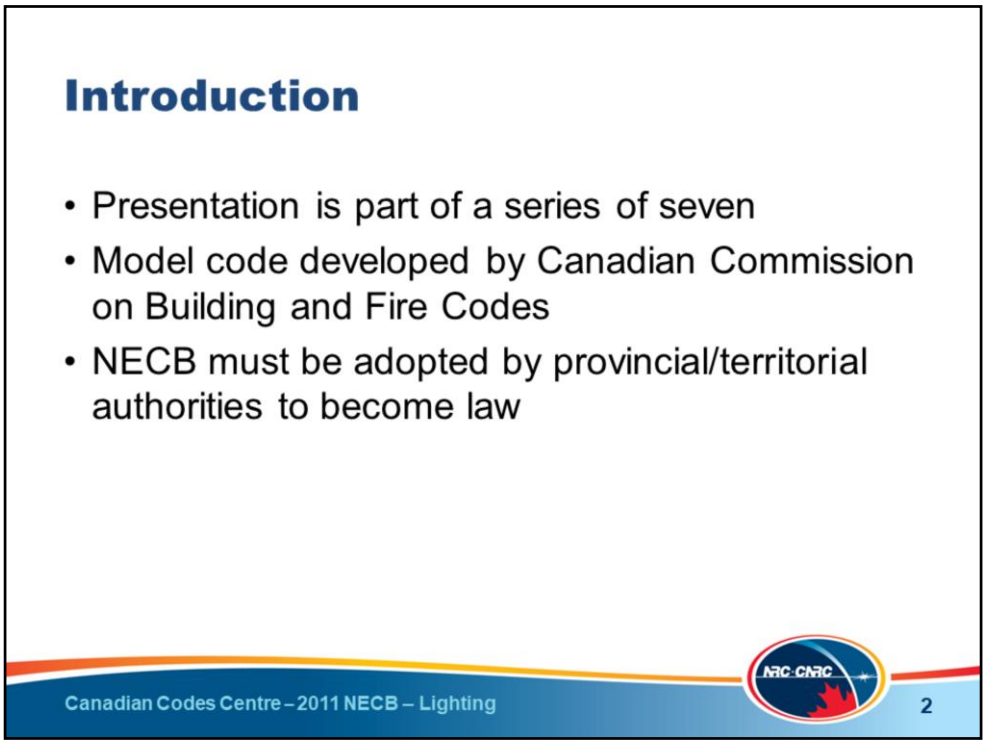
Welcome!
My name is Heather Knudsen.

This presentation focuses on Part 4 of the 2011 National Energy Code of Canada for Buildings (NECB), which addresses lighting.

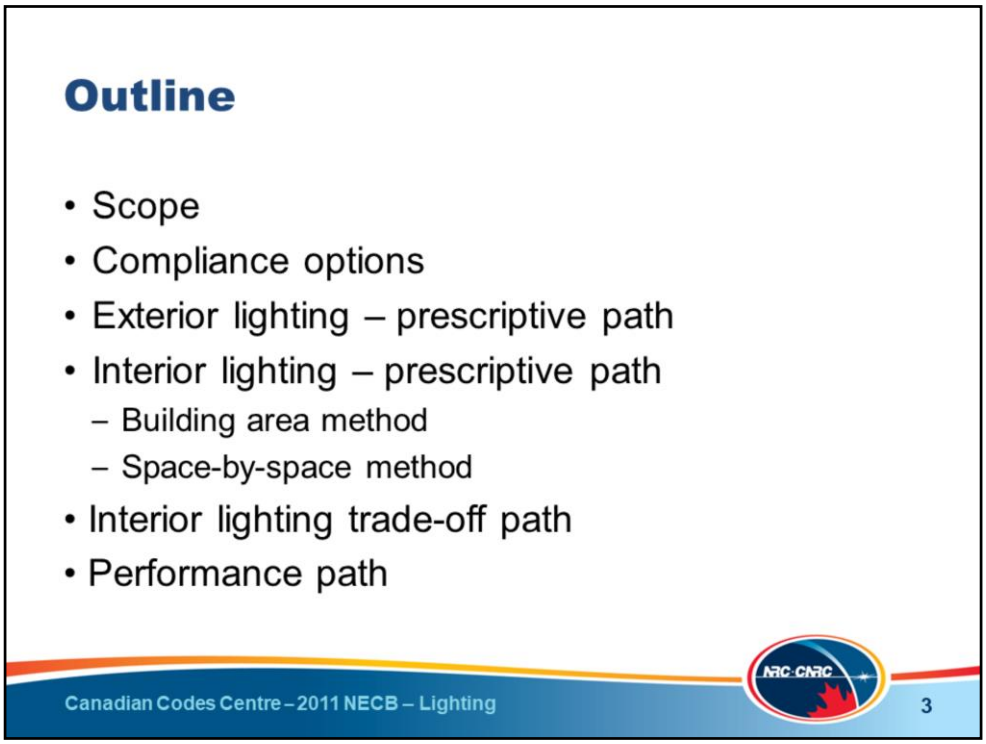


This presentation is part of a series of 7 on the 2011 NECB.

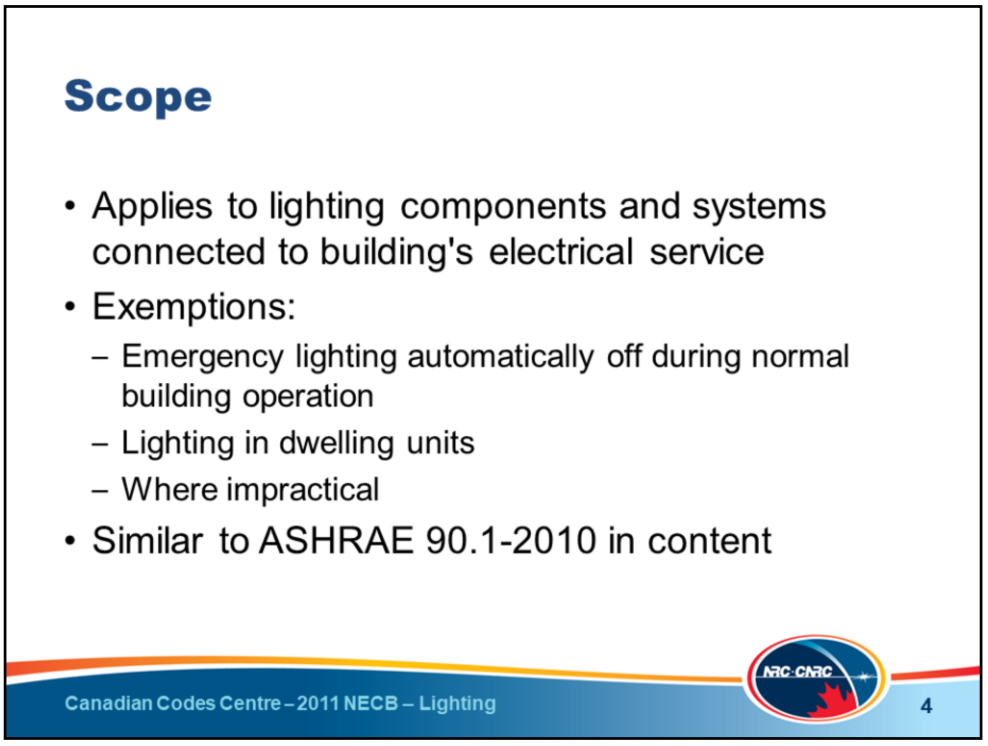
It is important to note that the NECB is a model code developed by the Canadian Commission on Building and Fire Codes that must be adopted by provincial and territorial authorities to become law.

