

- Use of light exposure for treatment of medical disease or disorders, including sleep disorders, dementias, seasonal mood disorders
- Implications of light and health research for lighting recommendations and lighting practice, including ethical and educational implications.

Authors are invited to submit two-page extended abstracts of their proposed contributions in English no later than 1 May 2006 to

CIE Central Bureau, Kegelgasse 27, A-1030 Vienna, Austria per mail or e-mail: ciecb@ping.at (please do not fax, as the extended abstracts, if accepted, will be used to print the Abstract Booklet).

Authors will be notified of acceptance of their abstract by 1 June 2006. Instructions for preparing camera-ready copy of papers will be forwarded to accepted authors. Final camera-ready copy is due at the Symposium. The Proceedings of the Symposium will be made available after the meeting.

Accepted contributions will be pre-published for Symposium participants at the web site of the meeting.

Registration Desk

Registration forms will soon be available on the Internet at: www.irc.nrc-cnrc.gc.ca/ie/lighting/health/cie_e.html as well as www.cie.co.at Or contact:

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Choreographing Light

Krishnesh S. Mehta

While on a night safari in a dense jungle on a dark moonless night, imagine that you lose your way and find yourself inside the famous Ajanta caves at two o'clock in the night. It is pitch dark inside and you have no source of light. In that situation can you admire the beauty of the caves and the paintings? Imagine further that a glow worm were to glow just at that moment. In that moment of light wouldn't your perception of the space change? What did that ever so little light do?

It is light that gives birth to space. It is in the presence of light that space takes shape, form and volume. It makes things visible. No matter how beautiful the space or the objects in it are, it is how the light falls or is directed on them that finally decides how they will eventually look – how they will be sensed, perceived and experienced. The nature and the quality of lighting guide the observer in deciding how alluring, delightful and charming the given space and the other elements in it are. Good lighting can make even the most un-charming things charming and bad lighting can make even the most charming things highly ugly and undesirable. Light lights your imagination, it also highlights your errors!

Just how important lighting is can be illustrated with the help of the following images:



Fig.A



Fig. B

Source: *Sensation and Perception: An integrated approach* by Harvey Richard Schiffman, 6th ed., John Wiley and Sons, USA, 2001, 220

Figure A is the inverted image of figure B. Notice that due to this inversion the direction of light is changed and hence the bumps appear to be pits and the pits appear to be bumps. This is the power of lighting. And this is how significantly it can affect our perception. It can create such drastic an effect so as to make bumps appear as pits and vice versa. Hence, lighting is not just about putting on the light. It is about directing light, about choreographing light.

The influence of Light

Light enters and affects our day to day life in a myriad of ways. Ever wondered in how many different ways does

light affect us and our lives?

Ever felt the beauty, joy, love, grace, blessings of light?
Ever felt the intoxication, enchantment, exuberance of light?

Ever been swirled by the vibrancy, pulsations, dance, fizzle, sizzle, of light?

Ever been perceived the sacredness, holiness, serenity, peace, bliss, divinity of light???

Ever been inspired by light?

Ever been moved and swayed by light?

Ever been engaged in the humour and wit of light?

Ever been provoked and persuaded by light?

Ever been drowned in light?

Ever been repelled by light?

Ever been depressed, sickened, dulled, and gloomed by light?

Ever felt the embrace, security and safety of light?

Ever been hugged by light?

Ever experienced the sweetness of light?

Ever sensed the volume, depth, contours, texture, and pattern of light?

Ever experienced the harshness, coolness of light??

Ever heard the SOUND of light?

What is the SMELL of light?

What are the colours of light?

Ever tasted light?

Ever experienced the LIGHT touch that touches the SOUL?

Ever heard the invocation, music, tunes, rhythms, harmony of light??

Ever felt the seasons of light?

Ever sensed the TIME of light?

Do you hear the whisper/voice of light?

Ever perceived the emotions, moods of light?

Ever been swept by the ROMANCE of light???

Ever fallen in love with light?

Ever been entranced by the sensory-ness, sensuality of light??

Ever been drenched in the fountain, rain, shower of light?

Ever been HEALED by light???

Ever been sensed the glamour, glitter, glitz and shimmer of light?

Ever listened to the POETRY of light?

Ever participated in the DRAMA of light?

Ever experienced the MAGIC of Light???

What is the SPIRIT of light??

Ever imagined life WITHOUT light???

