NECB 2017 Update: Design Impacts and Lighting Requirements

IES Edmonton Section

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History of the NECB

Replaced the Model National Energy Code for Buildings 1997

- MNECB 1997 was heavily influenced by ASHRAE 90.1-1989

National Energy Code of Canada for Buildings

- NECB 2011 enforced in Alberta since Nov 1, 2016
- NECB 2015 was adopted in some provinces, but not Alberta
- NECB 2017 enforced in Alberta since Dec 1, 2019

What is the NECB?

Applies to:

- New ‘Part 3’ buildings
- Additions to ‘Part 3’ buildings
- Some new ‘Part 9’ buildings*

Does not apply to:

- Existing buildings
- Renovations
- Farm buildings
- Buildings with heating/cooling output < 10 W/m^2 (unconditioned)

** Housing and small buildings under §9.36 of Alberta Building Code*

NECB overview

Regulates energy end use

- *At the building, not the source*
- *Metric is energy, not cost*

Silent on alternative energy generation

Based on climate zone

- *Most of Alberta is in zone 7A/7B*

Silent on most process loads

- *Except pools and ice rinks*

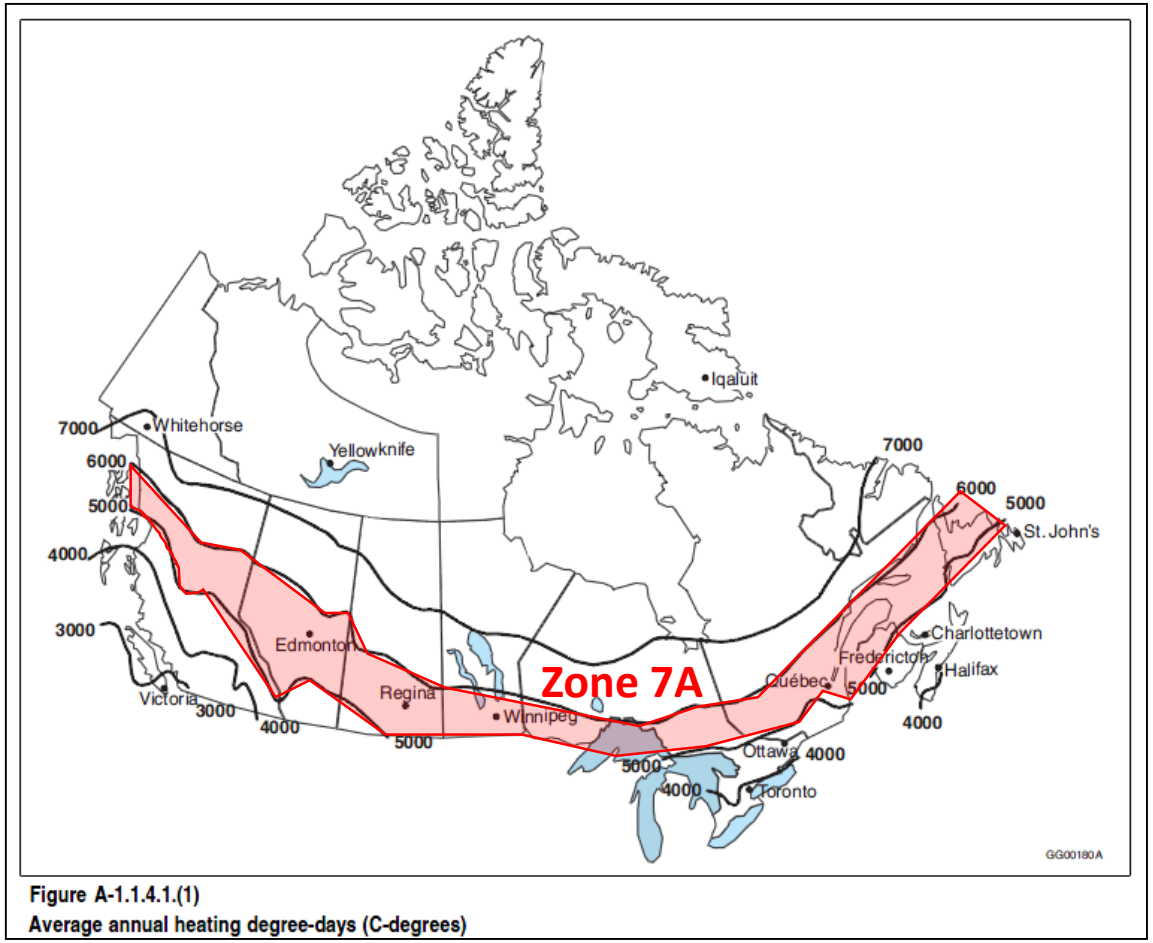


Figure A-1.1.4.1.(1)
Average annual heating degree-days (C-degrees)

NECB compliance

1. Prescriptive Path
 = checklist

2. Trade-off Path
 = calculation

3. Performance Path
 = energy model

Minimum performance (reference building) is defined by prescriptive requirements
 = "energy budget" or "baseline"

