Energy Efficiency in Homes

Renewable energy sources like solar and wind have found the attention because fossil fuel based power generation is not environmentally friendly and reservoir of crude oil is not unlimited. Efficient and economical use of energy can never be underemphasized. Solar power system and energy efficiency must go hand in hand. It does not make much sense to put effort and money in solar systems and continue to have appliances that are inefficient or wasteful.

Since the initial capital cost of solar systems is still quite high (of course, it is paid back over the years) it makes sense to pay attention to how efficiently the power is utilized. If the electrical load of the appliances can be reduced by using energy efficient gadgets, the cost of the system can be reduced significantly. Lights and fans are two items that can be easily put on solar power and the cost of the system can be minimized using replacing regular lights and fans with more efficient models.

EFFICIENT CEILING FANS

Top Ten Most Energy Efficient Ceiling Fans in India

In summer months, fans are the most used items in India despite the widespread availability of coolers and air-conditioners. Ceiling fans are the most neglected appliances, except maybe for their looks; people generally presume that all fans are alike and hardly look at the wattage rating of the fans though they may be concerned about the "watts" written on the lights. But the fact is that fans consume a lot more power than lights. To give a perspective, a regular (non BEE star rated) ceiling fan consumes about 70-75 Watts; in comparison, regular (most inefficient) tube lights consume 45-55 Watts and CFL lamps of 10 – 25 watts are more common in the middle class homes. Ceiling fans are used almost round the clock whereas lights are turned on only during the night.

In reality, ceiling fans consume two or three times more electricity than lights. The Bureau of Energy Efficiency (BEE) in India started rating ceiling fans of 1200mm sweep (regular sized ceiling fans) a few years ago, since then the manufacturers have started coming out with efficient ceiling fans. Here is a list of Top Ten Ceiling Fans in India by electricity consumption and size. The ratio air delivery/power consumption was used in ranking the models.

MOST EFFICIENT TOP 10 BRANDS IN INDIA*

Rank	Brand	Model	Power Rating (W)	Air Delivery (cum/min)
1	CROMPTON GREAVES	MAXIMUS	35.00	210.00
2	USHA	TECHNIX STAR RATED	45.00	210.00
3	KULIRMA FANS	PREMIUM	50.00	231.00
4	ORIENT	ENERGY STAR	48.00	220.00
5	CROMPTON GREAVES	FRONTIER	47.00	215.00
6	VASORA	SUPREME	46.94	211.76

7	HAVELLS	FUSION-5 STAR	50.00	225.00
7	WONDER	EMPIRE-1200	50.00	225.00
8	AIRWELL	DHOOM	50.00	220.00
8	KHAITAN	NEWTEC	50.00	220.00
8	UNITEX	DEA-1200	50.00	220.00
8	USHA	TECHNIX FLARE	50.00	220.00
8	VIJAY	XMARK	50.00	220.00
9	LAZER	ES48	48.00	210.00
10	SEABL	STAR 1	49.20	214.58

**This list is in no way complete. There are other similar models of various manufacturers not listed here. For more exhaustive list and regular updates please visit the following webpage:*

http://www.bijlibachao.com/Top-Ten-Appliances/best-ceiling-fan-khaitan-havells-usha-crompton-greaves-orient-in-india-electricity-consumption.html

EFFICIENT LIGHTING

LED Lighting

LED based lighting is the newest innovation in the lighting industry. It has revolutionized energy-efficient lighting. LED is short for **L**ight **E**mitting **D**iode: it is a diode which emits light when current flows through it. These small solid state lights are extremely energy-efficient. LED light assemblies normally combine several such diodes to get the desired brightness. They also consume considerably less electricity for same brightness. The LED technology is still improving very fast and is the lighting solutions of the future.

Low power consumption and long life pays-off in the long-run, apart from being a green technology. Well-designed LED lighting fixtures can retain 70% of their initial output for 50,000 hours or more, depending on operating conditions. LEDs are more efficient than both incandescent and CFL lamps for two reasons: One, they emit light in a targeted direction – instead of scattering it in all directions which is wasteful. Two, they don't emit great amounts of heat. In comparison, incandescent bulbs and the CFL lamps waste a large portion of power as heat: 70 percent or even higher.

