NECB 2017 Update: Design Impacts and Lighting Requirements

IES Edmonton Section
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History of the NECB

• 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/m² (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
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”
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

<table>
<thead>
<tr>
<th></th>
<th>Zone 7A U Value (W/sq.m. K)</th>
<th>Zone 7A ETR Imperial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NECB 2011</td>
<td>NECB 2017</td>
</tr>
<tr>
<td>Walls</td>
<td>0.21</td>
<td>0.21</td>
</tr>
<tr>
<td>Roofs</td>
<td>0.162</td>
<td>0.138</td>
</tr>
<tr>
<td>Floors</td>
<td>0.162</td>
<td>0.162</td>
</tr>
<tr>
<td>Fenestration</td>
<td><strong>2.2</strong></td>
<td>1.9</td>
</tr>
</tbody>
</table>

Semi-heated spaces considered Zone 6
Part 3 – window performance

U-value for fenestration and doors improved
NECB 2011: U-2.2 W/(m²-K) = R-2.58
NECB 2017: U-1.9 W/(m²-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
### Part 3 – thermal bridging

<table>
<thead>
<tr>
<th></th>
<th>R-value</th>
<th>U-value (W/m²-K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal</td>
<td>R-33 / RSI-5.81</td>
<td>0.172</td>
</tr>
<tr>
<td>Actual (2D heat transfer model)</td>
<td>R-23 / RSI-4.05</td>
<td>0.247</td>
</tr>
<tr>
<td>Actual (3D heat transfer model)</td>
<td>R-9.2 / RSI-1.62</td>
<td>0.617</td>
</tr>
<tr>
<td>NECB-Zone 6</td>
<td>R-23.0 / RSI-4.05</td>
<td>0.247</td>
</tr>
<tr>
<td>NECB-Zone 7a</td>
<td>R-27 / RSI-4.8</td>
<td>0.21</td>
</tr>
</tbody>
</table>
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
Part 4 – interior lighting

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

<table>
<thead>
<tr>
<th></th>
<th>NECB 2011</th>
<th>NECB 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Sales</td>
<td>18.1</td>
<td>13.1</td>
</tr>
<tr>
<td>Dining food court</td>
<td>9.6</td>
<td>6.8</td>
</tr>
<tr>
<td>Office</td>
<td>11.9-11.0</td>
<td>10</td>
</tr>
<tr>
<td>Conference/Meeting</td>
<td>13.2</td>
<td>11.5</td>
</tr>
<tr>
<td>Classroom</td>
<td>13.3</td>
<td>10.3</td>
</tr>
</tbody>
</table>

NECB 2015 aligns with ASHRAE 90.1-2013

NECB 2017 aligns with ASHRAE 90.1-2016
Part 4 – controls

Lighting controls:
X - mandatory
A - choose one
B - choose one
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*F_{occ,i} * F_{pers,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

8.4.4.5.(3) Controls Based on Space Occupancy

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 (i.e., Assume manual controls)
**Lighting Power** = \( \text{LPD} \times (1 - C_{A,i} \times C_{\text{occ,ctrl,i}}) \times (1 - C_{\text{pers,ctrl,i}}) \)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Range</th>
<th>Proposed vs Reference</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_{A,i} ) = factor for relative absence of occupants</td>
<td>0 if space often full \nMax = 0.9 if room often empty (i.e., Electrical/mechanical room)</td>
<td>Equal</td>
<td>If space often full, control type does not provide any savings since ( C_{A,i} = 0 )</td>
</tr>
<tr>
<td>( C_{\text{occ,ctrl,i}} ) = factor for occupancy sensing mechanisms</td>
<td>Manual controls 0.1 \nAutomatic full off controls (with manual on or automatic partial on) 0.75</td>
<td>Different if automatic lighting controls are included in design. If only use manual controls in design, no lighting savings.</td>
<td>If ( C_{A,i} \neq 0 ), savings can be up to 58% between proposed and reference if LPD same in reference and proposed</td>
</tr>
<tr>
<td>( C_{\text{pers,ctrl,i}} ) = factor to account for personal control</td>
<td>0 unless office space or patient room \n0.1 if office space or patient room</td>
<td>Equal</td>
<td>Can contribute 10% savings (max) to office space or patient room</td>
</tr>
</tbody>
</table>

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 of the calculation of estimated lighting energy use

Note to Figure 4-2:
(1) Adapted from Rosemann and Susvaga: Model To Determine Lighting Energy Savings In Commercial Buildings. Ingeria Iluminatului 2010; 12, 1: 33-42
Part 4 – exterior lighting

Reductions in base site allowances for exterior lighting

<table>
<thead>
<tr>
<th>Zone</th>
<th>NECB 2011</th>
<th>NECB 2015</th>
<th>NECB 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1300 W</td>
<td>1300 W</td>
<td>900 W</td>
</tr>
<tr>
<td>3</td>
<td>750 W</td>
<td>750 W</td>
<td>500 W</td>
</tr>
<tr>
<td>2</td>
<td>600 W</td>
<td>600 W</td>
<td>400 W</td>
</tr>
<tr>
<td>1</td>
<td>500 W</td>
<td>500 W</td>
<td>350 W</td>
</tr>
</tbody>
</table>
Part 4 – exterior lighting

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

<table>
<thead>
<tr>
<th>Exterior Application</th>
<th>Lighting Power Allowances According to Lighting Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Zone 0</strong></td>
<td><strong>Zone 1</strong></td>
</tr>
<tr>
<td>Uncovered Parking Areas</td>
<td>No allowances</td>
</tr>
<tr>
<td>Parking areas and drives</td>
<td>No allowances</td>
</tr>
<tr>
<td>Building Grounds</td>
<td>No allowances</td>
</tr>
<tr>
<td>Walkways less than 3 m wide</td>
<td>No allowances</td>
</tr>
<tr>
<td>Walkways 3 m wide or greater, plaza areas, special feature areas</td>
<td>No allowances</td>
</tr>
<tr>
<td>Stairways</td>
<td>No allowances</td>
</tr>
<tr>
<td>Pedestrian tunnels</td>
<td>No allowances</td>
</tr>
<tr>
<td>Landscape lighting</td>
<td>No allowances</td>
</tr>
<tr>
<td>Pedestrian and vehicular entrances and exits</td>
<td>No allowances</td>
</tr>
<tr>
<td>Sales Canopies</td>
<td>No allowances</td>
</tr>
<tr>
<td>Free-standing and attached</td>
<td>No allowances</td>
</tr>
<tr>
<td>Outdoor Sales</td>
<td>No allowances</td>
</tr>
<tr>
<td>Open areas (including vehicle sales lots)</td>
<td>No allowances</td>
</tr>
<tr>
<td>Street frontage for vehicle sales lots in addition to &quot;open area&quot; allowance</td>
<td>No allowances</td>
</tr>
</tbody>
</table>
How do these changes impact my projects?
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.

Data provided by Juan Monterrosa, City of Edmonton. Used with permission.

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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Edmonton observations with NECB 2011

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

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

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

Building Permit Submissions (Nov 2016 through Mar 2019)

Data provided by Juan Monterrosa, City of Edmonton. Used with permission.
What future changes are expected?
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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