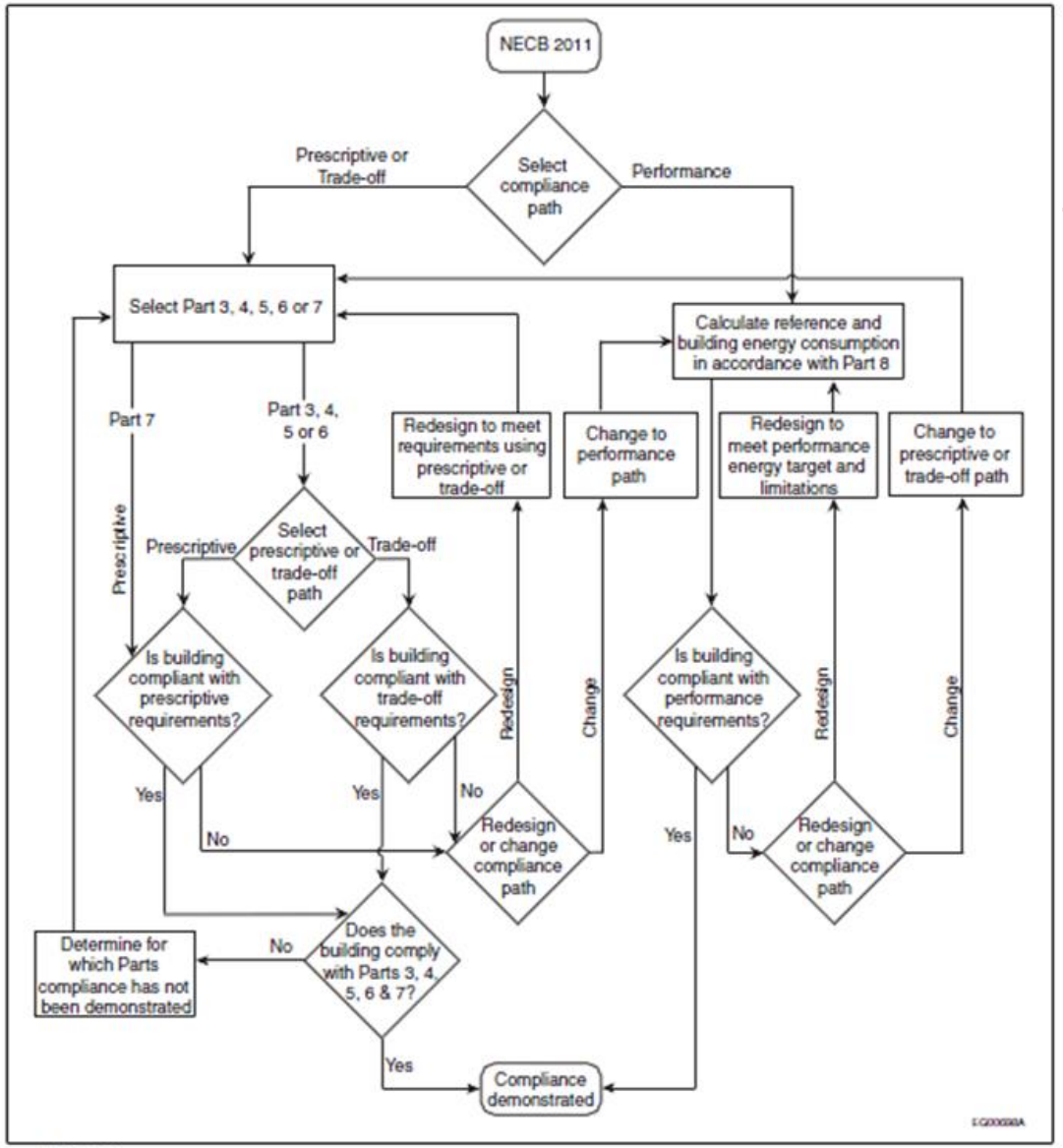


Figure A-1.1.2.1.
Decision flow chart for Code compliance

Why the update to NECB 2017?

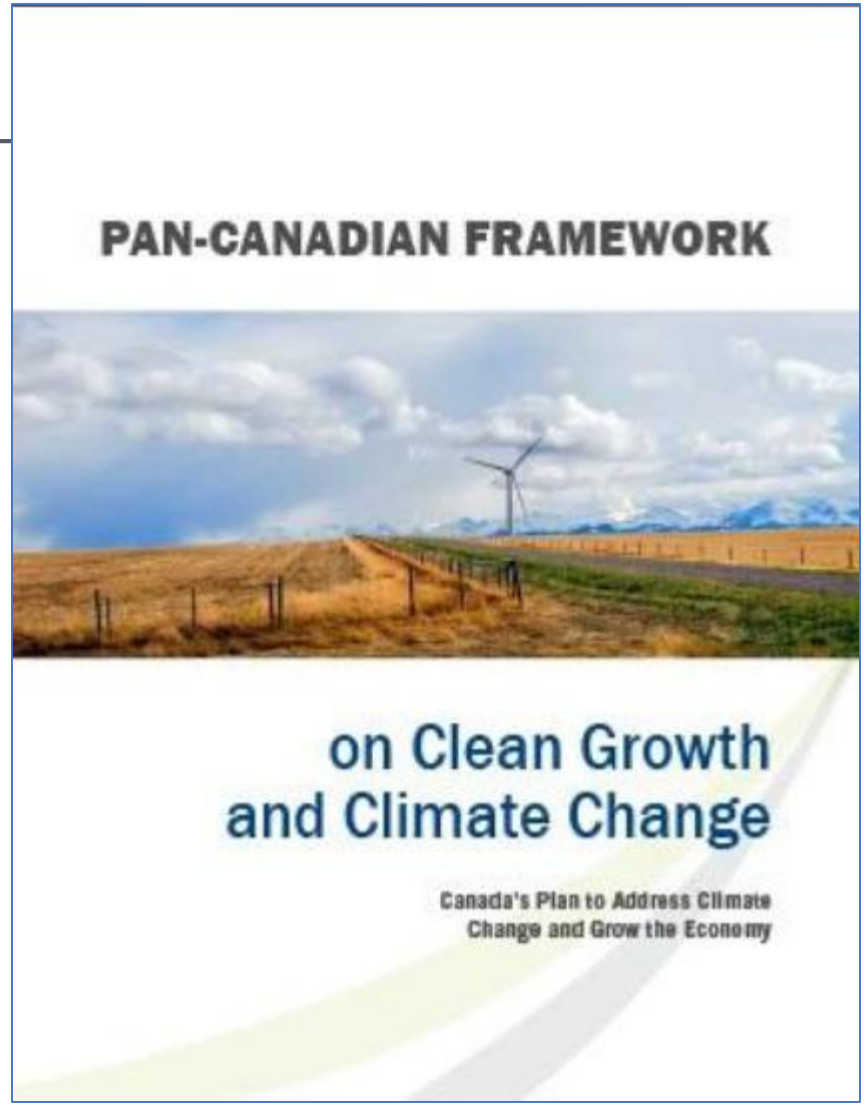
‘Net Zero Energy Ready’ by 2030

Savings ~10.3-14.4% over NECB 2011

Address loopholes and known issues in NECB 2011/2015

Align with other energy codes (particularly ASHRAE Standard 90.1)