This means that Code requirements enacted by legislation within your province or territory might differ from what is presented here.

Please check with your local authority.



This presentation covers the scope and compliance options available in the NECB lighting part. It also presents the prescriptive requirements for exterior and interior lighting, as well as the interior lighting trade-off path and limitations to using the performance path for lighting.



The scope of NECB Part 4 includes lighting components and systems that are connected to the building's electrical service.

Certain lighting applications are exempted from the Part 4 requirements:

- emergency lighting that is automatically off during normal building operation
- lighting in dwelling units, and
- where it can be shown to the authority having jurisdiction that the nature of the occupancy makes it impractical to apply the requirements.

The content of Part 4 is very similar to that of ASHRAE standard 90.1-2010. In fact, the NECB task group on lighting was fortunate to have the participation of a member of the ASHRAE lighting subcommittee.

Compliance options

- Prescriptive
- Interior lighting trade-off
- Performance compliance

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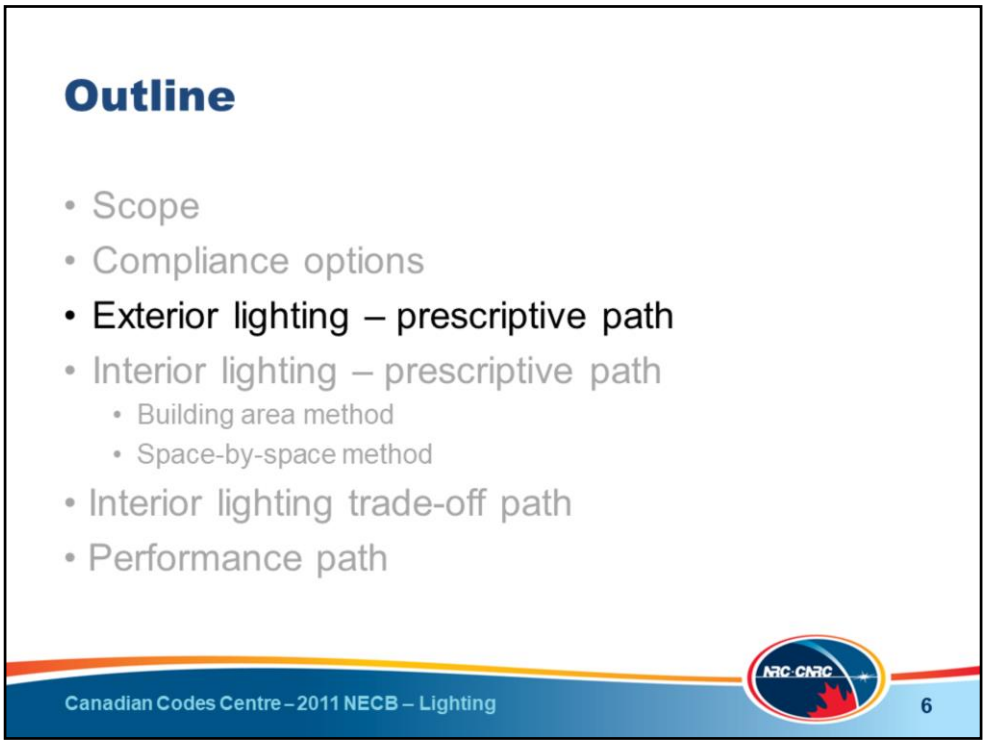
As with most of the other Parts in the NECB, Part 4 has 3 compliance paths for lighting.

- First, there is the prescriptive path, which is like a recipe for compliance: “To comply with the NECB lighting requirements, simply do x and y.”

- Then there is the new trade-off path for interior lighting, which provides more flexibility than the prescriptive requirements by, for example, allowing trade-offs between lighting power allowances and controls.

- Finally, there is the performance compliance route, which is the whole-building modeling approach.

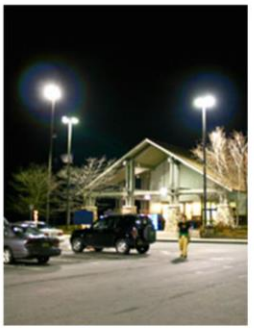
Each compliance path will now be explained in some detail.



Let's first look at exterior lighting.

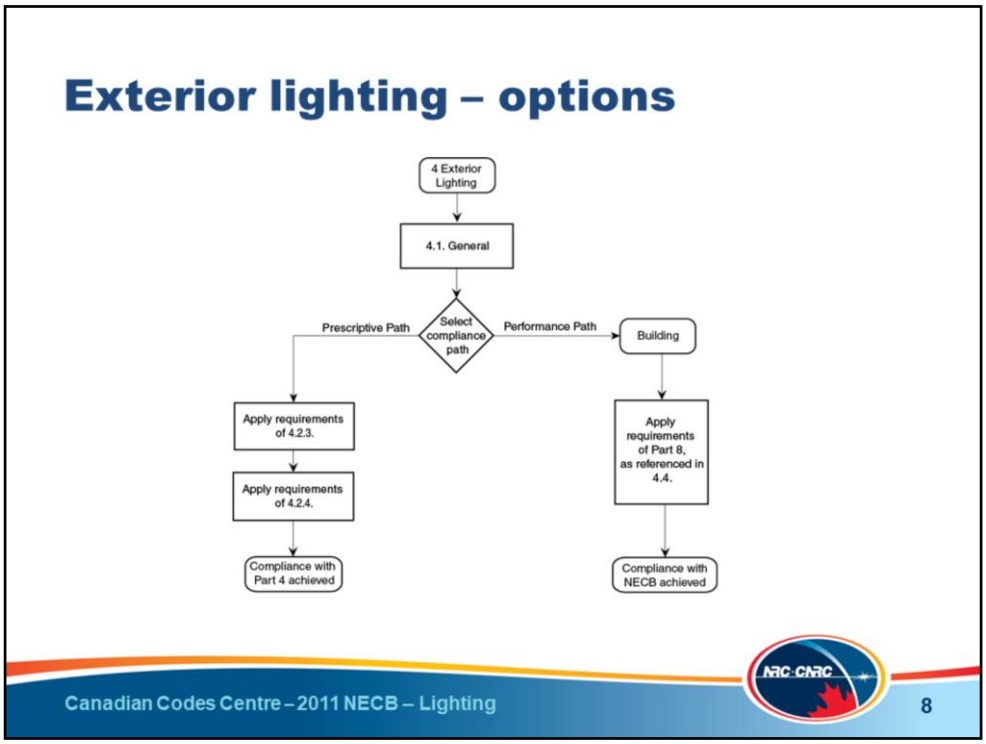
Exterior lighting – options

- Prescriptive or performance compliance only
- For systems connected to building's electrical service

