirements of the current edition of the Code. The obligation to upgrade an HVAC system is triggered when at least one of two criteria is met as a result of the *alteration*.

The first criterion, as set out in Clause 4.6.4.2.(3)(a), applies where a significant thermal load is added to the system, for example, to a *boiler* plant. This criterion may be evaluated by comparing the peak thermal loads served by the system before and after its *alteration*.

The second criterion, as set out in Clause 4.6.4.2.(3)(b), applies where a significant length of ductwork or piping is added to or replaced in the distribution system. This criterion may be evaluated using measurements on plans that are representative of the existing installation.

4.6.5. Electrical Power Systems and Motors

4.6.5.1 General

1) Scope: This Section is concerned with electrical power systems and motors covered in NECB Part 7.
2) Application: This Section applies to existing electrical power systems and motors subjected to *alteration* and new electrical power systems and motors installed in existing *building*s.

4.6.5.1. Requirements for compliance

1) Except as provided in Sentence (2) below, electrical power systems and motors shall comply with NECB Part 7.
2) Sentence 1) does not apply to
   a) repair and maintenance, and
   b) the relocation or reuse of existing equipment at the same *building* site.

4.6.6. Administration

4.6.6.1. Information Required for Alteration Work

4.6.6.1.1. General Information Required

1) Sufficient information shall be provided to show that the proposed *alteration* will conform to this Code and whether or not it will affect adjacent property. (See Note A-2.2.2.1.(1).)
2) Plans shall be drawn to scale and shall indicate the nature and scope of the proposed *alteration* and proposed *occupancy* in sufficient detail to establish that, when completed, the proposed *alteration* and the proposed *occupancy* will conform to this Code.
3) If the proposed *alteration* is changed during construction, information on the changes shall comply with the requirements of this Section for *alteration* work.

4.6.6.1.2. Design Calculations and Analysis

1) The calculations and analysis carried out in the process of ensuring conformity with the requirements of this Code shall be available for inspection upon request.

4.6.6.1.3. Documentation on the Alteration of the Building Envelope

1) The following documentation on the *alteration* of the *building envelope* shall be

provided:

a) documentation on new or altered components, assemblies or systems in accordance with Article 2.2.2.3., and
b) justifications and support documentation for the proposed air leakage rates of the *air barrier system* or air barrier assemblies of the areas of the *building envelope* subjected to *alteration*, in support of the exception permitted in Sentence 13.3.2.1.(6)-2025 (PCF 1857) of Division B.

4.6.6.1.4. Documentation on the Alteration of Lighting Systems

1) The following documentation on the *alteration* of lighting systems shall be provided:
   a) an as-built single-line diagram of the lighting control system showing the location of each illuminated zone and associated switches and controls, including the extent of the areas subjected to *alteration*,
   b) *installed interior lighting power*, in kW, of the new and altered luminaires within the scope of the *alteration*,
   c) if the total wattage of new and altered luminaires is not greater than the threshold stated in Sentence 13.4.2.1.(2)-2025 of Division B (PCF 1858), the *interior lighting* power, in kW, of existing lighting systems within the scope of the *alteration*,
   d) average lighting power density, in W/m^2, for the areas within the scope of the *alteration*, obtained by dividing the *installed interior lighting power* by the total *floor area* of the *alteration*,
   e) if the *building area* method is used to determine the *interior lighting power allowance*, the associated lighting power density, in W/m^2, and the *gross lighted area*, in m^2,
   f) if the space-by-space method is used to determine the *interior lighting power allowance*, a detailed line-by-line breakdown of spaces, their *floor area*, in m^2, the associated lighting power densities, in W/m^2, and the resulting lighting power allowances, in kW,
   g) *interior lighting power allowance*, in kW, for the scope of the
   h) *alteration*,
   i) installed interior automatic controls and justification for exemptions,
   j) *exterior lighting* power, in kW, including a detailed line-by-line breakdown of spaces and/or functions, and the extent of areas subjected to *alteration*,
   k) if the number of new and altered exterior luminaires within the scope of the *alteration* is less than the threshold stated in Sentence 13.4.2.1.(3)-2025 of Division B (PCF 1858), the *exterior lighting* power, in kW, of existing *exterior lighting* systems within the scope of the *alteration*, and
   l) installed exterior automatic controls within the scope of the
   m) *alteration* and justification for spaces and/or functions exempted.

