National Energy Code for Buildings (NECB) Overview

National Research Council Canada
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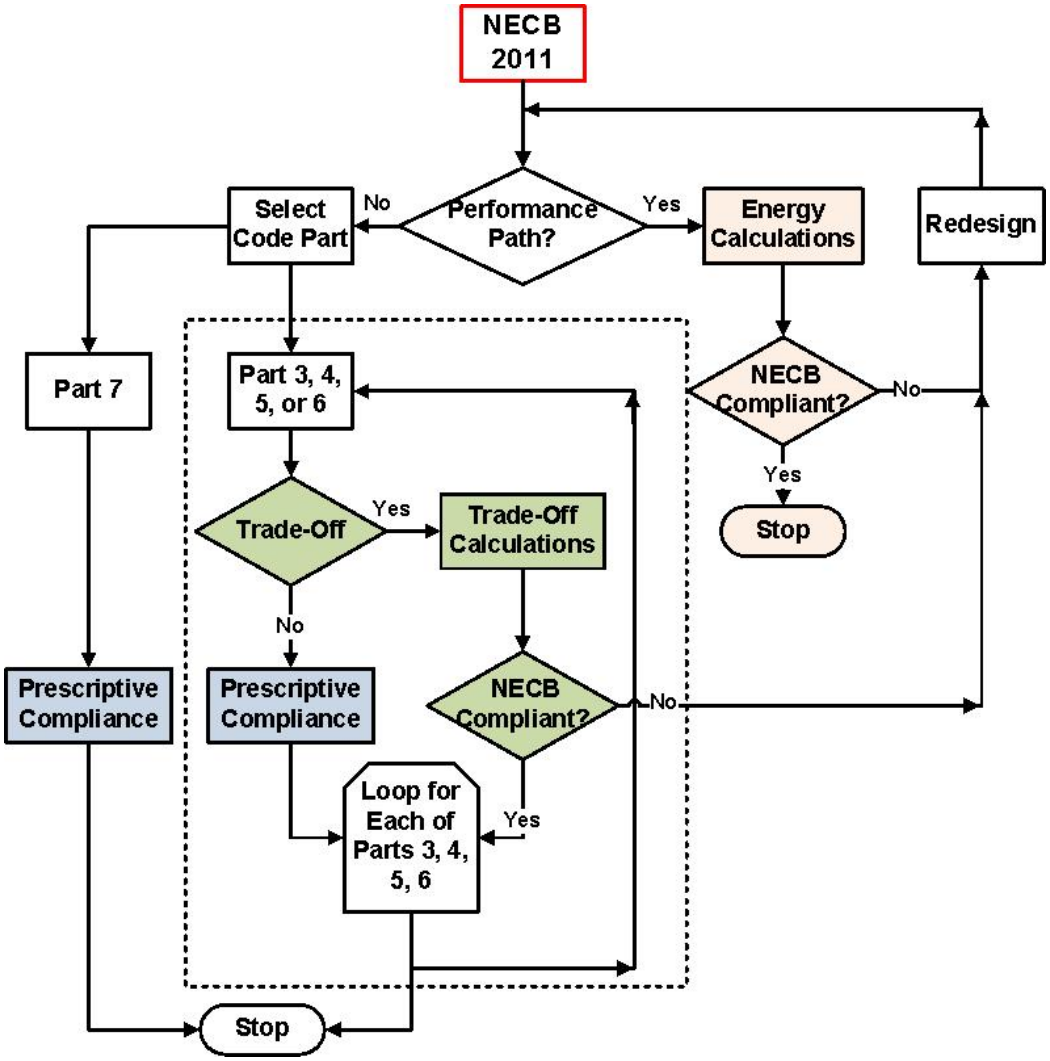
Document organization

- Division A: Objective
- Division B: Technical Requirement
  - Part 3: Building Envelope
  - Part 4: Lighting
  - Part 5: Heating, Ventilating and Air-Conditioning Systems
  - Part 6: Service Water Heating Systems
  - Part 7: Electrical Power Systems and Motors
  - Part 8: Performance Path
- Division C: Administrative requirements

NECB compliance paths



6 Service Water Heating

6.1. General

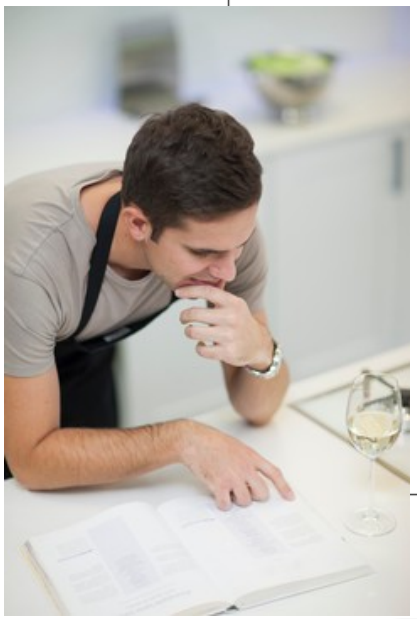
Select compliance path

Prescriptive Path

Performance Path

Trade-off Path

Building

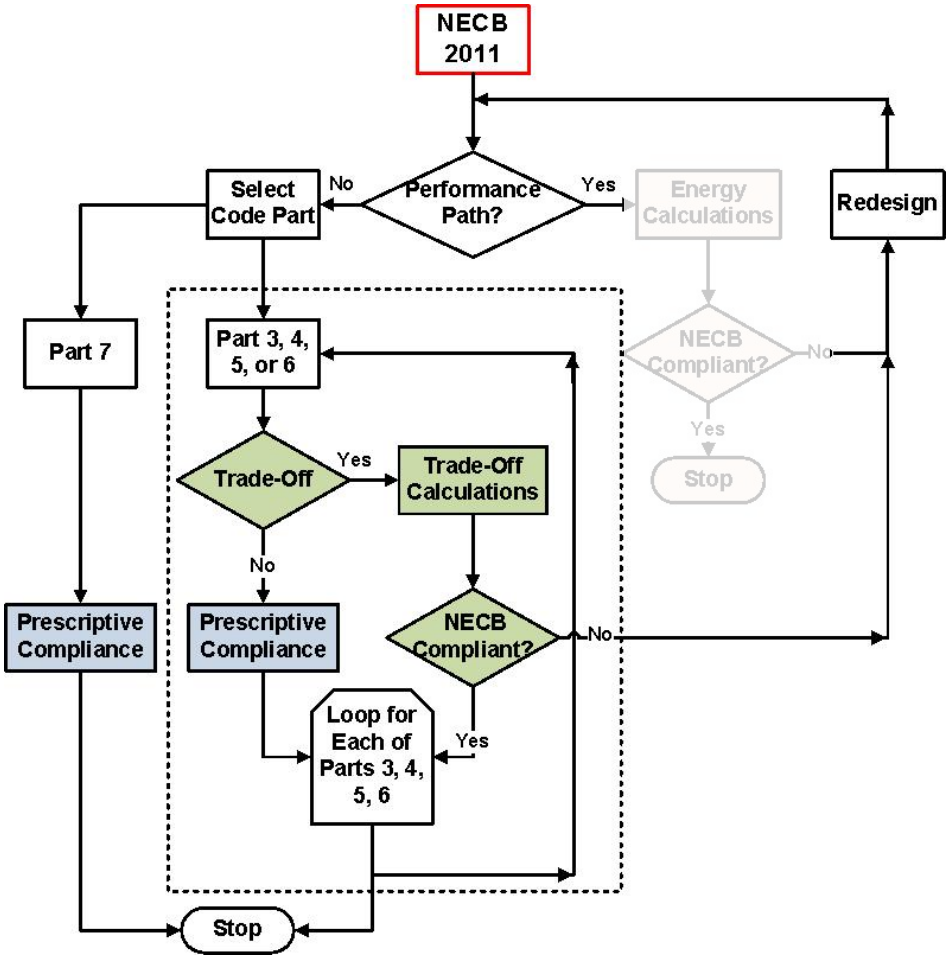


Compliance with Part 6 achieved

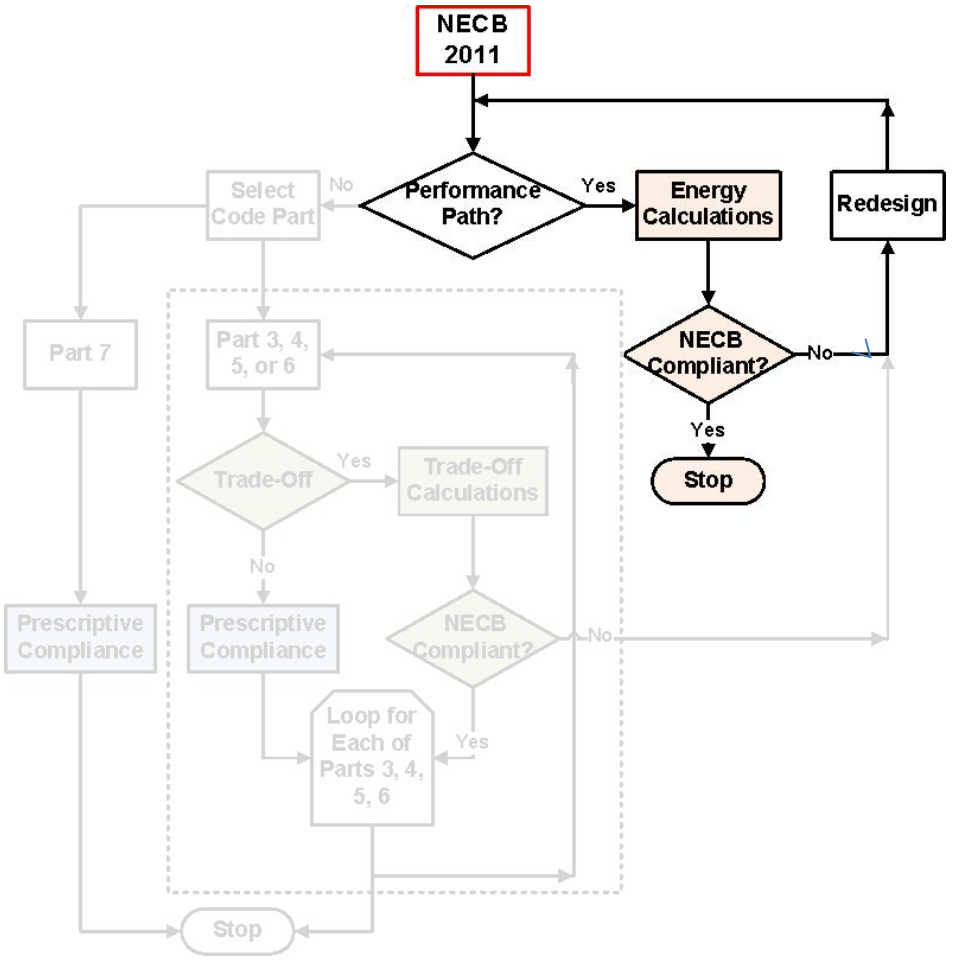
Compliance with NECB achieved

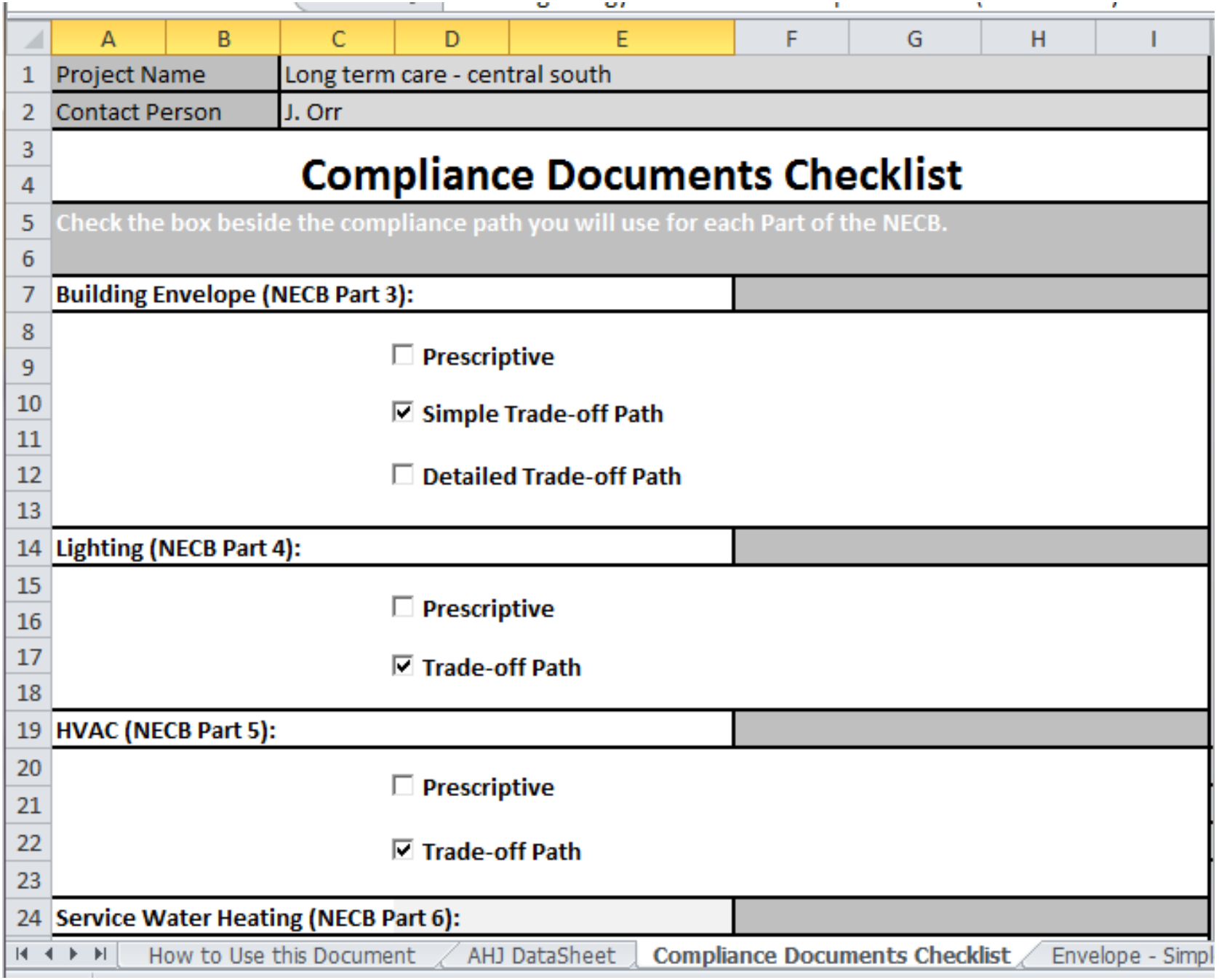
Prescriptive and trade-off paths

- Mix and match simple prescriptive and trade-off paths
- Use trade-off within same Part only



Compliance path





	A	B	C	D	E	F	G	H	I
1	Project Name		Long term care - central south						
2	Contact Person		J. Orr						
3									
4	**Compliance Documents Checklist**								
5	Check the box beside the compliance path you will use for each Part of the NECB.								
6									
7	**Building Envelope (NECB Part 3):**								
8									
9	☐ **Prescriptive**								
10	☑ **Simple Trade-off Path**								
11									
12	☐ **Detailed Trade-off Path**								
13									
14	**Lighting (NECB Part 4):**								
15									
16	☐ **Prescriptive**								
17	☑ **Trade-off Path**								
18									
19	**HVAC (NECB Part 5):**								
20									
21	☐ **Prescriptive**								
22	☑ **Trade-off Path**								
23									
24	**Service Water Heating (NECB Part 6):**								

How to Use this Document | AHJ DataSheet | **Compliance Documents Checklist** | Envelope - Simpl

Which is not a compliance path of Division B the NECB?

A. Prescriptive
B. Trade-off within part
C. Performance path
D. Alternative solutions

Which is not a compliance path of Division B the NECB?