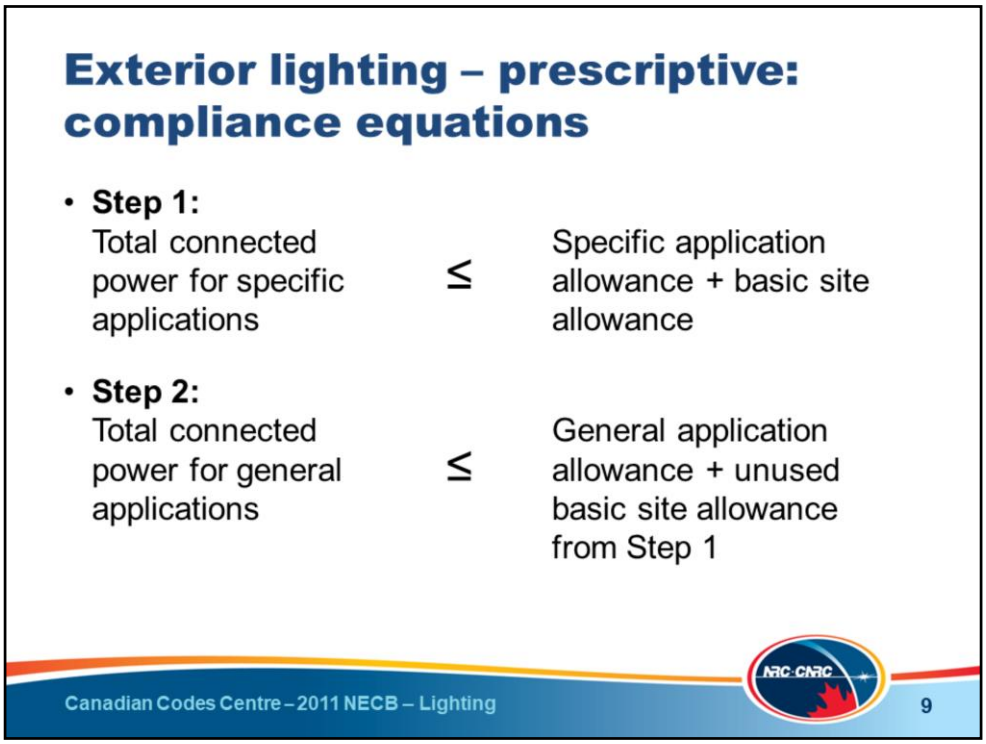


Exterior lighting can comply with the NECB using the prescriptive or performance path requirements only; there is no trade-off path for exterior lighting.

The requirements apply to exterior lighting systems that are connected to the building's electrical service.



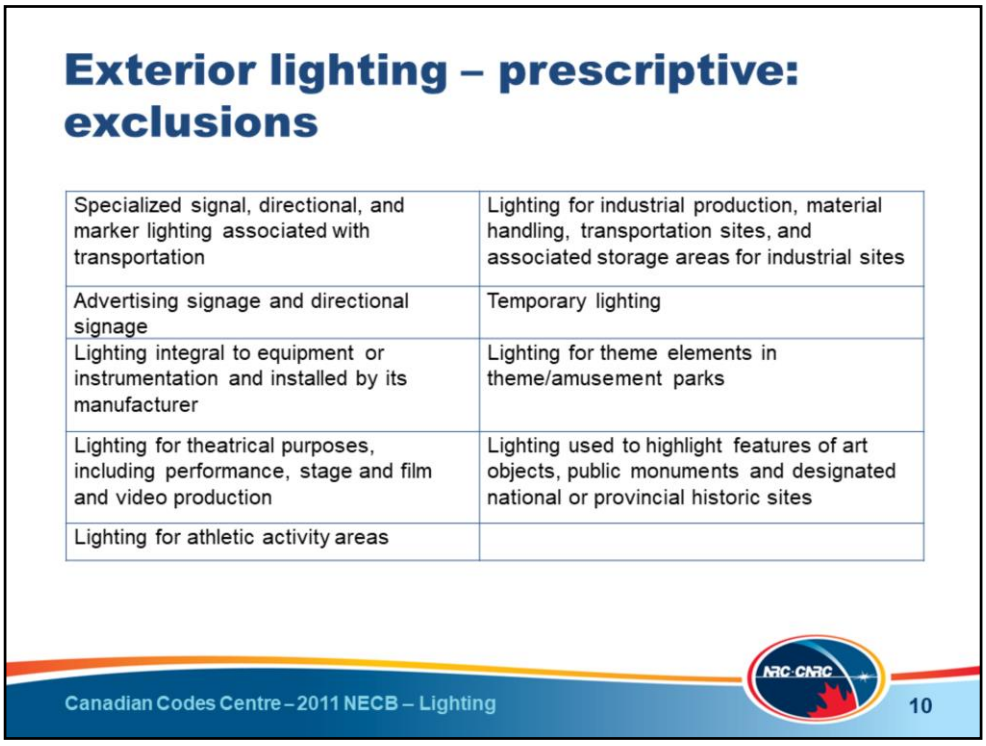
Here you see a flow chart showing the compliance options for exterior lighting. Compliance is achieved using the prescriptive path or through whole-building modeling using the performance path.



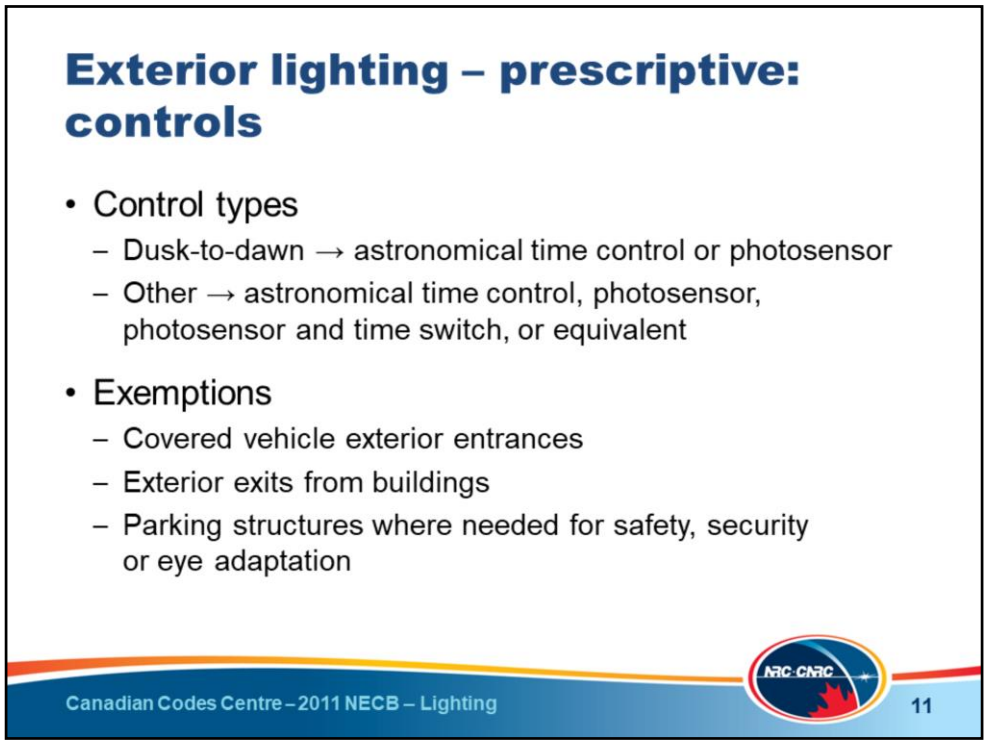
The calculation of exterior lighting allowance using the prescriptive path is a two-step approach.

