

interior



**VANCOUVER**  
GREEN CAPITAL\*

# Lighting

*green home renovation*

*healthy homes for a healthy environment*





# Green

## What is a green home?

It's an approach to design, construction and home improvements with the goal of not only making your home look better, but work better for both you and the environment. A green home can be healthier. It can also provide lower utility bills, reduced maintenance costs and a cleaner planet!

Our Green Home Remodel Guide series covers common remodeling topics and gives helpful hints on materials and strategies to create a home that's healthy, saves money, and is easy on the environment.

The other guides in the series include:

- Renovation Overview
- Bath & Laundry
- Kitchen
- Painting
- Landscape Materials
- Roofing
- Hiring a Pro
- Salvage & Reuse
- Do-It-Yourself Home Energy Audit Guide
- Green Home Buyer's Guide

Available at  
[vancouver.ca/sustainability](http://vancouver.ca/sustainability)

# Lighting

## What is efficient lighting?

Lighting is a crucial component of a comfortable, safe, attractive and efficient home. Yet all too often, even in "green" homes, little consideration is given to lighting design.

We've entered a new era. As you'll learn in this guide, efficient lighting comes in a diversity of styles and functionalities which helps to create flexibility for the discerning designer and homeowner.

According to the ENERGY STAR® program, if every household in Canada changed just one traditional incandescent light bulb to an ENERGY STAR labelled CFL, the country would save over \$73 million in energy costs every year and reduce GHG emissions by 397,000 tonnes of carbon dioxide (CO<sub>2</sub>) - which would have the same impact on climate change as taking 66,000 cars off the road for one year.

Lighting in your home accounts for between 5 to 20 per cent of your total household energy use. Lighting chosen for its durability, efficiency and appeal will last 6 - 20 times longer (depending on the lamp type) and cost less to operate and maintain.

# How

## How can I use this guide?

Whether you are just changing lamps, replacing existing fixtures, or considering an integrated lighting design, this guide will give you the tools to select the best products and technologies for your needs. It will also:

- Introduce you to the technology and art of efficient lighting design.
- Give you the knowledge to talk intelligently with design and lighting professionals.
- Serve as a launching point for you to create a beautiful and efficient lighting plan that benefits you, your family and the environment.



Cover photo: Graham Winterbottom Photography



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*Let this guide serve as a starting point for your research. Remember, every decision you make regarding your lighting project can help improve your home's performance – for you, your family and the environment.*

# Introduction

Gone are the days when a round ceiling fixture with two 60-watt incandescent light bulbs was the preferred lighting option for most of the rooms in a home. Now there are an overwhelming number of light bulbs and fixtures from which to choose. As you will learn in this guide, you can choose bulbs that vary in colour temperature, beam spread, light intensity, power consumption and longevity to name a few. And besides all the aesthetic choices, there are a myriad of fixture types that include wall sconces, pendants, chandeliers, ceiling fixtures, recessed cans and vanity strips. To help you get started in sorting out all these choices, you will find on the next page a list of important features to consider when replacing or adding new lighting.

## First, a word about terminology

Most homeowners use the term "light bulb" or "bulb" when referring to a light source; and the term "lamp" when referring to a light fixture. However, the lighting industry uses the term "lamp" when referring to the light source and the term "luminaire" when referring to the actual housing of the light source. Throughout this guide we will use the term "lamp" when referring to a light source but use the more colloquial term of "fixture" when referring to the housing.



## Decide What You Want

Look for the ENERGY STAR label when choosing new lamps and fixtures. Canada's ENERGY STAR program qualified product categories for lighting includes residential light fixtures, compact fluorescent lamps and decorative light strings. Make sure your choices include automated energy saving features where appropriate, such as occupancy sensors or timers. Select lamps that have a long life for maximum savings and minimal replacements.



### Functionality

Your lighting should put light where it's needed, in sufficient amounts, while consuming the least amount of power (watts). It should allow for comfortable performance of daily tasks. Think about where the activities usually occur in each room. These areas will need adequate task lighting. In other areas, ambient lighting may be enough. (See page 9 for more information.) Your lighting controls should provide maximum flexibility for a variety of light levels and ease of use.

### Efficiency/Cost

Look for the ENERGY STAR label when choosing new lamps and fixtures. Make sure your choices include automated energy-saving features where appropriate, such as occupancy sensors or timers. Select lamps that have a long life for maximum savings and minimal replacements.

### Beauty/Aesthetics

Check that your lighting choices allow for a diversity of effects and applications, such as colour temperatures, beam spreads, and direction light is focused. Consider highlighting interesting architectural elements, special artwork or décor.

### Ecological Benefits

Select energy efficient lamps for minimal toxic content. Plan for proper disposal when lamps burn out. Outside lighting should minimize "light trespass" into neighbouring properties and the night sky.

### Safety & Security

Your outdoor lighting should allow for safe movement by identifying uneven surfaces and other hazards. It should provide soft, non-glaring light to help you discern between wanted and unwanted visitors, and help identify your home for guests and emergency personnel. Indoors, the design should help identify transition areas such as counter edges and floor height changes. Avoid unshielded light sources that can cause glare.



## Expand Your Definition of Cost

Consumer decisions are often driven by the initial price tag on an item, with little regard for the long term costs. With the uncertainty of future energy costs, consumers have begun to consider the ongoing energy costs of their purchases. The initial price of an incandescent lamp, for example, is usually less than the price of a compact fluorescent lamp (CFL). But when you consider that a CFL lasts 6 - 10 times longer and take energy prices into account, the true dollar cost becomes clear. BC Hydro Power Smart offers in-store instant discounts on ENERGY STAR light fixtures and ENERGY STAR Specialty CFL bulbs at participating retailers [www.bchydro.com/rebates\\_savings](http://www.bchydro.com/rebates_savings)

*Photo left middle: Seagull Lighting  
Photo left bottom: Tacoma Power*

## Do Your Homework

Thorough research helps you ask the right questions of retailers, designers and contractors and avoid costly mistakes. It pays to start your research early, looking for manufacturers and retailers that offer the products that meet your needs and desires. You may wish to keep an electronic or paper file of contact names and businesses, and magazine and newspaper clippings that show products and design strategies you like.

Consider hiring a design professional. With the recent increase of high quality efficient lighting options, many forward-thinking designers are now specializing in high quality designs that incorporate energy-efficient lighting choices. Good lighting professionals can help you accomplish the priorities you identified in the *Decide What You Want* section.