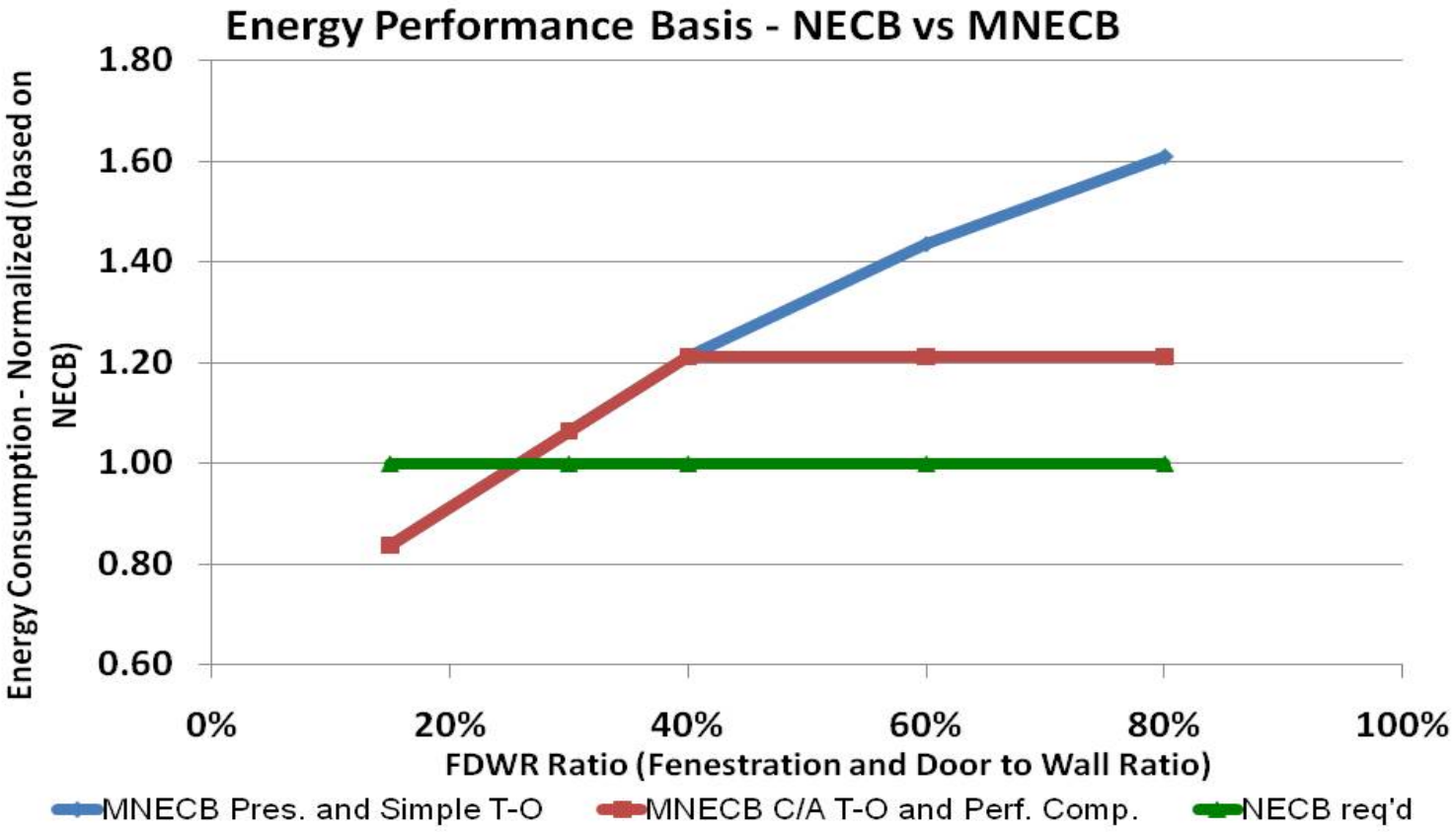
A. Prescriptive
B. Trade-off within part
C. Performance path
D. Alternative solutions

NECB performance levels

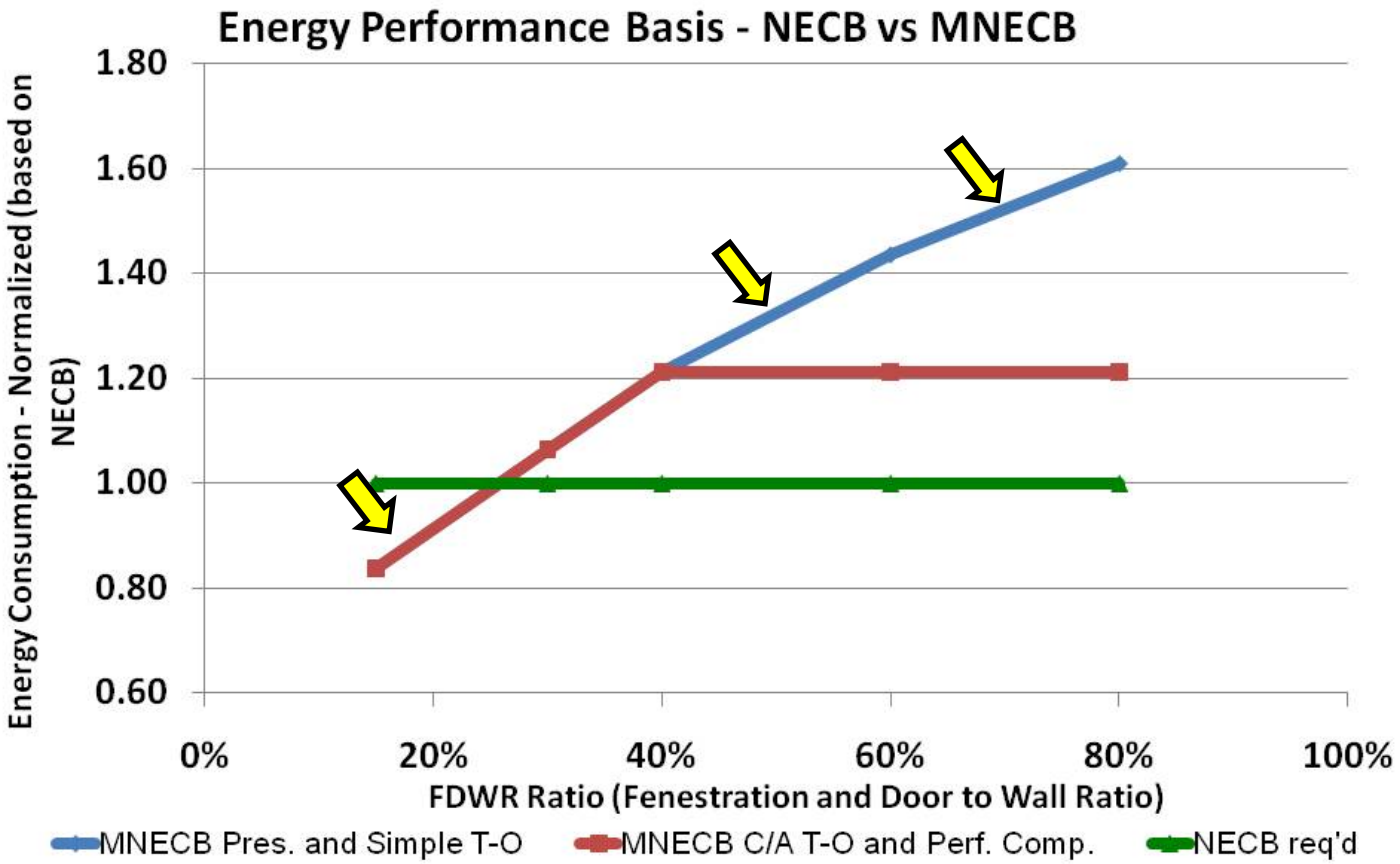
- One consistent minimum acceptable performance level for all paths

- Established by required U-value and maximum fenestration and door to wall ratio (FDWR) for location's climatic conditions

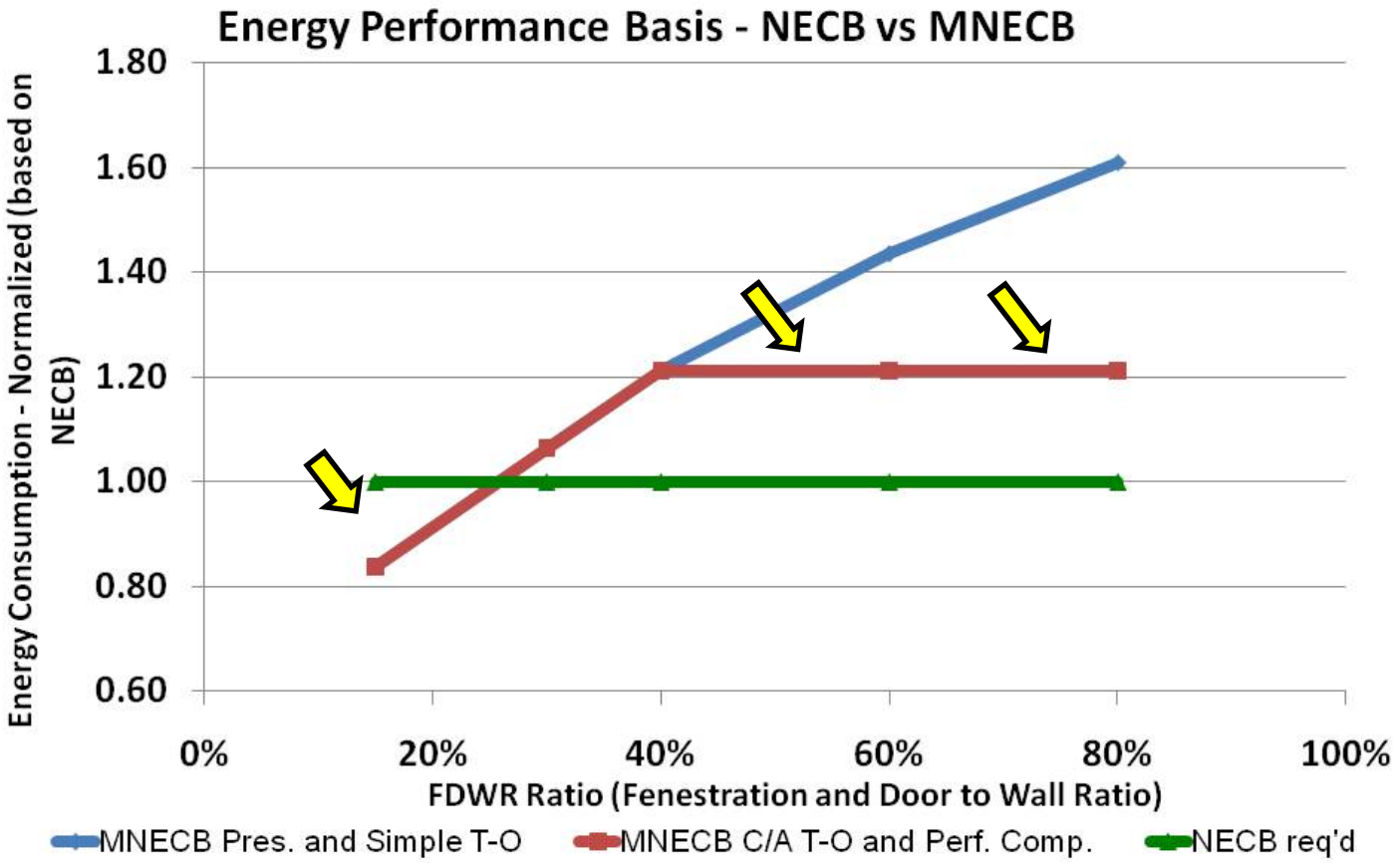
MNECB vs. NECB performance levels



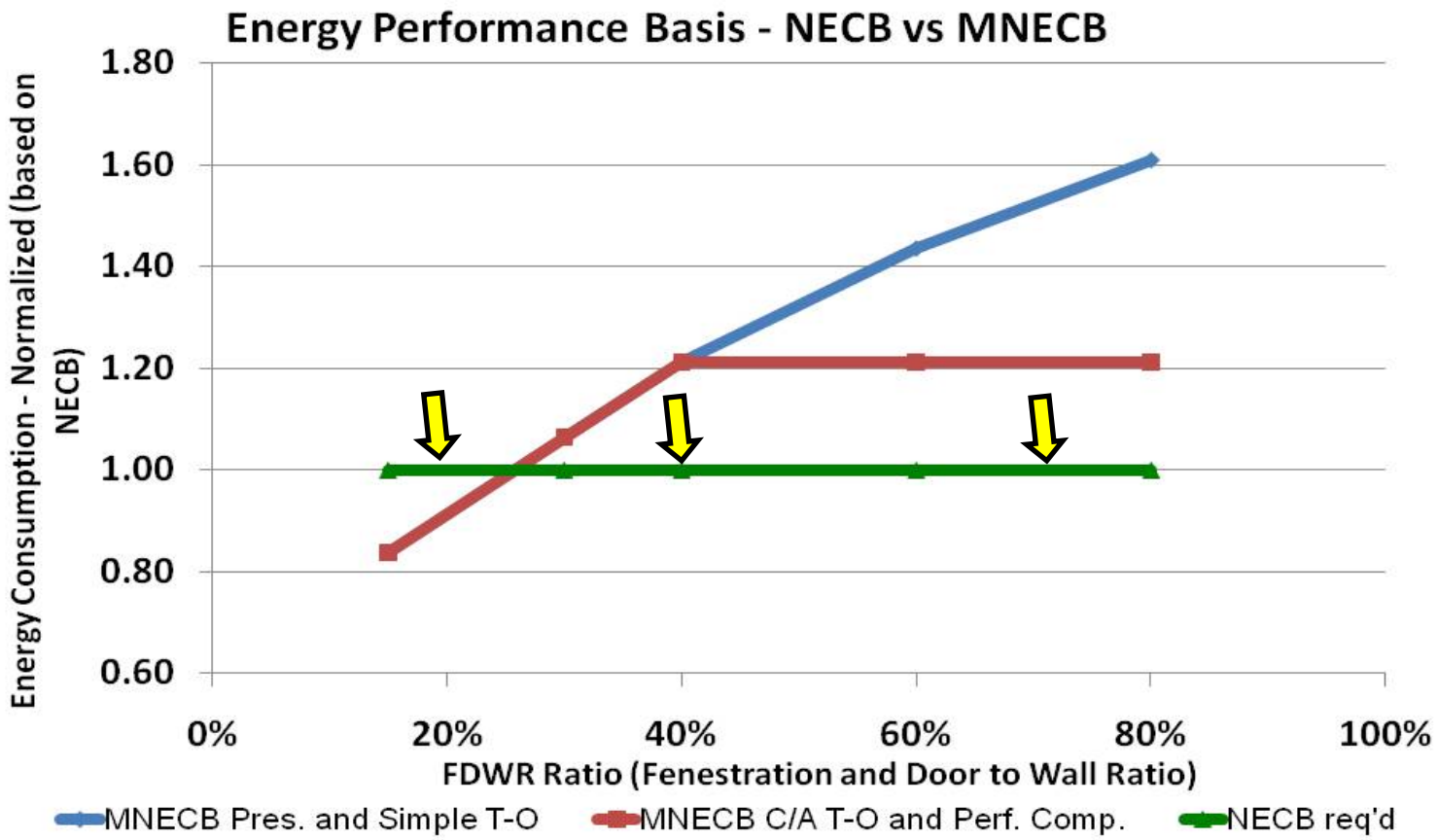
MNECB vs. NECB performance levels – MNECB prescriptive



MNECB vs. NECB performance levels - MNECB performance



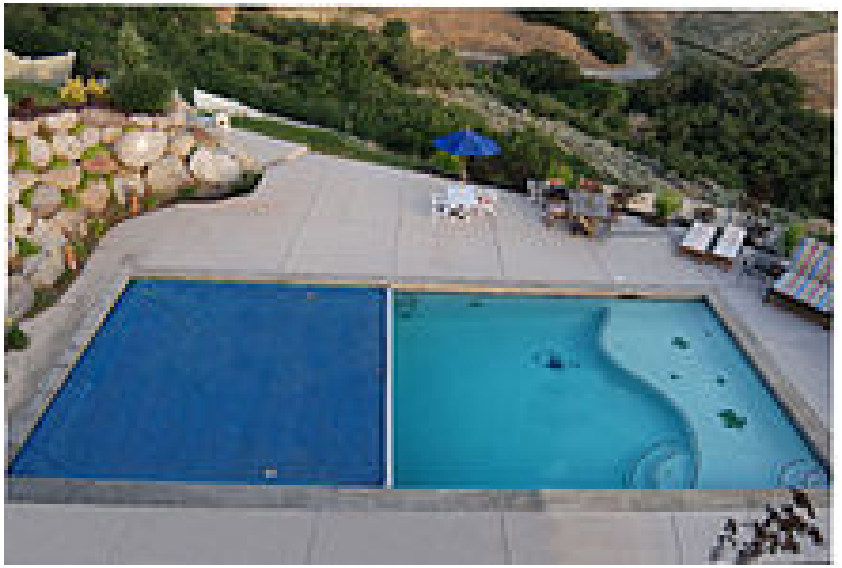
MNECB vs. NECB performance levels
NECB prescriptive and performance



