BC hydro
POWER SMART

High-Performance Building Program
Energy-Efficient Lighting Design Incentive

Reference Guide for Lighting Calculator

Version 2.4.1

(for projects with building permit dated
prior to September 5th, 2008)

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1. Program Information

Read carefully, follow the instructions and information provided and click on the "Start Here" button.

Recommendation:
BC Hydro recommends the use of the following words in the Applicant's Tender Document to ensure your project is installed as designed to meet the program criteria and receive the approved capital incentive:

"Intentions are to award the tender to the contractor which will install products that satisfy the BC Hydro Small Commercial High Performance Building Program requirements. This means:

- for projects outside the City of Vancouver the installed lighting power density (LPD) must meet the ASHRAE/IESNA 90.1-2004 standard.
- for projects within the City of Vancouver the installed lighting power density (LPD) must be 10% better than the ASHRAE/IESNA 90.1-2004 standard.

2. Terms and Conditions

This is legal disclaimer information. Pressing the "Accept" button will lead you to the next page (Contact and Facility Information). Clicking on the "Do Not Accept" button will return you to the Program Information page.

3. Contact and Facility Information

Complete the application by providing contact information for the owner as well as information on the project facility, lighting designer and lighting contractor or distributor. After completing "Contact and Facility Information" click "Next" to proceed to the "Luminaire Schedule". You can return to the previous worksheets by clicking "Previous".

4. Luminaire Schedule

The Luminaire Schedule allows you to customize your own luminaire symbol, input wattage and luminaire description as used in your lighting design drawings. The luminaire schedule automatically populates the next tab, which is the "Lighting Calculator".

Enter all your luminaire types for interior and exterior lighting as follows:

4.1 Data Entry

Luminaire Symbol: enter your own symbols as per your lighting drawings. This will allow for easy identification and quantity counting (e.g., A1, FA, etc.).

Luminaire Description: use technical specification details including detailed type of lamp and ballast (e.g., 1x4, recessed luminaire complete with 3" deep-cell reflectors, 2 -30W, T8 lamps and LBF, IS el. Ballast, etc).

Lamp Wattage: use nominal wattage for the luminaire's lamps, (e.g., 32W for 4ft T8's).

Number of Lamps: enter the luminaire's total number of lamps, (e.g., 2).

Ballast Type: select the type of ballasts/ power supply used to power the luminaire's lamps, (e.g., T8-Hi-Ef-IS-LBF).

Input Wattage: use total input wattage for the luminaire, including ballast and transformer, (e.g., 47W).

You can add more rows if needed to enter your luminaire types by clicking the button "Add Rows".

When Lighting Calculator is completed, a total of each luminaire type will be calculated on the Luminaire Schedule.

Click on "Next" to go to "Lighting Calculator". You can return to previous worksheets by clicking "Previous".

5. Lighting Calculator

5.1. General Overview

The "Lighting Calculator" automatically populates luminaire types from the previous tab ("Luminaire Schedule"). The lighting calculator allows you to view the calculation results found under "Output Summary" which is located at the top right hand corner of the page. Error messages will appear if an incorrect entry is made and will provide information for corrective measures. The following instructions below are the mandatory steps for performing the calculations properly.

5.2. Calculation Concept

Lighting Power Allowance
The *total lighting power allowance* of a building is determined according to the space-by-space method of the ASHRAE/IESNA 90.1 standard (see Section 7 Design Guideline, page 9).

The *total lighting power allowance* is calculated as the sum of the interior and exterior *lighting power allowances*. Each of these power allowances represents the sum of each *space lighting power allowances* for the interior and exterior of the building.

The program calculates *the total lighting power allowance* for both baseline (e.g., ASHRAE/IESNA 90.1 -1999) and the minimum criteria target (e.g., ASHRAE/IESNA 90.1- 2004) and compares it with the *total installed (designed) lighting power*. The *total installed lighting power* is the sum of all wattages of proposed lighting design and installed luminaires in the new building, as entered using the space-by-space method.

For an incentive to be awarded, both the *interior installed lighting power* and the *exterior installed lighting power* must be lower than the *interior* and the *exterior lighting power allowances* for the minimum criteria target. If the minimum design criteria target is met, the Lighting Calculator will display the dollar amount of capital incentive, and show a

"PASSES" under "Compliance to Minimum LPD" in the Output Summary of the Lighting Calculator worksheet. Important note: the capital incentive must be at least $500 to qualify for Program participation.

If the lighting design does not meet the minimum criteria target, the computed capital incentive value will be "nil" and one of the following messages will appear:

- "FAILS INT. LTG"
- "FAILS EXT. LTG"
- "FAILS INT. AND EXT. LTG"

If the proposed lighting design does not meet the minimum criteria target, then the lighting designer may chose to consider other more energy-efficient luminaire options (see Appendix A for suggestions).

Energy Savings

Energy savings are calculated using the space-by-space method and is the difference between the energy usages of the baseline ASHRAE 90.1 – 1999 (power allowance times typical usage hours) and proposed installed lighting design (installed power times installed and controlled usage hours). The hardwired savings and control savings are calculated separately.

Interior Lighting Power

The *interior lighting power allowance* of the building is the sum of lighting power allowances of all interior spaces.

For each interior space, the lighting power allowance is determined by multiplying the tabled Lighting Power Densities (LPD) with the respective space area (refer to Appendix B, Table 5).