Harmonize codes across Canada

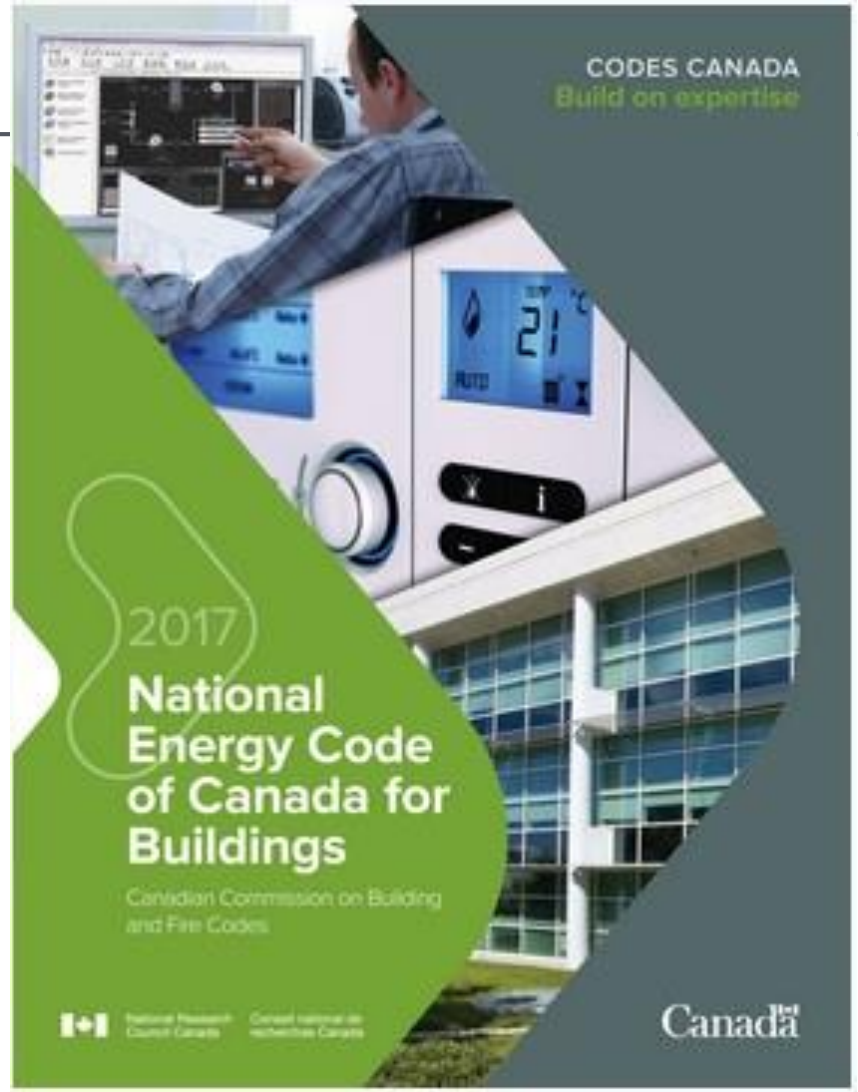


Notable updates in NECB 2017

Part 3: Building envelope performance
- R-values of roof, windows
- Air barrier requirements
- Thermal bridging analysis

Part 4: Lighting
- Lighting power densities
- Lighting controls
- Base site allowances for exterior lighting

Part 5: HVAC
- Equipment performance requirements
- Minimum energy (not just heat) recovery



Part 3 – wall and roof performance

Better wall and roof insulation

	Zone 7A U Value (W/sq.m. K)		Zone 7A ETR Imperial	
	NECB 2011	NECB 2017	NECB 2011	NECB 2017
Walls	0.21	0.21	27.04	27.04
Roofs	0.162	0.138	35.05	41.14
Floors	0.162	0.162	35.05	35.05
Fenestration	2.2	1.9	2.58	2.99

Semi-heated spaces considered Zone 6

Part 3 – window performance

U-value for fenestration and doors improved

NECB 2011: U-2.2 W/(m^2-K) = R-2.58

NECB 2017: U-1.9 W/(m^2-K) = R-2.99

Prescriptive window-to-wall ratio (FDWR) unchanged

Part 3 – air barrier

NECB 2011:

3.2.4.2.1) All opaque assemblies that act as environmental separators shall include an air barrier assembly.

NECB 2017:

3.2.4.2. Opaque Building Assemblies

1) All *opaque building assemblies* that act as environmental separators shall include an *air barrier assembly* conforming to Sentence (2) or (3).

2) Except as provided in Sentence (3), *air barrier assemblies* shall
a) conform to CAN/ULC-S742, "Air Barrier Assemblies – Specification," and
b) have an air leakage rate no greater than 0.2 L/(s·m²) at a pressure differential of 75 Pa.

(See Note A-3.2.4.2.(2) and (3).)

3) *Air barrier assemblies* are permitted to be tested in accordance with ASTM E 2357, "Determining Air Leakage of Air Barrier Assemblies," to meet the air leakage requirement stated in Sentence (2), provided
a) the *building* is erected in an area where the 1-in-50 hourly wind pressures do not exceed 0.65 kPa, and
b) the *air barrier assembly* is installed on the warm side of the thermal insulation of the *opaque building assembly*.

(See Note A-3.2.4.2.(2) and (3).)

Part 3 – thermal bridging

Effective R-value calculation more stringent

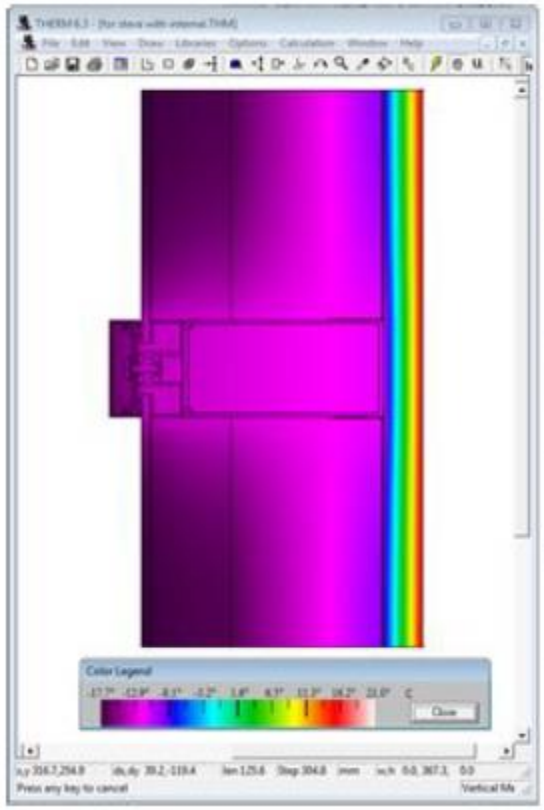
Thermal bridging calculated using 2D/3D heat transfer methods