Process loads

- Silent on most process loads
  - Except pools and ice surfaces

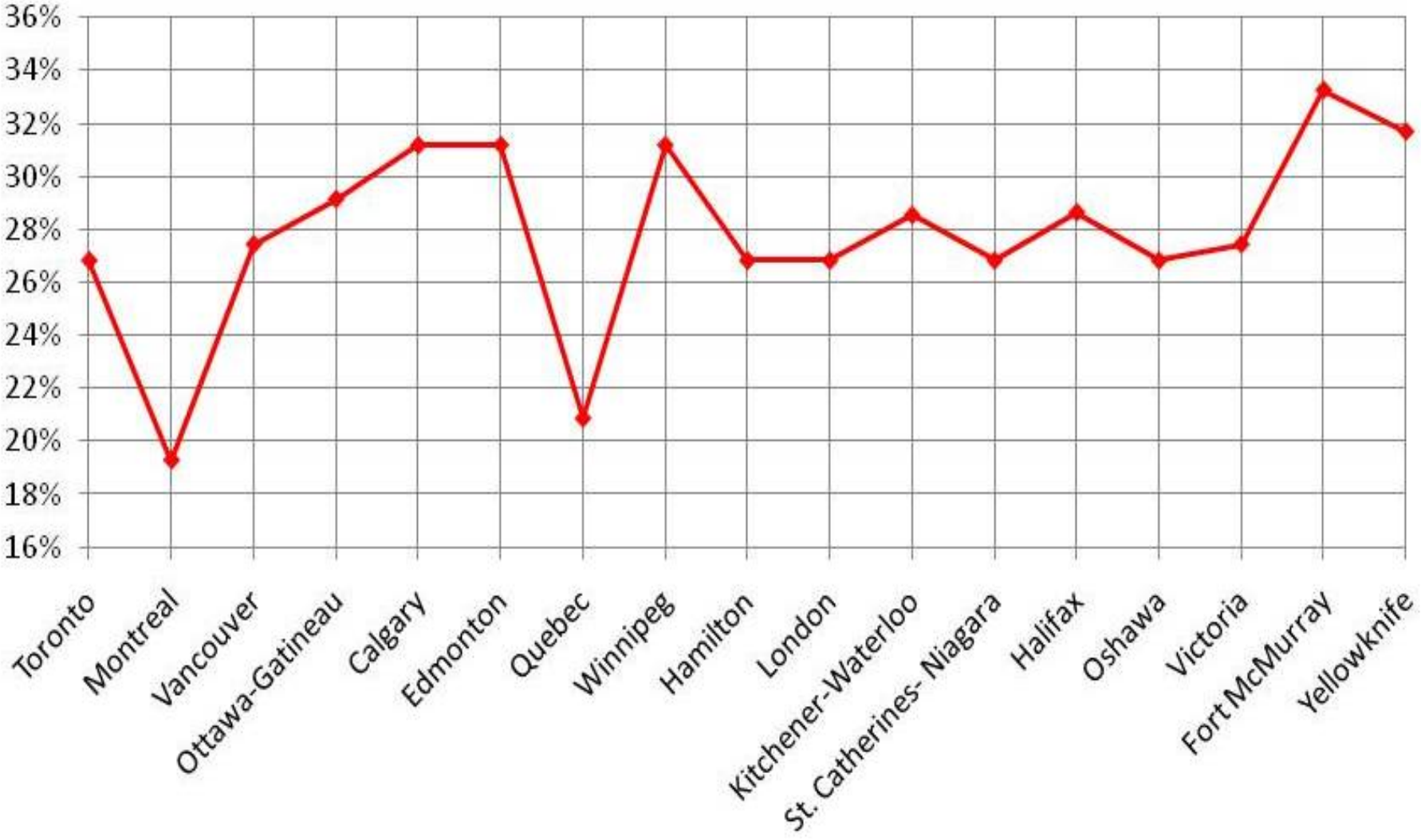
- Performance path includes:
  - Guidance
  - Flexibility



Summary on Energy requirements

- Several compliance paths
- Consistent minimum energy performance

NECB Performance Improvement over MNECB by City



National Energy Code for Buildings - Building envelope

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Scope

- Transfer of heat
- Air leakage

Definition

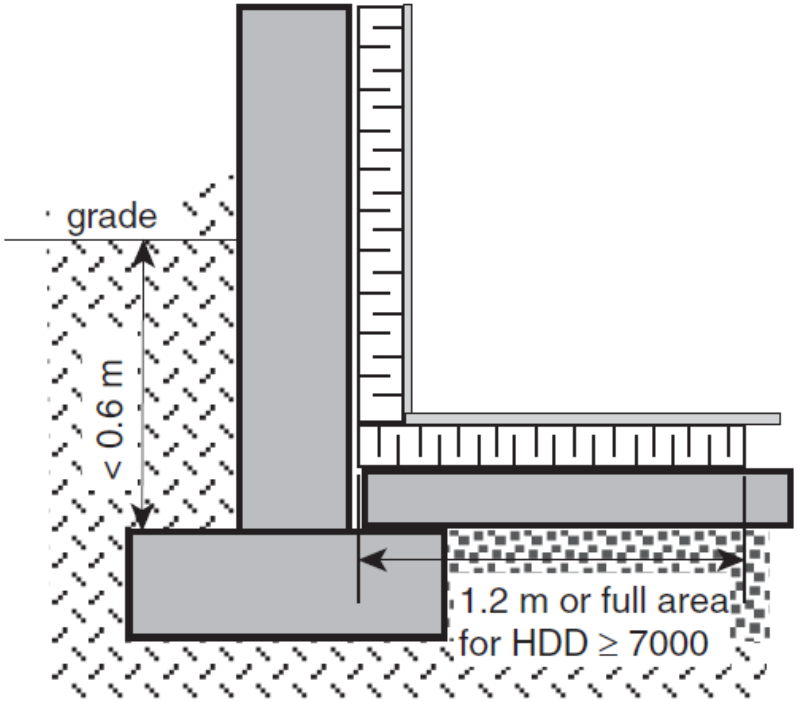
Building envelope means the collection of components that separate conditioned space from unconditioned space, the exterior air or the ground, or that separate conditioned spaces intended to be conditioned to temperatures differing by more than 10°C at design conditions

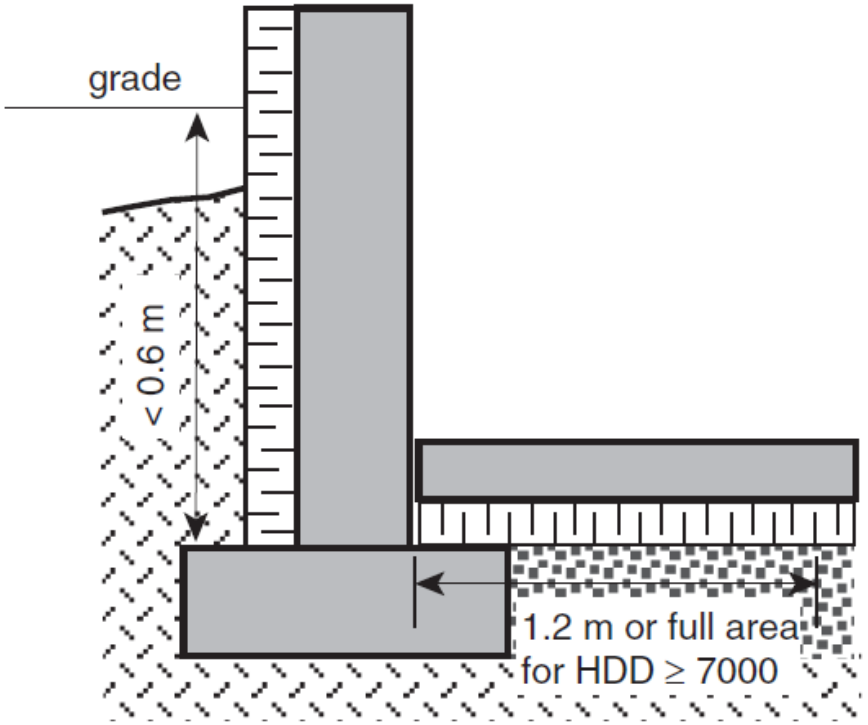
Compliance options

- Prescriptive path
- Trade-off path
  - Simple
  - Detailed
- Performance path–whole-building modeling

Insulation

- Protection of insulation materials
- Continuity of insulation





Maximum overall thermal transmittance

- Requirements for
  - Above-ground opaque building assemblies
  - Fenestration
  - Doors and access hatches
  - Assemblies in contact with the ground

$$U = 1/RSI$$

Above-ground opaque building assemblies

	Heating degree-days of building location, °C-days					
	Zone 4: Less than 3000	Zone 5: 3000 to 3999	Zone 6: 4000 to 4999	Zone 7A: 5000 to 5999	Zone 7B: 6000 to 6999	Zone 8: Greater than or equal to 7000
Maximum overall thermal transmittance (U-value, W/(m^2•K))						
Walls	0.315	0.278	0.247	0.210	0.210	0.183
Roofs	0.227	0.183	0.183	0.162	0.162	0.142
Floors	0.227	0.183	0.183	0.162	0.162	0.142

Above-ground opaque building assemblies

	Heating degree-days of building location, °C-days					
	Zone 4: Less than 3000	Zone 5: 3000 to 3999	Zone 6: 4000 to 4999	**Zone 7A: 5000 to 5999**	Zone 7B: 6000 to 6999	Zone 8: Greater than or equal to 7000
Maximum overall thermal transmittance (U-value, W/(m²•K))						
Walls	0.315	0.278	0.247	**0.210 (min R-27)**	0.210	0.183
Roofs	0.227	0.183	0.183	**0.162**	0.162	0.142
Floors	0.227	0.183	0.183	**0.162**	0.162	0.142

*U-values reduced by 20% where radiant heating or cooling included in assembly

Fenestration

	Heating degree-days of building location, °C-days					
	Zone 4: Less than 3000	Zone 5: 3000 to 3999	Zone 6: 4000 to 4999	Zone 7A: 5000 to 5999	Zone 7B: 6000 to 6999	Zone 8: Greater than or equal to 7000
Maximum Overall Thermal Transmittance (U-value, W/(m²•K))						
All Fenestration	2.4	2.2	2.2	2.2	2.2	1.6

Double glazing units with:

- Low-emissivity coating
- Non-metallic spacer
- Zone 4–argon gas not needed
- Zone 8–triple glazed

Doors and access hatches

	Heating degree-days of building location, °C-days					
	Zone 4: Less than 3000	Zone 5: 3000 to 3999	Zone 6: 4000 to 4999	Zone 7A: 5000 to 5999	Zone 7B: 6000 to 6999	Zone 8: Greater than or equal to 7000
Maximum overall thermal transmittance (U-value, W/(m²•K))						
Doors	2.4	2.2	2.2	2.2	2.2	1.6

- Relaxation: U ≤ 4.4 W/(m²•K) if assembly area ≤ 2% of gross wall area
- Exemption for storm, automatic sliding glass, revolving doors, fire shutters
- Access hatches U ≤ 1.3 W/(m²•K)

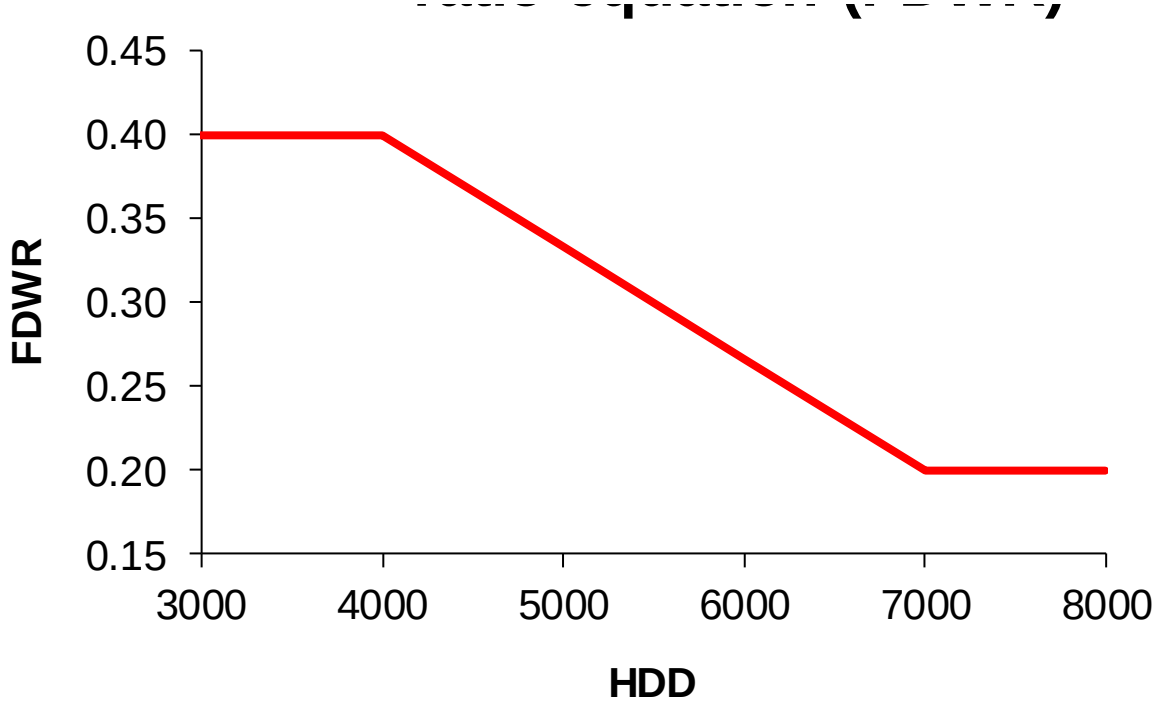
Assemblies in contact with ground

	Heating degree-days of building location, °C-days					
	Zone 4: Less than 3000	Zone 5: 3000 to 3999	Zone 6: 4000 to 4999	Zone 7A: 5000 to 5999	Zone 7B: 6000 to 6999	Zone 8: Greater than or equal to 7000
Maximum overall thermal transmittance (U-value, W/(m²•K))						
Walls	0.568	0.379	0.284	0.284	0.284	0.210
Roofs	0.568	0.379	0.284	0.284	0.284	0.210
Floors	0.757 for 1.2 m	0.757 for 1.2 m	0.757 for 1.2 m	0.757 for 1.2 m	0.757 for 1.2 m	0.379 full area

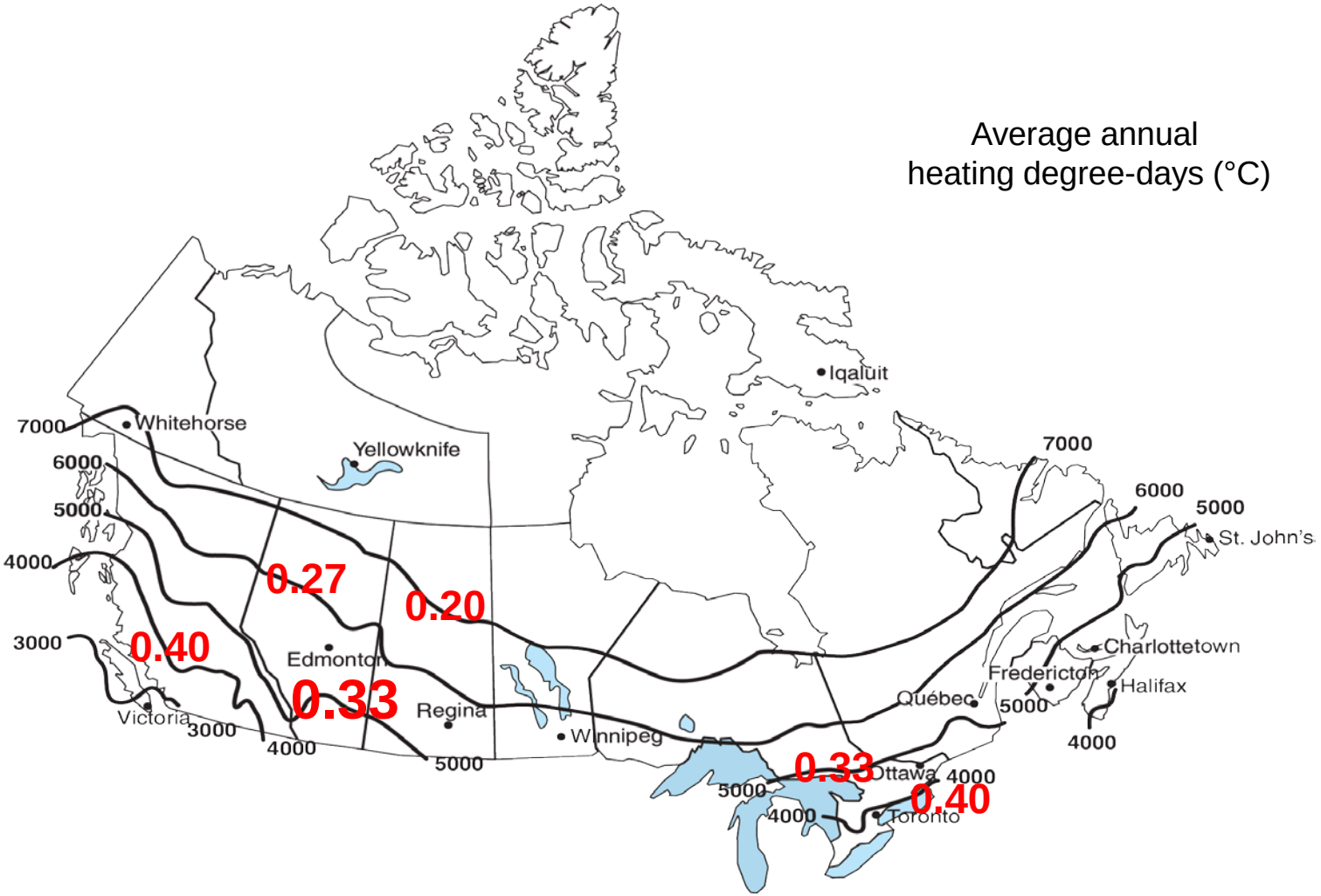
Assemblies in contact with ground

- Roofs < 1.2 m below ground
- Walls
  - 2.4 m below ground or bottom of wall
  - Footings < 0.6 m below ground → insulate slab perimeter to 1.2 m
  - Embedded radiant heating/cooling → reduce U-value by 20%
- Floors < 0.6 m below grade → insulate
  - Full area in zone 8 and if ducts/radiant heating/cooling embedded
  - 1.2 m around perimeter, except climate zone 8