Identifying all the items for your new lighting scheme – down to the fixture and lamp types – will help you determine cost and availability and reduce the need for expensive, last minute decisions. Factor into your schedule how long it takes to receive special-order items. When visiting lighting showrooms, ask to see samples of ENERGY STAR-qualified lamps and fixtures, and advice on how to best use them. (Keep in mind that some showroom sales staff may still have outdated ideas about efficient lighting and will direct you away from efficient choices.) The Internet is also a great place to search for information and products, but be aware of biases in information sources. The line between a sales pitch and factual information can be quite blurry. You can cross reference your research with information from green building product directories like those available from Metro Vancouver's BuildSmart program and Light House Sustainable Building Centre ([www.metrovancouver.org/buildsmart](http://www.metrovancouver.org/buildsmart) and [www.sustainablebuildingcentre.com](http://www.sustainablebuildingcentre.com)).

## Universal Design

*Universal Design* is a concept that reinvents the basic assumptions we have made in designing the spaces where we live and work and the products we use. The result is more flexible, adaptable spaces and products useful to a wide range of ages, sizes, or physical abilities. These principles can help homeowners *age in place* and reduce the need for costly and wasteful tear-out and renovation activity down the road.

Lighting strategies that put light where needed and allow for the increased lighting needs of elders help create welcoming and safer spaces for all. Light switches should be between 840 mm (33 inches) and 1,050 mm (41 inches) off the floor. Large rocker style switches, with their large pushable surfaces, are the easiest to use. Switches located both at the top and bottom of a set of stairs allow for safe passage in both directions. The Canada Mortgage and Housing Corporation adopted FlexHousing™, a program based on the principles of adaptability, accessibility, affordability and healthy housing; while the BC Building Code includes a set of Adaptable Housing Standards found at [www.housing.gov.bc.ca/building/adaptable\\_housing/summary.html](http://www.housing.gov.bc.ca/building/adaptable_housing/summary.html).



# Technology

There are numerous light sources available; the two most popular for residential applications are incandescent and fluorescent.

## Incandescent

Incandescent light sources generate light from heat. Any object heated to a suitably high temperature will emit light. We've all seen how hot stove burners glow red. The filament of an incandescent lamp must be heated to an even higher temperature (about 2427°C) to produce the warm yellowish colour of light typical in residential lighting.

Standard – Standard incandescent lamps used today are much like those invented by Thomas Edison in 1879! Unfortunately, these lamps convert only 5 per cent – 10 per cent of the electrical energy they consume into light. The rest of the consumed energy is emitted as heat, which is usually wasted energy, especially in the summer when still more energy may be used to run ventilation or air conditioning to dissipate heat.

Halogen – Halogen lamps are incandescent lamps in which the tungsten filament is sealed into a quartz capsule containing a small amount of halogen gas. This design allows the lamps to burn hotter and more efficiently, while producing a whiter colour of light. Halogen lamps last significantly longer than standard incandescent lights. The tiny size of the halogen capsule enables even small lamps to produce highly focused light, suitable for task and accent lighting.

Halogen IR – The most efficient type of incandescent lamp is halogen infrared (HIR). The quartz capsules of these lamps feature a special infrared-reflective coating that redirects the heat back to the filament, reducing the amount of electricity needed to maintain the required operating temperature. Since halogen IR lamps produce more light with less energy than conventional halogen lamps (up to 30 per cent), it is often possible to save energy by using a lower wattage halogen IR lamp to replace a standard halogen lamp.

## Fluorescent

Fluorescent lamps, which were first mass-produced by GE in the 1940's, produce light by passing an electric current through a glass tube containing tiny amounts of mercury gas. A phosphor coating on the inside of the glass converts the energy to visible light. A ballast is needed to start the lamp and to ensure a precise flow of electrical current.

Older fluorescent lamps used a single type of phosphor which produced greenish light, and magnetic ballasts which caused humming and flickering. Today's lamps incorporate electronic ballasts which eliminate flicker and hum. They use multiple high quality phosphors to generate light of excellent colour and quality. Depending on the style, a fluorescent lamp can last from 6,000 to over 24,000 hours and provide 3 – 10 times the light output per watt than an incandescent lamp.

Fluorescent lighting used for residential and decorative lighting is characterized by warm colour tones and excellent colour rendering. High colour rendering enhances skin tones and makes the colour of interior furnishings look natural. Manufacturers have accomplished this by much more precise mixing of several different phosphors to achieve more natural colour. In addition to more accurate colour rendering, you can now find fluorescent lighting in a variety of colour temperatures. (see page 7 for more information).

One drawback of fluorescent light sources is that they contain a small amount of mercury and should never be thrown into the trash. See the *Health and Safety* section on page 16 for more information about mercury and proper disposal options.

*CCFLs are a newer generation of fluorescent lamps. They can look just like regular household bulbs, globe lamps, or flame-tip lamps. An 8 Watt CCFL produces 40 Watt worth of illumination and lasts 25,000 hours.*



Linear Fluorescent – Linear fluorescent lamps refer to the tube type, of which the 4-foot length is the most common. Older style tubes were one and a half inches in diameter, or 12/8 of an inch (3.8cm), commonly referred to as a T12. The new standard diameter for 4-foot tubes (1.2m) is 1 inch (2.5cm), commonly referred to as a T8. Linear fluorescent lamps now provide excellent colour rendering, long life (up to 36,000 hours) and beautiful, even light. Fluorescent tubes are now being made in smaller sizes such as T5, T4 and T2 in a variety of lengths which make them perfect for vanity, under cabinet and cove lighting. As tube diameters shrink, efficiency increases and fixtures become more stream-lined.

Compact Fluorescent – Compact fluorescent lamps (CFLs) refer to the group of fluorescent lamps designed to replace standard incandescent lamps. The use of CFLs in the home is rising due to four major factors: improved performance, smaller sizes, huge increase in variety of styles and lower costs.

Cold Cathode Fluorescent Lamps – CCFLs are a newer generation of fluorescent lamps. They can look just like regular household bulbs, globe lamps, or flame-tip lamps. An 8w CCFL produces 40w worth of illumination and lasts 25,000 hours. CCFLs have a wide variety of colour temperatures and are dimmable to 90 per cent. They are not yet readily available, but can be found at specialty stores or bought online.