3.1.1.7. Calculation of Overall Thermal Transmittance

1) In calculating the *overall thermal transmittance* of assemblies for purposes of comparison with the provisions in Section 3.2., the effect of thermal bridging shall be considered for

a) closely spaced repetitive structural members, such as studs and joists, and ancillary members, such as lintels, sills and plates,
b) major structural elements that penetrate or intersect the *building envelope* (see Note A-3.1.1.7.(1)(b)),
c) the junctions between the following *building envelope* materials, components, and assemblies:
   i) glazing assemblies,
   ii) spandrels,
   iii) parapets,
   iv) roof-to-wall junctions,
   v) corners, and
   vi) edges of walls or floors, and
d) secondary structural members (see Note A-3.1.1.7.(1)(d)).

Part 3 – thermal bridging



	R-value	U-value (W/m²-K)
Nominal	R-33 / RSI-5.81	0.172
Actual (2D heat transfer model)	**R-23 / RSI-4.05**	**0.247**
Actual (3D heat transfer model)	***R-9.2 / RSI-1.62***	***0.617***
NECB-Zone 6	R-23.0 / RSI-4.05	0.247
NECB-Zone 7a	**R-27 / RSI-4.8**	**0.21**

Part 5 – energy recovery

NECB 2011: heat recovery required if > 2300 L/s

NECB 2017: energy recovery of 50%, based on O/A and S/A rates

Table 5.2.10.1.-A
Supply Fan Airflow Rate Threshold Values at which an Energy Recovery System is Required for the Exhaust Air System: NON-CONTINUOUSLY OPERATING VENTILATION SYSTEMS(1)
Forming Part of Sentence 5.2.10.1.(1)

Heating Degree-Days of *Building* Location,(2) in Celsius Degree-Days	Percentage of Outdoor Air at Design Airflow Conditions							
	≥ 10% and < 20%	≥ 20% and < 30%	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
	Design Supply Fan Airflow Rate Threshold Values,(3) L/s (ft.³/min)							
Zone 4:(4) < 3000	NR	NR	NR	NR	NR	NR	NR	NR
Zone 5:(4) 3000 to 3999	≥ 12 270 (25 999)	≥ 7 550 (15 998)	≥ 2 600 (5 509)	≥ 2 120 (4 492)	≥ 1 650 (3 496)	≥ 940 (1 992)	≥ 470 (996)	R
Zone 6:(4) 4000 to 4999	≥ 12 270 (25 999)	≥ 7 550 (15 998)	≥ 2 600 (5 509)	≥ 2 120 (4 492)	≥ 1 650 (3 496)	≥ 940 (1 992)	≥ 470 (996)	R
Zones 7A and 7B:(4) 5000 to 6999	≥ 2 120 (4 492)	≥ 1 890 (4 005)	≥ 1 180 (2 500)	≥ 470 (996)	R	R	R	R
Zone 8:(4) ≥ 7000	≥ 2 120 (4 492)	≥ 1 890 (4 005)	≥ 1 180 (2 500)	≥ 470 (996)	R	R	R	R

Part 4 – interior lighting

Reductions in interior Lighting Power Densities (LPD) range from 15-65%

NECB 2015 aligns with ASHRAE 90.1-2013

NECB 2017 aligns with ASHRAE 90.1-2016

	Lighting Power Density (W/sqm)	
	NECB 2011	NECB 2017
Retail Sales	18.1	13.1
Dining food court	9.6	6.8
Office	11.9-11.0	10
Conference/Meeting	13.2	11.5
Classroom	13.3	10.3

Part 4 – controls

Lighting controls:

X - mandatory

A - choose one

B - choose one

Table 4.2.1.6.
Lighting Power Density Using the Space-by-Space Method and Minimum Lighting Control Requirements
Forming Part of Sentences 4.2.1.6.(1), 4.2.2.1.(2), (3), (6), (8), (9), (10), (13), (16), (18) and (20), 4.3.1.3.(5), 4.3.3.2.(1) and 8.4.4.5.(8)

Space Type	Lighting Power Density, W/m²	Type of Lighting Control[1]								
		Manual [see 4.2.2.1.(3)]	Restricted to Manual ON [see 4.2.2.1.(6)]	Restricted to Partial Automatic ON[2] [see 4.2.2.1.(8)]	Bi-Level [see 4.2.2.1.(9)]	Automatic Daylight Responsive Controls for Sidelighting [see 4.2.2.1.(10)][3]	Automatic Daylight Responsive Controls for Toplighting [see 4.2.2.1.(13)][4]	Automatic Partial OFF [see 4.2.2.1.(16)]	Automatic Full OFF[5] [see 4.2.2.1.(18)]	Scheduled Shut-off [see 4.2.2.1.(20)]
Common Space Types[6]										
Atrium										
< 6 m in height	1.06 per m (height)	X	A	A	–	X	X	–	B	B
≥ 6 m and ≤ 12 m in height	1.06 per m (height)	X	A	A	X	X	X	–	B	B
> 12 m in height	4.3 + 0.71 per m (height)	X	A	A	X	X	X	–	B	B
Audience seating area – permanent										
for auditorium	6.8	X	A	A	X	X	X	–	B	B
for convention centre	8.8	X	A	A	X	X	X	–	B	B
for gymnasium	7.0	X	A	A	X	X	X	–	B	B
for motion picture *theatre*	12.3	X	A	A	X	X	X	–	B	B
for penitentiary	3.0	X	A	A	–	X	X	–	B	B
for performing arts *theatre*	21.8	X	A	A	X	X	X	–	B	B
for religious *building*	16.5	X	A	A	X	X	X	–	B	B
for sports arena	4.6	X	A	A	–	X	X	–	B	B
other	4.6	X	A	A	–	X	X	–	B	B
Banking activity area and offices	9.3	X	A	A	X	X	X	–	B	B
Classroom/Lecture hall/Training room										
for penitentiary	14.4	X	A	A	X	X	X	–	X	–
other	10.3	X	A	A	X	X	X	–	X	–

8.4.3.4. Proposed

Lighting Power = Proposed LPD*$F_{occ,i}$*$F_{pers,i}$

4.3.2.10 Determination of Factors for Occupancy Control and Personal Control

$F_{occ,i} = 1-C_{A,i}*C_{occ,ctrl,i}$

$C_{A,i}$= factor for relative absence of occupants

See Table 4.3.2.10-A (based on space type).

