efficient lighting in detail

Making Daylight Work for You

In residences, a fourth of all electricity is used for lighting. In commercial buildings, the ratio is even higher: 30 - 40%. Plus, electric lighting has an indirect impact on cooling costs due to the heat generated by electric fixtures. The general rule is that each unit of electric lighting contributes an additional half unit of electricity for space cooling.

Taking advantage of natural and free daylight from the sun makes economic as well as environmental sense. Not only can the energy savings from reduced lighting loads directly reduce air conditioning usage by an additional 10-20%, increasing daylight can also contribute to a building's sustainability through pollution avoidance. Electricity production is a significant contributor to CO2 emissions, which cause global warming.

Additionally, studies have shown that increased access to daylight improves comfort, productivity, health, academic performance and retail sales. For details on the positive effects of daylighting in schools and retail environments, refer to the Heschong Mahone Studies carried out in 1999 and 2003 (http://www.h-m-g.com/projects/daylighting/projects-PIER.htm) which state that student learning rates increased by 21% in classrooms with the most amount of daylight compared to those with the least. (However, it is best to avoid direct sunlight which causes glare and has a negative impact on learning.) In a retail environment, with all other factors being equal, the average non-skylit store would be likely to enjoy 40% higher sales by adding skylights.

There are a wide range of options for increasing daylight as well as increasing the efficiency of artificial lighting, both of which can reduce the demand for electricity. These options range from modifying windows and making other structural changes, to painting walls and ceilings lighter colours, using light shelves, changing the types of lamps and reducing ambient lighting needs by increasing task lighting or modifying use patterns. You could alternatively incorporate more sophisticated solutions such as lighting systems based on photocell controls that respond to daylight in a space, or even install occupancy sensors such as infrared or ultrasound that disable lights when the space is not in use.

There are three types of daylight that can enter a building space: direct, indirect and reflected. Direct daylight is the least desirable of the three as it causes glare and increases the cooling load i.e. the air conditioning system has to work harder. Reflected daylight can have similar consequences if not carefully controlled and therefore indirect daylight is the most ideal.

The challenge of daylighting is not so much how to provide enough of it but how to do so without its potential undesirable effects. Before adding windows or skylights, it is important to address issues such as heat gain, glare, variation in light availability (based on sky conditions), external

STRATEGIES
to increase indirect daylight include:

- Increase perimeter windows up to a point. The general rule of thumb is to limit glazing (amount of openings in the building envelope) to around 20%.

- Allow daylight penetration from high positions in a space, such as through clerestory windows, skylights and atriums. The higher the window, the deeper the daylight will penetrate.

- Reflect daylight within a space to increase a room's brightness through light-coloured ceilings and walls, higher gloss surfaces, light shelves or Venetian blinds angled to direct light straight up to a light-coloured ceiling, this will then allow light to be reflected deep into a room. The ceiling is the most important surface for reflecting daylight into a space; the next most important is the back wall followed by the side walls and finally, the floor. Keep any reflective surfaces clean and dust-free to allow maximum daylight to enter.

- Slope ceilings to direct more light into a space.

- Consider exterior elements such as overhangs, light shelves, horizontal louvers, vertical louvers or fins and vegetation. These elements are most effective on the south and west facades where heat gain is most intense.

- Consider interior elements such as the room geometry and interior shading controls such as blinds, draperies, solar screens and roller shades.

obstructions and the size of windows, as well as their spacing and materials, which all have a significant effect on the amount of daylight entering a building.

Just as a double pane window keeps heat inside in cold climates, it can also help keep heat outside in warm climates. The most important qualities of a window in a climate like Cayman are the Solar Heat Gain Coefficient (SHGC), which measures how well a window blocks heat from the sun, and whether or not it has a low-emissivity (low-e) coating. For example, on a scale of 0 to 1, a high-efficiency low-e window can have a SHGC of only 0.37, which means only 37% of the available solar heat is coming through the window. This compares to single-pane glass with a SHGC of 0.81 or double-pane with 0.70.

Low-e coatings allow a high level of visible light to transfer through the window but reflect 40% to 70% of infrared radiation and 5% to 37% of UV radiation. Protective glazings, in comparison, are often made up of metallic particles that do not allow as much visible light through the window. There are even various "smart windows" in development, which respond to light in much the same way as sunglasses with photochromic materials that darken as you transition from indoor to outdoor environments.

Individuals and businesses may only consider the initial cost of lighting and not the life-cycle cost. This is a mistake as installation of more efficient lamps can pay for their modest extra initial cost many times over. Even a change as simple as switching from incandescent to compact fluorescent light bulbs can have a significant impact.

Use of task lighting can allow for reducing the ambient light levels required in a space and lower the overall electrical energy demand by 20-50%. In particular, consider reducing ambient light levels in areas such as hallways, mechanical rooms and storage rooms. A few suggestions for sourcing energy-efficient lighting include the following manufacturers: Access Lighting (www.accesslighting.com), Forte Lighting (www.fortelighting.com), Light Concepts by Lithonia Lighting (www.lithonia.com) and Sea Gull Lighting (www.seagulllighting.com).

Even the most sophisticated and energy-efficient systems depend on how they are used, so a proactive plan to modify use patterns can save even more and have significant impact. For a business, create a lighting schedule that shows when lights in each space are used. First, define the type of occupancy for each time period; next, determine the type and level of light needed to fulfil safety and security needs; then, notify and train employees on the benefits of this schedule. In a business or a residence, the simplest advice is to regularly remind occupants to use lights only when necessary, use only the amount of light required and to turn off lights when not in use.

Lighting remains a visible reminder of energy conservation. Hence, lighting projects should be the cornerstone of any serious energy-management program. The more we conserve electricity and take advantage of natural forces such as daylight, the better our quality of life and the life of generations to come.

Sharon Patterson founded Om Your Home™, which focuses on creating healthy, sustainable, energy-efficient, comfortable and beautifully designed environments for homes, offices, schools and communities.