Fenestration and door to wall ratio equation (FDWR)



Fenestration and door to wall ratio



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Air leakage

- Air barrier assembly required
- Continuous air barrier system
- Testing of curtain walls, windows

Doors air leakage

- Tested to referenced standards
- Higher air leakage rate for
  - Revolving doors
  - Automatic commercial sliding doors
  - Overhead doors
  - Main entry exterior doors
- Loading docks seal with trucks that interface

Simple trade-off

- Sum of component's (U-value x Area)
- Proposed UA ≤ Reference UA
- Allows change in FDWR by using better materials

Simple trade-off

Example: Building with 5000 heating degree-days

Prescriptive = 33%

Simple trade-off = 65%
(with better windows and walls)

Simple trade-off tool

129	Total	341.06	

Assembly Summary of the Reference Building

Add Assembly | Remove Assembly

Assembly Location	Overall Thermal Transmittance of Assembly (W/m^2K)	Area of Assembly (m^2)
Wall A : North of the road	0.247	28
Wall B: South of the ramp	0.247	100
Wall C : West of the ramp	0.247	100
Accent Wall D: East	0.247	28
South - windows	2.2	72
East - windows	2.2	72
Total	380.032	

20 - The overall thermal transmittance of all above-ground assemblies of the envelope of the proposed building is as follows:

341.06 W/K

21 - The overall thermal transmittance of all above-ground assemblies of the envelope of the reference building is as follows:

380 W/K

22 - The overall thermal transmittance of the proposed building is less than or equal to that of the reference building, as required by Subsection 3.3.3. (This checkbox is automatically updated, see help).

Help

Detailed trade-off

Consumption of proposed building envelope ≤ **Energy target of reference building envelope**

- Scaled-down performance compliance:
  - areas of assemblies,
  - U-values,
  - configuration,
  - orientation,
  - thermal mass

Performance compliance limitations

- Limits on U-values of above-ground assemblies with embedded radiant heating/cooling
- Building envelope air leakage is neutral

Which of the following does not have a Maximum Overall Thermal Transmittance (U-value, W/(m²•K)?

- Wall
- Windows
- Doors
- Whole building air leakage

Which of the following does not have a Maximum Overall Thermal Transmittance (U-value, W/(m²•K)?

- Wall
- Windows
- Doors
- Whole building air leakage

What climate zone is Edmonton?

A. Zone 4
B. Zone 7a
C. Zone 8
D. FWDR is 0.36

What climate zone is Edmonton?

A. Zone 4

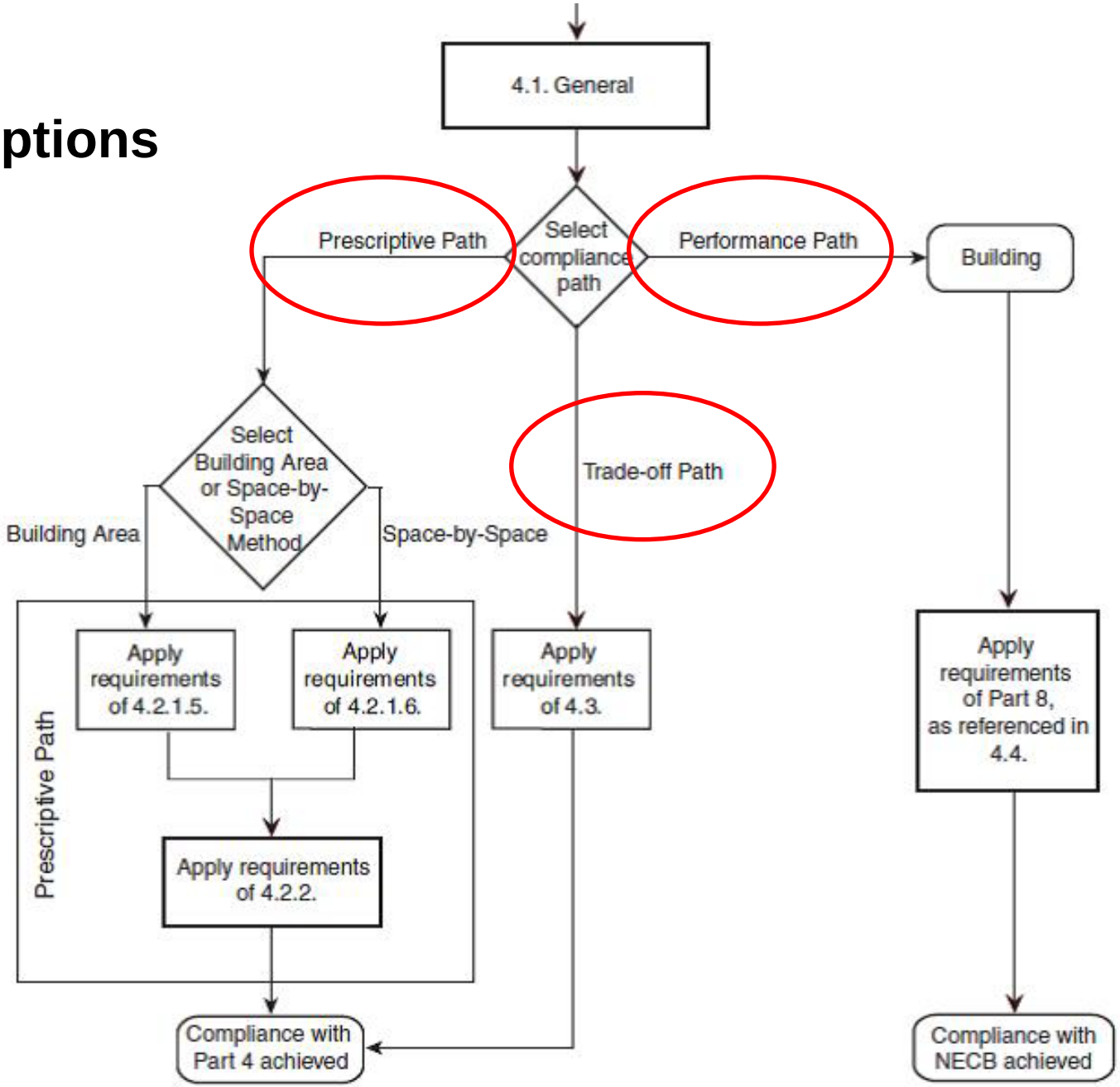
B. Zone 7a

C. Zone 8

D. FWDR is 0.36

Lighting

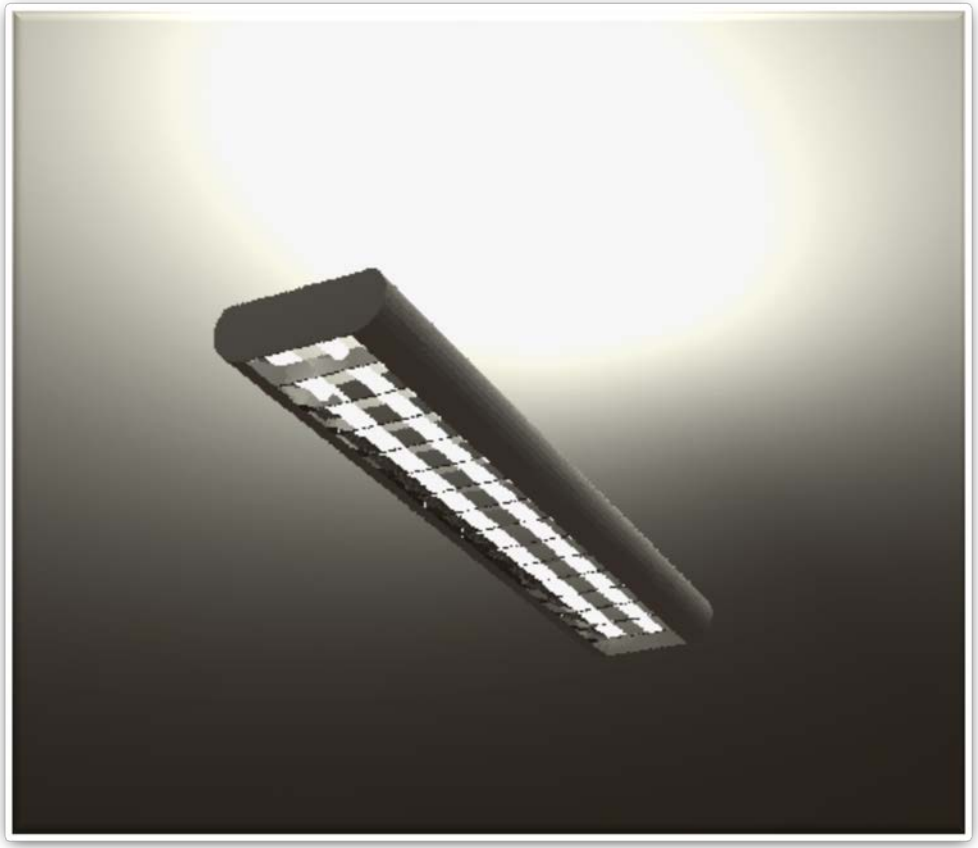
Compliance options



Installed interior lighting power

- Calculated with highest wattage
- Includes supplemental lighting
- Many exemptions
- Compare to allowance

- Two methods!



Building area method

Interior lighting power allowance = LPD[1] × gross lighted area

[1] LPD: Lighting power density

Building area method

Interior lighting power allowance = LPD[1] × gross lighted area

Table 4.2.1.5.
Lighting Power Density by Building Type for Use with the Building Area Method
Forming Part of Sentences 4.2.1.5.(1), (4) and (5)

Building Type	Lighting Power Density, W/m²
Automotive facility	8.8
Convention centre	11.6
Courthouse	11.3
Dining:	
bar lounge/leisure	10.7
cafeteria/fast food	9.7
family	9.6
Dormitory	6.6
Exercise centre	9.5
Fire station	7.6
Gymnasium	10.8
Health-care clinic	9.4
Hospital	13.0
Hotel	10.8
Library	12.7
Manufacturing facility	11.9
Motel	9.5
Motion picture *theatre*	8.9
Multi-unit residential *building*	6.5
Museum	11.4
Office	9.7

[1] LPD: Lighting power density

Space-by-space method

$$\text{Interior ligting power allowance} = \sum(\text{LPD}^1 \times \text{gross lighted area of enclosed space})$$

[1] LPD: Lighting power density

Building area vs. space-by-space method

Building area

Space-by-space

Image : Coles associates

What is LPD in the National Energy Code for Buildings?

A. Lighting placement dart
B. Lowest pot-light depth
C. Lighting power density
D. Amphibious transport dock

What is LPD in the NECB?

A. Lighting placement dart
B. Lowest pot-light depth
C. Lighting power density
D. Amphibious transport dock

Interior lighting controls

- Toplighting
- Sidelighting

Which is exempt from calculation of the lighting power density (LPD)?

A. Exterior lighting not connected to the buildings electrical service
B. Exterior lighting for athletic activity areas
C. Lighting used during medical or dental procedures
D. Lighting in retail displays in fully enclosed spaces
E. All of the above

Which is exempt from calculation of the lighting power density (LPD)?

A. Exterior lighting not connected to the buildings electrical service
B. Exterior lighting for athletic activity areas
C. Lighting used during medical or dental procedures
D. Lighting in retail displays in fully enclosed spaces
E. All of the above

Exterior lighting

Included:

Image : Coles associates

Excluded:

Exterior lighting–calculation

Step 1:

- Total power for specific site applications ≤ ∑ Specific application allowance and basic site allowance

Step 2:

- Total connected power for general applications ≤ ∑ General application allowance and unused basic site allowance from Step 1

Trade-off path

- Interior lighting only
- **Installed** interior lighting energy ≤ interior lighting energy **allowance**
- Adds daylight harvesting and controls to prescriptive calculation

Performance path

- No limitations

Summary

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NECB 2011 Part 4 - Lighting Trade-Off Path Compliance Calculation Tool

This tool can be used to demonstrate compliance with the NECB 2011 Part 4 (Lighting) Trade-Off path. Users must define the building's area and lighting systems using the Space-by-space method. The Trade-Off worksheet allows the entry of all required information, fields highlighted in BLUE, to define each space and its lighting system. The total building Gross Floor Area must be defined in the Trade-off worksheet for the compliance calculations to be valid.

Building Data	
Building Name	Building 1
Address	5555 street AAA
Total Gross Floor Area - m2	2000.0
Annual Number of days of operation	250

Language	English
Units	SI

Canada

CODESCANADA

Automatic daylighting controls for toplighting

- Daylighted area > 400 m² → photocontrol to reduce general lighting

- Exemptions
  - Light blocked
  - Insufficient skylight aperture
  - Small enclosed space above 55^0N

Automatic daylighting controls for sidelighting

- Sidelighted area > 100 m² → photocontrol to reduce general lighting

- Exemptions
  - Light blocked by adjacent building
  - Insufficient sidelight aperture
  - Retail spaces