First, the exterior lighting allowance for specific applications listed in a table in the Code are added to the basic site allowance for the building. This is then compared against the actual lighting power for those specific applications. If the actual lighting power is greater than the allowance for the specific application, then the basic site allowance is drawn down to compensate.

Next, the exterior lighting allowance for applications not addressed by the first step are determined from another table. To this is added any unused basic site allowance from step one. The sum of these is then compared to the actual lighting power for the applications not addressed by the first step.



There are quite a few exclusions from the application of the calculation of exterior lighting power, as shown here. For example, temporary lighting or lighting for theme elements in theme/amusement parks.

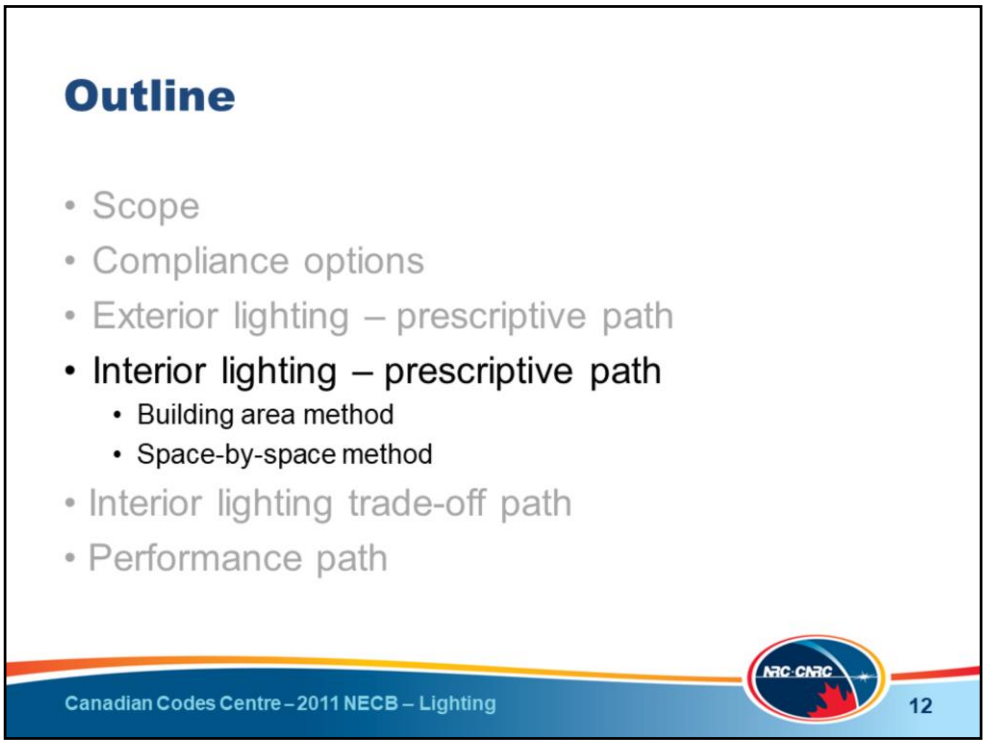


The requirements for exterior lighting controls are as follows.

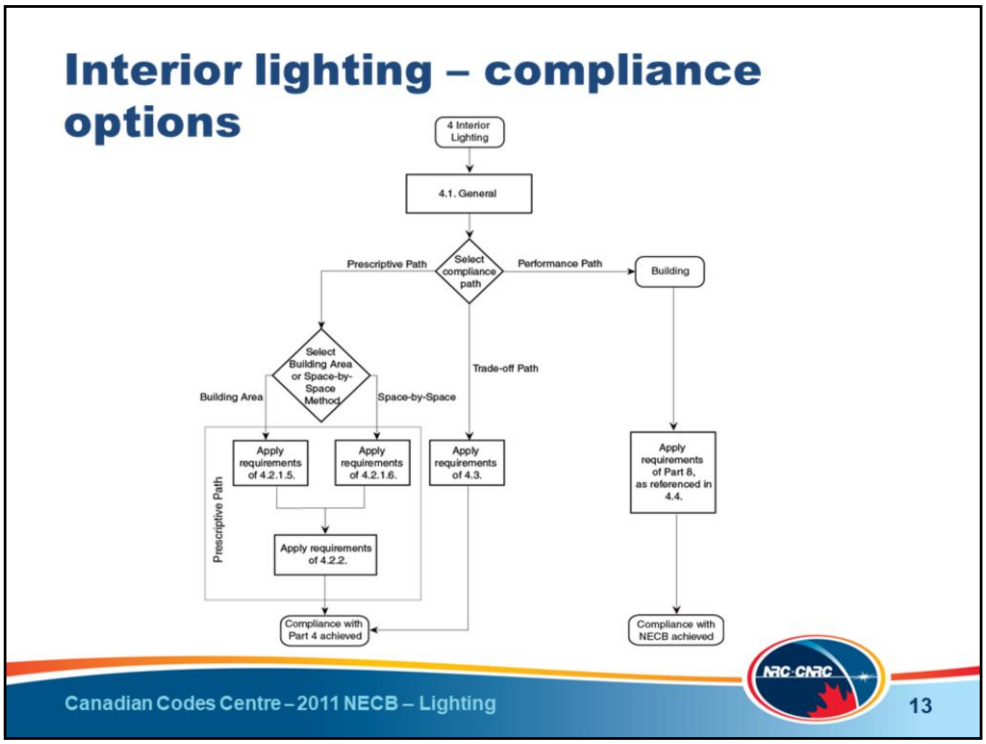
- For dusk-to-dawn operation, lighting must be controlled by an astronomical time control or a photosensor.
- For other applications, lighting must be controlled by an astronomical time control, a photosensor, a combination of photosensor and time switch, or a system that performs the equivalent function.

The following lighting applications are exempted from the requirements for controls:

- covered vehicle exterior entrances
- exterior exits from buildings, and
- parking structures where needed for safety, security or eye adaptation.



Now, let's look at the prescriptive requirements for interior lighting.



There are three compliance options for interior lighting:

- the prescriptive path
- the trade-off path, and
- the whole-building modeling using the performance compliance path.

