

HOME LIGHTING DESIGN GUIDE POCKET BOOK

Energy Efficiency
Reference Guide



Natural Resources
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1 INTRODUCTION

Good lighting can make our homes comfortable, functional and fun places to be, where art and architecture look great and friends and family love to visit. Our lighting can be both effective and efficient. Effective so it can evoke a mood, light a task or provide security. Efficient so we can use the least amount of energy and still get the effects we want. Effective and efficient residential lighting requires a mix of artistic and scientific skills.

So, what makes a room comfortable, a home inviting or a landscape interesting? How does light affect colour? What types of fixtures are used for which areas? How do you determine energy efficiency and the costs associated with various types of lighting? What are all the questions that need to be answered to create good home lighting?

This Home Lighting Design Guide Pocket Book is an updated summary of the previously published Home Lighting Design Guide (also available from CEATI) and is intended as a handy resource for homeowners, builders and designers. It answers common lighting questions and incorporates proven design techniques with energy efficiency opportunities throughout all areas of a typical home.

How does light help us see?

The four primary factors that influence our ability to see clearly are size, luminance, time and contrast. Everyone's vision changes differently over time, but here are a few general guidelines. As we age, our eyes need larger type for reading, so

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adjustments should be made to accommodate this whether when reading a book or using a computer.

Additional light (luminance) is also required to compensate for losses that occur in the ocular system. We require as much as double the light by age 50 as we did at 20. Time also plays a role in vision; for example, when driving we have a limited time to focus on an object and have it register to see properly. As we age, this time it takes to focus is increased. Finally, the contrast between the object we are focusing on and the immediate background allow us to see much better, and this contrast becomes more important with age. We also become more susceptible to glare, so we need the extra light to be diffused, and care must be taken to ensure the source is directly shielded from our eyes.

2 LIGHTING OPTIONS

We generally use the terms ‘lamp’ or ‘source’ for all types of light-emitting products used in light fixtures to produce the light we need. Every lamp has a variety of characteristics that help determine its most appropriate application. A variety of lamp types are available for residential applications. The most common are incandescent and fluorescent, with light-emitting diodes (LEDs) now beginning to permeate the market.

The following table is a quick reference of the most common lamp types, comparing their energy use, colour rendering, life, and where they are typically used. (Note: Due to rapid lighting technology changes, the reader should confirm the latest data from suppliers)

Light Source	Energy Use	Colour Rendering Index (CRI)	Life (Hrs)	Application
LED	Low	70+	50,000	Accent, Task, Decorative
Compact Fluorescent (CFL)	Medium	80	10,000	Ambient, Task
Linear Fluorescent	Medium	80	20,000	Ambient, Task
Standard Incandescent	High	100	1,000	Task, Accent, Decorative
Halogen Incandescent	High	100	4,000	Accent, Task

What is efficiency?

Efficiency in light fixtures is a measure of how much light escapes the fixture versus how much light is produced by the source. For example, if a bare compact fluorescent source provides 1000 lumens but, when installed in a fixture, only 600 lumens escape, the fixture is 60% efficient. Significant variations can exist from different manufacturers and within each light source.

Consequently, it is a good idea to look for the ENERGY STAR[®] symbol. Lighting fixtures that have earned the ENERGY STAR mark combine high performance, quality and the highest levels of energy efficiency, so they help save energy, save money on utility bills, and protect the environment.

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It is also worth learning how to calculate the cost of lighting in order to compare various options economically. You need to know three things to do this:

- Power of the source, in kilowatts (kW)¹.
- Length of time the source operates, in hours (h).
- Utility rate, in cents (¢) per kWh.

Annual cost = kW × annual operating hours × utility rate

Even though your utility rate is fixed, you can improve your lighting efficiency by determining the lumens required and choosing an energy-efficient lamp replacement.

¹ 1 kilowatt = 1000 watts

How to choose light fixtures

In many cases, a fixture is chosen simply because it looks attractive. However, if it is very inefficient or does not direct the light where it is required, it is not the best choice.

Light fixtures allow us to control glare, direct light where we want it, provide a place for ballasts and transformers and provide attractive aesthetics.

Another important consideration when choosing light fixtures is the colour produced. The Colour Rendering Index (CRI) is a scale, from 0 to 100, which describes how well colours are rendered under a particular light source.