We recommend that installed LPD values be less than the minimum criteria target LPD. However, for the entire lighting design to comply with the minimum criteria (and for an incentive to be awarded), it is not mandatory that *all* spaces' installed LPD values meet the minimum criteria target LPD. Trade-off among spaces is permitted provided that the total installed interior lighting power does not exceed the interior lighting power allowance.

For an incentive to be awarded, the *installed interior lighting power* has to be lower than the *interior lighting power allowance* for the minimum criteria target.

Exterior Lighting Power

The exterior lighting power allowance of the building is the sum of lighting power allowances of all exterior spaces/areas.

For each exterior space, the lighting power allowance is determined by multiplying the tabled LPDs (refer to Appendix B, Table 6) with the respective space area. Note that not all the LPD values from the ASHRAE/IESNA 90.1 -2004 standard are used for the HPB lighting calculations. Do not enter exterior spaces that are not found within Table 6.

For an incentive to be awarded, the *installed exterior lighting power* has to be lower than the *exterior lighting power allowance* for the minimum criteria target.

6. Lighting Calculator Instructions

Step 1: Input of Critical Information
The following required information is critical to calculate the savings and capital incentive:

- **City of Vancouver**: confirm if the building is located within the City of Vancouver municipality boundaries by selecting "Yes" or "No" from the drop-down menu.

- **Project Completion Date**: Enter the estimated date of completion in the YYYY/MM/DD format. This information is vital for the incentive calculator to work properly. An incentive will NOT be calculated if the project completion date is not entered and the system will generate an "ERROR" message.

- **Measurement Units**: choose the measurement units as dictated by your project construction documentation (drawings and/or specifications). For your convenience, the calculator allows the use of either imperial (ft, ft^2) or metric (m, m^2) units. Select and use the same measurement units throughout the project application.

- **Estimated Area Size**: enter the total interior building surface (total floor space including any underground parkade) of the facility. Do not enter the exterior surfaces (e.g. exterior parkade or walkways) surrounding the building.

Step 2: Indoor Lighting Calculations
Once the required general project data has been entered, you can start calculating the interior lighting energy use by entering data in the Lighting Calculator worksheet row-by-row in the white "entry" cells that pertain to your design. More step-by-step details for the exterior lighting calculation are below.

Step 3: Outdoor Lighting Calculations
Once the interior lighting calculations are completed you can start the exterior lighting calculations by entering data in the Lighting Calculator worksheet row-by-row in the white "entry" cells that pertain to your design. More step-by-step details are below.

6.1. Instruction for Entering Building Data

Data entry is allowed only in the white "entry" cells. Fill in all the white cells that pertain to the design using the space-by-space method.

Area: enter the space description as per your lighting drawings. If there are more than one identical spaces (e.g., 6 classroom spaces), then enter a number in brackets to designate the correct space to drawing (e.g., classroom (1), classroom (2), etc).

Identical Areas: to expedite work select from the droped down list the number of identical areas. Identical areas are defined by identical size, lighting design, control options and hours of use).

ASHRAE/IESNA 90.1 Common Space Type: from the drop-down menu provided, select the best representation of the proposed use of the space (e.g., court sports area, indoor playing field area, fine material storage, etc.).

Area Surface: enter the area floor space as taken from drawings and according to the selected measurement unit (m^2/ft^2).

Annual Hours: enter the estimated annual number of hours of operation for the respective space. When the hours of operation information is unavailable or unknown, then use the estimated typical annual hours of operation from Section 7 Design Guidelines, Table 2, Typical Annual Hours of Operations).

Note: the maximum annual hours of operation is 8,760. If a value grater than 8,760 is entered, an error message will appear. Click "Cancel" and fix the value.

Lighting Control Reduction: for specific areas of the building that use timers, occupancy and/or photocell sensors, BC Hydro will provide **a maximum of 30%** reduction in the hours of operation for the automated controlled load in that specific area. On/Off switches are not applicable for incentive calculations.

For a specific area where lighting is controlled, select the appropriate automated control option form the pull down menu. Calculations for control energy savings will apply for the entire area. The program will adjust the energy saving calculations accordingly.

Comment text with suggested control usage reductions is also provided for each cell. For detailed information refer to Section 7, Design Guidelines, under Automatic Lighting Control Credits.

For example, without timers or occupancy sensors, the total hours of operation is 4,000 hours; and with occupancy sensors, the maximum allowed reduction is 30%, which means total hours of operation will be 2,800 hours. The worksheet will adjust the calculation automatically. This ultimately means a reduction of energy use for the specified area and a slightly higher capital incentive payout.

6.2. Instruction for Entering Lighting Systems Data

Luminaire Type

The Lighting Calculator will allow a maximum of 4 different types of luminaire types to be used in the room or space. Luminaire types in a space can be powered by the same circuits or by more than one circuit and can be controlled.

The program considers that all the luminaire types in a space will be controlled by one automated control point and the hours of use for the space are dictated by the main luminaire type (that provides over 50% of the area's required illumination and is used more than 50% of the time).