Proposed factor = prescriptive

$C_{occ,ctrl,i}$ = factor for occupancy sensing mechanisms

Table 4.3.2.10-B (based on occupancy sensor)

Prescriptive: Table 4.2.1.6 dictates occupancy sensor type

Proposed = Design

$F_{pers,i} = 1 – C_{pers,ctrl,i}$

$C_{pers,ctrl,i}$ = factor to account for personal control

Table 4.3.2.10-A (based on space type)

Proposed = prescriptive for this factor

8.4.4.5 Baseline

Lighting Power = Reference LPD*Focc,i*Fpers,i

LPD = from tables 4.2.1.5 or 4.2.1.6 (based on building or space type)

If controls required (based on T4.2.1.6): use procedure from 4.3.2.10

A-8.4.4.5.(3) Controls Based on Space Occupancy. Subsection 4.2.2. presents several prescriptive control requirements for various space types. In establishing the reference building's energy consumption, the controls resulting in the highest energy consumption can be selected where compliance options are provided.

T4.2.1.6 gives multiple options for lighting control. Note A.8.4.4.5.(3) tells us that where multiple options are available, choose the one which will give the highest energy consumption for the reference model (ie. Assume manual controls)

Lighting Power = Proposed LPD*(1-CA,i*Cocc,ctrl,i)*(1-Cpers,ctrl,i)

Lighting Power = LPD * $(1-C_{A,i}*C_{occ,ctrl,i}) * (1-C_{pers,ctrl,i})$

Factor	Range	Proposed vs Reference	Impact
$C_{A,i}$ = factor for relative absence of occupants	0 if space often full Max =0.9 if room often empty (ie. Electrical/mechanical room)	Equal	If space often full, control type does not provide any savings since $C_{A,i} = 0$
$C_{occ,ctrl,i}$ = factor for occupancy sensing mechanisms	Manual controls 0.1 Automatic full off controls (with manual on or automatic partial on) 0.75	Different if automatic lighting controls are included in design. If only use manual controls in design, no lighting savings.	If $C_{A,i} \neq 0$, savings can be up to 58% between proposed and reference if LPD same in reference and proposed
$C_{pers,ctrl,i}$ = factor to account for personal control	0 unless office space or patient room 0.1 if office space or patient room	Equal	Can contribute 10% savings (max) to office space or patient room

Max savings from controls = 58% (example of mechanical room with automatic full off controls, manual on or automatic partial on controls – assuming LPD for proposed and reference are equal)

Refer to user guides for detailed explanations and example calculations

- NECB 2017
- ASHRAE 90.1-2016

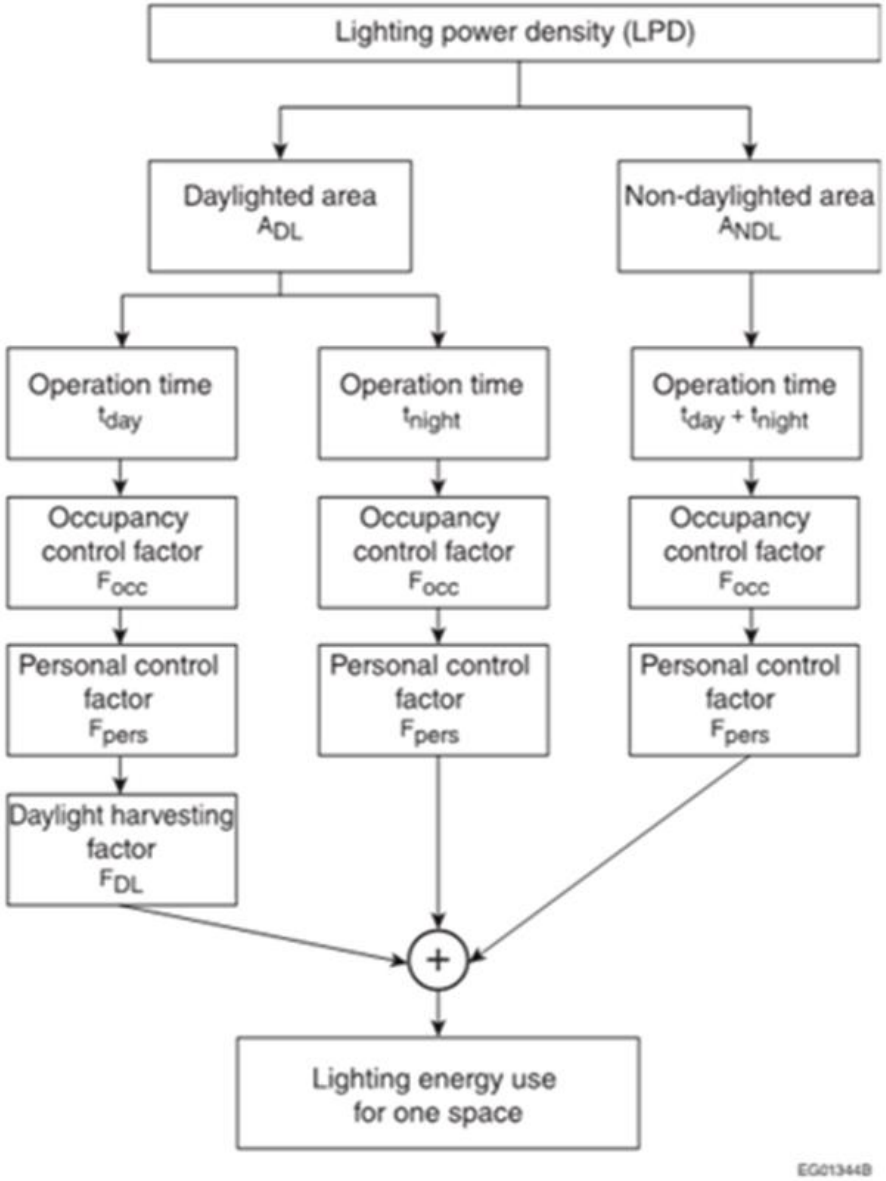


Figure 4-2
Graphical representation(1) of the calculation of estimated lighting energy use
Note to Figure 4-2:
(1) Adapted from Rosemann and Suvagau: Model To Determine Lighting Energy Savings In Commercial Buildings. Ingineria Iluminatului 2010; 12, 1: 33-42

