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Proposed Change 1858

Code Reference(s):	NECB20 Div.B 13.4. (first printing)
Subject:	Alteration of Existing Buildings
Title:	Alteration of Lighting Systems
Description:	This proposed change adds requirements that define the application of NECB Part 4 to lighting systems subjected to alteration.
Related Proposed Change(s):	PCF 1863

This change could potentially affect the following topic areas:

- | | |
|--|---|
| <input type="checkbox"/> Division A | <input checked="" type="checkbox"/> Division B |
| <input type="checkbox"/> Division C | <input checked="" type="checkbox"/> Design and Construction |
| <input type="checkbox"/> Building operations | <input type="checkbox"/> Housing |
| <input type="checkbox"/> Small Buildings | <input checked="" type="checkbox"/> Large Buildings |
| <input type="checkbox"/> Fire Protection | <input type="checkbox"/> Occupant safety in use |
| <input type="checkbox"/> Accessibility | <input type="checkbox"/> Structural Requirements |
| <input type="checkbox"/> Building Envelope | <input checked="" type="checkbox"/> Energy Efficiency |
| <input type="checkbox"/> Heating, Ventilating and Air Conditioning | <input type="checkbox"/> Plumbing |
| | <input type="checkbox"/> Construction and Demolition Sites |

General information

See the summary for subject Alteration of Existing Buildings.

Problem

The alteration of lighting components and systems in commercial buildings is very common. However, this opportunity to make energy-efficiency improvements is not well leveraged, such as by adopting more efficient LED lighting technology and products or employing new lighting controls to dim or switch off lights when the space is not occupied.

These alteration options provide a good opportunity to upgrade lighting systems to current minimum Code requirements. However, since renovation works in existing buildings are typically more costly than when building new constructions, the lighting requirements of Part 4 of Division B of the NECB applicable to these upgrades must be adapted to maintain an acceptable level of cost-effectiveness.

Justification

With the advent of LED lighting technology and products in today's marketplace, there are many opportunities to replace older lighting systems in existing buildings with these much more energy-efficient products as well as to employ new lighting control systems and schemes to manage more effectively the operation of lighting systems.

Examples include making better use of the daylight contribution and the ability to automatically turn off unnecessary lights to reduce the energy consumption of existing buildings. Due to the transformation of the lighting market to LED technology, the cost of LED lighting products has substantially reduced to make these products very competitive with older fluorescent lighting products.

This proposed change would align the threshold for interior lighting (2 000 W) and exterior lighting (10 luminaires) with those given in ANSI/ASHRAE/IES 90.1-2022, "Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings (I-P Edition)," and Vancouver Building By-law 2019.

PROPOSED CHANGE

[13.4.] -- Lighting

[13.4.1.] -- General

[13.4.1.1.] --- Scope

[1] --) This Section is concerned with lighting components and systems covered in Part 4.

[13.4.1.2.] --- Application

[1] --) This Section applies to existing lighting components and systems subjected to *alteration* and new lighting components and systems installed in existing *buildings*.

[13.4.2.] -- Compliance

[13.4.2.1.] --- Requirements

[1] --) Except for repair, maintenance and replacement, and except as provided

in Sentences (2) to (4), lighting components and systems shall comply with 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 Article 4.2.1.6., and
- [b] --) the *interior lighting* controls shall comply with Sentences 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 alterations*.

- [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 Article 4.2.3.1., and
- [b] --) the *exterior lighting* controls shall comply with Article 4.2.4.1.

Impact analysis

The impact analysis guidelines for the alteration of existing buildings, as illustrated in Figure 1, require that the proposed changes be evaluated for several building vintages. The key metric of interest in the impact analysis is the marginal difference between the current market practice and the proposed change.