4.6.6.1.5. Documentation on the Alteration of HVAC Systems

1) The following documentation on the *alteration* of HVAC systems shall be provided:
   a) documentation on new and altered components, equipment and systems, in accordance with Article 2.2.2.5., and
   b) thermal load and ductwork or piping length calculations for existing HVAC systems.

4.6.6.1.6. Documentation on the Alteration of Service Water Systems

1) The following documentation on the *alteration* of *service water* systems shall be provided:
   a) documentation on new and altered components, equipment and systems in accordance with Article 2.2.2.6., and
   b) hydraulic load and piping length calculations for existing hot *service water* distribution systems.

4.6.7. Application of Part 10

1) Except as provided in Sentences (2) and (3), Part 10 of Division B applies to the *alteration* of existing *building*s or parts of existing *building*s. (See Note A-4.6.7.(1))
2) Part 10 of Division B does not apply to
   a) farm *building*s,
   b) tents,
   c) *air-supported structure*s,
   d) relocatable *building*s,
   e) open-air *storage garage*s,
   f) garages or carports described in Sentence 9.35.1.1.(1), or
   g) construction camps.
3) Part 10 of Division B does not apply to heritage *building*s or to parts of a *building* that have been formally recognized by a federal, provincial, territorial or municipal authority as having heritage value.

Note A-4.6.7.(1) Application of Part 10.

The requirements in Part 10 are intended to improve the energy performance of existing *building*s that are undergoing *alteration*.

4.7 Energy Efficiency of Housing and Small Buildings

4.7.1 General

4.7.1.1. Replacement Work

1) Where a component is being replaced, the energy performance level of that component shall not be decreased, unless it can be shown that the *building*'s overall energy

performance level will not be decreased as a result of the replacement.

4.7.2. Energy Efficiency

4.7.2.1. Service Water Heating Systems (See Note A-4.7.2.1.)

1) Except for maintenance and repair, replacement *service water* heating equipment shall conform to the performance requirements stated in NBC Article 9.36.4.2.
2) Where piping forming part of a *service water* heating system is replaced or exposed, the exposed portion of the piping shall be insulated in accordance with NBC Article 9.36.4.4.
3) Where *service water* heating systems with storage tanks are replaced, the installation of automatic temperature controls shall conform to applicable provincial or territorial regulations or, in the absence of such regulations, to NBC Sentence 9.36.4.5.(1).

Note A-4.7.2.1. Abandoned Inlets.

If the replacement of the HVAC or *service water* heating system or its components results in an abandoned inlet opening in a *chimney* or vent, the opening should be closed by an approved method to make the *chimney* or vent safe (see Clause 2.6.1.4.(3)(b) of Division B of the National Fire Code-2020). Consideration should also be given to removing and sealing a dedicated make-up air vent if the provision of make-up air is no longer required for the replacement *service water* heating system or component or for any other equipment identified in NBC Article 9.32.3.8.

4.7.2.2. Fenestration, Doors and Skylights

1) Except for maintenance and repair, and except as provided in Sentence (2), the energy performance of replacement *fenestration*, doors or *skylight*s and new *fenestration*, doors or *skylight*s installed in existing *building envelope* shall comply with NBC Article 9.36.2.7. (See Note A-4.7.2.2.(1))
2) To the extent possible, where only a glazing unit is replaced as part of an *alteration* and not a repair, the replacement glazing unit shall conform to NBC Table 9.36.2.7.-C or have a level of energy performance equivalent to that of the existing glazing unit, whichever provides the higher level of energy performance.
3) Where *fenestration*, doors or *skylight*s are replaced, the interfaces between wall/ceiling assemblies and the replacement *fenestration*, doors or *skylight*s shall conform to NBC Sentence 9.36.2.10.(10).

Note A-4.7.2.2.(1) Energy Performance of Replacement *Fenestration*, Doors and *Skylight*s.