Heating, ventilating and air-conditioning systems

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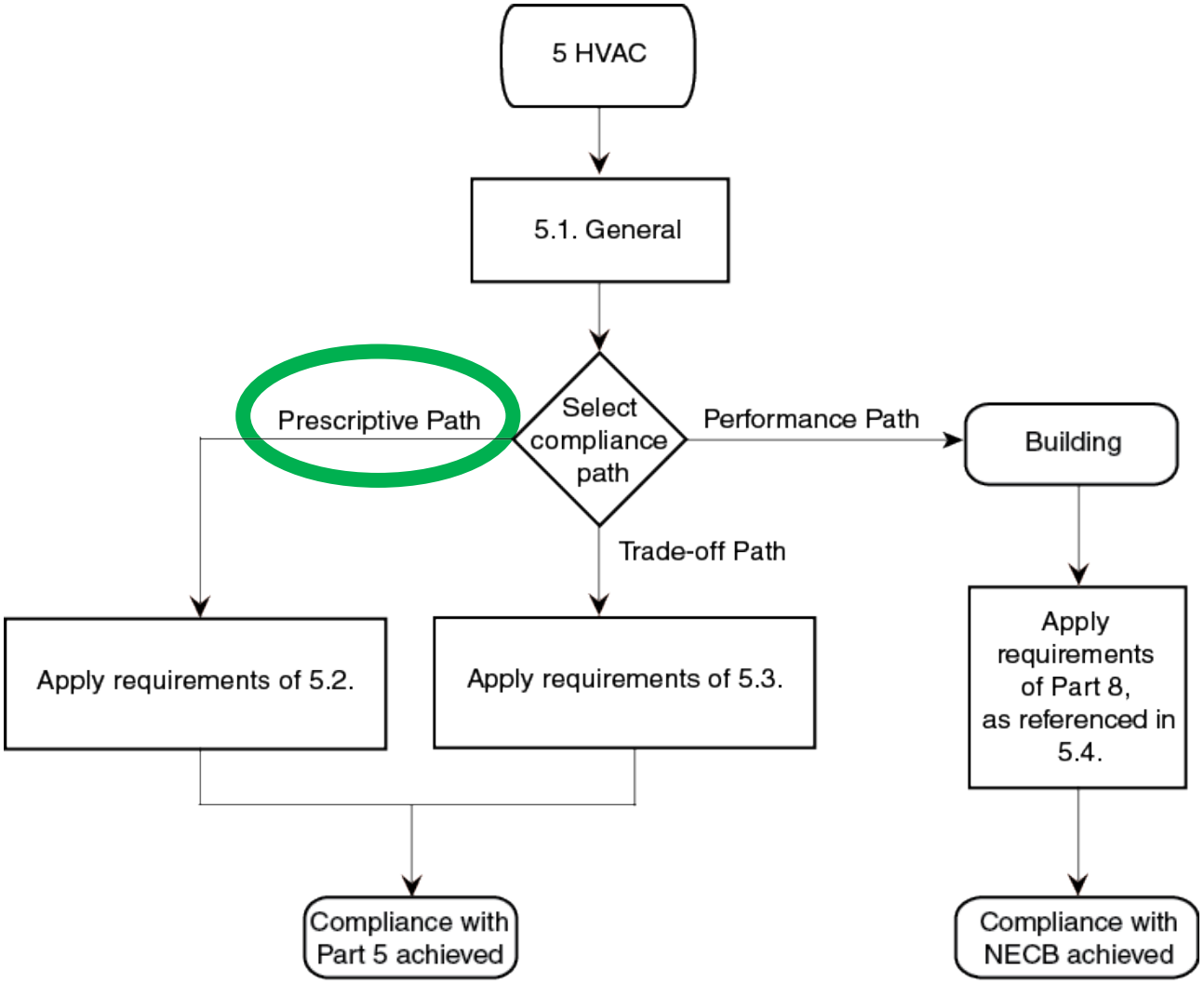
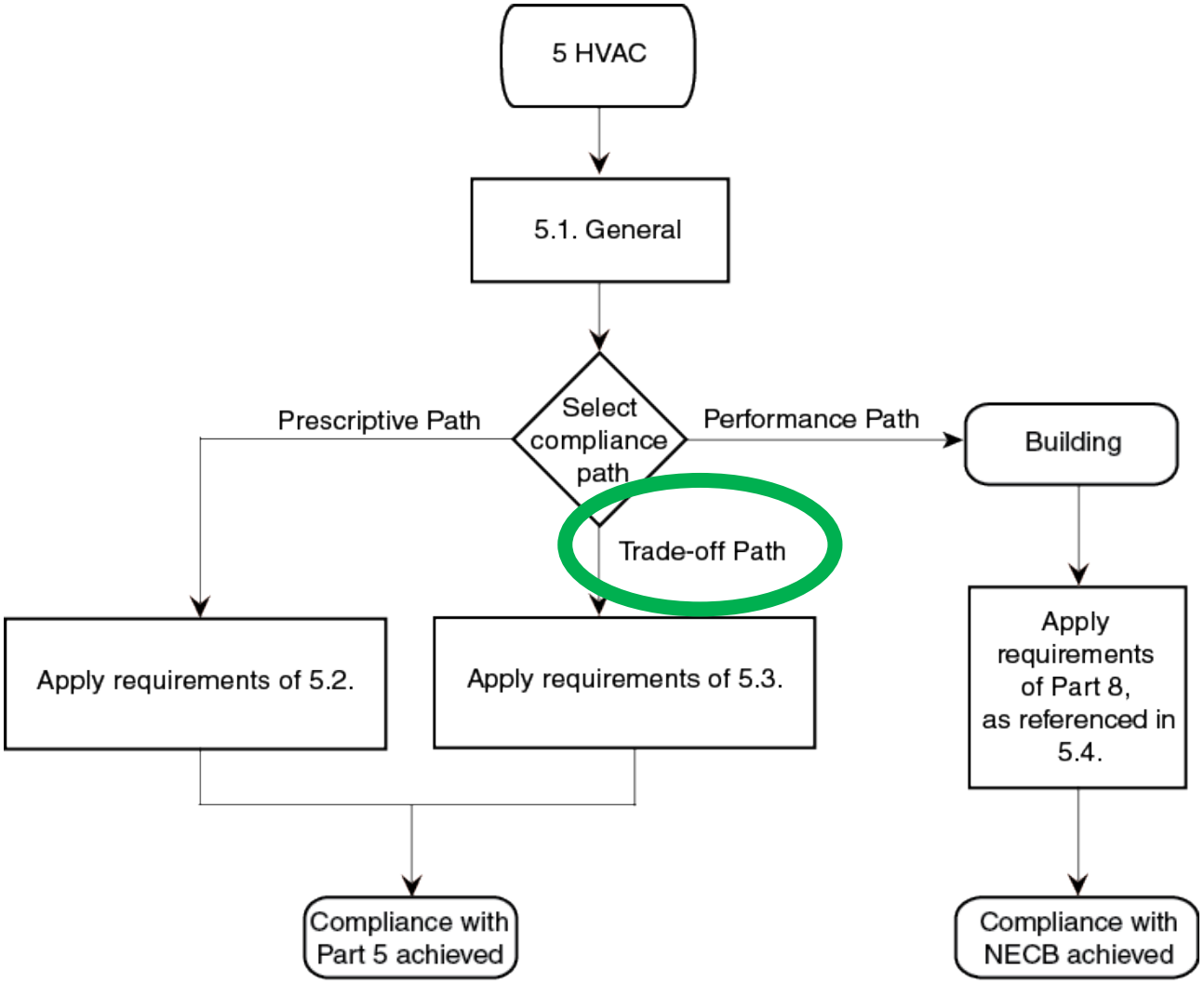
Scope

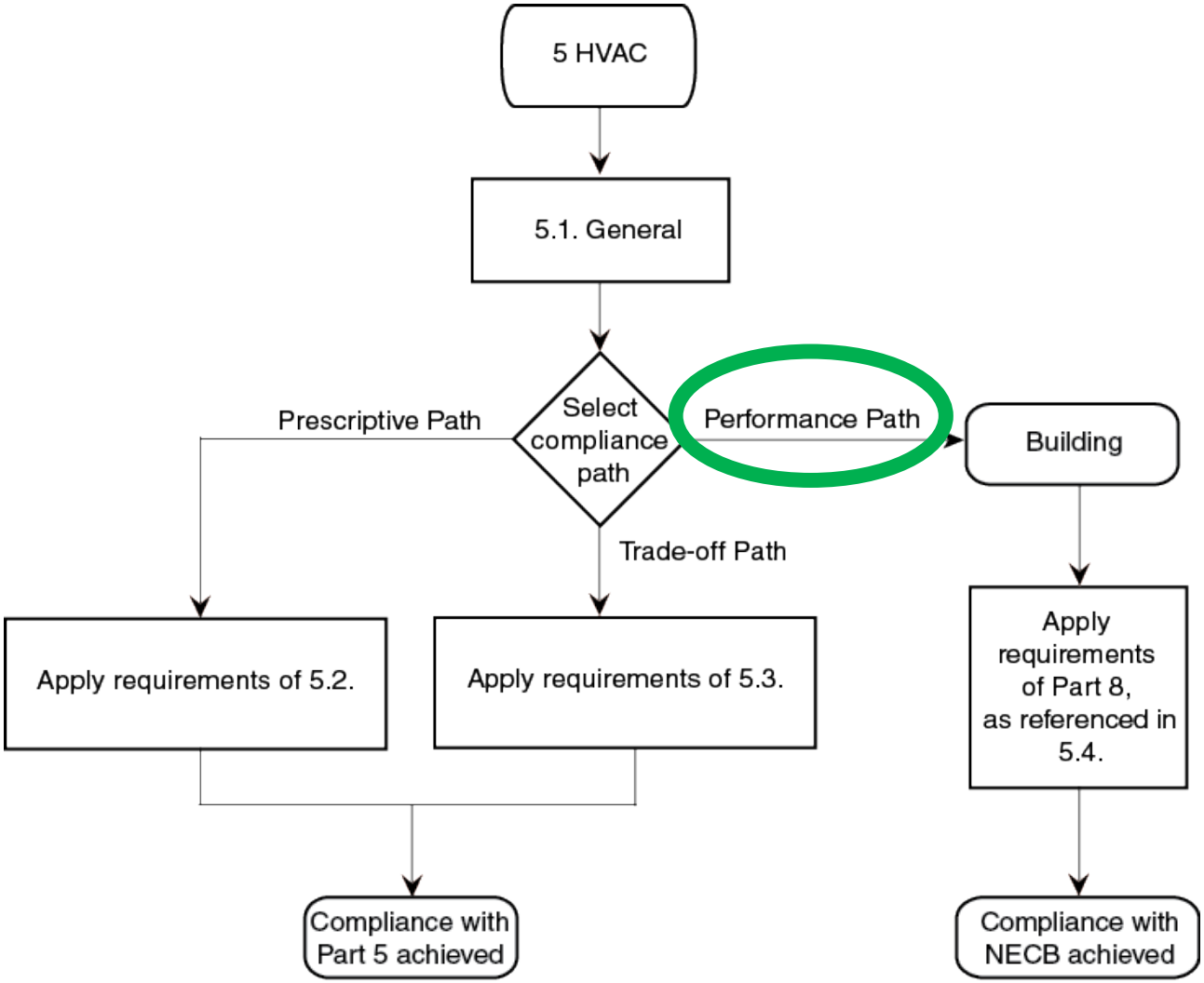
Compliance options



Compliance options



Compliance options



Equipment–minimum performance efficiency

Efficiency with referenced standard provided for:

- Boilers
- Warm-air furnaces
- Duct furnaces
- Unit heaters
- Packaged water chillers
- Packaged terminal A/C
- Computer room A/C
- Air-cooled A/C and heat pumps
- Water- and evaporatively cooled A/C and heat pumps
- Condensing units
- Ground water heat pumps

Other equipment requirements

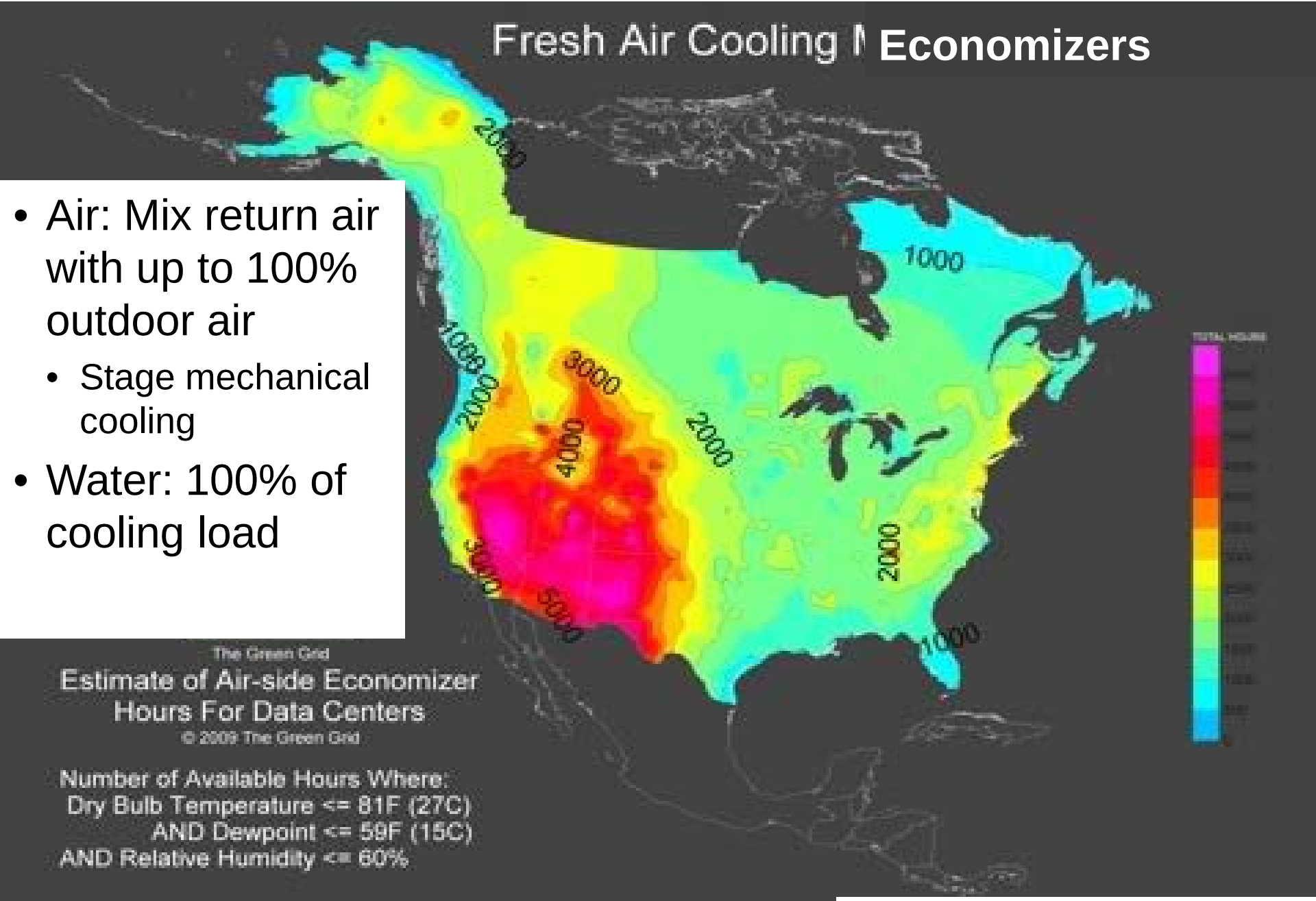
- Field-assembled equipment
- Combination space and service water heating
- Equipment installed outdoors

Air distribution and cooling with outdoor air

- Cool with outdoor air if capacity > 20 kW
- Air handler > 1500 L/s
- Dwelling units and hotel rooms exempt

Fresh Air Cooling Economizers

- Air: Mix return air with up to 100% outdoor air
  - Stage mechanical cooling
- Water: 100% of cooling load



Credit: The Green Grid www.thegreengrid.org

9

Fan systems demand

Criteria	Requirement
Power demand allowance	• 1.6 W per L/s for constant volume • 2.65 W per L/s for variable air volume
Demand between 7.5 and 25 kW	• 50% reduction in air volume and no more than 55% of design wattage
Demand greater than 25 kW	• 30% of wattage at 50% of design air volume

10

Dampers

- Motorized required except where
  - Not permitted
  - Continuous HVAC operation required, or
  - Opening ≤ 0.08 m2
- In closed position leakage < 15 L/s

Duct and plenum insulation

- Requirements based on temperature difference
- Sealed and air leakage tested

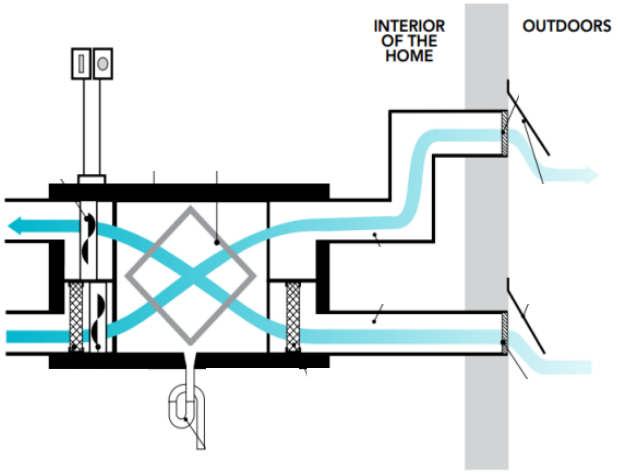
Delta T between 5 to 22C

Delta T > 22C

Heat recovery system

- Exhaust systems → sensible heat > 150 kW (~5000 cfm)
  - 50% efficiency requirement for heat-recovery apparatus
  - Exemption for specialized exhaust systems

- Humidity not included in heat content calculation
  - Energy-recovery ventilators can be used



Residential heat exchanger courtesy of NRCan Office of Energy Efficiency HRV guide

Heat recovery–dwelling units

- Dwellings with self-contained mechanical ventilation (except in climatic zones 4, 5 and 6)
  - Principal exhaust only
  - 50% sensible heat recovery
- Humidity not included in heat content calculation

Heat recovery–pools

- 40% recovery of sensible heat from exhaust air

or

- Dehumidification system provides 80% of dehumidification that would be accomplished by exhaust system

Ice surfaces

- Heat recovery required if heating load elsewhere
  - Either space or service water
- Ice and snow melt heater
  - Shut-down controls
  - Removed light indicator

Which is exempt from a heat recovery requirement?

A. Ice rinks with heating load
B. Pool dehumidification
C. Dwelling units with self-contained mechanical systems in Zone 4, 5 and 6
D. Exhaust systems with greater than 150 kW of sensible heat

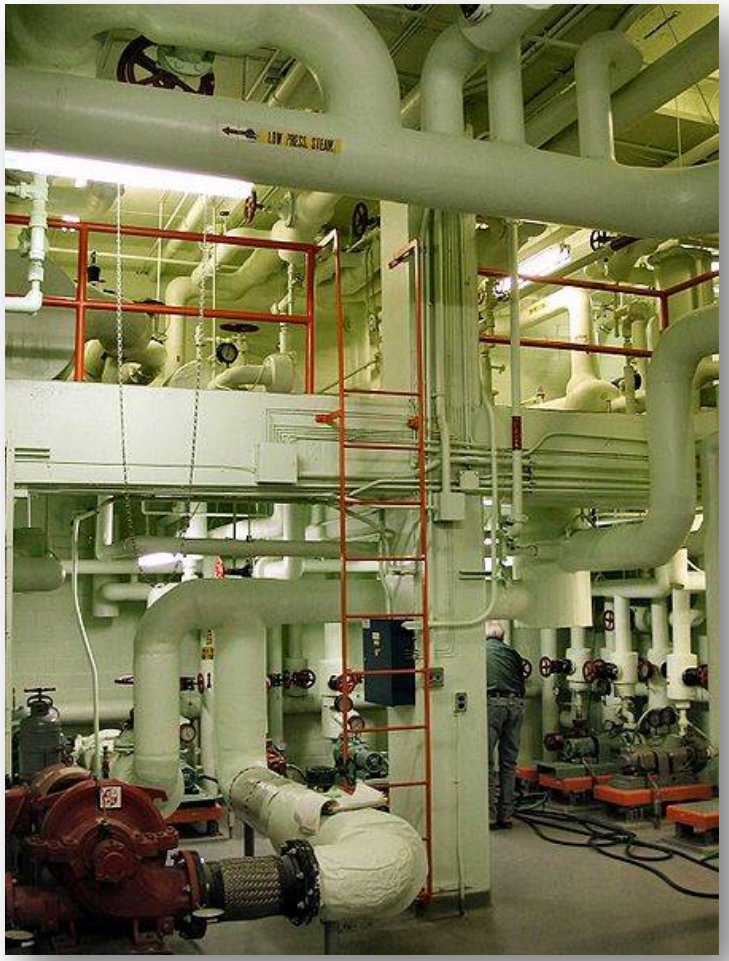
Which is exempt from a heat recovery requirement in ?