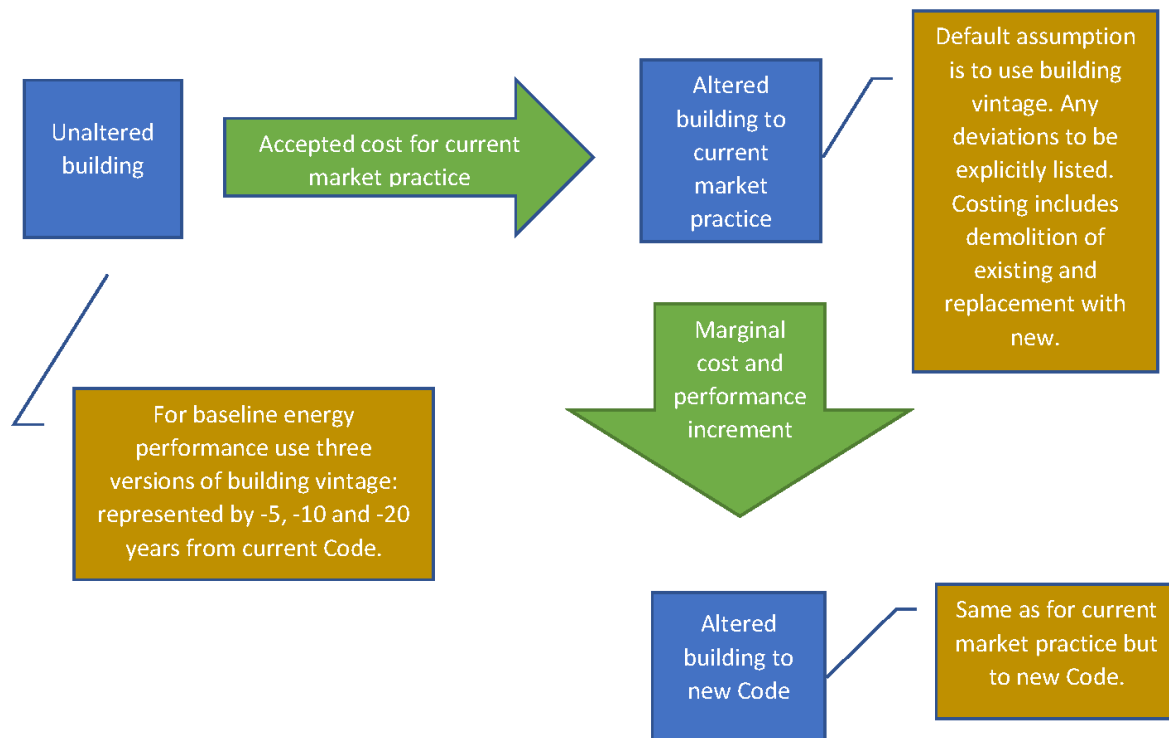


Figure 1. Impact analysis guidelines for the alteration of existing buildings

Since the prescriptive requirements for the alteration of existing buildings are triggered only when alterations are performed, the metric to evaluate the impact of the marginal cost and performance increment is defined as the comparison between the new prescriptive requirements and what would normally be done in the absence of such (i.e., current market practice).

For this analysis, four vintages of unaltered buildings were selected:

- Pre-1980
- 1980–2010
- NECB 2011
- NECB 2015

Current market practice is defined as complying with NECB 2017, and the proposed code is considered to be the NECB 2020.

To calculate the marginal energy increment, a model representing the vintage was created (see <https://github.com/NREL/openstudio-standards/tree/master/lib/openstudio-standards/standards/necb>). The lighting systems were then updated in the model to comply with the NECB 2017 requirements and the energy use intensity (EUI) calculated. The same process was followed for the NECB 2020 requirements. The marginal energy increment is the difference between these two EUIs. This process was repeated for all the vintages for 14 building archetypes in 32 locations across Canada; thus 1792 marginal energy increments were calculated. Summary results from the simulations are presented by region in Figures 2 and 3.