Part 4 – exterior lighting

Reductions in base site allowances for exterior lighting

Zone	NECB 2011	NECB 2015	NECB 2017
4	1300 W	1300 W	900 W
3	750 W	750 W	500 W
2	600 W	600 W	400 W
1	500 W	500 W	350 W

Part 4 – exterior lighting

Reductions in LPD / LP allowances for both specific and general exterior applications

Table 4.2.3.1.-D
Lighting Power Allowances for General Building Exterior Applications
Forming Part of Sentence 4.2.3.1.(4)

Exterior Application	Lighting Power Allowances According to Lighting Zone				
	Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
Uncovered Parking Areas					
Parking areas and drives	No allowances	0.32 W/m²	0.43 W/m²	0.65 W/m²	0.86 W/m²
Building Grounds	No allowances				
Walkways less than 3 m wide		1.6 W/m	1.6 W/m	2.0 W/m	2.3 W/m
Walkways 3 m wide or greater, plaza areas, special feature areas		1.1 W/m²	1.1 W/m²	1.2 W/m²	1.5 W/m²
Stairways		6.5 W/m²	7.5 W/m²	7.5 W/m²	7.5 W/m²
Pedestrian tunnels		1.3 W/m²	1.3 W/m²	1.5 W/m²	2.3 W/m²
Landscape lighting		0.32 W/m²	0.43 W/m²	0.43 W/m²	0.43 W/m²
Exterior Entrances and *Exterior Exits*	No allowances				
Pedestrian and vehicular entrances and *exits*		46 W/m of door width	46 W/m of door width	69 W/m of door width	69 W/m of door width
Entry canopies		2.1 W/m²	2.7 W/m²	4.3 W/m²	4.3 W/m²
Sales Canopies					
Free-standing and attached	No allowances	4.3 W/m²	4.3 W/m²	6.5 W/m²	7.5 W/m²
Outdoor Sales	No allowances				
Open areas (including vehicle sales lots)		6.5 W/m²	6.5 W/m²	6.5 W/m²	6.5 W/m²
Street frontage for vehicle sales lots in addition to “open area” allowance		No allowance	23 W/m	23 W/m	69 W/m

How do these changes impact my projects?

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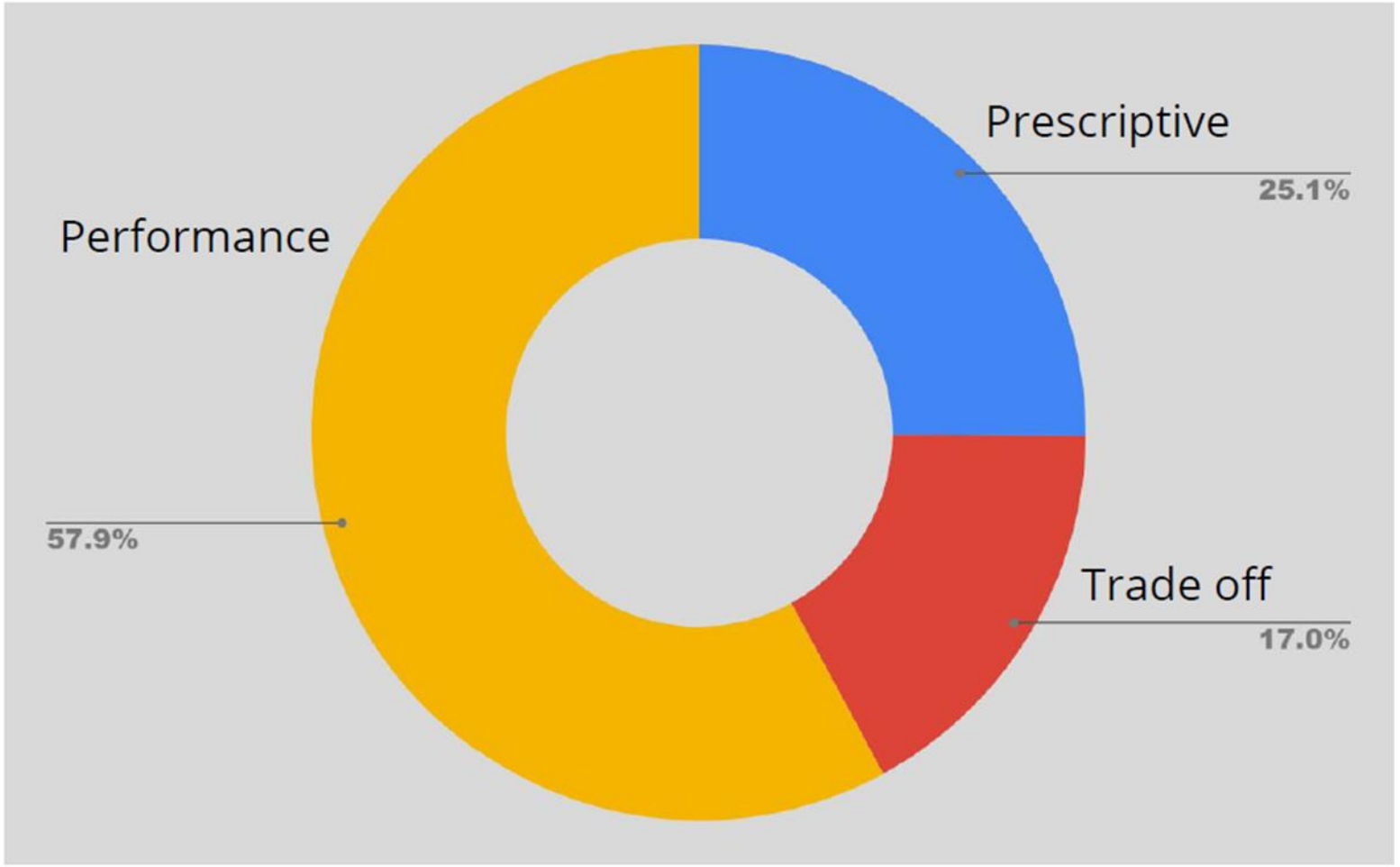
Edmonton observations with NECB 2011

Performance path was most common, with an increasing share of permit submissions since November 2016 as the industry gained familiarity with the new code.