Interior lighting – prescriptive: compliance equation

- Installed interior lighting power cannot exceed interior lighting power allowance as determined by either
  - Building area method, or
  - Space-by-space method
- Methods can't be mixed

The basic principle of the prescriptive requirements for interior lighting is that the actual installed interior lighting power cannot exceed the allowance for the interior lighting power when the allowance is calculated using either the building area method or the space-by-space method.

It is important to note that only one of these methods can be used for the entire building. You can't use the building area method for one part of the building and the space-by-space method for the other portions.

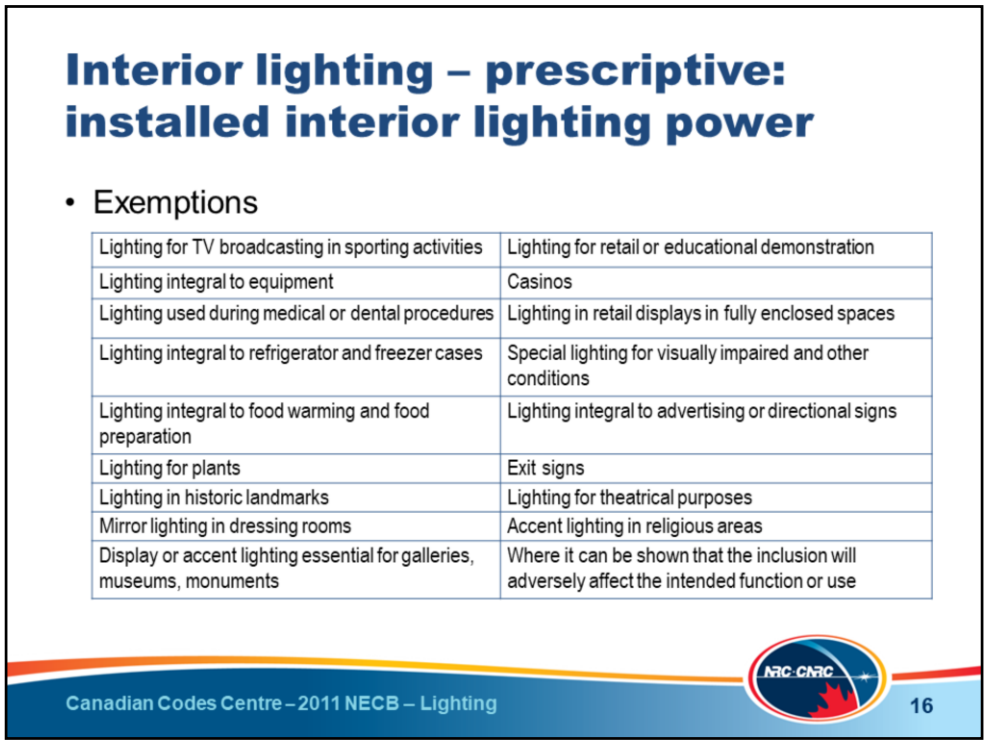
The space-by-space method can always be used, but some criteria govern the use of the building area method.

Interior lighting – prescriptive: installed interior lighting power

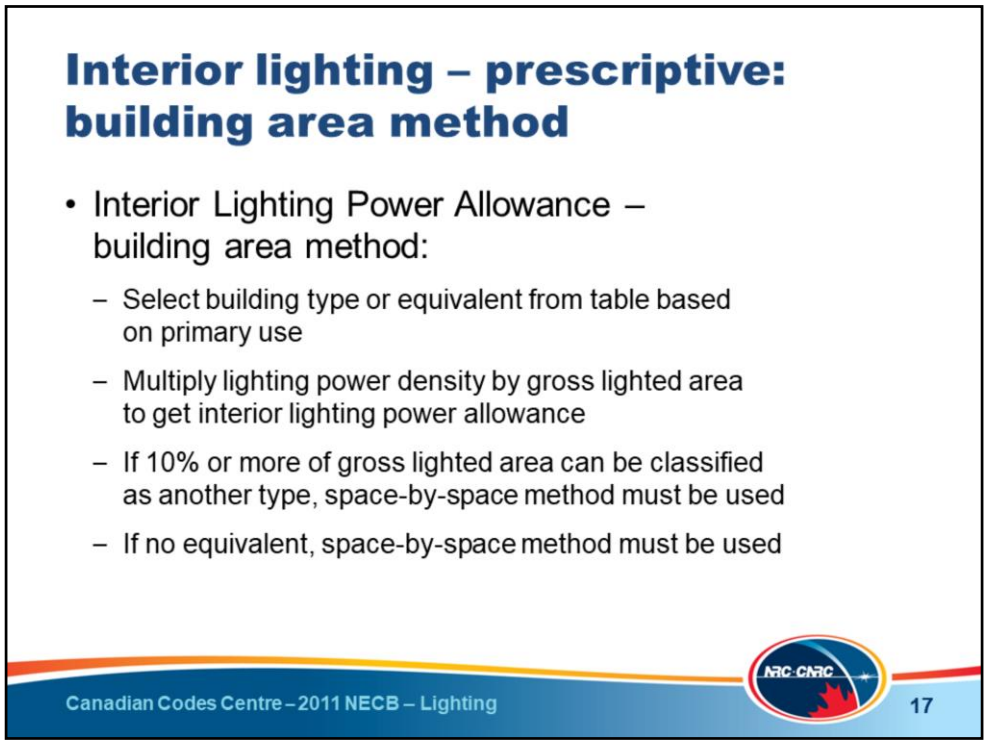
- Includes
  - All power used by luminaires to provide both permanent and supplemental lighting, including movable or plug-in luminaires
  - Higher wattage when more than one system provides lighting to an area at different times

The installed interior lighting power includes the total power used by all luminaires to provide both permanent and supplemental lighting, including that provided by movable or plug-in luminaires. When an area is served by multiple systems that provide lighting at different times (in other words, not simultaneously), the system with the highest wattage is included in the calculation.

There are specific requirements for determining the wattage of luminaires.



The lighting applications listed on this slide are exempted from the calculation of the installed interior lighting power, typically due to the function of the space. These exemptions include such things as lighting for retail or educational demonstration or lighting that is integral to equipment.