CFLs last 6 – 10 times longer and use 75 per cent less energy compared to standard incandescent lamps. Their longevity and energy savings are their two most important qualities.

Until recently, two-piece CFLs have been the standard in ENERGY STAR fixtures to ensure that inefficient incandescent replacement lamps could not be used. Unfortunately, having the ballast as a permanent part of the fixture meant that the replacement lamp had to be identical to the original in wattage and pin configuration. Many customers had difficulty finding the correct replacement. And, these inflexible fixtures would not allow customers to brighten or dim the light by switching lamps or using a dimmer switch.

A major barrier to wide-spread use of CFLs is their inability to work well with lighting controls such as dimmers, photocells, motion sensors and electronic timers. The electronic components found in most controls are not compatible with the electronics contained in fluorescent lamp ballasts. For instance, you need a CFL made specifically for use with dimmer switches for it to work properly with most existing in-home dimmers. Although dimmable CFLs are improving, they do not perform exactly like incandescent lamps in that when dimmed, they may not dim as far and the colour may not become warmer.

## Light Emitting Diodes (LED)

An LED is a semiconductor diode that emits light when an electrical current is applied. The effect is a form of electroluminescence. The first known report of a light emitting diode was made in 1907 and the first visible spectrum LED (red) was developed in 1962. LEDs have been used for many years in exit signs, indicator lights and in home appliances.

The future of LED lighting is extremely exciting! LEDs are very durable, compact, energy efficient, and free of toxic content. Life ratings of up to 50,000 hours allow arrays of LEDs to be integrated directly into fixtures without provision for replacement, allowing for radically new designs. Because the specification for ENERGY STAR qualified LED light fixtures was only recently made effective in late 2008, there are a limited number of qualified products available today. LED lighting for exterior use is readily available at hardware stores, whereas LED lighting for interior uses can be found at specialty lighting companies. When reading LED product labels, look especially for indications of light output indicated by lumens and colour temperature indicated by degrees Kelvin or "K". If this information is missing, the product is probably not acceptable for general lighting.



# The Colour of Light

Two ratings are used to describe the colour of white light sources. Colour temperature describes the shade of white light emitted, while Colour Rendering Index (CRI) rates the ability of the light to accurately portray colours in the area being lit.

## Colour Temperature

If you've ever tried to match white paint, you know that there are actually many different shades of white. A similar issue emerges with white light. While incandescent, fluorescent, LED, and other light sources all emit "white" light, they can look very different from one another. This colour appearance of light sources is described by the lighting industry in terms of colour temperature and is measured in terms of degrees Kelvin or "K".

The higher the colour temperature, the "cooler" or more blue the light source appears. Light sources that most observers would consider "warm", (more yellow/orange) such as incandescent lamps, have colour temperatures of around 2700K. Halogen light, often characterized as "crisp white", is around 3000K.

Fluorescent lamps are available in a full range of colour temperatures from 2700K for home use to over 6500K for certain commercial and industrial applications. Lamps can achieve these different temperatures by the careful mixing of phosphors - the white coating on the inside of the glass tubes. Commonly available fluorescent colour temperatures are 2700K (warm), 3000 - 3500K (bright white), 4100K (cool) and 5000 - 6500K (daylight). ENERGY STAR requires labeling of colour temperatures.

Many homeowners prefer warm colours, but cooler colours have benefits as well. Bright and daylight fluorescent light appears more like daylight and excels at revealing certain colours. For example, using a 5000K fluorescent lamp with a CRI of 90 in a closet can enable you to easily distinguish between black and navy sports jackets or brown and green socks. Studies have even shown that light colour affects our daily sleep cycles. Cooler colours promote wakefulness and productivity, while warmer colours tend to promote relaxation.


## Colour Rendering Index (CRI)

A major hurdle to consumers embracing fluorescent lighting is their experience of fluorescent technology in the past. Many early fluorescent lamps had poor colour rendering. Modern fluorescent lamps have solved the issue of colour rendering through advances in phosphor technology.


The measurement of light's ability to properly render colours is called the Colour Rendering Index or CRI. It involves measuring the extent to which a series of eight standardized colour samples differ in appearance when illuminated under a given light source. The highest possible score is 100, defined as the CRI of standard incandescent lamps and the sun.

For high-quality fluorescent lighting applications, look for lamps which are labeled with a CRI of 80 or greater. To make shopping for fluorescent lamps easy, look for the ENERGY STAR label, since ENERGY STAR qualification is granted only to lighting products with a CRI of 80 or greater. While no two lighting sources are identical, a fluorescent light source with a CRI rating of 80 or greater will result in object colouration largely indistinguishable from that produced by an incandescent light.


NOTE: When purchasing linear fluorescent tubes, beware of the "warm white" (WW) or "cool white" (CW) designation on the package or the tube itself. These terms were created well before advances in phosphor technology that now make excellent colour rendering possible. Tubes with a "WW" or "CW" mark may not be suitable for in-home applications where good colour rendering is important.



*For warm inviting light: choose a fluorescent lamp that states "warm white" or "soft white" on the package. (Colour temperature will be in the 2700 - 3000K range.)*



*For a crisper whiter light: choose a fluorescent lamp that states "bright white" on the package. (Colour temperature will be in the 3500 - 4200K range.)*



*For cool white light: choose a fluorescent lamp that states "cool white" or "daylight" on the package. (Colour temperature will be in the 5000 - 6500K range.)*

# Reading Lamp Labels

On most lamp packages, both incandescent and fluorescent, you will find three prominent numbers: light output (lumens), energy used (watts) and life (hours). These numbers can easily be used to calculate the lamp's efficacy (lumens per watt) and total cost of operation (see below).

Two lamp labels shown on the right side of this page illustrate the significant differences between a standard 100-watt incandescent lamp and an equivalent ENERGY STAR CFL.

**Light Output** – The total quantity of light emitted by a lamp is measured in lumens. Notice that the 100-watt incandescent lamp consumes more than 4 times the energy and produces less light than the 23-watt ENERGY STAR CFL.