Generally, replacing old *fenestration* products in an existing *building* with new products conforming to NBC Article 9.36.2.7. will sufficiently improve energy performance. However, some recently constructed Part 9 *building*s may have been designed and constructed to exceed the Code requirements for energy performance. Where making *alteration*s to these *building*s with the intent of replacing existing *fenestration*, doors or *skylight*s, Sentence 10.1.1.5.(1)-2025 (PCF 1824)

requires that the energy performance level of the replacement *building* component not be less than that of the replaced component. For these *building*s in particular, the selection of the appropriate *fenestration* products needs to take into account the characteristics of the existing *fenestration* products. For example, if an existing *building* has triple-glazed, windows, the replacement windows should have these same overall characteristics, even though these characteristics may exceed the minimum requirements set out in NBC Article 9.36.2.7.

Given that a glazing system in need of repair can only be replaced, it is important to use replacement glazing that provides a level of energy performance similar to that of the existing glazing. In order to provide adequate replacement glazing, the supplier will typically be able to determine the energy-performance characteristics of the existing glazing by performing a simple visual inspection or by considering the technical description of the existing glazing components and construction details.

For a *building* designed to a specific energy performance tier as specified in Section 9.36., the energy performance characteristics of the existing *fenestration* should ideally be identified in the documentation retained by the *authority having jurisdiction* and any replacement *fenestration* product should meet or exceed these energy performance characteristics.

Solar heat gain through windows in the summer is an important aspect that is often not considered in the design of *fenestration* for energy efficiency, which may focus on design for the winter (i.e., limiting thermal transmittance to the exterior).

4.7.2.3. Airtightness of an Existing Building Subjected to Alteration (See Note A-4.7.2.3.)

1) Where the continuity of the *air barrier system* is adversely affected by an *alteration*, or where a continuous *air barrier system* does not exist throughout the extent of the *alteration*
   a) discontinuous areas of the *air barrier system* shall be constructed in conformance with NBC Sentence 9.36.2.9.(1), or
   b) the *air barrier system* shall be tested in accordance with NBC Subsection 9.36.6. and achieve an Airtightness Level of at least AL-1A or AL-1B as specified in NBC Article 9.36.6.4. based on *building* type. (See NBC Tables 9.36.6.4.-A and 9.36.6.4.-B.)

Note A-4.7.2.3. Airtightness of an Existing Building Subjected to Alteration:

Effect of Airtightness on the Building Envelope

The *building envelope* is required to effectively minimize heat transfer, air leakage, vapour diffusion, and precipitation ingress. The systems performing these functions are interdependent, and a material in one of these systems may have multiple functions. To ensure that *alteration*s affecting airtightness do not adversely affect the overall performance of the *building* envelope, it is critical to understand that the *air barrier system* is one of several systems within the *building envelope* (see NBC Note A-9.25.3.3.(1)).

For materials that are used to fulfill the air barrier function, changing the location of the materials or selecting materials with different performance characteristics may affect the performance of other systems within the *building envelope*. For example, where rigid foam board is used as thermal insulation, it may also act as a component of an *air barrier system*; replacing the foam board with a material that offers thermal resistance, but does not provide acceptable air leakage resistance would compromise the performance of the *air barrier system*. (See also Notes NBC A-5.1.4.1.(2), A-9.25.4.2.(6) and A-9.25.5.1.) To avoid unintended consequences of *alteration*s, it is important to consider the house or *building* as one system required to perform multiple functions (*building*-as-a-system concept).

The intent of Article 4.7.2.3. is to improve the energy efficiency of *building*s subjected to *alteration* by increasing their airtightness, which may be achieved in different ways depending on the broader scope of the *alteration* project and its impact on the *building* as a system. The follow examples demonstrate simple and complex cases where the *air barrier system* may be upgraded within the scope of an *alteration* to an existing *building*:

- In a simple case of a single-room or -space renovation where the *air barrier system* is not the main focus, the goal might simply be to maintain, restore or improve the continuity of the existing *air barrier system* with minimal intervention.
- Another example of a simple case, but on a larger scale and with significant intervention, is a deep energy retrofit. The improvement of the entire *building envelope*, including the *air barrier system*, is the main focus of the project, particularly where the entire *air barrier system* is exposed and accessible. This case is similar to new construction, and it may be relatively easy to adhere to the *building*-as-a-system concept.
- More complex cases are renovation projects where as significant portion of the *building* is subjected to *alteration*, including cases where substantial upgrades are made to the *building envelope*, or where an extension is added to an existing *building*. In such cases, it is important to carefully apply the *building*-as-a-system concept to evaluate the risk of condensation in the parts of the *building envelope* that are unaltered. The risk of condensation may be lower where the thermal performance and airtightness of the new and existing parts of the *building* are relatively similar, while the risk of condensation may be higher where the new and existing parts of the *building* perform significantly differently.