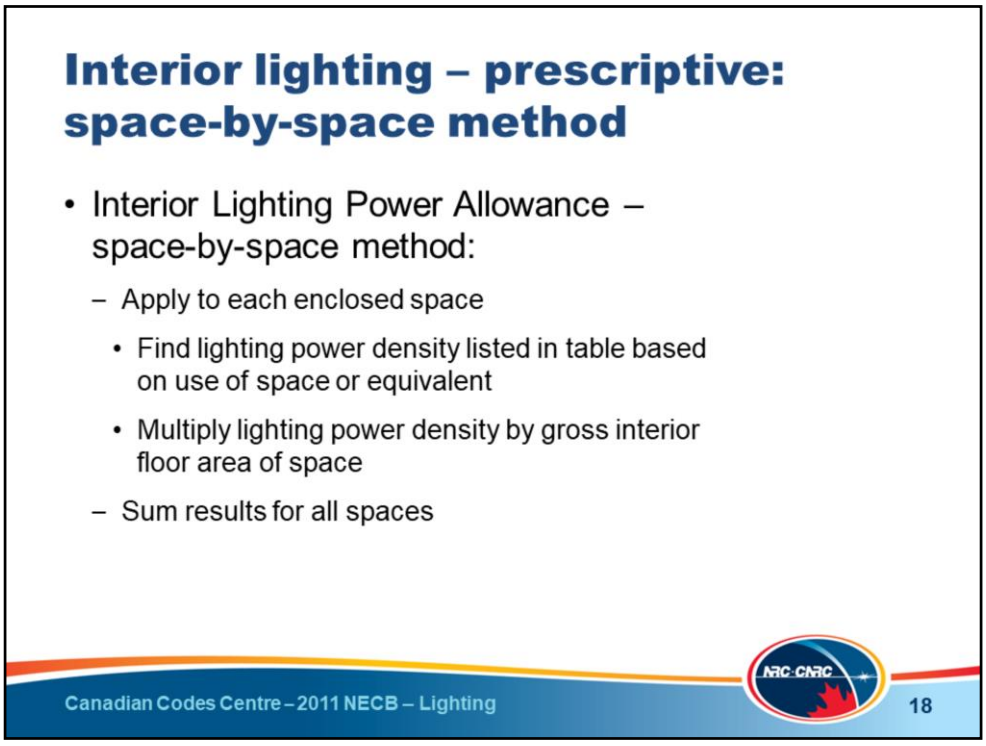


The building area method for determining the interior lighting power allowance uses the following approach.

- Based on the primary use of the building, the lighting power density associated with the building type or its equivalent is determined from a table.
- This lighting power density is then multiplied by the gross lighted area to calculate the interior lighting power allowance.
- The result is then compared against the installed interior lighting power.

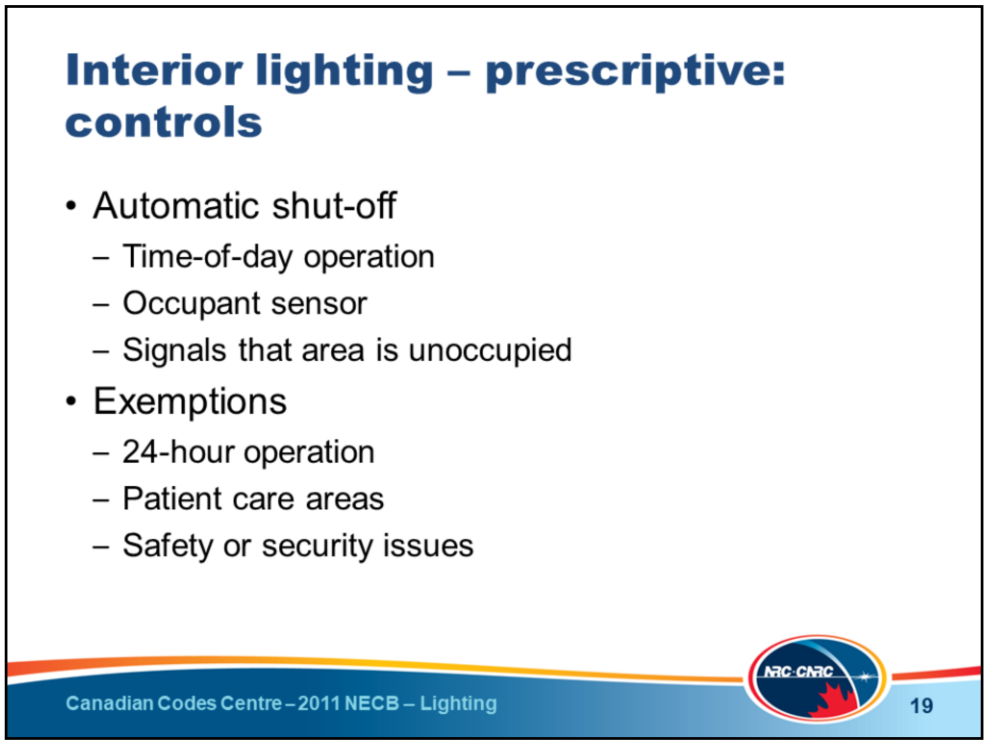
If 10% or more of the building's gross lighted area can be classified as being of a building type other than its primary type, then the building area method cannot be used. Instead, the space-by-space method must be used.

Also, if there is no building type listed in the building area method table that corresponds to the building being designed, the space-by-space method must be used.



To determine the interior lighting power allowance using the space-by-space method, the lighting power density for each space use, or its equivalent, is determined from a values table. The lighting power density is then multiplied by the gross interior floor area of the space.

This is done for each space, and all are summed to yield the interior power lighting allowance for the entire building. The result is then compared against the installed interior lighting power.

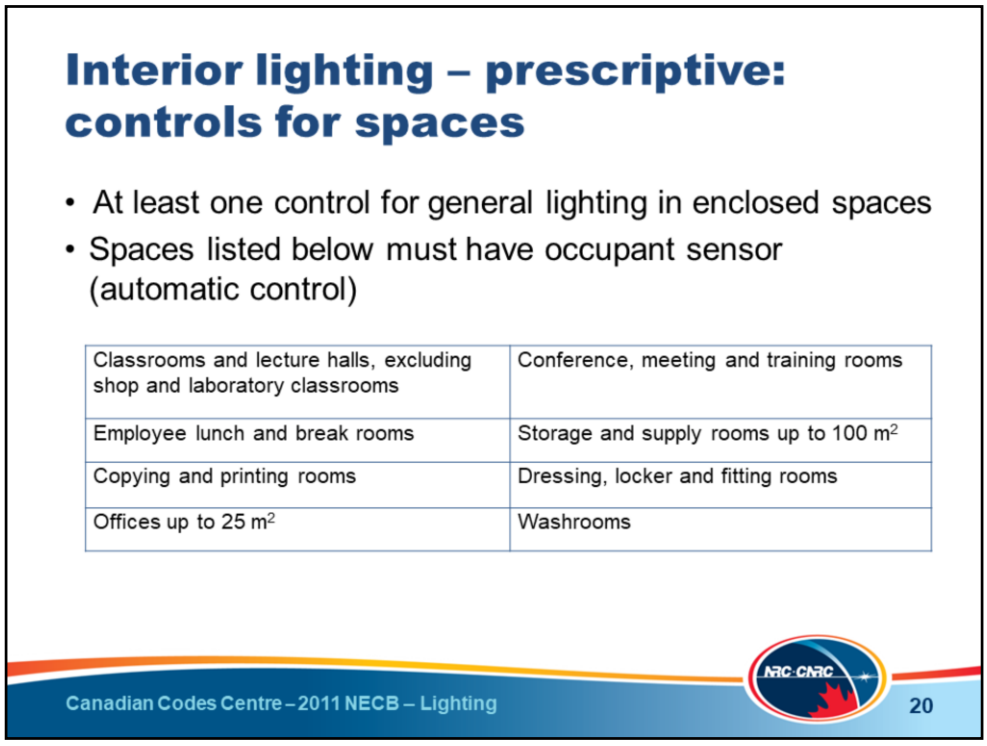


Automatic controls are required that shut interior lighting off in all spaces using either:

- time-of-day operation
- occupant sensors, or
- signals from a control or alarm system that the area is unoccupied.