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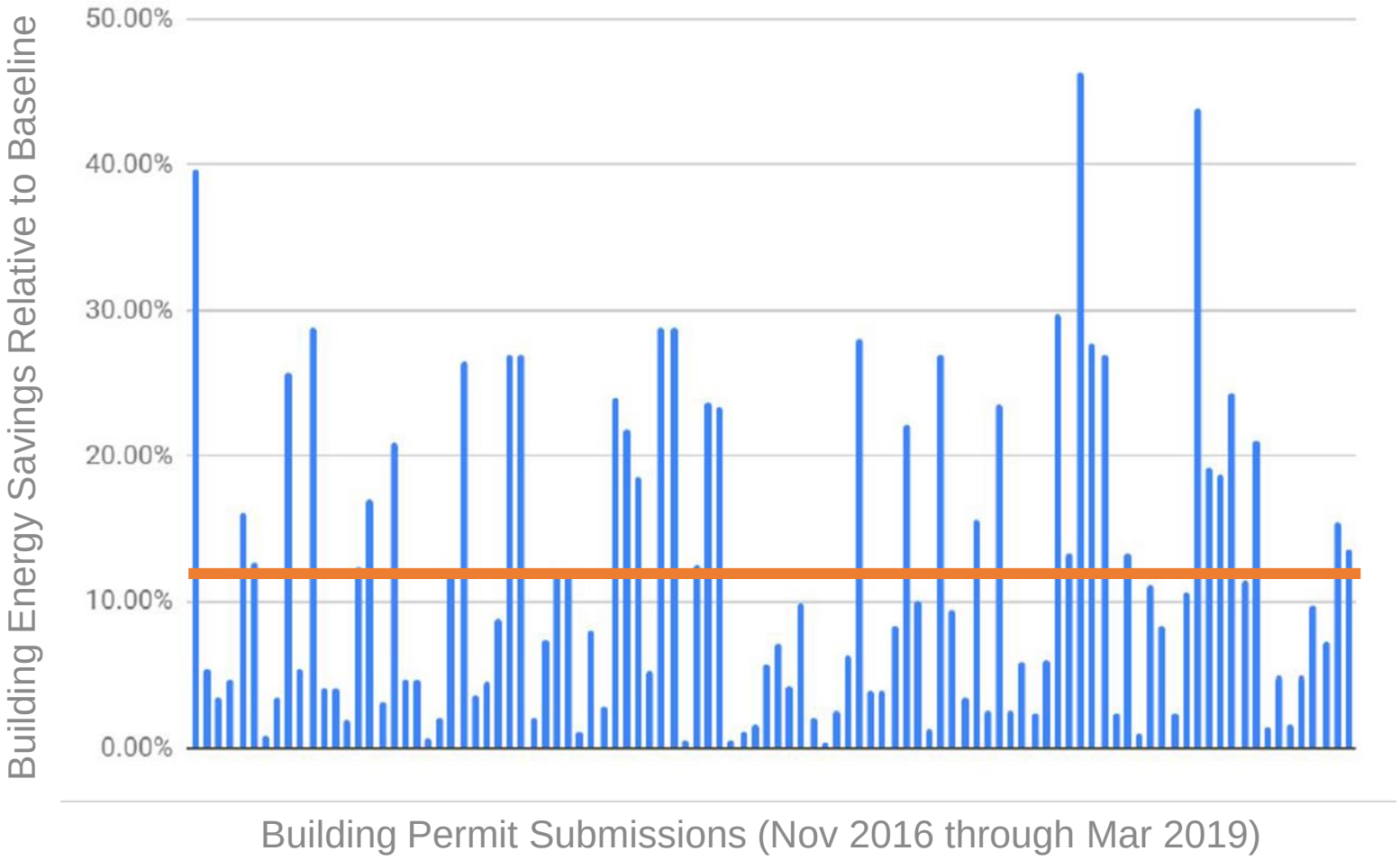
Edmonton observations with NECB 2011

Average energy performance **11.7%** better than baseline.

NECB 2017 is **~10-14%** better than NECB 2011.



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Average energy performance **11.7%** better than baseline.

NECB 2017 is **~10-14%** better than NECB 2011.

Building Type	Building Count	Average Energy Use (MJ)	Average Energy Use (kWh)	Average % better than NECB
Apartment	4	1,235,268	343,130	14.8%
Commercial	58	1,616,466	449,018	10.2%
CRU	1	2,068,399	574,555	2.1%
Group Home	0	-	-	-
Industrial	13	4,495,003	1,248,612	17.7%
Institutional	0	-	-	-
Mixed Use	8	2,695,507	748,752	9.6%
Public Service	5	2,382,525	661,813	22.3%
Residential	11	8,013,394	2,225,943	9.0%
TOTAL	100	2,808,236	780,065	11.7%

Building Permit Submissions (Nov 2016 through Mar 2019)

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What future changes are expected?

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Notable proposed changes for NECB 2020

Whole-building airtightness testing

Building envelope performance 15-20% better than 2017

(*more stringent R-values and FDWR*)