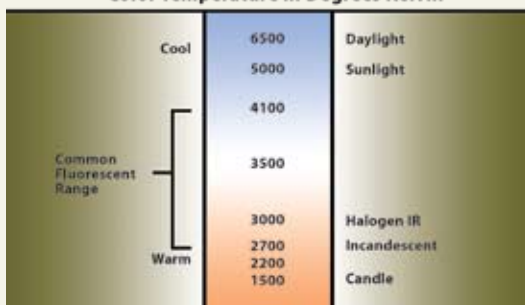
**Energy Used** – The electrical energy used by the lamp is measured in watts. While wattage is not a unit of brightness, CFL packages are often labeled with claims such as "100-watt replacement" as an aid to customers who are replacing existing incandescent lamps.

**Life** – Lamp life is determined through a standardized test manufacturers are required to perform. All lamps are turned on for one hour, then off for one hour, then on for three more hours and so on until one-half of the total number of lamps have failed. The rated lamp life is the number of hours at which half the lamps have failed. While individual lamp life varies considerably, the ENERGY STAR CFL with a rated life of 12,000 hours may last 16 times as long as the value-brand incandescent lamp with a rated life of 750 hours.

**Efficacy** – In lighting, this term refers to the lumens of light output for every watt of input power. It is the number you get when you divide the light output by the energy used. As illustrated, the 100-watt incandescent lamp producing 1605 lumens has an efficacy of 16 lumens per watt, while the 23-watt CFL producing 1640 lumens has an efficacy of 71 lumens per watt!

**Cost of Operation** – The total cost of operating a lamp for a fixed number of hours (1,000 hours) is its purchase cost plus its energy cost. The 1,000-hour purchase cost of a lamp is its price divided by 1,000 hours of rated life. For example, if the 750-hour incandescent lamp shown at right costs 20¢, its 1,000-hour purchase cost is 26¢ (\$0.20 divided by .75). If the 12,000-hour CFL shown right costs \$5, its 1,000-hour purchase cost is 41¢ (\$5 divided by 12). Adding the cost of energy priced at 8¢ per kWh, the total 1,000-hour cost of operation is \$8.26 for the incandescent lamp compared to only \$2.25 for the CFL. To minimize cost, choose lamps with long life and low energy use.

Color Temperature in Degrees Kelvin



*No matter what colour temperature light you choose, if it has a low Colour Rendering Index (CRI), nothing will look good under it.*

*Did you know that if you dim an incandescent lamp (standard, halogen or halogen IR) just 10 per cent, you double the lamp life? And if you dim it 20 per cent, you quadruple the lamp life! (More reason to enjoy those softly lit romantic dinners.)*

CFL Label



Incandescent Label



# Choosing the Right Light

Lighting should be planned to complement your lifestyle. Look at the activities that occur in each room, the atmosphere you want to create and the decorative elements you wish to emphasize. Keep in mind that light can be absorbed and even wasted in dark-coloured rooms, or reflected and used as additional illumination in light-coloured rooms.

## Basic Lighting Types

There are three basic types of lighting that work together to light your home. A good lighting plan combines all three types (known as “layering”) to light an area, according to function and style.

- Ambient (top right) – Provides overall, general lighting which radiates a comfortable level of brightness. Ambient lighting can be accomplished by chandeliers, ceiling or wall-mounted fixtures, recessed or track lights, or with lanterns mounted on the outside of a home. Having a central source of ambient light in all rooms is fundamental to a good lighting plan.
- Task (middle right) – Helps you perform specific tasks such as reading, sewing, cooking, homework, hobbies, crafts, games or balancing your checkbook. It can be provided by recessed and track lighting, pendant lighting, under cabinet lighting and even certain chandeliers, as well as by portable floor and desk lamps. Task lighting should be free of distracting glare and shadows but bright enough to prevent eyestrain.
- Accent (bottom right) – Adds drama to a room by creating visual interest. As part of a decorating scheme, it is used to emphasize paintings, house plants, sculptures and collectables; or to highlight the texture of a wall, drapery or outdoor landscaping. To be effective, accent lighting requires at least three times as much light on the focal point as the general lighting around it. This usually is provided by track, recessed or wall-mounted fixtures for indoor lighting and floodlights for outdoor lighting.

## Fixture Types

Once you've selected where and what you want to illuminate, you'll have to decide how best to accomplish it. Lighting showrooms are an excellent place to view the many different styles, sizes and shapes of fixtures to deliver the ambient, task and accent lighting you need. Make sure you view the fixture from many angles to check for glare.

Answer these questions before you choose your fixture:

- Does it have the ENERGY STAR label?
- Will it accommodate a variety of different lamps, including efficient styles, a variety of lumen outputs or different beam spreads, i.e., SP (spot), NFL (narrow flood), FL (flood) and WFL (wide flood)?
- Will the fixtures blend in with the architecture or make some sort of statement with light or structure?
- Will the fixture itself be highly decorative, or does it also have to function as a task light, such as a chandelier over a dining room table?
- What is the availability of the fixture, i.e., does it need to be special-ordered?
- Will I be able to easily find and replace the lamp when it burns out?

Remember the concept of “layering”. Not only does layering give more options for how the space is lit, but different fixtures are more suited to ambient, task or accent lighting. For example, recessed or track lights work well for accent lighting, linear fluorescents for under cabinets, in coves or on each side of a bathroom mirror are excellent for task lighting and decorative fixtures with CFLs work well for ambient light. Often a fixture may do double duty; the accent lighting may provide task light, the task lights may provide enough ambient light, or the architectural coffer lighting may provide ambient light. This layering strategy is critical to creating a rich visual environment.

*Choose fixtures that have the ENERGY STAR® label.*

*Products with this label*

*have met strict energy*

*efficiency guidelines*

*and are promoted and*

*monitored by Natural*

*Resources Canada's Office*

*of Energy Efficiency*



## COMMON FIXTURE TYPES



**Wall Sconce**  
Used mostly for ambient light



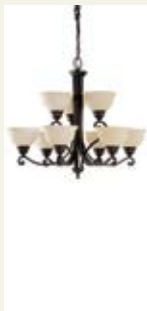
**Under Cabinet/  
Under Shelf**  
Used for task and accent light primarily in kitchens



**Portable Table/  
Floor**  
Used for task and ambient lighting



**Pendant**  
Can be used in kitchens over islands, or over an eating area



**Chandelier**  
Used for ambient light; as a decorative fixture as part of the overall ambiance in halls, foyers, dining rooms or bathrooms; or even as a task light when installed over a dining room table



**Track and Rail**  
Used primarily for accent lighting; but can also be used for ambient lighting



**Vanity**  
Typically used over or on either side of a bathroom mirror



**Recessed**  
Used for ambient or accent lighting



**Cove**  
Used to create ambience in a formal space



**Ceiling Fixture**  
Used for ambient light



**Utility**  
Serves as ambient and task lighting in garages, shops or laundry areas

## Recessed downlights

In many new homes, recessed downlights are often overused by builders because they are easy and relatively inexpensive to install. But more is not necessarily better. Recessed downlighting can be an excellent choice for ambient and accent lighting, but it usually does not work well for task lighting. Recessed downlighting can cause shadows on your task and are difficult to move once installed. Also, each installed recessed fixture requires a hole in your ceiling. If installed in the ceiling just below your roof, there is an opportunity for significant heat loss if the hole is not sealed properly. (This type of work usually requires a permit. Check with your local municipality.) If you are changing out existing fixtures for recessed downlights, make sure you understand all the options before you make that cut. Often, changing the type of lamp within an existing fixture solves the problem.