For example, a meeting room has a four fluorescent 1x4 recessed luminaire type for ambient lighting, 6 PAR 30 for accent lighting and 2 MR16 wall washers for the white board. It is expected that the fluorescent luminaire type will be used most of the time (max. 3,800 hours as per Section 7, Design Guidelines, Table 2 Typical Annual Hours of Operation) and will thus dictate the number of hours. The occupancy sensor installed controls all the luminaire systems.

For each luminaire type, fill in the white "entry" cells:

Luminaire Type: Select from the drop-down menu the luminaire symbol that corresponds to the proposed lighting design system in the specified room or space. The luminaire symbol was generated by entering data in the "Luminaire Schedule".

Quantity: Enter the quantity of luminaires that makes up the respective luminaire system.

Wattage: Will be automatically populated as provided in the "Luminaire Schedule" in previous worksheet.

Dimming**:** For specific lighting functions, dimming measures will be granted **0.1 W/ft^2 (1W/m^2)** reductions when light power density (LPD) values are calculated for the respective space. The dimming credits apply to the primary lighting system that provides more than 50% of the lighting in the space and more than 50% of the hours of operation. To activate dimming credits select "Yes" or "No" from the pull down menu on the worksheet. The program will adjust the energy saving calculations accordingly.
Dimming credits are awarded for interior lighting only.

For example, for a proposed office space in Burnaby, without dimming devices, the total design LPD may be 1.2 W/ft^2. If you provide fluorescent luminaires with dimming ballasts, the calculated LPD will be automatically reduced by 0.1 W/ft^2 (1 W/m^2). This means the new LDP would be 1.1 W/ft^2 which meets minimum design criteria (ASHRAE/IESNA 90.1 -2004). The worksheet will adjust the calculation automatically. This ultimately means a reduction of energy use for the specified area, and a slightly higher capital incentive payout.

Refer to the Section 7, Design Guideline, Lighting Power Density (LPD) Calculation Credits for details.

You can add more rows if needed to enter your luminaire types by clicking the button "Add Rows".

Remaining Columns under "Demand and Energy Saving" section:
The remaining columns titled Design LPD, Min. Criteria Compliance, Energy Saving Hardwired, Energy Saving Control and Energy Saving Total are automatically calculated. You are not required to make any entries in these columns.

Table 1. **Definition of Terms under Demand and Energy Savings**

Design LPD – the design LPD after any allowable dimming credits have been applied.

Min. Criteria Compliance: this section shows if the minimum Design LPD criteria have been reached for the respective space. It is not mandatory that all spaces meet the LPD criteria.

Demand Savings: shows the total installed power for the specified area. This information may provide estimated size circuits and balance electrical panels.

Energy Savings Hardwired: calculates the energy savings from the lighting equipment and helps to determine the capital incentive amount.

Energy Savings Control: calculates the energy savings from the automated controls and helps to determine the capital incentive amount.

Energy Savings Total: the sum of energy savings from hardwired lighting equipment and automated controls.

6.3. Instruction to Complete Exterior Lighting Calculations

Complete the Exterior Lighting Calculation per above instructions (section 6.1).

6.4. Output Summary

The "Output Summary", located at the top right hand corner, displays a series of resulting values for:

- Compliance to Minimum LPD - displays if the design passes the test of minimum Lighting Power Design criteria.
- Co-incident Demand Savings - displays the estimated lighting demand (kW) savings if 70% of lighting system was operating at any given moment.
- Energy Savings Hardwired - see above for definition .
- Energy Savings Control - see above for definition .
- Energy Savings Total - see above for definition .
- Energy Savings Total Cost - estimated annual energy cost based on commercial BC Hydro electrical tariff that considers both demand (kW) and electric rates charges (kWh).
- **Capital Incentive** - incentive is calculated based on pre-determined fixed incentive rate, energy savings from the proposed lighting design, and equipment life expectancy of installed lighting and automated control technologies. Capital Incentive must be at least $500 for program participation. If the incentive does not meet the minimum amount of $500, the following error message will occur "FAILS MIN. INCENTIVE AMOUNT" and building project does not qualify for participation in this program. The lighting designer may want to incorporate more energy-efficient lighting options (see Appendix A for suggestions).

You can return to the previous worksheets by clicking "**Previous**".

Click "**Next**" to go to Project Summary and Applicant's Declaration

7. Design Guidelines

7.1. Lighting Design Practice Baseline

Until further notice from BC Hydro, the ASHRAE/ IESNA 90.1– release 1999 will be considered as the baseline for current design practice, except for projects located in the City of Vancouver. The City of Vancouver customers must comply with local municipal energy

code bylaw; therefore, City of Vancouver projects have a different baseline for current design practice which is ASHRAE/ IESNA 90.1– release 2004.

The baseline applies for the installed lighting power densities and is part of the mandatory provisions as outlined below. The baseline will constitute the starting point in calculating demand and energy savings, as well as the financial incentive.

Lighting Power Density (LPD) is defined as the installed lighting power, in wattages, in a building space *divided by* the space area in square meters or square feet (e.g., watts/ft^2 or watts/m^2). See Table 5 and 6, Appendix B for list of LPD by common space types. A spreadsheet calculator is provided to determine the LPD, using the space-by-space method.