The Correlated Colour Temperature (CCT) of a lamp describes the mood created by the lighting – how warm or cool the space feels. We use the Kelvin temperature scale to rate light sources; the higher the Kelvin number, the cooler the light source.

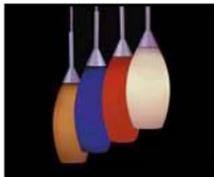
Add to this a wide choice of colours, finishes, locations and types, and the selection can be overwhelming. It is useful to sort fixtures into the general type categories of surface, pendant, recessed, track, portable, landscape and fiber optic.

2 Lighting Options

Surface mounted fixtures are exposed, but remain close to - or flush with - the ceiling or wall and are popular in hallways and bedrooms.



Pendant fixtures are suspended by a cord, chain, cable or other means and are popular over tables, kitchen islands and in higher-ceiling areas.



Recessed lighting, usually in the form of downlights (or potlights), is typically found within a ceiling cavity. Recessed lighting can be used in virtually every room in the home; however, it should not be used to provide all the layers of light required in a design.



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Track lighting answers the need for flexibility in location, quantity and aiming angles. Track lighting has become much more sophisticated in function and appearance, with multiple circuits and voltages, finishes, colours and styles and can be surface mounted on walls or ceilings or suspended.



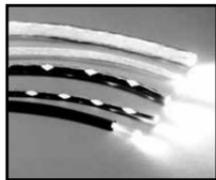
Portable fixtures are defined typically by their cord, which can be plugged into any available electrical outlet. Desk and bed lights, pole lights, torchieres and some picture lights fall into this category.



Landscape lighting refers to outdoor-rated fixtures, used to accent trees, walkways and flower gardens and often includes deck lighting.



Fiber optic lamps provide thin, clear fibers, which emit colour-changing light out the ends. The fibers carry only light - no electricity - so they are completely safe in any location.



2 Lighting Options

3 DESIGN PRINCIPLES & EXAMPLES

This section brings together the various design principles and techniques to provide a practical approach to efficient and effective lighting for the home.

Efficient and effective lighting design means using the most efficient sources with the required controls that will supply the lighting layout desired.

When considering a lighting layout, it is a good idea to focus first on people, then architecture, then art. None is excluded, but lighting a home is primarily for people – to enhance their comfort and communication, as well as to facilitate the daily tasks of eating and working.

In home lighting design, light layering uses four primary layers of light – ambient, task, accent and decorative – and there are some common techniques that supplement and enhance light layering, such as grazing, silhouette and wall washing.

Part of the design process involves controlling the fixtures in an intuitive and appropriate way. The best way to do this is to visualize the space as you carry out day-to-day tasks. What events take place when you park in the garage and come in with groceries? Where would you like the switches to be? Which light fixtures would you like them to control? When you have company over for dinner and want to create an intimate atmosphere, which fixtures would you like to be able to dim?

3 Design Principles & Examples

Of course, it is essential to meet all applicable codes and regulations when installing or upgrading a lighting system. All electrical devices must be approved, as indicated by a CSA or cUL stamp or sticker. Check with the local electrical provider for details regarding code, permit and inspection requirements.

The following provides a brief description of the various techniques needed for an effective lighting design.

Ambient light is soft, diffuse light that fills a room, reduces shadows and creates a sense of openness and comfort.

Task lighting provides additional light to carry out a particular job.

Accent lighting requires an understanding of where items might be placed that deserve particular attention, such as paintings, photographs, flower arrangements, art pieces or architectural details.

Decorative fixtures are often meant to look attractive rather than provide much useful light. Wall sconces and chandeliers are the two most common decorative products.

Wall washing puts light where we see it best—straight ahead on the walls – and is a great method of creating soft ambient light.

Silhouette a special object in an alcove by shining light on the wall behind. This can create interest and provide drama.

Grazing is a method of highlighting wall texture by passing a narrow beam of light from top to bottom.

Dimmers or switches should be used for each layer of light. Three-way switches allow control of lights from two locations, a useful approach in rooms with multiple entry points. Consider dimmers to extend the life of lamps and generate energy savings.

Motion detectors can detect the movement of heat sources such as our bodies. These provide convenience and energy savings and work well in locations such as garages, storage rooms and play rooms, as well as outside to discourage trespassing, vandalism and theft.