*Photos right: Seagull Lighting*

*Photos above and to the right: Seagull Lighting*



# Lamping Options

The performance of any light fixture depends very much on the type of lamp used. Here is a very basic explanation of different types. NOTE: Because there are numerous common styles of lamps within each lamp type, we did not include illustrations of them in the chart below.

## Reflector (R) or Parabolic Aluminium Reflector (PAR)?

Choosing between R and PAR lamps can be confusing. Both R and PAR lamps have reflective coatings inside the lamp that directs the light in one direction providing better beam control than standard lamps. But whereas R lamps have a frosted smooth glass top that provides soft light, PAR lamps have a harder, prismatic top that tends to focus the light more precisely and sharply. PAR lamps come in a variety of defined beam spreads from narrow spot (10 degrees) to wide flood (60 degrees).

LAMP TYPE	DESCRIPTION	BENEFITS	DRAWBACKS
<b>Incandescent - Standard</b>	A tungsten wire filament is placed inside a glass bulb. An electric current is passed through the filament and the resistance in the filament causes it to heat and "incandesce" or glow.	<ul style="list-style-type: none"> <li>• Low initial purchase price</li> <li>• Available in many wattages, shapes and sizes</li> <li>• Easily dimmable</li> <li>• Many options for directional source</li> </ul>	<ul style="list-style-type: none"> <li>• High overall costs due to high energy use</li> <li>• Short lamp life</li> <li>• Not very energy-efficient</li> </ul>
<b>Incandescent - Halogen</b>	A halogen lamp is an incandescent source. But halogen lamps contain halogen gas which slows down the deterioration of the tungsten filament and extends the lamp life.	<ul style="list-style-type: none"> <li>• Whiter light than standard incandescent</li> <li>• Available in many wattages, shapes, sizes and bases Increased lamp life over standard incandescent</li> <li>• Fairly easy to dim</li> <li>• More energy-efficient than standard incandescent</li> <li>• Excellent as a directional source of light</li> </ul>	<ul style="list-style-type: none"> <li>• More costly than a standard incandescent</li> <li>• Less energy-efficient than fluorescent</li> <li>• Shorter lamp life than fluorescent</li> </ul>
<b>Incandescent - Halogen IR</b>	Halogen IR (infrared) lamps feature a special infrared-reflective coating that redirects the heat back to the filament reducing the amount of electricity needed to maintain the required operating temperature.	<ul style="list-style-type: none"> <li>• Whiter light than incandescent</li> <li>• Available in many wattages</li> <li>• Increased lamp life over regular halogen</li> <li>• Up to 30% more efficient than standard halogen</li> </ul>	<ul style="list-style-type: none"> <li>• More costly than regular halogen</li> <li>• Shapes and sizes are limited</li> <li>• Less energy-efficient than fluorescent</li> <li>• Shorter lamp life than fluorescent</li> </ul>
<b>Fluorescent</b>	A lamp that uses chemical phosphors to convert electrical energy into visible light. The types of phosphors used will determine the colour temperature of the light.	<ul style="list-style-type: none"> <li>• Very energy-efficient</li> <li>• Long life</li> <li>• Available in many wattages, shapes and sizes</li> <li>• Lowest overall operating cost</li> <li>• Produces less heat than incandescent</li> </ul>	<ul style="list-style-type: none"> <li>• Requires a ballast to operate</li> <li>• Special dimmable products can be expensive</li> <li>• Higher initial cost than standard incandescent</li> <li>• Contains trace amounts of mercury and should be disposed of properly</li> <li>• Not a good source for directional light</li> </ul>
<b>Light Emitting Diodes (LEDs)</b>	LEDs contain a semiconductor diode that emits light when an electrical current is applied. The effect is a form of electroluminescence.	<ul style="list-style-type: none"> <li>• Very energy-efficient</li> <li>• Very long life</li> <li>• Small</li> <li>• Dynamic colours</li> </ul>	<ul style="list-style-type: none"> <li>• Very high in initial cost</li> <li>• Very few high quality residential fixtures currently available</li> <li>• May not be able to find replacement parts due to rapidly changing technology</li> </ul>