The following areas are exempted from the interior lighting control requirements:

- areas where lighting is required for 24-hour operation
- areas where patient care is rendered, and
- areas where having automatic shut-off controls would negatively impact safety or security.



Each enclosed space must have at least one control device to independently turn off the general lighting within the space.

For the spaces listed in this table, that control must be an occupant sensor.

All other spaces must have a control device that can be activated either manually by an occupant or automatically by a sensor.

There are specific requirements for the location and identification of controls.

Interior lighting – prescriptive: automatic daylighting controls for toplighting

- Daylighted area > 400 m^2 → photocontrol to reduce general lighting
- Exemptions
  - Light blocked
  - Insufficient skylight aperture
  - Small enclosed space above 55°N latitude
- Requirements on how to calculate daylighted area

There are requirements for automatic daylighting controls for toplighting (skylights and rooftop monitors).

When the daylighted area under skylights and rooftop monitors is greater than 400 m^2, a photocontrol must be installed to reduce general lighting.

A photocontrol is not required when adjacent buildings or natural objects block light from entering the skylight or rooftop monitor (certain criteria must be demonstrated) and when the skylight aperture is insufficient. Small enclosed spaces in buildings located above 55°N latitude are also exempted.

There are specific requirements on how to calculate the daylighted area under skylights and rooftop monitors.

Interior lighting – prescriptive: automatic daylighting controls for sidelighting

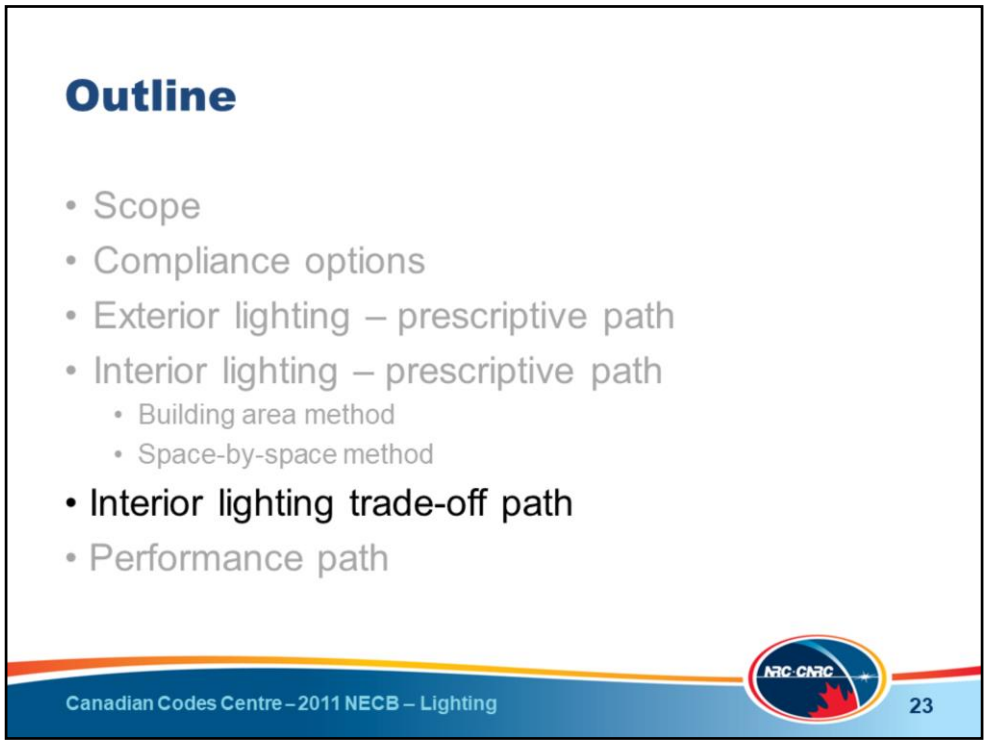
- Sidelighted area > 100 m^2 → photocontrol to reduce general lighting
- Exemptions
  - Light blocked by adjacent building
  - Insufficient sidelight aperture
  - Retail spaces
- Requirements on how to calculate sidelighted area

There are also requirements for automatic daylighting controls for sidelighting (windows).

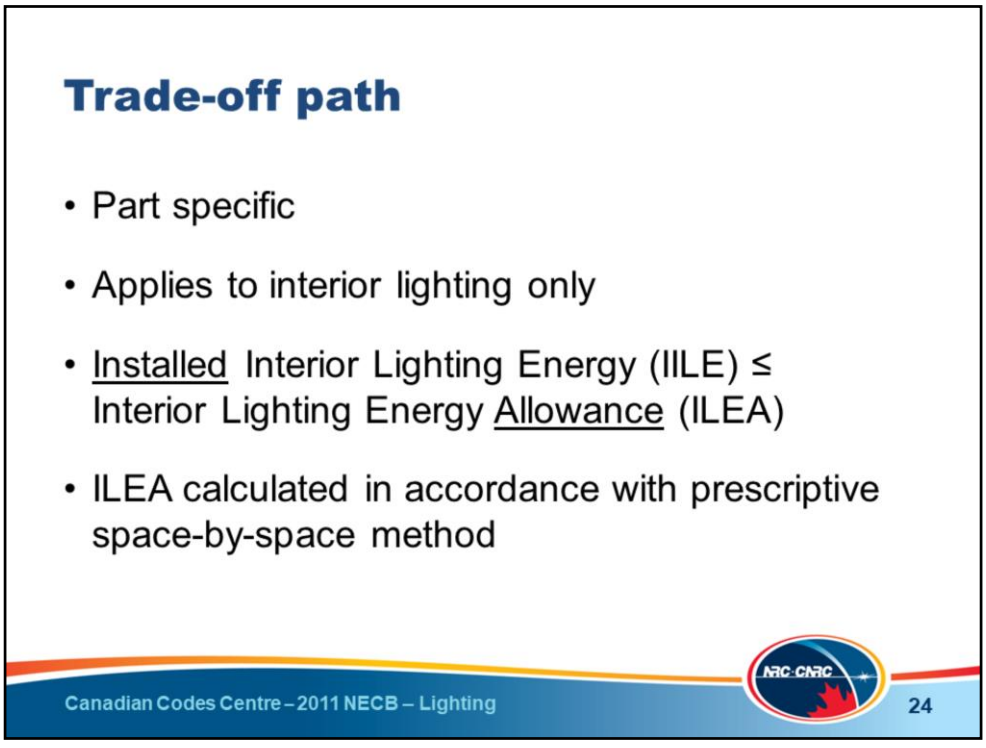
When the sidelighted area is greater than 100 m^2, a photocontrol must be installed to reduce general lighting.

A photocontrol is not required when a line from the top of the window at 63.4° intersects an adjacent building and when the aperture of the sidelight is insufficient. Retail spaces are also exempted.