A. Ice rinks with heating load
B. Pool dehumidification
C. Dwelling units with self-contained mechanical systems in Zone 4, 5 and 6
D. Exhaust systems with greater than 150 kW of sensible heat

Piping

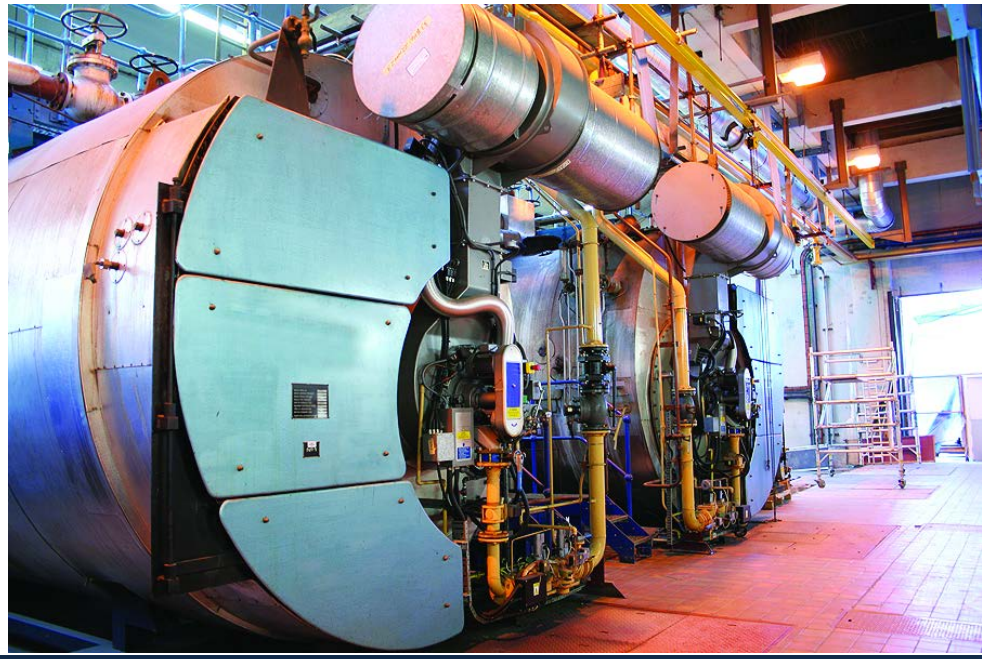
- Ability to balance
- Minimum insulation
  - Operating temperature
  - Insulation conductivity
  - Nominal pipe diameter

- Outdoors insulated to operating temperature > 177 °C



Pumping system

- Variable-flow if > 7.5 kW
  - Nameplate power rather than break power
  - Capable of reducing flow to 50% of design flow or less



Space temperature controls

Independent perimeter systems per 15 m of building exposure

Dwelling units: thermostat and a manual or automatic control

Temperature controls

- Thermostat installation
- Electric heating updated to CSA C828, “Thermostats Used with Individual Room Electric Space Heating Devices”
  - No requirement for universal remotely mounted

Photo courtesy of BC hydro

Vestibule

- Control device to limit heating to a maximum of 15 °C

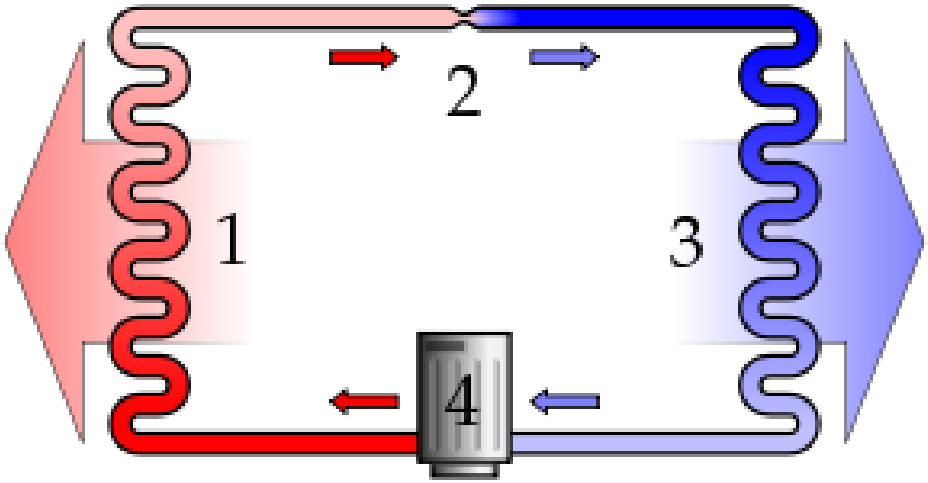
Image Coles and associates

Reheating and recooling controls

- Prevent at air leaving supply air handler
- Automatic space temperature adjustments when mixed

Heat pump controls

- Heating load to be met with heat pump first, prior to secondary heater
  - Clarification that supplementary heat applies to load above peak load

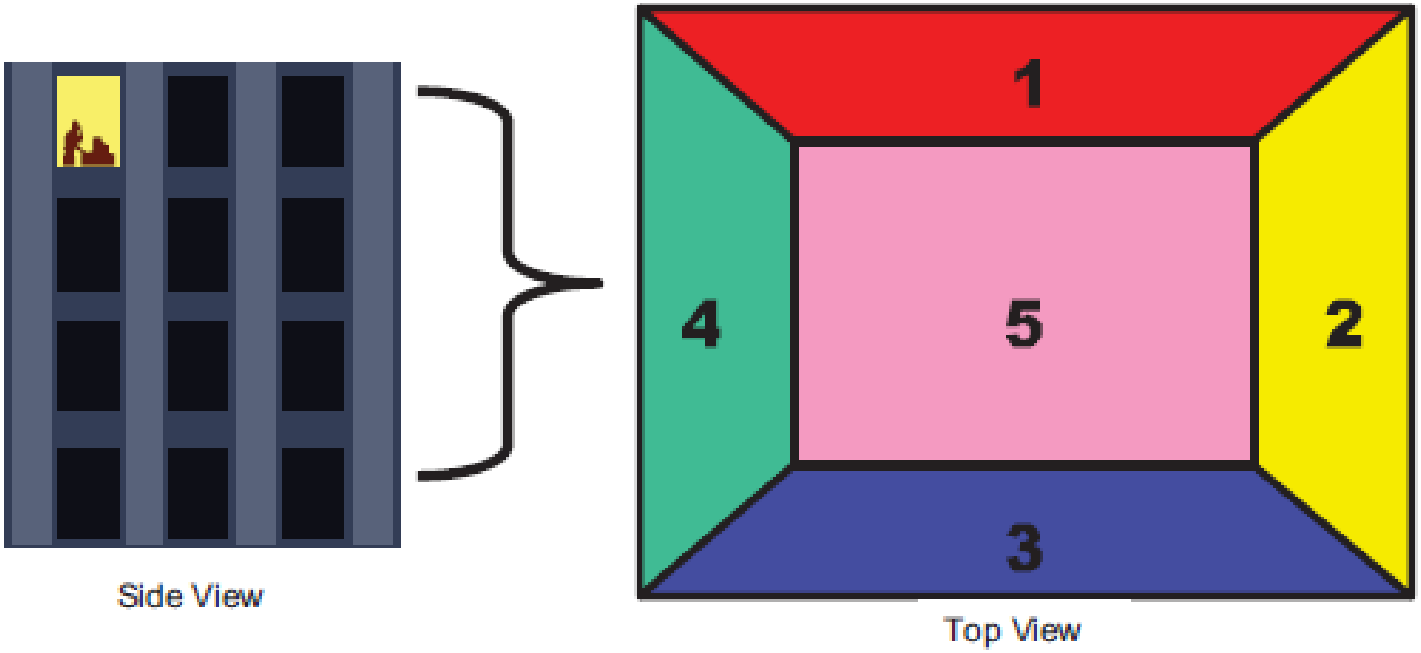


Shut-off and setback

- Dwelling units and non-continuously operating areas
  - Capacity > 5 kW
  - Automatic controls for non-use periods

Airflow control areas

- Control areas to allow airflow reduction or stoppage
  - Limit area not more than 2500 m²
  - Exhaust airflow controlled



Boiler controls

- Moderately sized boilers
  - (176 kW) → staging required
- Large boilers
  - (352 kW) → full modulation required

Photo courtesy of Weil-McLain

Trade-off concept

- Considers energy use throughout system

Trade-off concept

- System efficiency approach considers HVAC system as a whole
- Intended to permit flexibility for typical design

Total **proposed** system efficiency **≥** Total **reference** system efficiency

Trade-off detail considered

- Compares system to same system
- 27 typical system types
- 32 components

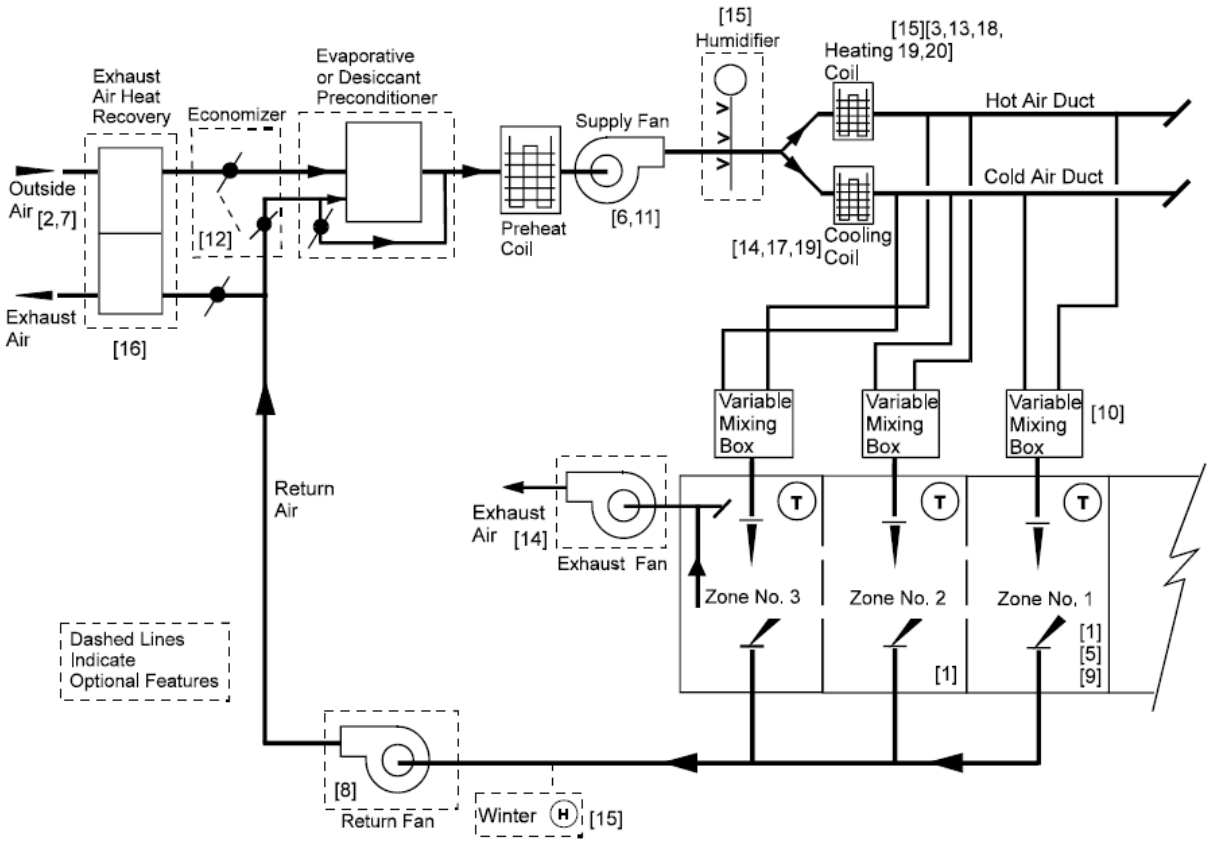


Figure 20 Dual-duct fan system (DDS)

Source: DOE 2.2 User manual

Coefficients

$$HVAC_{TOI} = \sum_{i=1}^{32}\left(\alpha_i \bullet ToV_i + \beta_i \bullet ToV_i^{\,2}\right) \bullet \gamma_i$$

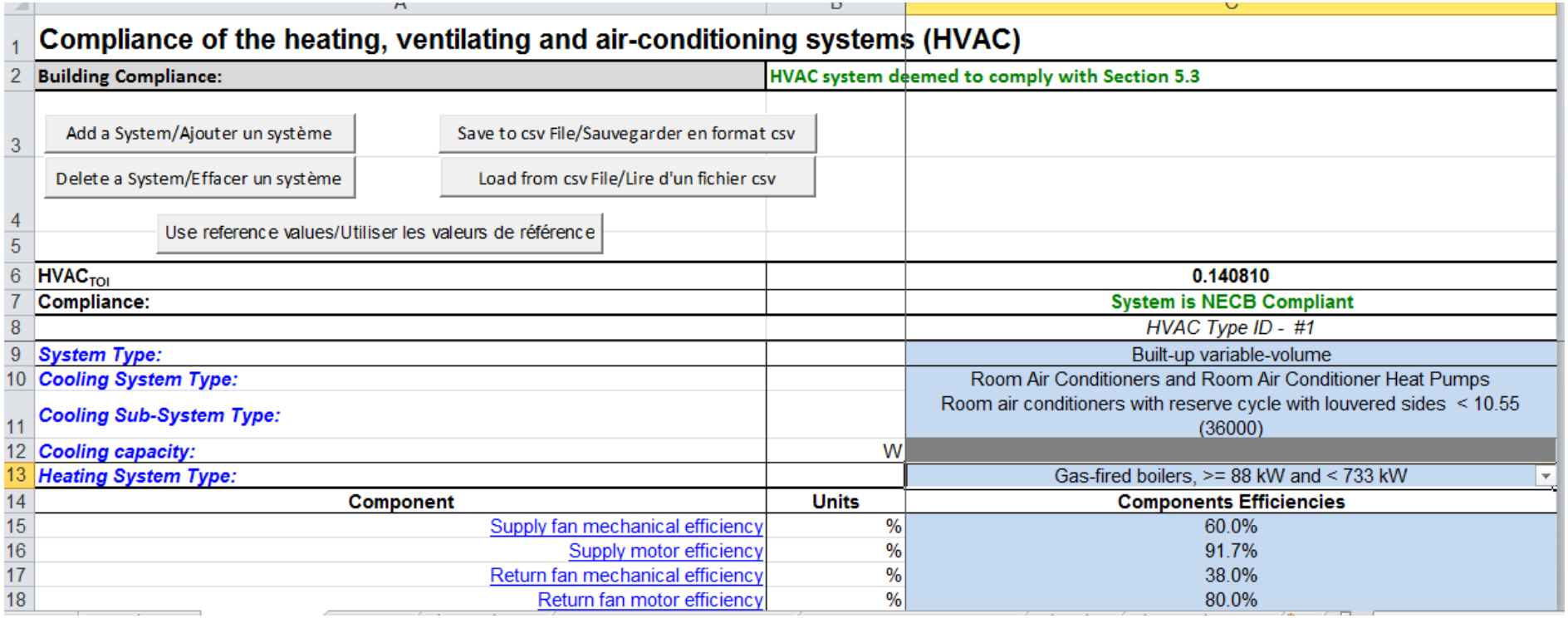
Proposed System

$$-\sum_{i=1}^{32}\left(\alpha_i \bullet BaV_i + \beta_i \bullet BaV_i^{\,2}\right) \bullet \gamma_i$$

Prescriptive system

Built-up Variable Volume							
Component	XDD	α1	α2	α3	β1	β2	β3
ToV_1- Supply Fan Mechanical Efficiency	HDD	9.901E-01	-1.418E-04	5.710E-09	-5.191E-01	7.037E-05	-2.626E-09
ToV_2 -Supply Motor Efficiency	HDD	6.994E-01	-1.013E-04	4.055E-09	-2.670E-01	3.687E-05	-1.362E-09
ToV_3- Return Fan Mechanical Efficiency	HDD	6.087E-01	-5.513E-05	7.352E-10	-5.244E-01	4.324E-05	-2.153E-10
ToV_4 - Return Fan Motor Efficiency	HDD	2.916E-01	-2.712E-05	3.972E-10	-1.264E-01	1.095E-05	-8.620E-11
ToV_5 -Supply Temperature Control	HDD	-2.175E-01	1.610E-04	-1.976E-08	1.081E+00	-3.448E-04	2.887E-08
ToV_6 - Airflow Control Efficiency	TDD	1.034E-01	3.422E-05	-3.997E-09	8.110E-01	-2.076E-04	1.353E-08

Free computer-program-assisted



1	**Compliance of the heating, ventilating and air-conditioning systems (HVAC)**		
2	**Building Compliance:**		**HVAC system deemed to comply with Section 5.3**
3	Add a System/Ajouter un système	Save to csv File/Sauvegarder en format csv	
4	Delete a System/Effacer un système	Load from csv File/Lire d'un fichier csv	
5	Use reference values/Utiliser les valeurs de référence		
6	**$HVAC_{TOI}$**		**0.140810**
7	**Compliance:**		**System is NECB Compliant**
8			*HVAC Type ID - #1*
9	***System Type:***		Built-up variable-volume
10	***Cooling System Type:***		Room Air Conditioners and Room Air Conditioner Heat Pumps
11	***Cooling Sub-System Type:***		Room air conditioners with reserve cycle with louvered sides < 10.55 (36000)
12	***Cooling capacity:***	W	
13	***Heating System Type:***		Gas-fired boilers, >= 88 kW and < 733 kW
14	**Component**	**Units**	**Components Efficiencies**
15	Supply fan mechanical efficiency	%	60.0%
16	Supply motor efficiency	%	91.7%
17	Return fan mechanical efficiency	%	38.0%
18	Return fan motor efficiency	%	80.0%

Trade-off limitations

- Energy sources must be natural gas, propane, oil or electricity
- Back-up equipment must meet prescriptive requirements
- One of the 27 “traditional” systems

Can the trade-off path be used to predict energy consumption?