Further information on airtightness and condensation control can be found in the Canadian Home Builders' Association (CHBA):2021, Renovators' Manual.

Effect of Airtightness on Other Building Systems

Improving the airtightness of a *building* not only improves the *building*'s energy efficiency, but also affects the *building*'s mechanical systems (e.g., ventilation, space heating, and cooling). Improved airtightness reduces the stack effect across the height of the *building*, which has the desirable effect of reducing unintended air infiltration through the *building envelope* assemblies.

However, indoor air quality may be adversely affected by the (unintentional) reduction of air flow,

which reduces the dilution of contaminants. The performance of ventilation systems (and possibly forced-air heating systems) should be reviewed and adjusted, especially in partially renovated *building*s where the unaltered part of the *building* may receive more of the unintended infiltration (and, with it, potentially moisture and other contaminants such as *soil* gases). One particular concern associated with increasing the airtightness of *building*s is that the indoor radon concentration could also increase (see NBC Note A-9.13.4.).

4.7.2.4. HVAC Systems

(See Note A-4.2.1.)

1) Except for maintenance and repair, and except as provided in Sentences (2) to (5), HVAC systems and equipment shall conform to NBC Subsection 9.36.3.
2) Where the *alteration* includes newly installed ducts and *plenum*s, they shall conform to NBC Article 9.36.3.2.
3) Where portions of existing HVAC ducts or *plenum*s are exposed within the extent of the *alteration*, the joints of those portions of ducts or *plenum*s shall be sealed in conformance with NBC Sentence 9.32.3.11.(8) and NBC Articles 9.33.6.2. and 9.33.6.3., as applicable.
4) Except as provided in Sentence (5), where a previously unconditioned space in a residential *building* is converted to a *conditioned space*, HVAC systems serving the space shall comply with NBC Sections 9.32. and 9.33.
5) Where the capacity of existing HVAC equipment is determined to be adequate to serve the existing *building* and extended portion, the HVAC equipment need not comply with NBC Table 9.36.3.10.-2020 and NBC Articles 9.36.11. and 9.36.12.-2025.

4.7.2.5. Thermal Characteristics of Above-Ground Opaque Building Assemblies

(See Note A-4.2.1. and Note A-4.7.2.5.)

1) Except for maintenance and repair, and except as provided in Sentence (7), where above-ground opaque *building* assemblies are subjected to *alteration*, and the structure is exposed or made accessible, the *effective thermal resistance* of the *building* assembly shall conform to Sentences (3) to (6).
2) Where insulation is installed to meet the requirements of Sentence (1), all applicable requirements in Part 9 shall be met. (See Note A-4.7.2.5.(2))
3) Except as provided in Sentence (7), where the stud cavity of an exterior wall or the interior unfinished surface of an exterior mass wall is exposed or made accessible by the *alteration* or is within the extent of the *alteration*, the *effective thermal resistance* of the wall shall
   (a) be assessed in accordance with NBC Article 9.36.2.2., and
   (b) conform to NBC Article 9.36.2.6.
4) Except as provided in Sentence (7), where the space above a ceiling below *attic* is exposed or made accessible by the *alteration* or is within the extent of the *alteration*, the *effective thermal resistance* of the ceiling shall

(a) be assessed in accordance with to NBC Article 9.36.2.2., and
(b) conform to NBC Article 9.36.2.6.