7.2. Lighting Design Minimum Criteria

In order to receive a BC Hydro incentive, the following minimum design criteria are required:

- Except for City of Vancouver, the proposed lighting installations must result in an installed lighting power density (LPD – measured in watts per square foot or square meter) that meets the ASHRAE/IESNA 90.1–2004 standard for the space or building type. ASHRAE/IESNA 90.1 – 2004 is the minimum criteria target for program participation. For calculations make reference to the code's space-by-space method in Appendix B.
- For projects located in the City of Vancouver, the installed LPD values must be at least 10% better (i.e., lower) than the LDP in the ASHRAE/IESNA 90.1–2004 standard.
- Energy savings are calculated by multiplying the hours of operation (see Table 2) by the difference of LPD values (between the baseline and the proposed energy efficient lighting design).
- For baseline or City of Vancouver's energy code compliance and energy savings calculations the consultant shall use the LPD spreadsheet calculator provided by BC Hydro (see Appendix B, under HPB - City of Vancouver).
- The system must still provide adequate lighting levels as recommended by the Illuminating Engineering Society of North America (IESNA).
- To help promote energy-efficiency technologies it is recommended (but not mandatory) that the lighting design includes two or more of the following lighting measures:
  - High-efficiency lamps
  - High-efficiency ballasts
  - Pulse-Start/Ceramic metal halide technology
  - High-bay fluorescent luminaires
  - Occupancy sensors/timers
  - Photoelectric/daylight (dimming) controls
  - Lighting design software shall be used to provide sample calculations for significant areas.

7.3. Lighting Power Density (LPD) Calculations Credits

The following dimming measures will be granted improvements in interior LPD allowance. These measures apply only to the space-by-space method:

- As per paragraph 9.6.2 of ASHRAE/IESNA 90.1 (2004) *for specific lighting functions.*
- *Provision of manual dimming controls* allows 0.1 W/ft^2 (1W/m^2) reductions when LPD values are calculated for the respective space. This applies to the primary lighting

system that provides more than 50% of the lighting in the space and more than 50% of the time of operation.

- *Provision of photoelectric dimming controls* allows 0.1 W/ft^2 (1W/m^2) reductions when LPD values are calculated for the respective space (e.g., perimeter workstation areas).
- *Provision of combined dimming controls* (i.e., lighting systems with personal manual dimming and photosensors) allows 0.1W/ft^2 (1W/m^2) reduction when LPD values are calculated for the respective space (e.g., perimeter workstation areas).

7.4 Automatic Lighting Control Credits

Space Control

BC Hydro recommends the use of automated controls for space control as per ASHRAE/IESNA 90.1 – 2004 code. However, for participation in the program the use of automated space controls is *not mandatory*; except for the projects in the City of Vancouver, where automated controls are mandatory with some exceptions (please consult code).

Therefore, BC Hydro will award energy savings credit as follows:

- For projects outside of City of Vancouver, for interior lighting designs that use timers and occupancy and/or photocell sensors, BC Hydro will approve savings up to a **maximum of 30%** of hours of operation reduction for the controlled load. The savings shall be calculated using the space-by-space method, based on the lighting load multiple by the estimated controlled usage hours (the difference between the usage hours without lighting controls and with lighting controls). To be granted control savings, the control devices shall be able to turn the lighting completely off.

- For projects within City of Vancouver, for interior lighting designs that use timers and occupancy and/or photocell sensors for classrooms, conference/ meeting rooms, employee lunch and break rooms and any other spaces not included in release 2004 version of the code, BC Hydro will approve savings up to a **maximum of 30%** of hours of operation reduction for the controlled load. The savings shall be calculated as above.

- For exterior lighting, photocells or timers from dawn-to-dusk lighting applications are mandatory under the ASHRAE/IESNA 90.1 - 1999 and 2004 code and therefore considered as baseline design by BC Hydro; resulting savings will not be approved for incentive under this program.

- For exterior lighting designs, BC Hydro will approve savings up to a **maximum of 30%** of hours of operation reduction for the controlled load only for systems with a means of supplementary time control beyond the dawn-to-dusk hour mechanisms. The savings shall be calculated space-by-space, based on the lighting load multiplied by the estimated controlled usage hours (the difference between the usage hours only with dawn–to-dusk controls, and with supplementary lighting controls).
  For example, an outdoor parking area should not be in use more than 4,380 hours per year (operating 12 hours/7 day per week) since is using dusk-to-dawn photocells. However if a timer is added, the parking lights could turn off earlier than dawn, allowing for energy savings.

- For upgrades involving multiple-switched luminaires (using multiple ballasts, Hi-Lo mechanisms, etc.), BC Hydro will approve savings up to a **maximum of 30%** where load is controlled by automated controls (occupancy sensors, timers, photo-sensors, etc.). The savings shall be calculated as mentioned previously, reflecting the expected usage hours for each set demand (e.g., luminaire will work 80% of the time at 50% power when space is unoccupied, and the remainder 20% of the time at 100% power when space is occupied).

We recognize that the true energy savings related to dimming and automatic lighting controls may exceed the limits set out by BC Hydro in this document; however, the capital incentive amount will be calculated with the set limits.

Building Automated Lighting Control Upgrades
Both ASHRAE/IESNA 90.1 - 1999 and 2004 codes require the use of automated control devices to shut off lighting in all building spaces. Therefore, BC Hydro will not approve energy savings for using whole or partial (split floors) building control devices (DDC, BMS, relay panels, etc). The baseline usage hours should reflect the presence of the above-mentioned automated building control devices (see the typical hours of use in table 2).