A. Yes
B. No

Can the trade-off path be used to predict energy consumption?

A. Yes

B. No

Performance path limitations

- Equipment performance efficiency shall comply with Energy Efficiency Regulations

- Back-up equipment must comply with prescriptive path

Summary

- Requirements for energy use
  - Heating, cooling and pumping equipment
  - Air distribution
  - Controls
  - Insulation

- New trade-off path provides opportunity to consider HVAC system efficiency

Service water heating

What is it?

6 Service Water Heating

6.1. General

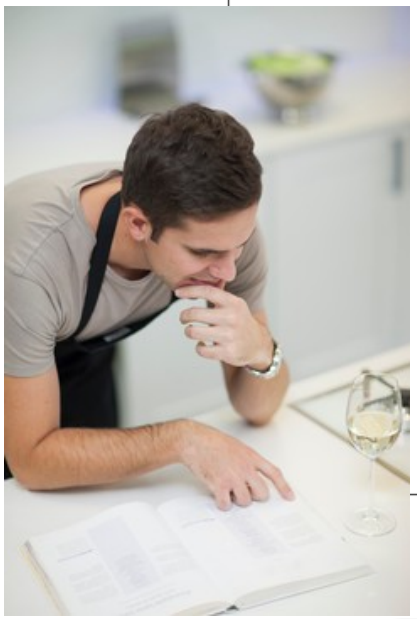
Select compliance path

Prescriptive Path

Performance Path

Trade-off Path

Building



Compliance with Part 6 achieved

Compliance with NECB achieved

Equipment minimum performance efficiency

Set to current practice at median of sales

Table 6.2.2.1.
Service Water Heating Equipment Performance Standards
Forming Part of Sentences 5.2.12.3.(1), 6.2.2.1.(1), 6.2.2.4.(2), 6.2.2.5.(1), 6.3.2.5.(1) and 6.3.2.6.(1)

Storage-Type and Non-Storage-Type (Instantaneous) Service Water Heaters							
Component	Input	Capacity, L	V_t, L (US gal.)	Input/V_t, W/L (Btu/h/US gal.)	Standard	Rating Conditions	Performance Requirement[1]
Gas-fired	< 22 kW	—	—	—	CAN/CSA-P.3	—	EF ≥ 0.67 – 0.0005V
	> 117 kW		—	< 310 (4000)	ANSI Z21.10.3/CSA 4.3	Δt = 50°C (90°F)	$E_t \geq 80\%$
			< 37.8 (10)	≥ 310 (4000)			$E_t \geq 80\%$[3]

Other equipment requirements

- Combination space and service water heating
- Space heating equipment used for indirect service water heating
- Service water heating equipment must comply with 3 conditions

Other equipment requirements

- Booster heater
  - For system with 50% total design flow below 60 ˚C
- Outdoor installation
- Enable solar thermal technology

At what temperature is a common rating for service water heating equipment?

- 32 °C
- 50 °C
- 60 °C

At what temperature is a common rating for service water heating equipment?

A. 32 °C

B. 50 °C

C. 60 °C

Piping insulation

- Based on fluid temperature
- Conditions for non-circulating system with heat traps
- Tank insulation of 0.45 W/(m²•K)

Controls

- Systems with storage tanks
  - Automatic temperature control
- Controls for heat maintaining system
- Seasonal shutdown controls

Showers and lavatories

Limit flow:

- 9.5 L/min for showers
- 8.3 L/min for lavatories

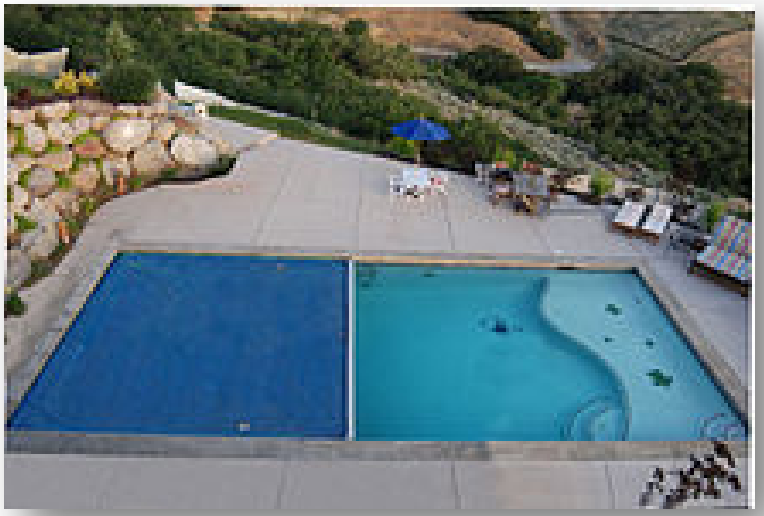
Automatic shut-off valves in assembly occupancy spaces

Pools

If heated, covers required

- for 90% of surface area
- no greater than 0.48 W/(m^2•°C) if temperature greater than 32 °C
- indoor excepted

Shut-off controls on pumps and heaters



Which control is NOT required?

A. Storage tank automatic temperature controls
B. Automatic controls for heating elements along service water heating pipes maintaining temperature
C. Means to limit maximum hot water discharge flow rate of showers
D. Automatic shut-offs in public access washroom lavatories
E. Time switches for pool pumps and heaters required to operate on a 24-h basis

Which control is NOT required?

A. Storage tank automatic temperature controls
B. Automatic controls for heating elements along service water heating pipes maintaining temperature
C. Means to limit maximum hot water discharge flow rate of showers
D. Automatic shut-offs in public access washroom lavatories
E. Time switches for pool pumps and heaters required to operate on a 24-h basis

Trade-off concept

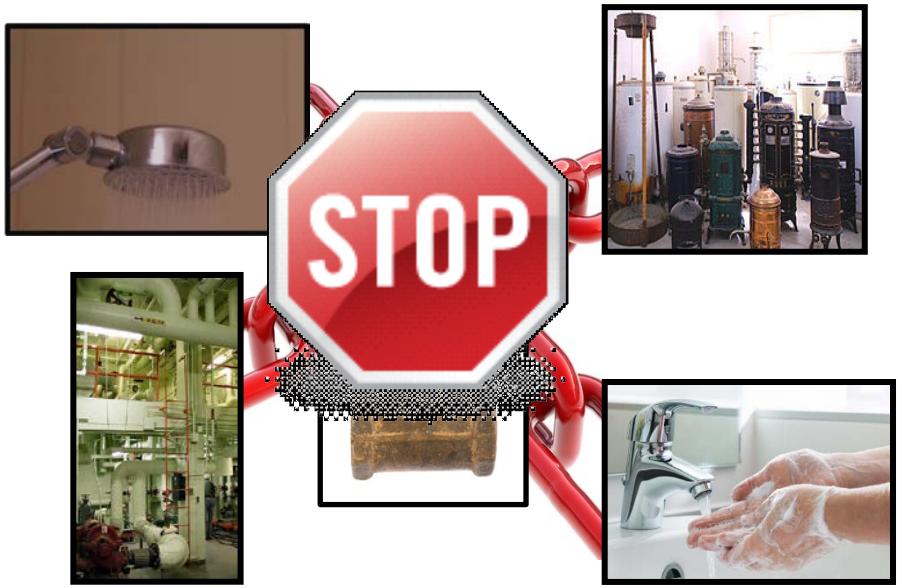
Trade-off concept

Total **proposed** system efficiency ≥ Total **reference** system efficiency

- Heat generator equipment efficiency
- Tank insulation value
- Piping insulation value
- Pump motor efficiency
- Pump efficiency
- Heat recovery
- Average flow of faucets and showers
- Ratio of showers to faucets

Trade-off limitations

- Energy used natural gas, propane, oil or electricity
- Back-up equipment must meet prescriptive requirements
- One of the 3 systems



Performance limitation

- Equipment performance efficiency at least meeting Energy Efficiency Regulations

- Back-up equipment must comply with prescriptive path

Trade-off path method

- Parameters entered into equation for system
  - Example: tank system

$$SHW - TOI = 2.813 \bullet \left\{ \begin{array}{l} \dfrac{2.813 \bullet PDR}{\mathrm{ToV}_1} \bullet \left\{ 1 - 0.6514 \bullet \mathrm{ToV}_6 \bullet e^{-0.312 \bullet \mathrm{ToV}_6} \right\} \\ \qquad + 0.06153 \bullet \left(\dfrac{A_{norm}}{\mathrm{ToV}_2} + \dfrac{26.180}{\mathrm{ToV}_3} \right) + \dfrac{0.00677}{\mathrm{ToV}_4 \bullet \mathrm{ToV}_5} \end{array} \right\}^{-1}$$

$$- 2.813 \bullet \left\{ \frac{2.813}{\eta_{ref}} + 0.06153 \bullet \left(\frac{A_{norm}}{12.4} + 6.807 \right) + 0.0141 \right\}^{-1}$$

Electrical power systems and motors

Scope

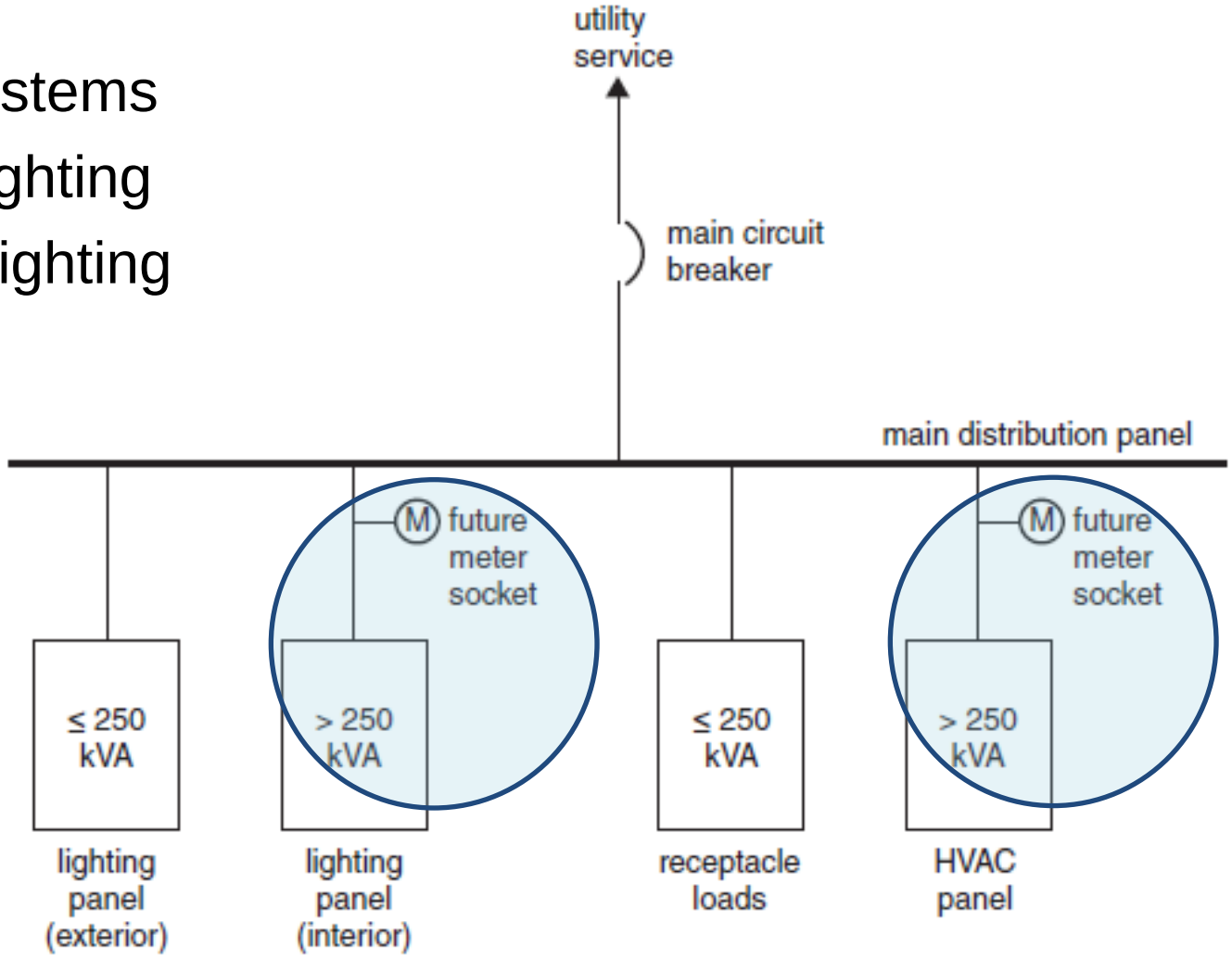
- Electrical power systems and motors connected to building’s electrical service