There are specific requirements on how to calculate the sidelighted area.



The next section looks at trade-off options.



As with the trade-off paths in other Parts, the lighting trade-off option is Part-specific, i.e. lighting component efficiencies cannot be traded with other non-lighting building parameters. As well, the lighting trade-off option can only be applied as another compliance route to meet the interior lighting requirements, not those for exterior lighting.

The basic equation for the lighting trade-off path is that the Installed Interior Lighting Energy (IILE) must be less than or equal to the Interior Lighting Energy Allowance (ILEA).

The Interior Lighting Energy Allowance is calculated in accordance with the prescriptive space-by-space method.

Trade-off path

- More detailed calculation → series of equations to calculate ILEA and IILE

$$ILEA = \sum_{i=1}^{N} E_{i,\,prescriptive} \qquad IILE = \sum_{i=1}^{N} E_{i,\,proposed}$$

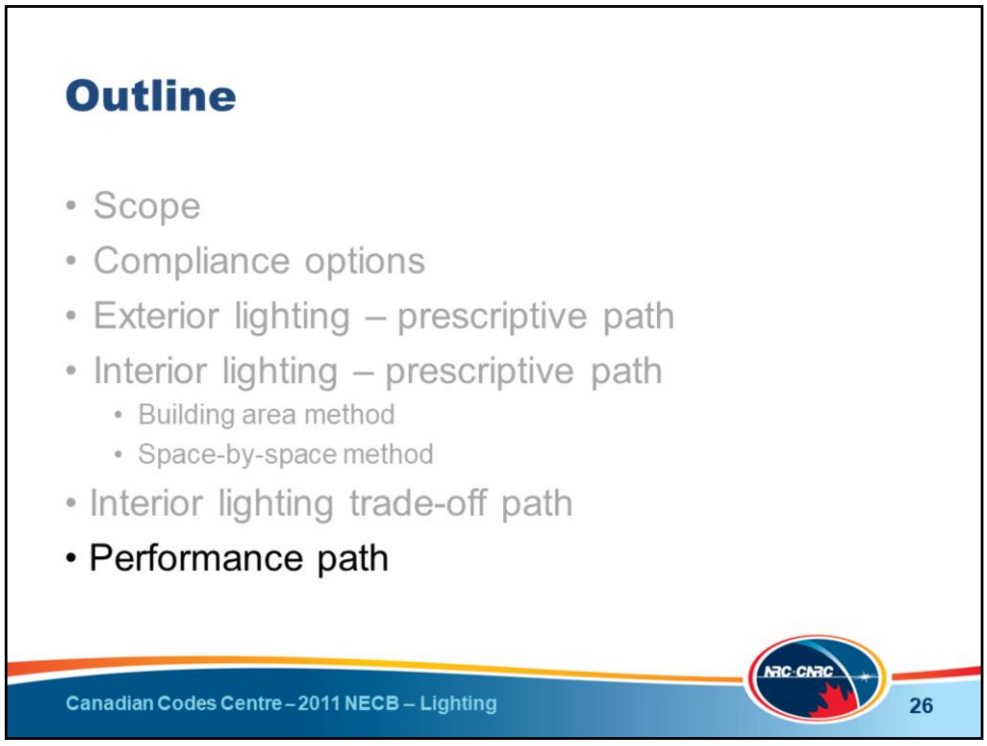
$$E_{i,proposed} = p_i \cdot \left[A_{DL,i} \cdot \left(t_{eff,day,DL,i} + t_{eff,night,i}\right) + A_{NDL,i} \cdot \left(t_{eff,day,NDL,i} + t_{eff,night,i}\right)\right]$$

$$t_{eff,day,DL,i} = t_{day,i} \cdot F_{DL,i} \cdot F_{occ,i} \cdot F_{pers,i} \qquad t_{eff,day,NDL,i} = t_{day,i} \cdot F_{occ,i} \cdot F_{pers,i}$$

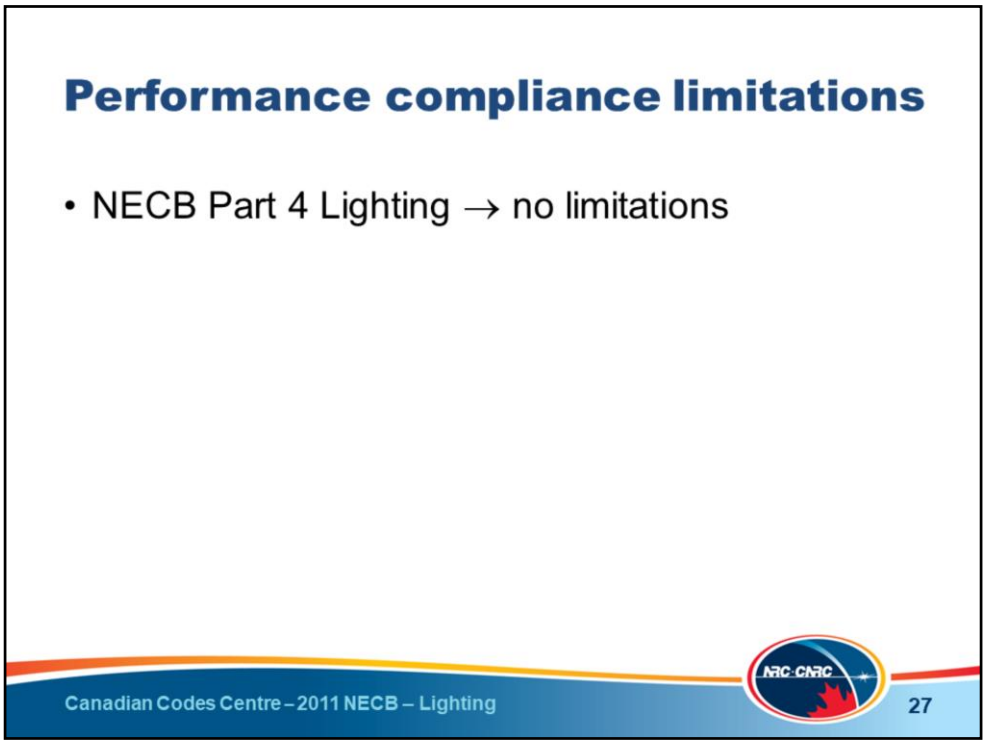
$$t_{eff,night,i} = t_{night,i} \cdot F_{occ,i} \cdot F_{pers,i} \quad \ldots$$

The trade-off path uses a more detailed calculation procedure for allowable and installed lighting than the prescriptive path requires. It uses a series of equations and factors to calculate the Interior Lighting Energy Allowance and the Installed Interior Lighting Energy.

Samples of some of the equations are shown here.



Lastly, let's look at the performance compliance path.



The performance compliance path is a whole-building modeling approach. The designer can choose to use the performance path to design a Code-compliant building, or may need to use it because the building does not meet the prescriptive path or the trade-off path.

Part 4 of the NECB places no criteria or limitations on the design of lighting using the performance compliance path.

This concludes the presentation on Part 4 of the NECB, Lighting.