# Lighting Control Options

TYPE	DESCRIPTION	BENEFITS	DRAWBACKS
<b>Switch</b>	Turns fixture either ON or OFF.	<ul style="list-style-type: none"> <li>• Inexpensive</li> <li>• Easy to use</li> </ul>	<ul style="list-style-type: none"> <li>• Light is either ON or OFF</li> <li>• Wastes energy if switch left in ON position when not needed</li> </ul>
<b>Dimmer</b>	Gives user the ability to vary the intensity of the light level.	<ul style="list-style-type: none"> <li>• Can be inexpensive</li> <li>• Fairly easy to install</li> <li>• Provides flexible light levels</li> <li>• Saves energy/increases incandescent lamp life</li> </ul>	<ul style="list-style-type: none"> <li>• Must be compatible with lamp type; i.e. low voltage, incandescent, fluorescent, LED</li> <li>• Fluorescent dimming can be expensive</li> </ul>
<b>Timer</b>	Keeps lights on for the amount of time you select. Once the countdown is complete, the lights turn OFF.	<ul style="list-style-type: none"> <li>• Can be inexpensive</li> <li>• Mechanical or electronic</li> <li>• Electronic versions can be programmable and adjust to daylight</li> <li>• Saves energy</li> </ul>	<ul style="list-style-type: none"> <li>• Do not always work with fluorescent lamps, especially electronic types (read packaging carefully)</li> </ul>
<b>Photocell</b>	Senses change in outdoor light levels so exterior lights turn ON at dusk and OFF at dawn.	<ul style="list-style-type: none"> <li>• Saves energy</li> <li>• Excellent feature when manufactured as an integral part of an exterior fixture</li> <li>• Can be integral to fixture, switch or stand alone</li> </ul>	<ul style="list-style-type: none"> <li>• As a stand-alone component, compatibility with CFLs can be problematic</li> <li>• For best operation, must be exposed to bright sunlight</li> </ul>
<b>Motion Sensor</b>	Turns lights ON instantly when motion is detected (usually used for outdoor security).	<ul style="list-style-type: none"> <li>• Newer models can gradually fade OFF rather than quickly turn OFF after no motion is detected</li> <li>• Can be integral to fixture, switch or stand alone</li> </ul>	<ul style="list-style-type: none"> <li>• If aimed improperly, small animals can trigger false ONs</li> </ul>
<b>Occupancy Sensor Switch</b>	Detects when a room becomes occupied and turns ON the lights automatically. If no occupancy is detected for a specified time, the lighting automatically switches OFF.	<ul style="list-style-type: none"> <li>• No need to remember to turn the lights OFF</li> <li>• Saves energy</li> <li>• May be useful if user is physically unable to turn on switch</li> </ul>	<ul style="list-style-type: none"> <li>• Typically more costly than timer</li> <li>• False OFFs can occur by little movement in area</li> <li>• Lower user acceptance in occupied spaces with stationary tasks</li> <li>• Must be compatible with lamp type</li> <li>• Lights stay ON longer than if manually switched OFF by user</li> </ul>
<b>Vacancy Sensor Switch</b>	User turns light ON manually, but if user forgets to turn light OFF, it will turn OFF automatically. Lights stay on as long as the detector senses motion.	<ul style="list-style-type: none"> <li>• Light will turn off automatically if user forgets</li> <li>• Saves energy</li> </ul>	<ul style="list-style-type: none"> <li>• Typically more costly than timer</li> <li>• False OFFs can occur by little movement in area</li> <li>• Lower user acceptance in occupied spaces with stationary tasks</li> <li>• Must be compatible with lamp type</li> </ul>
<b>Scene Controller</b>	Dims all the lighting loads of one room with the touch of a button.	<ul style="list-style-type: none"> <li>• Multiple lighting "scenes" can be programmed by owner</li> <li>• Smooth transitions between light levels</li> </ul>	<ul style="list-style-type: none"> <li>• More expensive than dimmers but considerably cheaper than whole house controls</li> </ul>
<b>Whole House Controller</b>	Can control one or all the lights in a home.	<ul style="list-style-type: none"> <li>• Controls different room "scenes"</li> <li>• Can utilize touch screens</li> <li>• Extremely flexible</li> <li>• Smooth transitions between light levels</li> <li>• Can incorporate shade and music controls</li> <li>• Engraveable custom plates</li> </ul>	<ul style="list-style-type: none"> <li>• Expensive</li> <li>• High installation costs</li> <li>• Programming can be complicated</li> </ul>



# Lighting Choices Room By Room

Once the fixture and lamps have been chosen, the next step is to select the best location so the subject is illuminated in an optimal way. A professional lighting designer can be a great resource for this task. For example, if you are lighting a vanity, you would not want to put the lamp behind where a person would stand; you would place the lamp on the wall by the mirror so that it shines evenly on the person's face. Lighting both sides of the face provides the best light. For lighting above or below kitchen cabinets, a long diffuse source such as linear fluorescent is the best choice.

If you are lighting a workshop, the lamps are often placed directly over the workbenches. Linear fluorescents are good choices. In all of these examples, we are addressing the location and direction of the light from a normal viewing perspective. This is often done unconsciously, but it helps to know the process.

The following is a room-by-room guide to help you place your lighting fixtures.

## Kitchen

The kitchen is primarily a work area, but it is also a gathering place for family and friends. The variety of functions requires lighting solutions that are both functional and comfortable.

Good kitchen lighting incorporates both ambient and task. A large ceiling fixture equipped with linear fluorescent lamps with high CRI and 3000 - 3500K will supply well-diffused ambient lighting. As the only source, however, it will create shadows when you are working at the counters. You will need supplemental task lighting where you will be chopping vegetables and washing dishes. Under-counter linear fluorescent lighting with high CRI is an excellent choice. Not only is linear fluorescent lighting extremely efficient and long lasting, it provides soft, comfortable and even light.





You can also use it above your cabinets for ambient lighting. It lights the ceiling and bounces the light around the room making everything seem brighter. With today's colour temperature options and high colour rendering, linear fluorescents are an excellent option in the kitchen.

Stylish, shiny granite counters with incandescent point source lighting can cause uncomfortable glare in the kitchen. Be careful with downlights or recessed cans, since they can put the light behind you, creating shadows in your task areas. They also provide no light on the ceiling, making it appear darker.

Consider placing the recessed cans 30cm (12 inches) in front of the upper cabinets. This allows the upper cabinets to be highlighted when closed but provides light into the cabinets when opened. At the sink area, an ENERGY STAR-qualified recessed light fixture works well as long as the fixture is not installed directly above you, but placed 30cm (12 inches) from the wall. (For existing downlights, 3000 - 3500K fluorescent R lamps work very well.)

Dinettes, nooks and island counters can be illuminated with decorative pendants. When used with dimmer controls, these ceiling-hung fixtures will provide you with adequate task lighting for homework, hobbies or family paperwork. The dimmer will allow you to adjust the light for alternate activities such as dining or entertaining. For an existing fixture, consider a dimmable CFL. Although CFLs don't dim exactly like incandescents, they may meet your needs.

## Bathroom

In the bathroom, it is important to provide a good source of illumination on both sides of the mirror for grooming and applying makeup. Linear fluorescent bath bars with high CRI lamps are an excellent choice. Soft, diffuse light on either side of the mirror eliminates harsh shadows under the eyes and nose. Sometimes the light around the bathroom mirror provides both ambient and task lighting. If you have a large bathroom, you may want to add additional light such as an ENERGY STAR-qualified ceiling-mounted fixture in the middle of the room. For wet areas such as the shower, make sure the fixture is rated for that application.