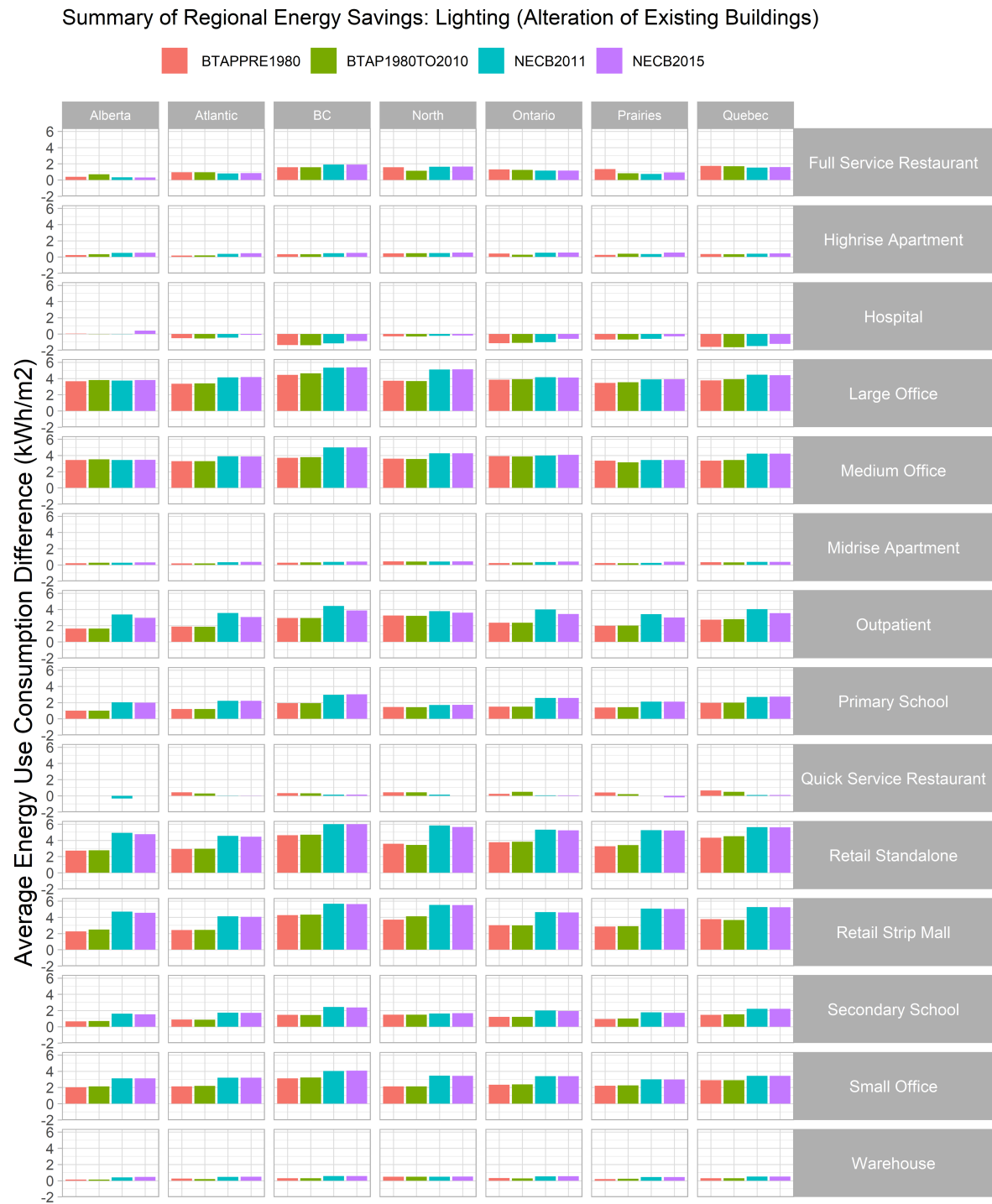


Figure 2. Marginal energy use intensity increment for various building archetypes and vintages in regions across Canada

Summary of Regional Percentage Energy Savings: Lighting (Alteration of Existing Buildings)



Figure 3. Marginal percentage energy use intensity increment for various building archetypes and vintages in regions across Canada

As can be seen, the increment is positive in almost all cases (i.e., the proposed change represents a reduction in energy use at the building level). The exception is the hospital archetype, where energy use increases slightly (less than 1%). This result was also observed in previous studies and is due to the increase in lighting power density (LPD) requirements for hospitals given the increased illumination requirements.

For the remainder of the archetypes, the changes are positive for all vintages and broadly similar across regions. The impact is greatest for buildings that are sensitive to lighting loads, i.e., office and retail buildings (up to 4% improvement over the current market practice). For buildings with minimally regulated lighting loads (e.g., multi-unit residential buildings (MURBs)) or energy use that is dominated by other subsystems (e.g., quick-service restaurants), the impact is minimal. Overall, the energy analysis demonstrates that the proposed change is no worse than current practice (excluding hospitals) and in some cases represents an improvement in energy performance.

The change in total lighting energy end use is presented in Figure 4. Comparing the results for the NECB 2020 and the NECB 2017 vintages, energy use increases for hospitals, but decreases for all other archetypes.