Light and Lighting

Light is a physical entity; created physically, powered electrically/naturally, sensed biologically, perceived neuro-psychologically, experienced holistically. We can do little to alter the properties of light but we can certainly use them to create the desired and intended effect. We may not be able to design light but we can certainly direct light. Hence, lighting design is more about choreographing

light than about designing light. Further, in this emerging knowledge and experience economy, isn't all of the world a stage and all work theatre, dance and play? Isn't the entire world a stage and all lighting, choreographing light? Lighting is not just about illuminating or illumination.

What's the difference between illumination and lighting?

Illumination is engineering, helps meet the required lux levels and makes the space visible and lit. Lighting is an art and science; helps create interest, magic, surprise and anticipation, persuasion and attention, focal hierarchy. It enhances the overall perception of the space and the elements therein.

Illumination is about switching on the light so that the space and things become visible; lighting is about directing light –choreographing light- to show what needs to be seen as it is intended to be shown. Illumination removes darkness, lighting creates darkness. Illumination is about creating a sterile wash of light, about spreading light evenly; lighting is about carefully and meaningfully choreographing the dance and play of highlight and shadow. Illumination is a homogenized ocean of light generated by street light at an intersection; lighting is a spot light on a stage. Illumination is about meeting the lumens need; lighting is about addressing the human dreams, emotions, sensations and perceptions and sensibilities –meeting the human needs. Illumination tends to flatten the space and the objects within; lighting enhances the three/four dimensionality of the form and space. Illumination elicits general interest and so lack of attention in anything particular; lighting generates interest points and focal hierarchy to make things that much more desirable. Illumination creates just one more space, lighting crafts a destination. Illumination lights, lighting delights. Illumination is a function; lighting a celebration.

Good lighting enacts suspense, tells a story, weaves poetry, plays the tunes, presents a drama, evokes emotions, sells dreams, appropriately triggers the human perceptions, senses and sensibilities, and produces experiences. Good lighting is a treat for the senses. Good lighting attracts, persuades, distinguishes, satisfies, seduces, transforms, sublimates, synergizes, serenades, entices, tickles, personifies, inspires, motivates, teases, captivates, romances, mystifies, thrills, provokes, amuses, wows, surprises, lures, celebrates, enchants, entrances, fascinates, bewilders, perplexes, relaxes, embraces, soothes, comforts, synthesizes, simplifies, delights...Good lighting makes one **lust** for it...makes one fall in love with it...makes it irresistible!

Good lighting requires that light is directed, trickles or spills into the space without, as far as possible, directly or indirectly showing the light source. Hidden sources,

or the placement of sources such that the audience is kept guessing as to where the light is coming from is any day a universally surefire hit. Light is to be seen, not the light source. Further, good lighting integrates the different spaces through a well defined connectivity and system. It leads one from one space to the other in full continuity and flow. However, this necessitates that the lighting design is integrated into the building right from the drawing board stage of the project. Though, lighting is often likened to the last coat of paint, it is the final most important element of design that can make or mar the subtle detailing, delicacies and intricacies so painstakingly accomplished by the architect and the interior designer and hence is too important to be taken up after everything else is done with. Unfortunately, nonetheless, even today, most lighting is applied as the last coat of paint, and sadly is treated so as well. It is generally done after all of the building and interiors are over. Small surprise, then, that it almost always ends up being illumination and not lighting.

The way lighting is done these days, one could actually tell the time when the building was built, or the interiors were done, by looking at the light sources used. Generally, most architects and lighting designers use the light sources that are the latest in the market at the given time, little caring about whether the type of light given by that light source is appropriate to the given space, function and context. Worse still is that the people responsible for lighting do not talk to those doing the interior design / architecture and vice versa. A glaring, jarring example of this is the countrywide stores of a famous retail chain in the country which has used high ceilings to hide the light sources from the cone of vision of the customers, but has used glossy vitrified flooring that reflects all the light sources and brings them within the cone of vision.

It is also so depressing that worldwide almost 90% spaces, public and private, retail or recreational, are illuminated in the name of lighting. One common excuse is that lighting is not energy efficient but illumination is. Under the garb of lighting, when, even the unnecessary spaces and objects are illuminated, it is illumination that is not energy efficient, not lighting. And, by the way, what are more important and relevant, energy efficiency alone, or the quality of life and the overall well-being of the humans. Does social responsibility mean energy efficiency at the cost of health, peace of mind, security and safety of the very social beings for whom the energy is being saved? World over, lighting is still mostly done by the illumination engineers and designers, who are mainly electricians or electrical engineers by training and very rarely by lighting designers or even more sparingly by those who transcend lighting design –those who choreograph light. Besides, doing and teaching illumination is easy –it

is like teaching $2+2=4$, not much thinking or creativity is required, simply follow the rules or the 'light meter', whereas executing and imparting lighting design and choreography is difficult. It requires a distinct intuitive sensitivity to feel the space, empathize with the people who will use that space and their needs, experience and envision the connection of that space with the other spaces, have the contextual clarity about the focal hierarchy to be created and of the nature of light required and hence the appropriateness of the light source/s to be used and an ability to creatively collate and synergize all of these to then direct light to produce a choreography that is one continuum of an all sensory experiential delight. No wonder, live examples of lighting design and further choreographing light are few and far apart. But, where there is one, one connects instantaneously and is moved by the sheer excellence and brilliance of such artistic expression, and feels at once attuned, transcendental and transformed –blessed and sublimely 'blissed'. Which is a bigger social responsibility, lighting or illumination?