LED's are now commonly available with efficiencies of **100-120** Lumens per watt compared to 65-80 Lumens/watt of CFL, 45 Lumen/Watt of Mercury vapor and 75 Lumen /watt of metal halide or 94 Lumen / watt of sodium Vapor.

In dozens of nations, green initiatives and energy-efficiency directives are hastening the shift towards LED lighting systems, which have the lowest energy consumption and environmental impact, the longest useful life, and the lowest operational cost. LED lamps are now widely used in

solar systems because they offer superior light output per watt which reduces total cost of the system.

Light Output: LED vs Incandescent vs CFL

Light Output	Light Emitting Diodes (LEDs)	Incandescent Light Bulbs	Compact Fluorescents (CFLs)
Lumens	Watts	Watts	Watts
450	**4-5**	**40**	**9-13**
800	**6-8**	**60**	**13-15**
1,100	**9-13**	**75**	**18-25**
1,600	**16-20**	**100**	**23-30**
2,600	**25-28**	**150**	**30-55**

***NOTE**: The above values are merely indicative and must not be taken too rigidly because the lighting technology is evolving very fast.*

More Advantages of LEDs

Feature	Light Emitting Diodes (LEDs)	Incandescent Light Bulbs	Compact Fluorescents (CFLs)
Life Span (Hours)	**Typically above 50,000**	**1,000 – 2,000**	**8,000 – 10,000**
Wattage (equivalent to 60 W Incandescent Bulb)	**6 – 8 W**	**60 W**	**13 – 15 W**
Temperature Sensitivity	**None**	**Yes, Somewhat**	**Yes**
Sensitive to humidity	**No**	**Yes, Somewhat**	**Yes**
Switching On/off Quickly	**No Effect**	**Yes, Somewhat**	**Yes - lifespan can reduce drastically**
Turns on instantly	**Yes**	**Yes**	**No - takes time to warm up**
Durability	**Durable - Can handle jarring and bumping**	**glass or filament are fragile**	**glass can break easily**
Toxic Mercury	**No**	**No**	**Yes**

Need to Think Differently

Because of long experience with incandescent light bulbs, most people have learned to correlate brightness with wattage of the light source: a 100-watt lamp puts out more light than a 60-watt lamp. Thus, when people look for lighting source, they think in terms of 40, 60, or 100-watt bulbs. Generally, incandescent lamps use the same filament material heated to the same temperature, so the only way to increase their light output is to increase the wattage. It is different with LED light assemblies. They involve no filament or heating but current is merely passed through diodes which

results in emission of light. Usually several tiny LED devices are mounted alongside to get the desired illumination. Different LEDs may use different materials, each with its own light emission efficiency. For this and other reasons, two different LED sources can consume the same number of watts but give out different light output.

Another issue is directionality of light. An incandescent light bulb illuminates in a 360-degree spherical pattern regardless of the shape of the bulb. When we light an area with such a 'spherical bulb' source, even with a reflector, only a small proportion (50% or less) of the *light* is *delivered* to the surface we are lighting – the rest is lost. Light is wasted by diffusers; or through filtering or lensing; or when directed away from the target area.

The way LEDs are shaped and designed, light is not emitted in all directions; with proper design over 80 percent light can be directed where it is needed. LED fixtures deliver light in the desired direction and create brighter illumination, allowing efficient use of the produced light. Thus, an LED lighting fixture with lower rated lumens (a measure of illumination explained later) may deliver the same or more useful light to a targeted area than a comparable fluorescent lighting fixture with a higher rated light output.

Thus, people should now learn to think differently when they talk about lighting. With LED lights it is more useful to talk in terms of brightness delivered rather than brightness produced by the fixture.

How is Light Brightness Measured?

Lumen and Lux

Casually speaking, *lumen* is a measure of the total "amount" of visible light produced by some source. Conventionally, different light sources have been compared by the *lumens* they produce. But the fact is that only a little portion of it is actually delivered to the area it is needed; the rest goes towards walls and ceilings where it serves little useful purpose.