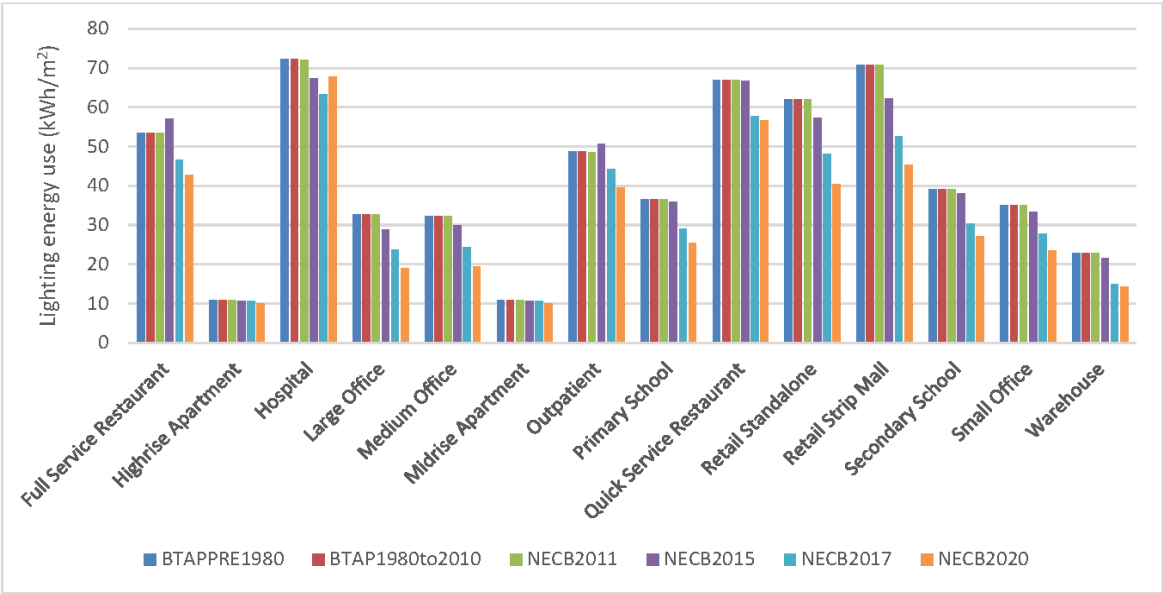


Figure 4. Lighting end use energy consumption by archetype and vintage

Cost estimates are subject to high levels of uncertainty. The following section is based on a 2019 report by Quantum Lighting Inc. on the lighting costs associated with switching from the LPDs prescribed in the NECB 2017 to those in the NECB 2020.

The costs for different fixtures to be expected in the 16 archetypes considered in this analysis are presented in Table 1. The average unit cost is the per fixture cost. Both the “Baseline” and “Current” columns refer to the same type of lighting fixture but specifically to different products with different illuminance (i.e., average performance (lm/W)). In some cases, fixtures in the baseline column are FL/CFL and are upgraded to LED; in other cases, LEDs are already used in current practice and the cost difference reflects the use of newer products.

Table 1. Changes in Per Unit Costs for Commonly Used Fixture Types

Type of Lighting Fixture	Baseline			Current Practice			Proposed Change		
	Average Performance, lm/W	Average Unit Cost, \$	Average Rated Life, LM70 hours	Average Performance, lm/W	Average Unit Cost, \$	Rated Life, LM70 hours	Performance Improvement, %	Unit Cost Reduction, %	Average Rated Life Improvement, %
CFL Downlight, replaced by LED	56	190.00	10 000	84	177.00	60 000	50	7	500
Inc Downlight, replaced by LED	56	153.00	5 000	84	177.00	60 000	50	-16	1100
CFL Wall Sconce, replaced by LED	56	85.00	10 000	76	75.50	60 000	36	11	500
Fl. Wall-mount Linear, replaced by LED	53	89.00	24 000	112	133.00	60 000	111	-49	150
LED Downlight	63	220.00	50 000	84	175.00	60 000	33	20	20
LED Direct	105	140.00	50 000	120	110.00	60 000	14	21	20
LED Linear Dir./Indir.	95	500.00	50 000	125	350.00	70 000	32	30	40
LED Task	56	140.00	50 000	60	29.99	50 000	7	79	0
LED Liner Wall Cover	88	230.00	50 000	150	135.00	60 000	70	41	20
LED Liner Wall Wash	75	580.00	50 000	106	520.00	50 000	41	10	0
Linear Direct Lensed	105	140.00	50 000	120	110.00	60 000	14	21	20
LED Linear Industrial	110	245.00	60 000	128	210.00	60 000	16	14	0
LED indirect Pendant	50	760.00	50 000	125	500.00	60 000	150	34	20
LED Low-Bay	117	315.00	80 000	135	225.00	100 000	15	29	25
LED High-Bay	113	450.00	100 000	145	250.00	100 000	28	44	0

Table 1 shows a cost savings instead of increase for the majority of the fixtures with the upgrades to NECB 2020. These findings, and the fact that the use of LED is already common practice for some spaces/archetypes, mean that the adherence to NECB 2020 would likely result in cost savings and a simple payback of 0 years.

Enforcement implications

The requirements for lighting in existing buildings subjected to alteration could be enforced by existing means and resources involved in the enforcement of the Part 4 requirements of the NECB.

Who is affected

Designers, specification writers, manufacturers, contractors, building owners and building officials.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[13.4.1.1.] -- ([1] --) no attributions

[13.4.1.2.] -- ([1] --) no attributions

[13.4.2.1.] -- ([1] --) no attributions

[13.4.2.1.] -- ([2] --) no attributions

[13.4.2.1.] -- ([2] --) no attributions

[13.4.2.1.] -- ([2] --) [F94-OE1.1]

[13.4.2.1.] -- ([3] --) no attributions

[13.4.2.1.] -- ([3] --) [F94-OE1.1]