Photocells control a fixture so that it turns on with darkness and off with light. Motion detectors can be combined with photocells to provide best of security and energy savings.

Whole-house controls are available, but due to their complexity, a great deal of research is required to ensure the chosen system is easy to use, effective, expandable if required and functions as desired.

Design Checklist

You now have a collection of tools (sources and fixtures) and techniques (ambient vs. task lighting, dimmers and switches, etc.) to work with, and you want to apply these to your home. On a room-by-room, space-by-space basis, answer the following questions to help think through the steps and prepare a sketch for each room.

- Make some basic notes for each room.
 - What are the colours and finishes to be used?
 - What furniture will be added, and where?

3 Design Principles & Examples

- What is the size, shape, and ceiling height?
- What tasks will be carried out in the room?
- What vertical surfaces can be washed with light to provide softer, diffuse overall light?

- ☑ Does the room need lighting design, or is a simple utility fixture adequate?
- ☑ Choose decorative fixtures that blend with the colours, finishes and architecture. Sometimes, there's no other way to determine this, but to actually purchase one and place it in the space.
- ☑ Add task lighting as required, referring to the list of tasks you made above. Make sure that the source does not shine directly in your eyes when working on the task. Be careful not to create reflected glare off shiny surfaces.
- ☑ If there are pictures, art, antiques, or other objects worth accenting, add lighting in those locations. Again, visualize yourself walking through the space and make sure you can never look directly into the source. If the feature will be permanent, choose aimable recessed lighting. If a lot of flexibility is required, consider track, rail or cable lighting.
- ☑ Decide how to achieve at least some ambient light in the room, considering indirect or direct/indirect fixtures. This can be done through hidden coves, by locating lights above furniture or cupboards or with portable torchieres and fixtures.
- ☑ Make sure each layer is controlled separately. Visualize yourself walking through the room from

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every entry point to ensure the controls are comfortable and convenient for day-to-day use. Is a switched floor or wall receptacle a good option for portable fixtures in this space?

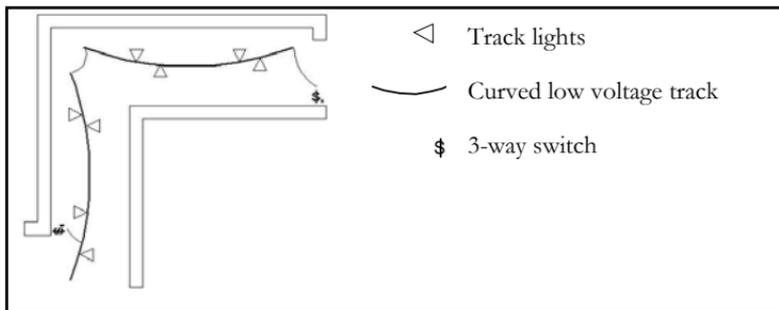
Using the Design Checklist, consider the following key ideas for each part of your home; the sample floor plans and pictures may help inspire ideas of your own.

Note: The images do not fully reflect the schematics and are used simply to show various lighting options.

Entry way and hallway

- Avoid using only potlights, which can shadow.
- Provide accent lighting on art or pictures.
- Track lighting or aimable downlights can provide both accent and ambient wall wash.
- Use a decorative pendant or wall sconce near the door to create a welcoming atmosphere.
- Ensure access to switches from multiple locations.
- Use efficient sources, as these lights are often on for longer periods of time.