7.5. Recommended Lighting Levels

Appropriate lighting levels and other lighting quality parameters for the studied areas/sites should refer to the most updated Illuminating Engineering Society of North America (IESNA) Handbook, (9th Edition, 2000). The recommended illuminated values provided are based on the Society's judgement of best practise for 'typical' applications. A professional engineer or certified lighting designer should be consulted for particular spaces to ensure the space is properly designed to IESNA, WCB and any other industry or government specific regulations.

7.6. Typical Hours of Use for Various Installations

The following maximum hours of use for lighting applications will be used in calculating the approved savings for incentive applications, unless the Consultant or Owner can provide acceptable documented rationale for longer hours of operations to BC Hydro.

Table 2. Typical Annual Hours of Operation

Facility	**Maximum Hours of Use / Year**	**Facility**	**Maximum Hours of Use / Year**
Elementary School		Secondary School	
Classroom	2200	Classroom	2500
Corridors / Gymnasiums	2800	*Corridors / Gymnasiums*	3200
Storage Rooms	600	*Storage Rooms*	600
College / University		Strata Units / Hotels	
Classrooms / Offices	3000	Common areas	8760
Parking Garages	8760	*Parking garages*	8760
Storage Rooms	600	*Offices*	2600
Gymnasium	3200	*Guest room*	1500
Hospitals	8760	*Storage Rooms*	600
Warehouses	3600	Restaurants	4000
Shopping Mall	4800	Convenience Stores	6500
Office Buildings		Retail (food)	5800
Low rise	3800	Retail (non food)	4500
High rise	4000	Industrial	Confirm on a site by site

Source: Building Check Up (BCU) Data 1999

7.7 Lighting Design Software

BC Hydro intends to promote the use of computer-aided lighting design simulations. Effective use of lighting simulation software allows for quick and detailed calculations with effective graphic visualizations. This is helpful to effectively communicate the designer's concept and enable other stakeholders in the project to visualize and understand the lighting solution.

Assisted Lighting Design

Table 3 following lists BC Hydro approved lighting software for assisted lighting design. The selection is based on the ability to provide inter-reflected calculations of illuminance and effective graphic visualizations. Any upgraded release of these software programs will be automatically approved. Software programs not included on the list are subjects for review and approval by BC Hydro.

Table 3. BC Hydro approved Lighting Software

Product	GENESYS II/ III/ GENESYS LITE	LITE PRO 1.0/ 2.0	LUXICON 2.2.8	AUTOLUX 6.20	AGI 32/ 1.1	SIMPLY INDOOR 2.0	LUMEN MICRO 7.5
Vendor	Canlyte/ Genlyte	Columbia Prescolite Moldcast	Cooper Lighting	Independent Testing Laboratories Inc.	Lighting Analysts, Inc.	Lighting Technologies, Inc.	Lighting Technologies, Inc.
Product	LIGHT WORKS PRO 4.5	MICRO-SITE-LITE 2.2	LIGHT 3.0.	LIGHT STAR 3.20	SIMPLE 3.20	VISUAL BASIC 2.0	VISUAL PRO 2.0
Vendor	Light Work Design	Lighting Sciences, Inc.	Optis	Oxytech	Oxytech	Lithonia Lighting	Lithonia Lighting

Energy-Efficient Lighting Analysis

Table 4 lists free lighting software that can help designers evaluate alternatives for energy-efficient lighting (e.g., daylighting). The use of the freeware program is not mandatory; however, it can be a valuable feedback tool and may help achieve better designs.

Table 4. Energy-Efficient Lighting Software

Product	Lightswitch Wizard	DAYSIM	COM*check-EZ*	SPOT
Vendor(free)	NRC	NRC	PNW National Laboratory	Architectural Energy Co.
Source	www.buildwiz.com	www.daysim.com	www.energycodes.gov	www.archenergy.com/SPOT

APPENDIX A: Specifications for Standard Lighting Equipment

To help promote energy-efficiency technologies and design, BC Hydro recommends the lighting design include any of the following lighting measures:

- High-efficiency lamps
- High-efficiency ballasts
- Pulse-Start/Ceramic metal halide technology
- High-bay fluorescent luminaires
- Occupancy sensors/timers
- Photoelectric/daylight (dimming) controls
- Lighting design software shall be used to provide sample calculations for significant areas.

The following specification below outlines the minimum acceptable requirements for lighting equipment to qualify projects for BC Hydro incentive.

FLUORESCENT LIGHTING SYSTEMS

T12 Lighting

BC Hydro does not approve incentives for luminaires equipped with T12 lamps and magnetic or electronic ballasts, nor with T8 lamps and magnetic ballasts.

T8 Lighting

Following are the technical criteria for T8 lamps and electronic ballasts.