5) Except as provided in Sentence (7), where the joist cavity of a cathedral ceiling or flat roof is exposed or made accessible by the *alteration* or is within the extent of the *alteration*, the *effective thermal resistance* of the ceiling or roof shall
   (a) be assessed in accordance with NBC Article 9.36.2.2., and
   (b) conform to NBC Article 9.36.2.6.
6) Except as provided in Sentence (7), where the joist cavity of a floor over unheated space is exposed or made accessible by the *alteration* or is within the extent of the *alteration*, the *effective thermal resistance* of the floor shall
   (a) be assessed in accordance with NBC Article 9.36.2.2., and
   (b) conform to NBC Article 9.36.2.6.
7) Except as provided in Sentence (8), where the *effective thermal resistance* of the *building* assembly cannot be improved to meet the requirements of Sentences (2) to (6) due to construction limitations, structural constraints or loss of functionality of the space, the *effective thermal resistance* shall be improved to the extent possible. (See Note A-4.7.2.5.(7))
8) Where the *effective thermal resistance* of the *building* assembly cannot be improved in accordance with Sentence (7), another above-ground *opaque building assembly* within the extent of the *alteration* is permitted to be upgraded in accordance with NBC Sentence 9.36.2.11.(2).

Note A-4.7.2.5. - Thermal Characteristics of Building Assemblies.

If the thermal performance of an area of existing insulation is compromised, actions should be taken to bring the affected area to a compliant state. Typical issues that affect the thermal performance of cavity insulation and recommended actions are as follows:

1) Improper installation: This condition results from insufficient quality assurance and quality control during the original construction of the wall. The most common problems related to improper installation include
   - missing sections of insulation,
   - overly compressed insulation, and
   - gaps between the insulation and the surrounding constructionelement (e.g., studs, plates, exterior sheathing).

   All of these issues reduce the thermal resistance of the insulation and/or allow heat energy to bypass the insulation. Insulation should be added to fill missing sections and gaps. Overly compressed insulation should be replaced.
2) Settlement over time: Certain types of loose-fill insulation will slowly settle or compress over time. This settlement may occur with older installations of “blown-in” insulation, as

the original loft of the installation can be decreased by gravity. As a result, the insulation has an increased density and a lower thermal resistance. In exterior wall cavities, the top section of the cavity may become empty; thus, the original thermal performance of the design is compromised. Insulation should be added to fill these empty sections.

3) Deterioration of the cavity environment: Air and moisture movement within the cavity may result in dirt, moisture and/or mould accumulation within the insulation and cavity. These accumulations affect the thermal performance of the insulation by reducing the volume of still air captured by the insulation, which reduces the thermal resistance. Compromised insulation should be replaced.

Further information on best practices for the installation of insulation can be found in the following:

- Canadian Home Builders' Association (CHBA) (2021), "Renovators' Manual,"
- ASTM C1015-17, "Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation,"
- ASTM C1320-20, "Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction,"
- ASTM C1848-17a, "Standard Practice for Installation of High-Pressure Spray Polyurethane Foam Insulation for the *Building* Enclosure Significance and Use Achieving Quality Insulation Installation. Online at Insulation Installation, "Cellulose Insulation Manufacturers Association (CIMA), "Standard Practices for Installation of Cellulose Insulation in Canada", Technical Bulletin, February 2023,
- North American Insulation Manufacturers Association (NAIMA) website (www.insulationinstitute.org),
- NAIMA B1402-12, "Recommendations for Installing Mineral Fiber Insulation in Residential and Other Light-Frame Construction," and
- ANSI/RESNET/ICC 301-2019, "Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index."

Note A-4.7.2.5.(2) - Applicable Part 9 Requirements.

When increasing the *effective thermal resistance* of walls, ceilings below *attic*s, floors over unheated spaces, cathedral ceilings, or flat roofs, it is important to review Part 9 to confirm that all relevant requirements are met. As a result of Sentence 4.7.2.5.(2), the desired design approach may be constrained by the following Part 9 requirements, for example:

- NBC Subsection 9.10.3., Ratings,
- NBC Subsection 9.10.14., Spatial Separation Between *Building*s,
- NBC Subsection 9.10.15., Spatial Separation Between Houses,

- NBC Article 9.10.17.10., Protection of Foamed Plastics,
- NBC Section 9.19., *Roof Spaces*,
- NBC Section 9.25., Heat Transfer, Air Leakage and Condensation Control,
- NBC Subsection 9.25.5., Properties and Position of Materials in the *Building Envelope*,
- NBC Article 9.27.3.8., Flashing Installation, or
- NBC Section 9.29., Interior Wall and Ceiling Finishes