What is lighting?

Lighting is creating intended, contextually meaningful and purposeful contrast/harmony in a given space using light.

Types of lighting

Lighting can be said to have many different types depending on the function performed by the light. However different they may sound the basic underlying principles for choreographing light for each of them remains the same. Only the detailing may be different. Often these different types are seen as watertight compartments and each type is treated separately. And there is a separate expert for each of these. The proverbial right nostril doctor cannot understand what's wrong with the left nostril syndrome. However, they need not be and should not be so. Just as the whole body functions holistically, so does lighting, they are all done with the same light, which follows the very same principles. Modern lighting and especially lighting design and choreography demands that there is optimal and appropriate mix of each or the relevant few of these in every type as necessitated by and is apt for the given context. This can only bring synergy and not chaos. The following is an indicative and by no means exhaustive list of the various specialized function specific types of lighting:

- **Perceptual, Mood and Emotional Lighting, Ambience Lighting** – lighting that invokes/induces emotions and moods, perceptions, lighting to create desired ambience/s
- **Spiritual, Transformational, Transcendental, Sublime, Divine and Ecclesiastical lighting** –

cathedrals, churches, temples, and other religious buildings, Meditative places, memorials

- **Lighting for Safety and Crime reduction** – lighting of public spaces
- **Experiential and event lighting** – galleries, museums, exhibitions, events
- **Retail and Presentational lighting** – shops, stores, supermarkets, visual and retail merchandising
- **Auditorial lighting** – theatre, assembly and auditorium, lecture halls
- **Lighting for Corporate and Professional Communications** – Board rooms, Conferences Meeting rooms, presentation suites
- **Human Interaction and Conversational Lighting**– Cafes, restaurants, pubs, bars, and dining areas
- **Therapeutic lighting** – alternative therapies, fitness and wellness centers
- **Transportation Lighting** – lighting the interiors of vehicles, lighting for navigation, lighting for airports, railway stations, bus terminus, etc.
- **Ambulatory/Transitory lighting** – Reception Space, Waiting Areas, Corridors and WCs
- **Altitudinal lighting** – Atria, Malls and High Spaces,
- **Behavioural and Attitudinal lighting** – lighting to affect the behaviour, circadian rhythms, etc
- **Integrative and Systemic lighting** – lighting for connectivity, brand identity
- **Functional and Operational lighting** – offices and workspaces, shop floors, industrial
- **Inclusive-Universal lighting** – lighting to meet the needs of the able and the less abled – elderly, physically challenged, lighting for special needs, etc.
- **Glitterati and Special Effects (SFX)and Futuristic lighting** – Starlight and other special effects and high tech – lasers, projections, gobo lighting, robotic lighting, electronic and artificial intelligence based light control
- **Nightscaping** – Lighting as nocturnal image maker, city beautification and human lighting, street lighting
- **Stadium Lighting** – stadiums, sports fields, etc. (indoors and outdoors)
- **Natural Lighting** –using the sun, moon as the sources of light
- **Recreational lighting** – spas, jacuzzis, swimming pools, etc.
- **Dynamic Lighting** – for signboards, focal hierarchy, subliminally transient lighting
- **Lighting for Health and healing** – hospitals, operation theatres, patient rooms
- **Hospitality lighting** – hospitality spaces, Monumental lighting, enhancing tourism
- **Landscape and outdoor lighting, Water body lighting**
- **Atmosphere lighting and Lighting the sky**
- **Façade lighting and Ambient lighting**