1. Fluorescent T8 lamps shall have the following maximum rated input wattage:
   - 8’ lamps shall be 59 watts or lower (high efficiency, premium lamps).
   - 4’ lamps shall be 32 watts or lower (high efficiency, premium lamps).
   - 3’ lamps shall be 25 watts or lower (high efficiency, premium lamps).
   - 2’ lamps shall be 17 watts or lower (high efficiency, premium lamps).
2. High efficiency/lower wattage T8 lamps usually have some limitations (such as min. 60F/16C operating temperature and no dimming abilities) that have to be considered when choosing the suitable design for the given application.
3. Minimum lamp life for all T8 lamps shall be 18,000 hours, but recommendable to be 24,000 hrs or more, at 3 hours per start regardless of the type of electronic ballast.
4. Colour rendering index (CRI) shall be 82 minimum. There is no restriction on lamp colour temperature.
5. T8 lamps may be remote tandem-mounted as recommended by the ballast manufacturer (usually up to 20 feet).
6. Ballasts shall be dedicated only for T8 systems and shall be high frequency electronic type. Ballasts shall operate lamps between 20 kHz and 60 kHz and shall have a 5-year warranty.
7. Instant Start electronic ballasts, Dimming electronic ballasts and Programmed Start ballasts are eligible for incentive. Rapid Start ballasts are not eligible for incentive as they are currently replaced by Programmed Start ballasts.

8. Instant Start electronic ballasts shall have low power input for 2 to 4 lamps ballasts (low power input means the ballast has a low ballast factor). The input wattage shall not exceed:

Standard Efficiency Ballast	Maximum Input Watts for Number of Lamps – Standard T8 lamps (Low BF)			
Lamp Length	1 lamp	2 lamp	3 lamp	4 lamp
2 foot	17W	29W	43W	56W
3 foot	24W	43W	60W	84W
4 foot	29W	52W	78W	102W
8 foot	57W	100W	N/A	N/A

Standard Efficiency Ballast	Maximum Input Watts for Number of Lamps – Standard T8 lamps (Normal BF)			
Lamp Length	1 lamp	2 lamp	3 lamp	4 lamp
2 foot	18W	31W	47W	61W
3 foot	26W	46W	64W	87W
4 foot	31W	60W	90W	112W
8 foot	60W	110W	167W	220W

9. High-efficiency electronic ballasts shall provide a minimum 3W energy savings over comparable standard-efficiency electronic ballasts of similar ballast factor.
10. Instant Start ballasts are not recommended in applications where the lamps are turned on and off frequently (i.e., with occupancy sensors) because they may shorten lamp life. Programmed Start ballasts are recommended for these applications.
11. Ballast power factor shall be 0.95 minimum (lead or lag).
12. For 4-foot linear 32W (or lower) T8 lamps and electronic ballasts, the mean system efficacy shall be:
    - greater or equal to 90MLPW (mean lumens per input watts) for Instant Start ballasts
    - greater or equal to 88MLPW for Programmed Start ballasts.
13. Normal Ballast Factor ballasts have a ballast factor of between 0.85 and 1.00, as per ANSI C82.11.
14. Low Ballast Factor ballasts shall have a ballast factor between 0.70 and 0.85.
15. High Ballast Factor ballasts shall have a ballast factor between 1.10 and 1.20.
16. For the standard electronic T8 ballasts, the total harmonic distortion (THD) limit shall not exceed 20% at either rated 5% above and 5% below nominal primary voltage. For high efficiency electronic ballasts, THD shall be less than 10%.

T5 Fluorescent

1. This measure will apply to T5 systems with linear lamps rated 18 watts to 80 watts inclusive.
2. Ballasts shall be dedicated for T5/ TT5/ T5HO systems and shall be high frequency electronic type. Ballasts shall operate lamps between 20 kHz and 60 kHz.
3. Total harmonic distortion (THD) limits for input current shall not exceed 17% at either rated 5% above, and 5% below nominal primary voltage.
4. New T5 luminaires must have an efficiency of minimum 70% to qualify for incentive.

Compact Fluorescent

1. For the present incentive program BC hydro does not approve luminaires for screw-base compact fluorescent lamps.
2. The measures apply to all hardwired CF lamps of 2-pin, 4-pin and double, triple 2D, biax tubes, etc.
3. Lamps shall start and operate reliably at temperatures down to +10°C throughout their rated lives. Low temperature ballasts to be suitably rated for cool temperature applications.
4. There is no restriction on the lamp colour temperature, but the colour rendering index (CRI) shall be 82 minimum.
5. It is recommended that CFL luminaires be operated by high power factor ballasts (>0.95) to limit stress to the electrical distribution system and to avoid possible power factor penalties to the Owner.

High-bay Fluorescent Luminaires

1. It is recommended that High-bay fluorescent luminaires save a minimum of 100 input watts/ luminaire when compared with incandescent or HID technology.
2. Accepted lamps for high-bay fluorescent luminaires are: T8, T5, T5HO, CFL and Induction lamps. Ballasts shall be high power factor electronic and suitable for the lamp type.
3. High-bay fluorescent luminaires shall be capable of multiple switching.
4. Luminaires to be provided with optimal heat dissipation for electronic ballasts.

LED Exit Sign

1. LED Exit Signs are considered baseline design and do not qualify for an incentive.

High Intensity Discharge Luminaires

1. The incentive applies to both interior and exterior lighting systems. HID ballasts can be magnetic or electronic type.
2. All HID ballasts shall have a ballast factor of 0.95 minimum and a high power factor (0.90 minimum).

Occupancy Sensor Switches

1. Principle of operation shall be on the basis of passive infrared energy or ultrasonic energy response or a combination of both, and be of commercial quality only.