Note A-4.7.2.5.(7) - Improvement of Effective Thermal Resistance

The term "to the extent possible" is used to provide flexibility in response to the conditions encountered in the *alteration* of an existing *building*. In some instances and in certain locations, achieving the required *effective thermal resistance* will not be feasible in the *alteration* of an existing *building*. For example, the installation of insulation may be prevented or made difficult by the following:

- existing mechanical and electrical elements that are not intended to be changed in the *alteration*,
- existing structural components (e.g., walls, columns or beams) that obstruct the installation of insulation,
- stairwells located against an existing exterior wall, since Part 9 requirements might not permit the addition of insulation or since reconstructing or relocating the stairwell might require significant effort and cost,
- existing doors *framed* close to the existing wall that are not being changed as part of the *alteration*,
- a small room in a very old house, where adding insulation on the interior of exterior walls would make the room unusable (e.g., as a small bedroom or washroom) without rerouting *building* services or substantially reconstructing walls or structural supports.

"To the extent possible" is intended to encourage increasing thermal resistance as much as possible within these limitations. It is important to understand that there will be instances where upgrading, for example, the installation of additional insulation, will not be possible and that this is an acceptable outcome for specific locations.
The installation of any insulating materials should be implemented in a manner that manages the risk of undesirable consequences, such as condensation, especially where parts of the *building envelope* are insulated to a lower thermal resistance level than required or where insulation is added on the inside of a *masonry* wall, which may exacerbate the degradation of the *masonry*.

4.7.2.6 Thermal Characteristics of Building Assemblies Below-Grade or in Contact with the Ground

(See Note A-4.2.1.)

1) Except for maintenance and repair, and except as provided in Sentence (7), where *building* assemblies that are below-*grade* or in contact with the ground are subjected to *alteration*, and the structure is exposed or made accessible, the *effective thermal resistance* of the *building* assembly shall conform to Sentences (3) to (6).
2) Where insulation is installed to meet the requirements of Sentence (1), all applicable requirements of NBC Part 9 shall be met.
3) Except as provided in Sentence (7), where the stud cavity of an exterior *foundation* wall or interior surface of an exterior mass *foundation* wall is exposed or made accessible by the *alteration* or is within the extent of the *alteration*, the *effective thermal resistance* of the wall shall
   a) be assessed in accordance with NBC Article 9.36.2.2., and
   b) conform to NBC Article 9.36.2.8.
   c) Except as provided in Sentence (7), where a floor-on-ground isreplaced within the extent of the *alteration*, *effective thermal resistance* of the floor-on-ground shall conform to NBC Article 9.36.2.8. (See Note A-4.7.2.6.(3)(c))
4) Except as provided in Sentence (7), where a heated floor or an unheated floor above the frost line is exposed or made accessible by the *alteration* or is within the extent of the *alteration* and has accessible space belowit, the *effective thermal resistance* of the floor shall
   a) be assessed in accordance with NBC Article 9.36.2.2., and
   b) conform to NBC Article 9.36.2.8.
5) Except as provided in Sentence (7), where the exterior perimeter of a slab-on-*grade* with an integral footing or a heated or unheated floor on permafrost is exposed or made accessible by the *alteration* or withinthe extent of the *alteration*, the *effective thermal resistance* of the slab-on- *grade* or floor shall
   a) be assessed in accordance with NBC Article 9.36.2.2., and
   b) conform to NBC Article 9.36.2.8.
6) Where the *effective thermal resistance* of the *building* assembly cannotbe improved to meet the requirements of Sentences (2) to (6) due to construction limitations, structural constraints or loss of functionality of the space, the *effective thermal resistance* shall be improved to the extent possible. (See Note A-4.7.2.5.(7))

Note A-4.7.2.6.(3)(c) Alteration of Unheated Floors-on-Ground Below the Frost Line.

NBC Table 9.36.2.8.-A does not require insulation below unheated floors-on-ground that are below the frost line (i.e., typical *basement* slabs). If, within the extent of an *alteration*, a *basement* slab or a portion thereof is replaced or newly installed, additional insulation above or below this floor and further sealing of the air barrier to reduce the ingress of *soil* gases will offer additional benefits to occupants.