## Living/Family Room

These rooms may require the most flexibility in the lighting system, especially if you like to rearrange your furniture. Layering your lighting is especially important here. (See page 9 for the three basic types of lighting needed to achieve a layered effect). When using fluorescent sources, most people find lamps with warm tones (2700K) most pleasing. Here is an example of four different layers of light:

1. Table and floor lamps. These work great with CFLs and provide both ambient and task lighting.
2. Wall sconces. These can provide low level ambient lighting suitable for TV viewing.
3. Linear fluorescent. This an excellent choice for placing over bookshelves or behind curtain valances and coves. The light sources is hidden (no glare) and the up-lighting bouncing off the ceiling produces a soft and diffuse light.
4. Recessed directional downlights. These work well to highlight art, architectural features such as fireplaces or to just wash a wall with diffuse light. Point-source lamps (rather than fluorescent) work best for these applications.

Try to avoid using recessed downlighting over seating areas as these cast unappealing shadows on people's faces and cause uncomfortable glare.



## Dining Room

Dining room lighting should be both decorative and functional. Having several layers of light can establish the mood for a variety of functions; including dining, homework or crafts. When using fluorescent sources, most people find lamps with warm tones (2700K) most pleasing. Here is an example of three light layers that can be used all together or in different combinations:

1. A chandelier above the dining table (placed 76cm above the table). Consider if you want a fixture that just shines light down on the table, one that can shine both down and up, or one that provides light all around.
2. Wall sconces with CFLs (regular and dimmable) placed on the wall on either side of a buffet or sideboard. Again, think about directionality – some sconces shine light up, down, in both directions or just glow softly.
3. Recessed directional downlights with point-source lamps to highlight art on the wall or to highlight objects on a buffet or sideboard.

## Bedroom

Ideal bedroom lighting should provide a mixture of soft, ambient lighting along with task lighting for reading and dressing. Warm colour temperatures (2700K) are usually preferred. General ambient lighting can be provided by ceiling fixtures, chandeliers, fan lights or wall sconces. Task lighting can be provided by portable wall, table or floor fixtures. Accent lighting can include track lighting or recessed spot lights. Here is an example of three light layers:

1. Swing-arm wall fixtures on either side of the bed with 2700K CFL.
2. Low-voltage track lighting along one wall to highlight art or bounce light off the wall.
3. Recessed downlights to light the dresser. Fluorescent R lamps can work well in this application.
4. Portable table lamp with 2700K CFL on the vanity or dresser.



## Exterior Lighting

Soft, even light by entry ways, paths and outbuildings is the best night-time strategy for visibility since it avoids creation of harsh shadows and high contrast areas. A photocell will automatically turn the light on at dusk and off at dawn. A motion sensor will turn the light on only when it senses movement. The sensor can be set to stay on for varying lengths of time. CFLs are best used in manually controlled fixtures since electronic controls may interfere with the electronic components in the ballast. Also, make sure the CFL you choose is rated to operate at low temperatures. If you want to connect a timer to a fixture with a CFL, you'll have better luck with a manual one rather than an electronic timer due to competing electronic components found in the timer and the CFL.

# Health & Safety

## Electrical Safety

Caution should always be observed when installing, removing or operating any electrical product. Before installing or replacing a fixture, power should be turned off at the electric panel. Use only products that have been approved by Underwriters Laboratories (UL) and show the UL label.

Portable plug-in fixtures should have grounded plugs and be plugged into ground fault interrupters (GFIs) when they are used around water (bathrooms, kitchens, and outdoors). Do not plug portable fixtures into loose outlets or use any switch that has a broken wall plate. Do not run fixture cords under rugs, and replace frayed cords.

Especially in older homes, you may encounter hazards created by previous design and product decisions. Exercise extreme caution whenever dealing with electricity. Old wiring may be frayed or improperly installed. Consult with an electrician if there's any doubt about your existing wiring.

## Mercury

A small amount of mercury is necessary to energize any kind of fluorescent lamp. Most lamps contain between 2 and 5 milligrams of mercury sealed within the glass tubing. By comparison, mercury thermometers contain 500 milligrams of mercury. Fluorescent lights are safe to use in your home and no mercury is released when in use. If you break a CFL in your home, unhealthy exposure to mercury is extremely rare. Visit Natural Resources Canada's website at [www.oeenrncan.gc.ca](http://www.oeenrncan.gc.ca) for questions and answers about compact fluorescent lamps.

## PCB's

Polychlorinated biphenyls (PCB's) are chemicals which were used for their insulating qualities but have been found to be very hazardous to the environment and all life. Ballasts manufactured after 1978 are often marked "non-PCB". Older fluorescent or mercury vapour lamps may contain PCBs and should be disposed of at a hazardous waste facility. Magnetic ballasts may contain a PCB alternative, DEHB, which itself has been linked to cancer. Visit Metro Vancouver's recycling centre at [www.metrovancouverrecycles.org](http://www.metrovancouverrecycles.org) or phone the BC Recycling Council at 604-RECYCLE to learn about proper disposal of these items (See Resources section.)

## Disposal

Treat all fluorescent products as hazardous waste - the same as batteries, motor oil or lead-based paint. Visit the following BC Hydro website for recycling drop off centres for your CFL light bulb: [www.bchydro.com/guides\\_tips/green-your-home/lighting\\_guide/recycling\\_compact.html](http://www.bchydro.com/guides_tips/green-your-home/lighting_guide/recycling_compact.html)

*Especially in older homes,  
you may encounter hazards  
created by previous design  
and product decisions.  
Exercise extreme caution  
whenever dealing with  
electricity. Old wiring may  
be frayed or improperly  
installed.*

*Previous Page:*

*Photo left middle: Lighting for Tomorrow and Lightlier (2008 winner)*

*Photo left bottom: Tom Woltjer*





**ENERGY STAR®** – ENERGY STAR® – Natural Resources Canada's (NRCan's) Office of Energy Efficiency (OEE) promotes the international ENERGY STAR symbol in Canada and monitors its use. Products earning the ENERGY STAR have met strict energy efficiency guidelines. Visit [oee.nrcan.gc.ca/residential/ENERGY\\_STAR-portal.cfm](http://oee.nrcan.gc.ca/residential/ENERGY_STAR-portal.cfm) for more information and lists of qualified products.

**Daylight** – Fluorescent products described as "daylight" have a colour temperature between 5000 – 6500K and a CRI over 80. This colour approximates the colour of a sunny day at noon on a clear day. Daylight lamps can appear to be a bit blue in interior lighting situations.