2. Switch format to be either a wall-mounted type for the replacement of conventional wall switches, or a ceiling mounted version. Switch contacts to be suitable for application on fluorescent and HID lighting systems. Switching shall be via parting/making of mechanical contacts and not solely with electronic components. Sensor switches to be used in conjunction with approved low voltage relay systems will also be permitted. Switch to have no minimum loading requirement to stay activated.

3. Sensor switches shall have OFF-AUTOMATIC selector modes with no "ON" position.

4. Sensor switches can have an optional ambient light sensing feature with an adjustment range to result in a lighting system not being turned "ON" during occupancy with generous daylight contribution.

5. An adjustable "ON" time feature shall be provided with a continuous range of one to 15 minutes. Occupancy "scan" frequency shall be at least once every two seconds, with automatic timing function reset. LED indicator to show activity detection.

6. All sensors shall have a sensitivity adjustment feature to "tune in" for proper operation for a variation of room or area geometric.

7. This measure accepts the use of two or more sensor switches suitably interconnected as a system for situation such as highly irregular areas, partitioned work station areas, very large areas, etc.

8. Occupancy sensor layout and arrangement to be in accordance with individual manufacturer's recommendations.

9. For situation where an "OFF" option is required during room occupancy where ceiling-type sensors are used, a wall switch is suggested to electrically switch off the occupancy sensor.

10. Switch to have humidity resistant circuitry and components.

11. It is important that the sensor have adequate inrush current capability for the subjected application, particularly electronic ballasts.

APPENDIX B: LPD Tables

Table 5. Lighting Power Densities (LPD) using ASHRAE / IESNA Standard 90.1 Space-by-Space Method

Common Space Types		90.1-1999 (Baseline)		90.1-2004 (HPB[a])		HPB-City of Vancouver[b]	
		W/m^2	W/ft^2	W/m^2	W/ft^2	W/m^2	W/ft^2
Office-enclosed		17	1.6	12	1.1	11	1.0
Office-open plan		14	1.3	12	1.1	11	1.0
Conference/ Meeting/ Multipurpose		16	1.5	14	1.3	13	1.2
Classroom/ Lecture/ Training		17	1.6	15	1.4	14	1.3
	For Penitentiary	15	1.4	14	1.3	13	1.2
Lobby		19	1.8	14	1.3	13	1.2
	For Hotel	18	1.7	12	1.1	11	1.0
	For Performing Arts Theater	13	1.2	36	3.3	32	3.0
	For Motion Picture Theatre	9	0.8	12	1.1	11	1.0
Audience/ Seating Area		17	1.6	10	0.9	9	0.8
	For Gymnasium	5	0.5	4	0.4	4	0.3
	For Exercise Center	5	0.5	3	0.3	3	0.3
	For Convention Center	5	0.5	8	0.7	7	0.7
	For Penitentiary	20	1.9	8	0.7	7	0.7
	For Religious Buildings	34	3.2	18	1.7	16	1.5
	For Sports Arena	5	0.5	4	0.4	4	0.3
	For Performing Arts Theatre	19	1.8	28	2.6	25	2.3
	For Motion Picture theatre	14	1.3	13	1.2	12	1.1
	For Transportation	11	1.0	5	0.5	5	0.4
Atrium-first three floors		14	1.3	6	0.6	5	0.5
Atrium-each additional floor		2	0.2	2	0.2	2	0.2
Lounge/Recreation		15	1.4	13	1.2	12	1.1
	For Hospital	15	1.4	9	0.8	8	0.8
Dining area		16	1.5	10	0.9	9	0.8
	For Penitentiary	15	1.4	14	1.3	13	1.2
	For Hotel	11	1.0	14	1.3	13	1.2
	For Motel	13	1.2	13	1.2	12	1.1
	For Bar Lounge/Leisure Dining	13	1.2	15	1.4	14	1.3
	For Family Dining	24	2.2	23	2.1	21	1.9
Food Preparation		23	2.1	13	1.2	12	1.1
Laboratory		20	1.9	15	1.4	14	1.3
Restrooms		10	0.9	10	0.9	9	0.8
Dressing/Locker/Fitting Room		9	0.8	6	0.6	5	0.5
Corridor/Transition		8	0.7	5	0.5	5	0.4
	For Hospital	17	1.6	11	1.0	10	0.9
	For Manufacturing Facility	6	0.6	5	0.5	5	0.4
Stairs – active		10	0.9	6	0.6	5	0.5
Active Storage		12	1.1	9	0.8	8	0.8
	For Hospital	31	2.9	10	0.9	9	0.8
Inactive storage		4	0.4	3	0.3	3	0.3
	For Museum	15	1.4	9	0.8	8	0.8