Compliance paths

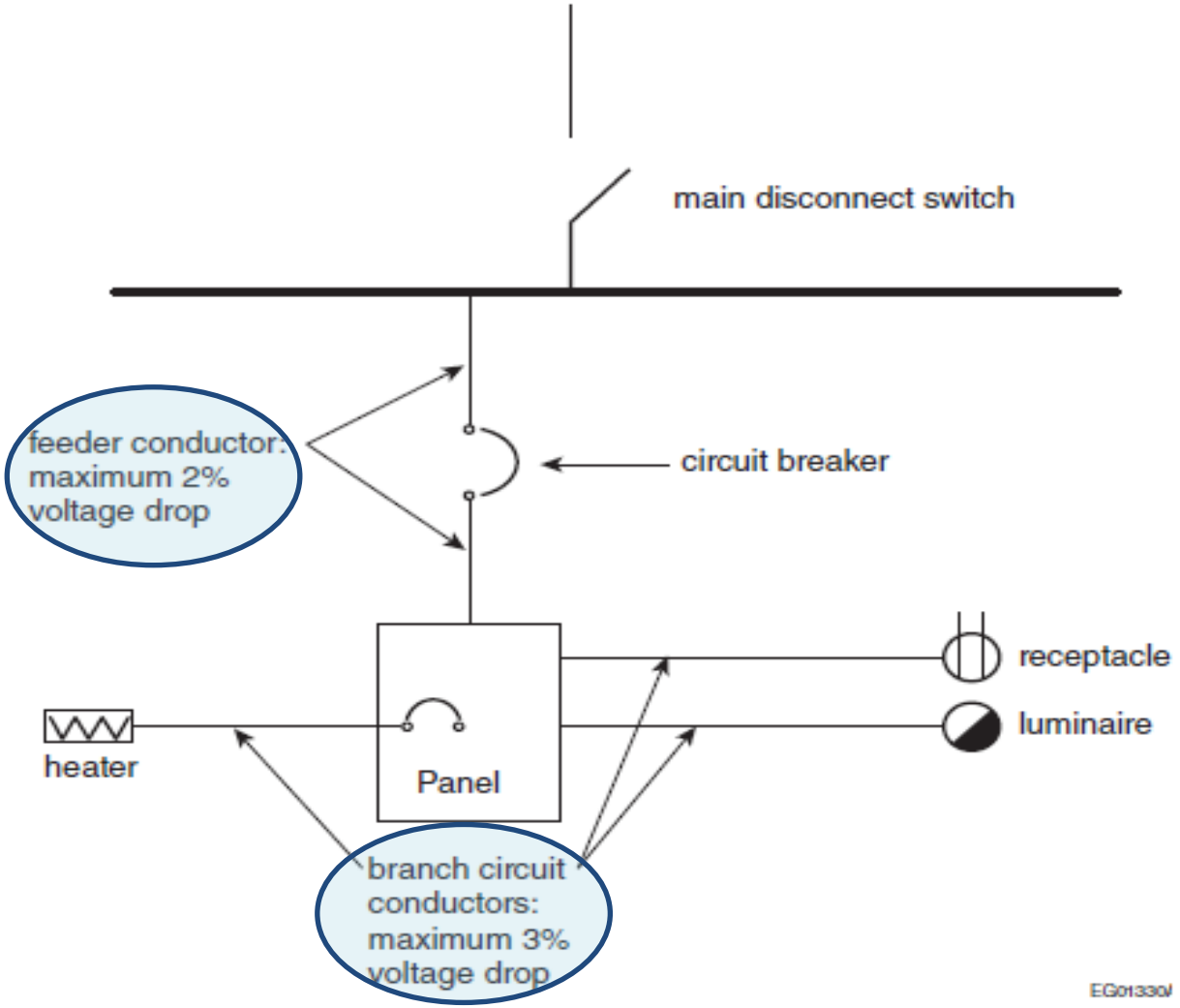
- Prescriptive
- Performance compliance

Means to monitor

- HVAC systems
- Interior lighting
- Exterior lighting



Voltage drop



Equipment efficiency

- 

Referenced standards

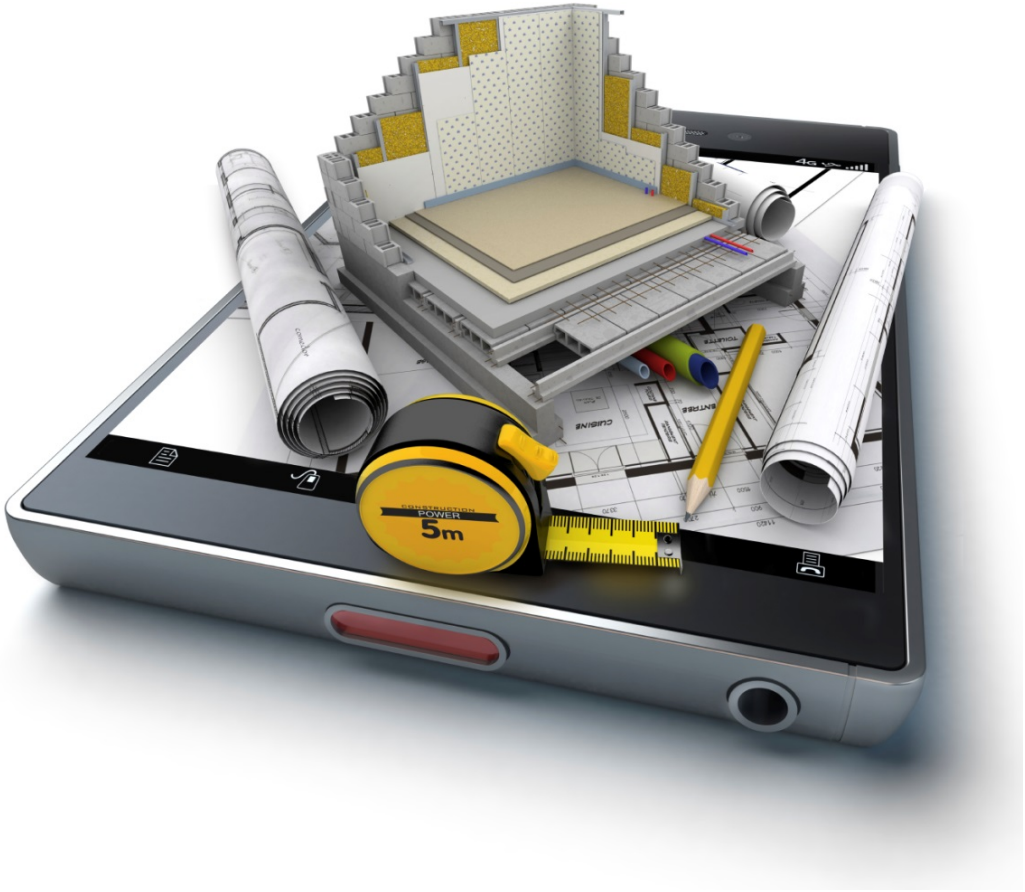
Image courtesy of CSA

Performance compliance

- No limitations

Performance compliance

What is Part 8?

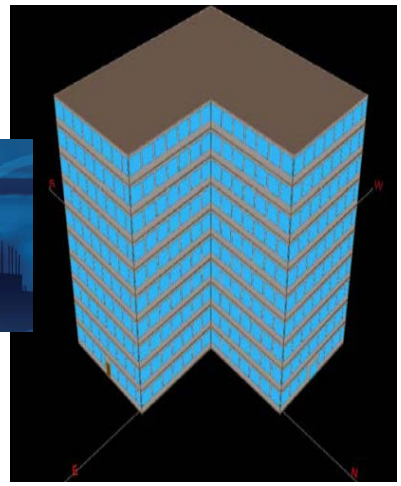


The direction we take in creating our vision of the good life, and of the future, has been a direct function of what we have thought is possible.

Paraphrase Joseph Pitt

Whole building energy use comparison

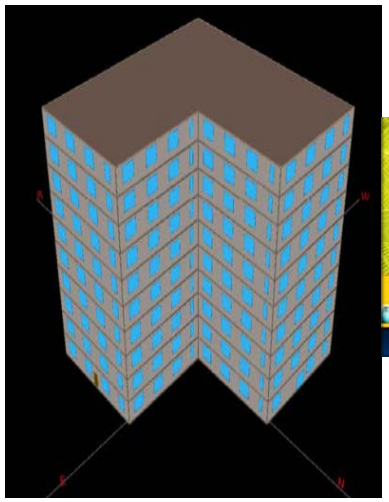
Annual energy consumption

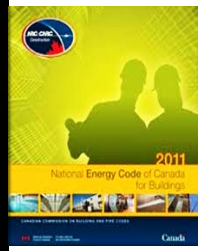


Proposed design

≤

Building energy target





Prescriptive basis for reference benchmark

Limitation for use to demonstrate compliance

- Sufficient information must be known
  - Building occupancy
  - Components, materials and assemblies

Photo courtesy of Justin Pockar

Building process

- Consult Code
- **Preliminary modeling and path selection**

- Compliance with Code

- Compliance with Code

Limitation for design and construction of building

- Insulate thermally active opaque components
- Avoid air leakage, wetting or moisture by-pass
- Equipment performance met or exceed the Energy Efficiency regulations

Renewable and process energy

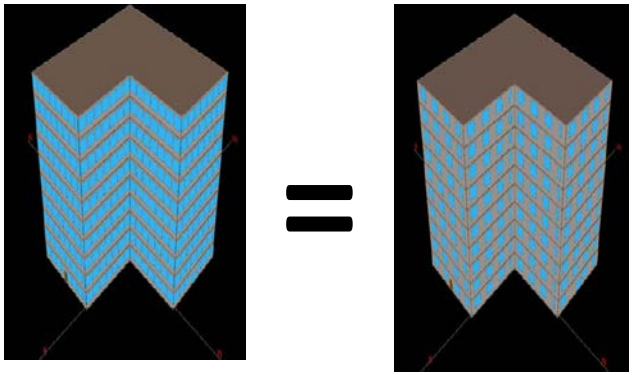
- Flexibility on process load and renewable energy
- No credit for purchased energy
- Guidance in Appendix
  - Industrial processes
  - Medical imaging equipment
  - Computer servers
  - Commercial kitchens

Required detail

- Hourly time step for one year
- Average 10 years of climatic data
- Account for
  - Thermal mass
  - Space temperature
  - Heat transfer
    - Internal loads
    - Radiant and convective heat from lighting
  - Solar absorptance
- Envelope assembly covering < 5% total assembly area need not be modeled separately

Proposed must match reference

- Floor area
- Use
- Thermal blocks
- Shape and exterior dimensions
- Orientation
- Default schedules and loads



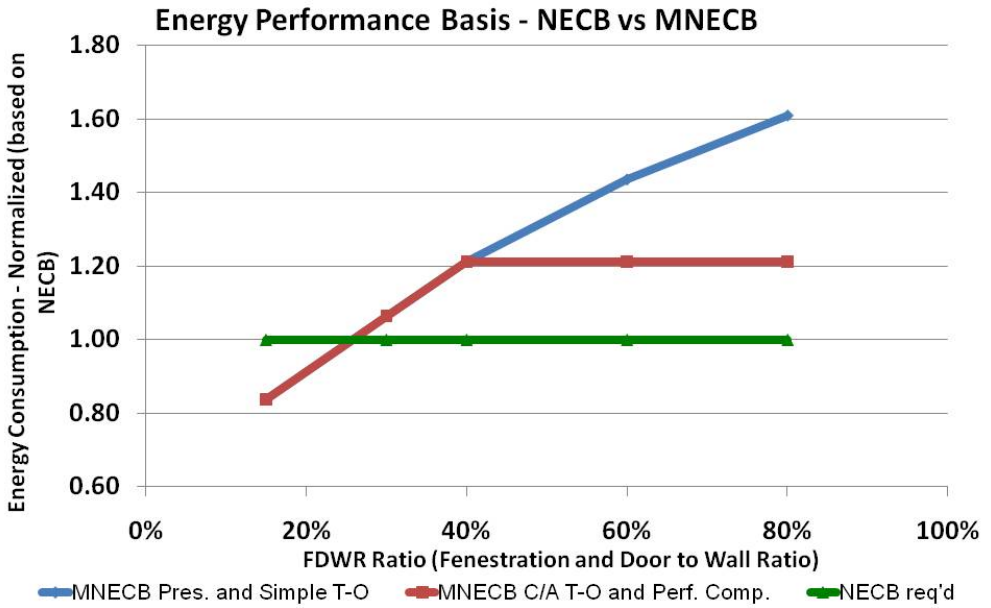
Compliance calculation

- Not software specific

- CanQuest
  - Builds reference building automatically
  - Free from NRCan

Envelope

- No differentiation
  - Assembly type
  - Fuel type or region
- Fenestration and door to wall ratio
  - % window and doors based on climatic region



Semi-heated building

- Reference building internal temperature set to 18 °C
- Heating equipment capacity no more than peak heating load plus 5%

Building envelope thermal characteristics

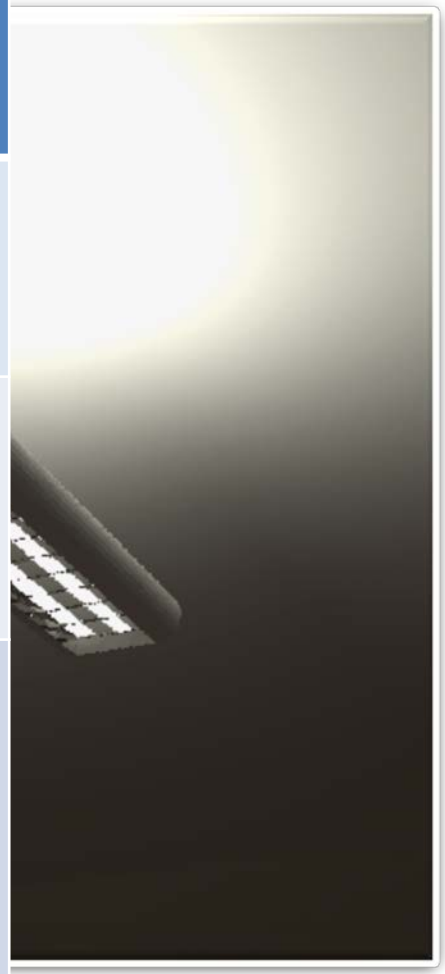
Envelope element	Reference modeling
Thermal mass	Light
Roof solar absorptance	0.7 if proposed known, otherwise match
Exterior permanent shading	No shades
Whole building air leakage	0.25 L/(s•m²)

Building envelope thermal characteristics

Envelope element	Reference modeling
Thermal mass	Light
Roof solar absorptance	0.7 if proposed known, otherwise match
Exterior permanent shading	No shades
Whole building air leakage	0.25 L/(s•m²)

Lighting

Requirement	Reference modeling
Occupant sensors	10% credit
Daylighting	Part 4 trade-off, if not in software
Lighting density in dwelling units not mandated	5 W/m^2



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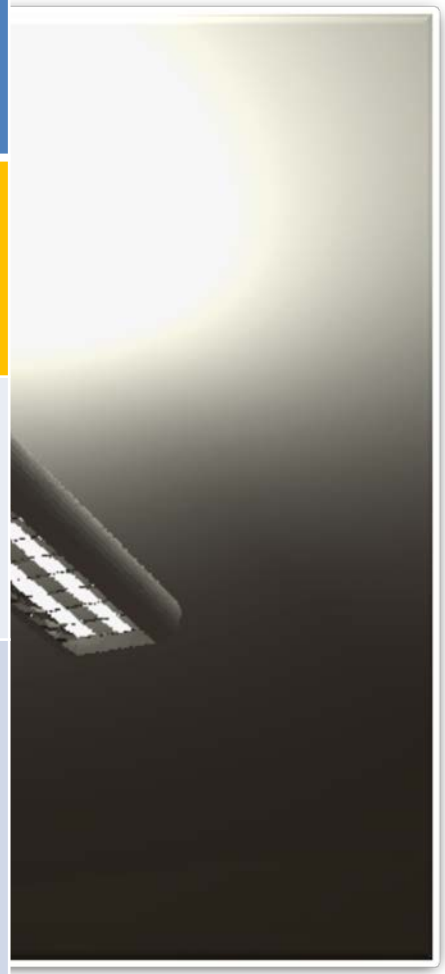

HVAC system selection

Building or space type of the proposed building	Size of building or space	Type of HVAC system required
Sleeping area: dormitory, detention cell, sleeping quarters	All sizes	System–3
Data processing area: control room, data center	All sizes	Where the proposed building or space has a cooling capacity exceeding 20 kW, the reference building or space shall use system–2;otherwise, the reference building or space shall use system–1

System types fuel neutral

System number	Type of HVAC system	Fan control	Type of cooling system	Type of heating system
System–1	Unitary air-conditioner with baseboard heating	Constant–volume	Air-cooled direct-expansion with remote condenser	Hot water with fuel-fired water boiler or electric resistance baseboard
System–2	Four-pipe fan-coil	Constant–volume	Water-cooled water chiller	Fuel-fired or electric resistance water boiler
System–3	~~Single-zone packaged~~ rooftop unit with baseboard heating	Constant–volume	Air-cooled direct-expansion	Fuel-fired or electric resistance furnace for rooftop, hot water with fuel-fired boiler, or electric resistance for baseboards

HVAC–ventilation

Element	Reference modeling
Ventilation	Constant volume, except general area > 2 storeys Cooling with outside air
Self contained dwelling units	Heat recovery, except in climatic zones 4, 5 and 6
Fans	Part load default provided
Parking garages	Demand control ventilation

HVAC–ventilation

Element	Reference modeling
Ventilation	Constant volume, except general area > 2 storeys Cooling with outside air
Self contained dwelling units	Heat recovery, except in climatic zones 4, 5 and 6
Fans	Part load default provided
Parking garages	Demand control ventilation

HVAC–heating and cooling

Element	Reference modeling
Radiant systems	2˚C difference in temperature set-point (e.g. heated to 21 °C versus 19 °C)
Oversizing	Heating not > 30% Cooling not > 10%
Part load performance	Defaults provided

HVAC–heating and cooling

Element	Reference modeling
Radiant systems	2˚C difference in temperature set-point (e.g. heated to 21 °C versus 19 °C)
Oversizing	Heating not > 30% Cooling not > 10%
Part load performance	Defaults provided

No credit

- Space temperature 1 °C throttling
- Outdoor air rate
  - Special consideration of displacement ventilation
- Service water
  - supply and storage tank temperature
  - Number of tanks
- Priority for use of systems with multiple energy types

Summary

- Reference linked to prescriptive requirements
- Consistency eased with
  - Fenestration and door to wall ratio based on heating-degree days
  - HVAC selection based on building type
- Most flexibility of all compliance paths in acceptable solutions

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Thank you

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Thank you

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