**Footcandle** – A term commonly used by lighting professionals when describing the amount of light that reaches a surface (illuminance). Footcandles are an expression of lumens per square foot.

**Full Spectrum** – When used to describe light quality in lamps, this is a marketing term some lighting manufacturers use as a selling feature. In lighting, the term "full-spectrum" refers to light that contains all colours in the rainbow: violet, blue, green, orange, yellow and red. It is a common misconception that only "full-spectrum" lighting contains a full spectrum of colours, but that is not the case. Most household lighting, including CFLs, contain all visible colours of light. Lamp manufacturers often refer to their lamps as full-spectrum because they put out light similar in colour to the midday northern sun ("daylight"). These lamps have a high colour temperature, usually in the 5000 – 6500K range and a CRI of 90 or greater. Depending on the light source's spectral power distribution curve, the same objects may appear to be a different shade or colour under different light sources.

Although research has shown that some people claim to feel better and are more productive in a "daylight" atmosphere, full spectrum lamps are about 100 times less intense than true sunlight.

**Glare** – Uncomfortable brightness caused by the light source shining directly in the eyes of the occupants of the space.



*Photos of ENERGY STAR-qualified fixtures on page 17 and 18 courtesy of: American Fluorescent, Designer's Fountain, ENERGY STAR, Lightolier, Lithonia, Nuvo Lighting a Satco Product, Progress Lighting, Royce Lighting and Seagull Lighting.*

**Kelvin (K)** – The unit of measure used to designate the colour temperature of a light source. The higher the kelvins, the cooler (bluer) the colour; and the lower the number, the warmer (more yellow/orange) the colour. (See Colour Temperature above.) Common kelvins are 2700K (warm), 3000 – 3500K (bright) and 5500K (daylight).

**Light Pollution/Trespass** – Light that intrudes on other property (trespass) and/or into the sky (pollution). Light pollution inhibits night viewing of stars, affects sleep patterns of humans, and can disrupt the migratory patterns of birds. See the International Dark Sky Association's website at [www.darksky.org](http://www.darksky.org) for more information on reducing light pollution.

**Linear Fluorescent** – Used to describe long, tubular fluorescent lamps that come in a variety of lengths anywhere from 15.5cm (6 in) to 2.4 metres (8 feet). Linear fluorescent lamps have two pins on either end that are fitted into a fixture made to hold a specific length of linear lamps.

**Lumens** – A measurement term that refers to the amount of light produced by the lamp – the higher the lumens, the brighter the light.

**Lumens Per Watt (LPW)** – Lumens divided by watts in order to determine a lamp's efficacy. The higher the number, the more efficacious the lamp. CFLs are in the range of 50 – 60 LPW, while incandescent lamps are only 12 – 18 LPW.

**Light Source** – Two different types:

- Point Source – a lamp that has the potential to direct a concentrated beam of light on a specific surface or object; i.e., incandescent PAR lamps.
- Diffuse Source – a lamp that spreads light over a wide area; i.e., fluorescent lamps.

**Seasonal Affective Disorder (SAD)** – Usually diagnosed by a medical professional, SAD is a depression that afflicts up to 10 per cent of people in the northern latitudes, primarily during the fall and winter months due to shorter days. Getting 15 minutes of daylight before 10 am is a well known treatment for SAD. Even in winter on a cloudy day, the light outside can be 100 times brighter than the amount of light in our buildings.

**Universal Design** – Is a design approach whereby products, services and environments are usable by as many people as possible regardless of their age, ability or circumstances. In lighting, for example, light switches with large flat panels rather than small toggle switches are easier to operate. CFLs are an especially good option as they last 6 – 10 times longer than incandescent lamps so need much less frequent changing.



CFL with  
GU-24 base

*Photos of energy-efficient lamps on page 19 and 20 courtesy of: ENERGY STAR, Lighting for Tomorrow, Lithonia, Seagull Lighting, OSRAM SYLVANIA, Technical Consumers Products, and WATT-MAN Lighting.*

# Resources

This section provides resources to assist home builders, designers and consumers in selecting and using ENERGY STAR-qualified lighting in the home.

## BC Hydro's Powersmart Programs

BC Hydro's Powersmart program provide a lighting guide with tips for homeowners to reduce their energy use relating to indoor and outdoor lighting.

- [www.bchydro.com/powersmart/](http://www.bchydro.com/powersmart/)

## ENERGY STAR®

Visit the ENERGY STAR website to access lists of products that qualify for the ENERGY STAR label, technical specifications, participating manufacturers, and new specifications in development.

- [www.energystar.gov](http://www.energystar.gov)

## ENERGY STAR® Fixture Manufacturer Websites

The ENERGY STAR website currently lists over 130 manufacturers who sell ENERGY STAR-qualified fixtures.

- [www.energystar.gov](http://www.energystar.gov)

## Daylighting

Daylighting and access to natural sunlight are essential for living spaces, as this quality of light promotes occupant comfort. Good daylighting eliminates the need for artificial lighting, reducing energy consumption for this purpose. For more information, see the City of Vancouver's Passive Design Toolkit for Homes.

- [vancouver.ca/sustainability/building\\_green.htm](http://vancouver.ca/sustainability/building_green.htm)

For a list of lamps and fixtures and where you can purchase them locally,

- MetroVancouver's BuildSmart product directory at [www.metrovancouver.org/buildsmart](http://www.metrovancouver.org/buildsmart),
- Light House Sustainable Building Centre's green building directory under Electronic and Lighting [www.sustainablebuildingcentre.com](http://www.sustainablebuildingcentre.com)

## Incentives & Funding

Look for rebates and savings available from BC Hydro Powersmart:

- [www.bchydro.com/rebates\\_savings](http://www.bchydro.com/rebates_savings)

## Recycling Information

- Recycling Council of British Columbia: [www.rcbc.bc.ca](http://www.rcbc.bc.ca)
- CFL recycling locations: [www.bchydro.com/guides\\_tips/green-your-home/lighting\\_guide/recycling\\_compact.html](http://www.bchydro.com/guides_tips/green-your-home/lighting_guide/recycling_compact.html)
- Health Canada information on mercury: [www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/merc-eng.php](http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/merc-eng.php)





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[vancouver.ca/sustainability](http://vancouver.ca/sustainability)



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