Common Space Types (continued)		90.1-1999 (Baseline)		90.1-2004 (HPB[a])		HPB-City of Vancouver[b]	
Electrical/ mechanical		W/m^2	W/ft^2	W/m^2	W/ft^2	W/m^2	W/ft^2
Workshop		27	2.5	20	1.9	18	1.7
Gymnasium/ Exercise Center							
	Playing Area	20	1.9	15	1.4	14	1.3
	Exercise Area	12	1.1	10	0.9	9	0.8
Courthouse/ Police Station/ Penitentiary							
	Courtroom	23	2.1	20	1.9	18	1.7
	Confinement Cells	11	1.0	10	0.9	9	0.8
	Judges Chambers	11	1.0	14	1.3	13	1.2
Fire Stations							
	Fire Station Engine room	10	0.9	9	0.8	8	0.8
	Sleeping Quarters	11	1.0	3	0.3	3	0.3
Post Office - Sorting Area		18	1.7	13	1.2	12	1.1
Convention Center - Exhibit Space		36	3.3	14	1.3	13	1.2
Library							
	Card File & Cataloguing	15	1.4	12	1.1	11	1.0
	Stacks	20	1.9	18	1.7	16	1.5
	Reading Area	19	1.8	13	1.2	12	1.1
Hospital							
	Emergency	30	2.8	29	2.7	26	2.4
	Recovery	28	2.6	9	0.8	8	0.8
	Nurse station	19	1.8	11	1.0	10	0.9
	Exam/Treatment	17	1.6	16	1.5	14	1.3
	Pharmacy	24	2.2	13	1.2	12	1.1
	Patient Room	12	1.1	8	0.7	7	0.7
	Operating Room	82	7.6	24	2.2	22	2.0
	Nursery	11	1.0	6	0.6	5	0.5
	Medical Supply	32	3.0	15	1.4	14	1.3
	Physical Therapy	20	1.9	10	0.9	9	0.8
	Radiology	5	0.5	4	0.4	4	0.3
	Laundry-Washing	8	0.7	6	0.6	5	0.5
Automotive - Service/Repair		15	1.4	8	0.7	7	0.7
Manufacturing							
	Low Bay (<7.6 m (25 ft) Floor to Ceiling Height)	23	2.1	13	1.2	12	1.1
	High Bay (>=7.6 m (25 ft) Floor to Ceiling Height)	32	3.0	18	1.7	16	1.5
	Detailed Manufacturing	67	6.2	23	2.1	21	1.9
	Equipment room	8	0.7	13	1.2	12	1.1
	Control room	6	0.6	5	0.5	5	0.4
Hotel/ Motel Guest Rooms		26	2.4	12	1.1	11	1.0
Dormitory - Living Quarters		21	2.0	12	1.1	11	1.0
Museum							
	General Exhibition	17	1.6	11	1.0	10	0.9
	Restoration	27	2.5	18	1.7	16	1.5
Bank/Office - Banking Activity Area		26	2.4	16	1.5	14	1.3

Religious Buildings							
	Worship-pulpit, choir	56	5.2	26	2.4	23	2.2
	Fellowship Hall	24	2.2	10	0.9	9	0.8
Retail (general- no accent)							
	Sales area	23	2.1	18	1.7	16	1.5
	Mall Concourse	19	1.8	18	1.7	16	1.5
Sports Arena							
	Ring Sports Area	41	3.8	29	2.7	26	2.4
	Court Sports Area	46	4.3	25	2.3	23	2.1
	Indoor Playing Field Area	20	1.9	15	1.4	14	1.3
Warehouse							
	Fine Material Storage	18	1.7	15	1.4	14	1.3
	Medium/Bulky Material Storage	12	1.1	10	0.9	9	0.8
Parking Garage - Garage Area		3	0.3	2	0.2	2	0.2
Transportation							
	Airport - Concourse	7	0.7	6	0.6	5	0.5
	Air/Train/Bus - Baggage Area	14	1.3	11	1.0	10	0.9
	Terminal - Ticket counter	19	1.8	16	1.5	14	1.3

[a] HPB projects should meet or exceed the ASHRAE/IESNA 90.1 – 2004
[b] HPB for City of Vancouver is on average 10% more restrictive than ASHRAE/IESNA 90.1-2004

Table 6. Lighting Power Densities (LPD) for Selective Building Exteriors using ASHRAE / IESNA Standard 90.1

Common Space Types[c]	90.1-1999 (Baseline)		90.1-2004 (HPB[a])		HPB[b] -City of Vancouver	
	W/m^2	W/ft^2	W/m^2	W/ft^2	W/m^2	W/ft^2
Uncovered parking lots and drives	N/A	N/A	1.6	0.1	1.4	0.1
Walkways 3 meters wide or greater Plaza areas or Special Feature Areas	N/A	N/A	2.2	0.2	2.0	0.2.
Stairways	N/A	N/A	10.8	1.0	9.7	0.9
Canopies and Overhangs	32.4	3.0	13.5	1.3	12.2	1.1
Open areas (incl. auto sales)	N/A	N/A	5.4	0.5	4.9	0.5
Building Façades (per illuminated wall or surface)	2.7	0.3	2.2	0.2	2.0	0.2
Entrances and gatehouse inspection stations at guarded facilities	N/A	N/A	13.5	1.3	12.2	1.1
Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	N/A	N/A	5.4	0.5	4.9	0.5
	W/m	W/ft	W/m	W/ft	W/m	W/ft
Main entries (per linear door width)	108.3	33.0	98	29.9	88.2	26.9
Other doors (per linear door width)	65.6	20.0	66	20.1	59.4	18.1

[a] HPB projects should meet or exceed the ASHRAE/IESNA 90.1 – 2004
[b] HPB for City of Vancouver is on average 10% more restrictive than ASHRAE/IESNA 90.1-2004
[c] HPB projects use selective ASHRAE/IESNA 90.1 exterior LPD values. All exterior lighting allowances are tradable among listed exterior spaces. Do not use for calculations non-listed exterior common/typical areas.