Track lights or downlights

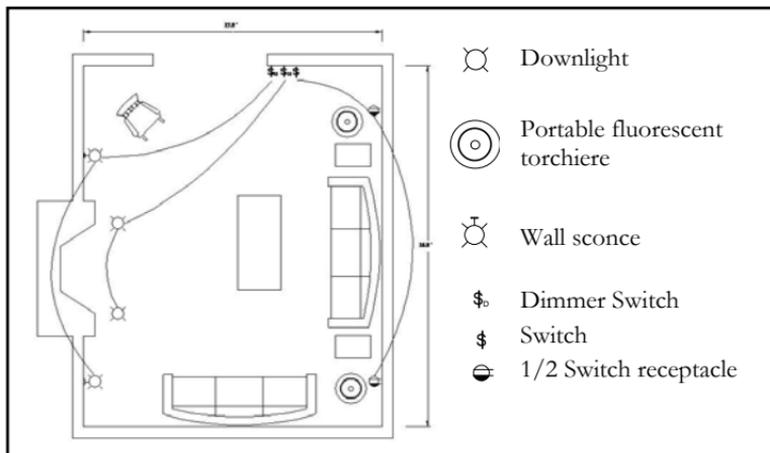


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Living room

- Create flexibility through portable lighting.
- Provide good ambient/indirect lighting.
- Make sure glare is controlled for comfortable reading.
- Use switched receptacles to integrate fluorescent torchieres.
- Accent lighting should be used in some locations to create various scenes and an intimate atmosphere.

Downlights and wall sconces, plus portable lamps

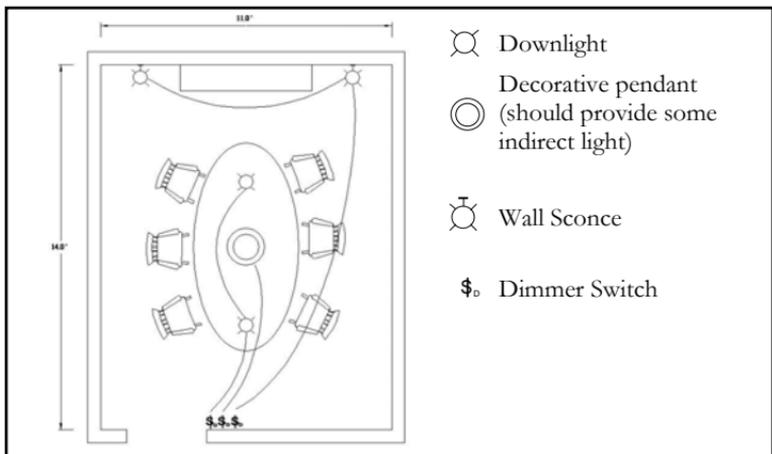


Multiple fixture types in one room allow for flexibility. Wall sconces can provide effective ambient light if directed up. Portable lamps are always a good option for living rooms. Also, consider matching wall sconces and pendants.
Courtesy: Randall Whitehead, Kichler Lighting

Dining room

- Separate the control of multiple layers to create various moods.
- Don't rely on a chandelier to provide all the light; supplement with downlights and sconces.
- Aim downlights toward walls to create ambient light.
- Provide dimming controls to enhance an intimate atmosphere and allow flexibility.

Downlights, pendants and wall sconces



Chandeliers are decorative and should be kept relatively dim. Supplement with downlights. Most of the light on this table is from the recessed downlights, not the chandelier. Also, remember that portable lights can take many forms and will enhance the atmosphere of most rooms.

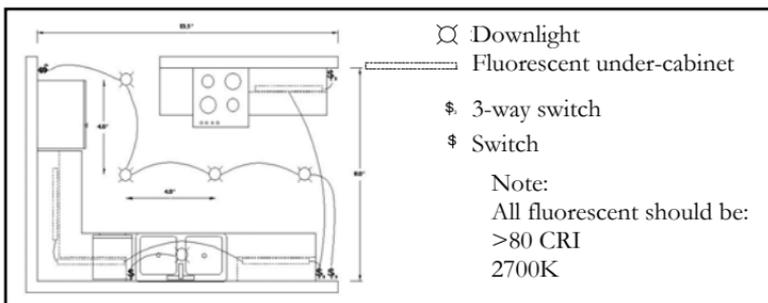
Courtesy: Juno Lighting

3 Design Principles & Examples

Kitchen

- Avoid track lighting in favour of multiple layers with separate controls.
- Add light where needed for meal preparation with task lights under the front of cabinets.
- Wash light down cabinets to bring out colours and wood grains.
- Kitchen lights are on a lot, so energy-efficient choices are particularly important.