We should be more concerned with the amount of light that is delivered on a given area; not in the total amount of light emitted by any light source. This delivered light is measured as light falling on a given surface area. This is the useful light we are interested in – light that falls on the working table, the kitchen platform, near the entrance gate, at receptionist's desk, and so on.

This delivered light is called illuminance: it is the intensity of light (lumens) falling on a given surface area. If the area is one square feet, the unit is *footcandle* (fc) and if the area is one square meter, the unit of illuminance is *lux*. Thus, 1 lux illumination means *one lumen per square meter*. There is no harm in taking 1 lux as roughly 10 fc.

Experience tells us that for comfort, working tables should have illumination of around 300 lux (30 fc), while serious reading requires around 500 lux (50 fc) of the page of the book. Lecture halls where some demonstrations are involved should have light level of around 1000 lux (100 fc).

Now consider these facts:

- A bright office has illumination of about **400** lux (or **400** lumens per square meter).
- When sky is clear, normal outdoor light at sunset or sunrise is also about **400** lux.
- Moonlight is about **1** lux.
- Television studios are lit with about **1000** lux.
- During the day, sunlight ranges from **32,000** to **100,000** lux

1000 lumens falling on one square meter area will give more brightness than when they fall on 10 square meter area. If your writing desk is 3 feet by 2 feet then you will be more concerned with the amount of lights (lumens) on the desk which has 6 square foot area; not elsewhere in the room.

How many Lumens do I Need?

Let us apply the above knowledge of delivered light in *foot-candle* or *lux* for lighting a small house. Lumens represents the actual amount of ambient light coming from a lamp. The higher the lumens, the more "lit-up" a room will be. But how much "lit-up" is enough?

A good rule of thumb is:

Floors require 20 Lumens per Sq Foot
Tables and Raised Surfaces need 30 Lumens per Sq Foot
Desks and Task Lighting require 50 Lumens per Sq Foot

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For an average 15 x 17 feet (250 square feet) living room, you'll need roughly (20 lumens x 250 square feet) 5,000 lumens to "lit-up" the room. It means five 10 watt LED lights. If you read on the couch, add about 4 sq feet of task lighting for each couch – 50 lumens x 4 sq feet (200 lumens). These will be just 2 watt LED lights. So, in all the living room becomes comfortable with 54 watts of LED lights. If you try it with CFL or 4 feet fluorescent tubes, you will easily exceed 100 watts.

In your dining room, you mainly require about 30 lumens per sq foot on your dining table (you want to see your food, but not examine it). For a 6 x 3 feet table, that's 540 lumens. So, a 5 – 6 Watt LED above the table is sufficient for dining area.

Bear in mind, however, that these are just typical numbers and are based on 8-foot ceilings and average height task lamps. If the walls and furniture are dark colored, you'll need brighter light sources. The distance between the light and the surface also changes the equation. Finally, personal preference will play a major role in your decision. If you prefer a more "lit-up" environment, add 10 – 20% extra to the numbers. In fact, the best idea is to install brighter lights with dimmers so that the brightness can be changed or adjusted as required.

Light Quality

Lumen doesn't describe the quality of the generated light – its color, tone or other variables. People often describe the lights as “warm,” "cool," "pale" or "dim." The biggest challenge for LED manufacturers is creating lightings that mimic the light quality of conventional lamps. There are two parameters that are often talked about while discussing LED lightings: Color Rendering Index (CRI) and Color Temperature (K)

Color Rendering Index is a subjective measurement of how well a lamp source renders colors. A measurement of the degree of color-shift an object undergoes when illuminated by a light source when compared to a reference source of comparable color temperature. Incandescent light is assumed to have a CRI of around 100 so it will render all colors correctly. Metal Halides only has a CRI of about 70, so only 70% of colors will be rendered correctly. HPS has a CRI of 22.

Color Temperature is not how hot the lamp is. Color temperature is the relative whiteness of a piece of tungsten steel heated to that temperature in degrees Kelvin. HPS has a warm (red) color temperature of around 2700K as compared to MH at 4200K, which has a cool (blue) color temperature.

It is important to remember that two light sources can only be compared if their color temperatures are equal. You cannot compare the CRI of HPS (2700K) and Metal Halide (4200K).