Interior LPDs align with ASHRAE 90.1-2019, 17% below 2017

Exterior lighting power allowances for unlisted applications

Delete HVAC, SWH trade-off paths

Introduce tiered performance levels

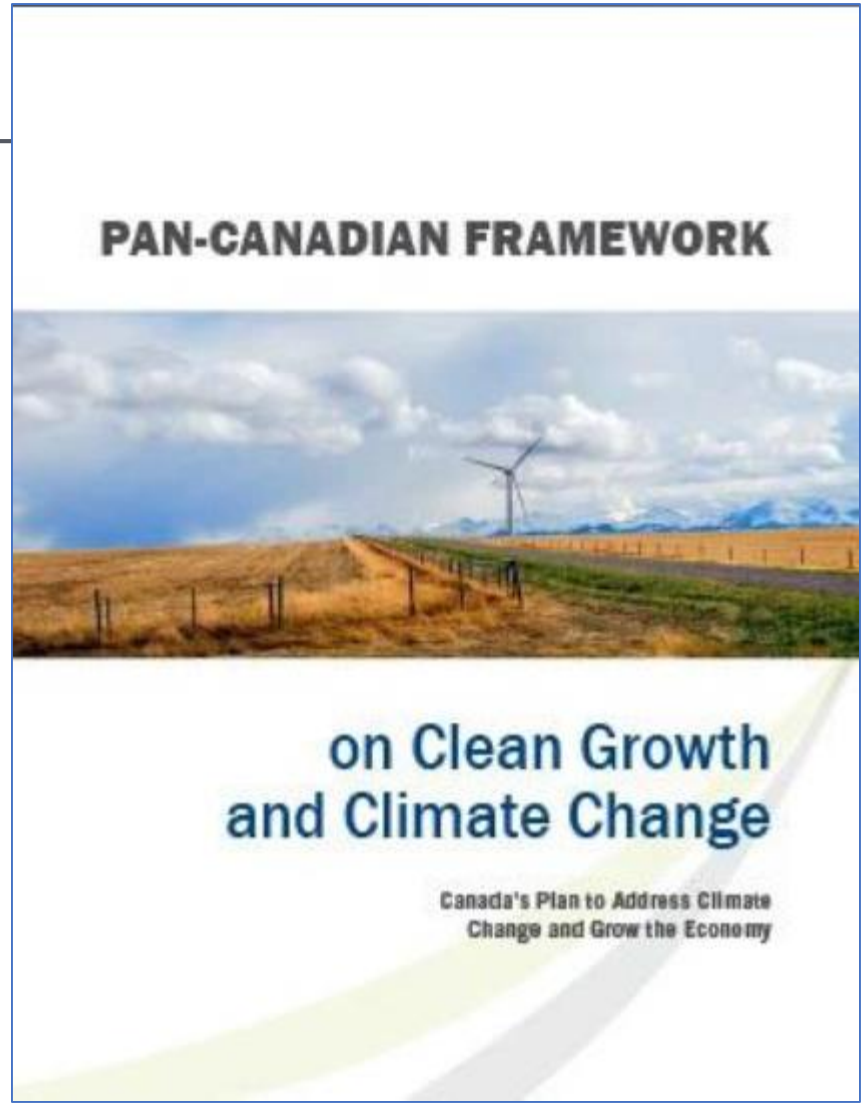
(*100% / 75% / 50% / 40% better than reference*)

Next steps for NECB 2020

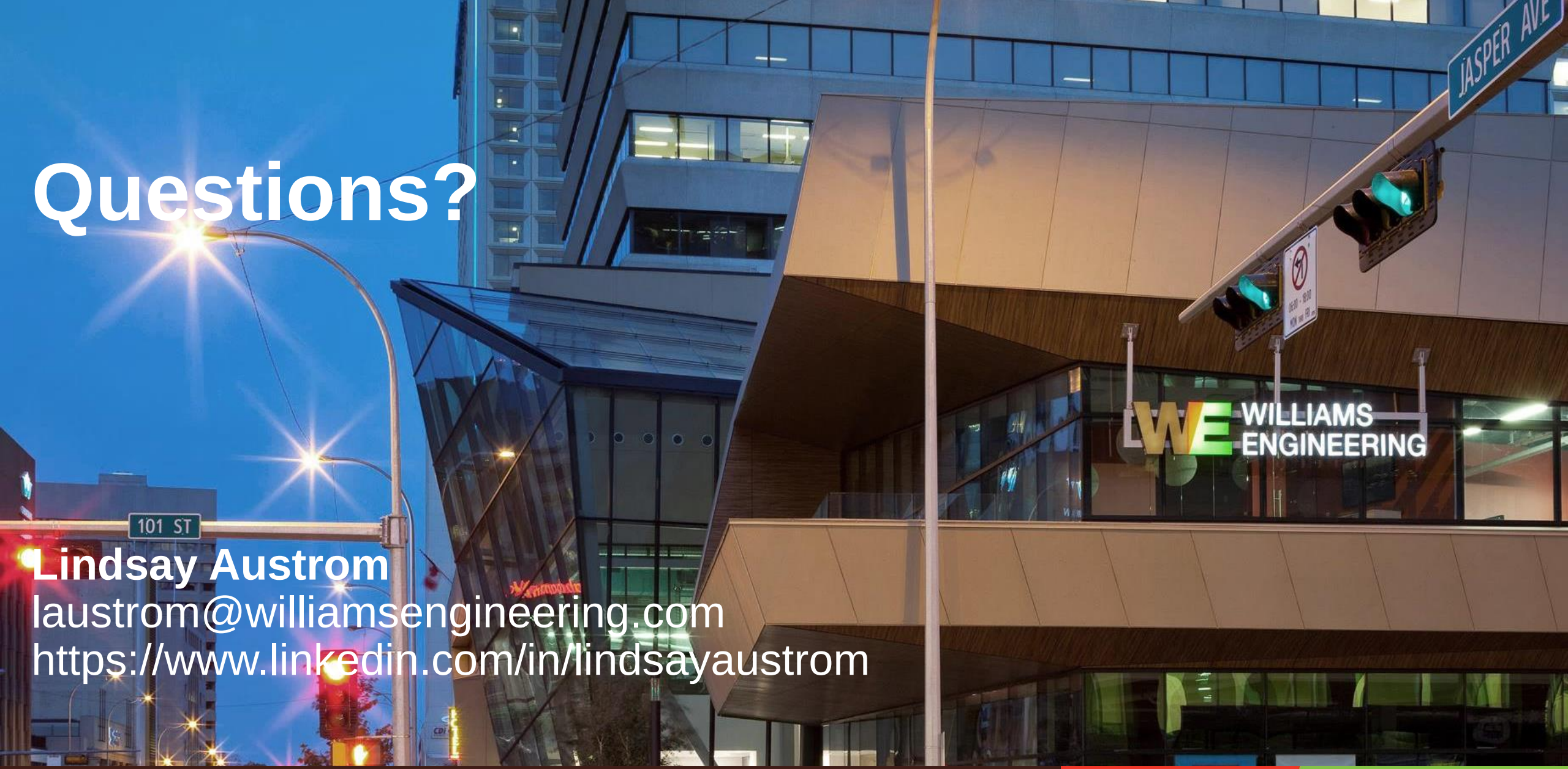
Public review of proposed code changes (NBC, NFC, NECB) January 13 to March 13, 2020

Review and submit your comments!

New model codes automatically adopted in Alberta code regulations, come into force 12 months from publication date



Questions?



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