Recessed downlights and under-cabinet lamps



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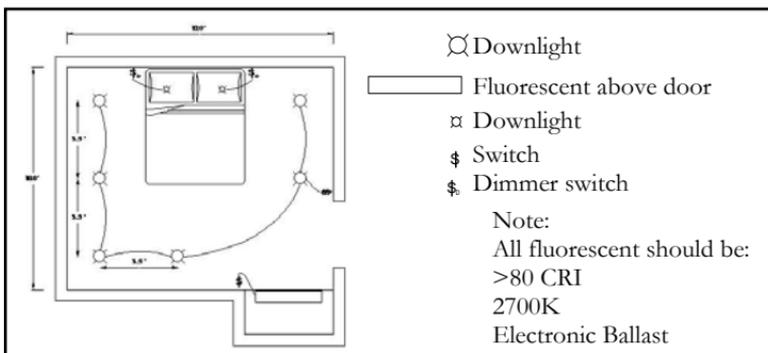
Larger pendant fixtures can be an attractive focal point, while a skylight, finished with a soft diffuser, brings welcome daylight into a kitchen. Using no electricity, skylights use the most efficient light source - the sun!

*Courtesy: Kichler Lighting,
Sunscope*

Bedroom

- Create ambient light by washing walls with downlights or with surface or pendant fixtures.
- Provide glare control for reading.
- If using a single fixture, consider a pendant with both uplight and downlight.
- Put closet lights directly above the doorframe.
- Choose efficient sources for kids' bedrooms especially if they are used a lot.

Recessed downlights



Recessed halogen downlights on dimmers allow the homeowner to set a relaxing mood. LED reading lights can be dimmed and directed as required. Closet lighting above the door highlights clothing.

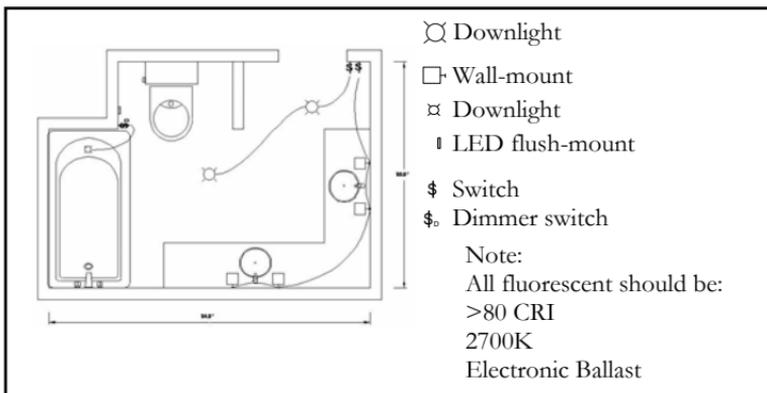
Courtesy: Lighting Solutions Inc

3 Design Principles & Examples

Bathroom

- Strong light should be directed towards the face of someone standing at the mirror. Use wall-mounted sconces or decorative linear fluorescent strips.
- Consider a small LED light with a GFCI outlet by the toilet for safe night passage without blinding light.
- Provide a dimmable light over the tub for reading, located over the head area. Consider a low voltage for increased safety.
- Separate the fan control from the lighting control.
- Screw-in fluorescent lamps provide efficiency while allowing stylish fixture choices.

Recessed downlights and wallmounts



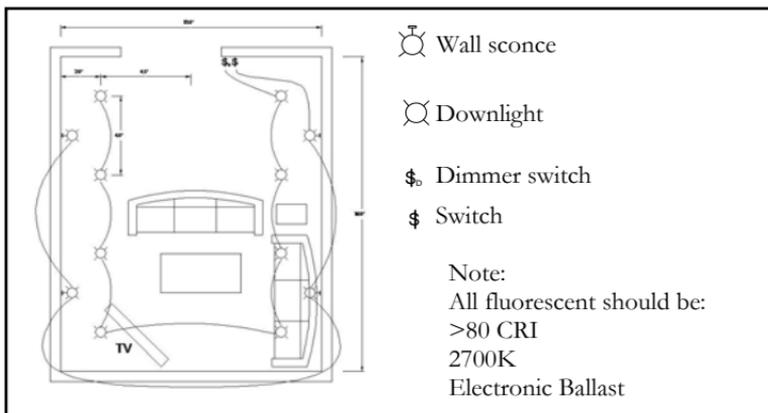
A wide variety of wall sconces and sink area fixtures are available to fit in with the décor or make a statement on their own.

Courtesy Kichler Lighting

Family/great room

- Use multiple layers to create a bright space for play and dimmable light for parties or TV watching.
- Use decorative recess T8 dimmable lamps for general illumination.
- Remember that CFL sources are not always dimmable, so use these for good ambient lighting, and consider dimmable options for a few wall sconces or grazing the fireplace.
- Add wall sconces for visual appeal.

Wall sconces and downlights



Combining small downlights with dramatic accents creates an intimate atmosphere for parties and TV watching.

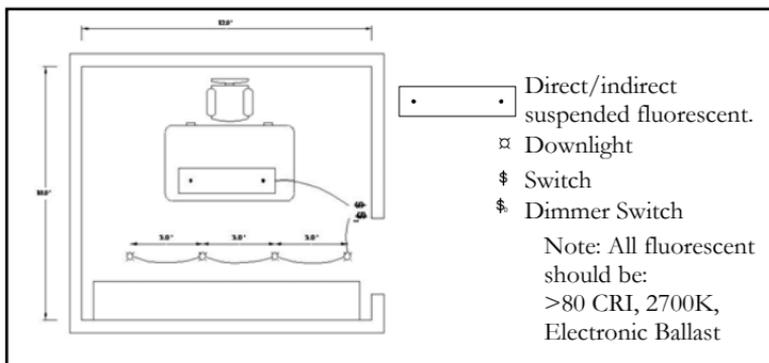
Courtesy: Cooper Lighting

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Home office

- Direct/indirect suspended fixtures create a bright, but low-glare space for long hours of computer or paper work and are very energy-efficient.
- Use a cooler lamp (3500K is a good choice) than in the rest of the home.

Direct/indirect suspended and downlights



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Stairwells

- Ensure switches are easily accessible from both the top and bottom of the stairs
- Consider small LED or halogen step lights for safe yet low-level lighting.

Garage

- Avoid downlights, as they create harsh shadows and are not good for the various tasks carried out in this space.
- 4-foot, 2-lamp vapour-proof fluorescent fixtures work well, even in the cold, and provide excellent light.

- Locate fixtures to each side of the vehicle(s), rather than overhead.

Laundry room

- Ensure access to switches from multiple entries if needed.
- Provide task lighting over appliances and tables.

Exterior deck

- Don't allow direct viewing of lamps; the eyes are particularly sensitive to glare at night.
- Consider fixtures with frosted glass panes or fixtures that provide only down light.
- Ensure that all fixtures are approved for wet locations.
- Consider low voltage (12V), low wattage (<20W) lighting under rails or on posts.
- Make sure stairwells are well-defined.

Landscape

- Illuminating trees is not a good use of electricity, and it adds to the urban sky glow and light pollution.
- If considering landscape lighting, use solar-powered LED pathlights, which provide small way-finding points of light.

Ten tips for lighting your home

1. Compact fluorescent lamps (CFLs) are an energy-efficient light source for many home applications.
2. Lamp choices should be 2700-3000K to create a warm, inviting and relaxing atmosphere.
3. To save energy and money, choose a bulb at the desired brightness, and then select the most efficient option available.
4. LED options are excellent choices for under-cabinets and stairs. CFLs or linear fluorescent lamps are very good for task and ambient lighting.
5. Try things out first! If you're not sure about a lamp or a fixture, buy one and try it before using it everywhere.
6. All lamps and fixtures produce heat, which must be vented if in enclosed or recessed fixtures to avoid safety hazards or premature failure. Use the proper lamp with the proper fixture for the lighting task.
7. High-quality energy-efficient lighting products may cost more initially, but save you money over their lifetime and last longer.
8. Ask for help! Lighting showrooms can help by providing lighting catalogues. Always ask for ENERGY STAR qualified fixtures.
9. When creating a flexible, intimate atmosphere, use ENERGY STAR qualified fixtures or lamps with dimming capabilities. Or, install a dimmer on your halogen lights. Dimming will not only save energy, but also extend the life of your lamps.
10. Layer your light using the “accent, ambient, decorative, and task” ideas, and have them operate separately.

In conclusion...

By adding your own imagination to the principles and ideas in this guide, you will enjoy the benefits of an efficiently and effectively lit home for years to come, while minimizing your utility bills and environmental impact.

3 Design Principles & Examples

Your feedback and comments are appreciated.
Please provide suggestions to:
info@ceati.com

Energy Efficiency is Good Business

- Economic Prosperity
- Environmental Performance
- Social Responsibility
- Security