• **Lighting for film and photography**

Learning Lighting Choreography

Can Lighting and lighting choreography be taught and learnt? If some one can do it, all else can learn to do it, given the right attitude and guidance. Learning lighting design and choreography requires not only a good thorough knowledge of the physics and engineering of light but also the philosophy of light, of how the light blends with the various elements of space, ability to synthesize, understand the part and whole relationship, a very robust ability to imagine and visualize space in 3D and 4D –how it changes with time (computers still are way off as visualization tools for lighting)-, a very good understanding of humans and human behaviour, of human sensation and perception, of the human senses and sensibilities, the effects of light on neurophysiology and the neurobiology, neuropsychological cognition, human behaviour and the brain. A deep ability and sensitivity to empathize with the humans, the given space and its context; capability to feel a space and understand the aesthetics, poetry, drama, music and emotion relevant to it, and then find the appropriate light source and lighting technique to best express the same. Basically, have an 'eye' for all of these. Of course, these things cannot be taught in the conventional mode of imparting. It needs learning by imagining, thinking, questioning, doing and experiencing. Teaching lighting is much like learning choreography; one has to be clear of how each element behaves individually and how they work collectively, how to put all the elements together to create that perfect harmony, a faultless synergy. To learn lighting one has to constantly and aggressively learn to see, observe and perceive, how the light and shadow interplay, what emotions they evoke. What light sources, colours, angles; what effects are suitable for what context. For example observe how the shadows emerge, move, elongate and vanish, how their grey value changes, as you ride under the street lights, or how the light filters through the leaves of the tree, or how the water casts a shimmering reflection on the wall.

Artificial light is mainly used for human consumption but it can be employed meaningfully for all living and non living things. For this, a proper understanding of how it affects and alters all of them is necessary. For the well being of animals, it is essential that the artificial light mimics the natural light as far as possible. For the non living, it is essential to gauge the sensitivity of the given material to heat and to different light intensities and frequencies.

To be able to choreograph light as intended and to achieve proficiency in lighting for any of the above mentioned lighting types, one needs to master the following principles. Of course, each is a full topic in itself and requires a lot of experimentation and exploration before

it is mastered. All these are to be dabbled into keeping in mind the other softer skills mentioned above.

Lighting, in principle is just about manipulating any one, two or all of the following three things to create the desired contrast and/or harmony:

- **Manipulate Source:**
 - What light source to use (incandescent, fluorescent, CMD, HMI, LED, etc.) and with which kind of luminaire –ready made or custom made, its optics, enclosures, matte or clear, direct or indirect, whether at all to use a luminaire or not, etc.
 - Where to keep this source –the right angle of throw, whether to hide or make visible
 - What source with what light distribution -the colour spectrum and intensities, whether to use filters –depends on what are the properties of the objects lit
- **Manipulate Medium:**
 - Whether to use smoke, water screen, scrims, holographic screens, screen curtains, etc.
- **Manipulate Illuminated forms & surfaces:**
 - Change the texture, surface finish and material, colour, reflectivity, form, etc. of the objects / surfaces on which light is directed

Some of the various kinds of contrasts-harmony that can be created are as follows:

Light – dark: using absence and presence of light

Diffuse – harsh: between light sources that create harsh and diffuse shadows. Given the same coloured source, diffuse lighting is relaxing and harsh is stimulating. On the other hand harsh lighting creates texture, sparkle and glitter, diffuse lighting creates smoothness

Colour contrast: lighting a green object with a light source producing more green light will enhance greenness of the object, using a light source with more of red on the same object will lessen the greenness and so on. Use the light source with a colour spectrum appropriate for the colours of the objects to be lit, to create the planned contrast or harmony. Also, understand the concepts of simultaneous colour contrast and colour interaction. The same colour looks different under different light sources. Also, colours tend to give a sense of depth depending on the colour interaction, for e.g. yellow tends to jut out and blue tends to recede on a black background and reverse happens on a white background.

Static – Dynamic: Light that is moving / changing with time as opposed to a fixed light, e.g. blinking neon as opposed to a static bulb; or a static light falling on a

moving and stationary object. Moving objects are perceived before static ones are.

Vertical plane lighting v/s horizontal plane lighting: Horizontal plane is better suited for lighting the humans

Pure v/s filtered light: to get the right colour rendering

Warm light –Cool light: using both usually enhances the colour rendering

Direct light –Transmitted light: to create special effects

Electric light sources v/s Electronic: e.g. incandescent bulb v/s LED

Mid field v/s far field v/s near field: where to light most decides how large the space will be perceived as. Lighting the near field brighter than the far field makes the space look smaller and so on.

Front lighting v/s backlighting: front lighting tends to flatten the 3Dness, backlighting shows the silhouette or enhances the figure.

Natural Light v/s Artificial light: how to mix and match the both to create harmony and energy saving

Texture Contrast:

Pattern Contrast:

Plane v/s volumetric:

Sparkle v/s glitter:

Focused v/s Defocused:

Our eyes do not see the whole space in one go. When we encounter a new space, our eyes register the different areas of that space in small spots in rapid succession and then our brain stitches all these small images and creates an illusion of seeing the full picture all together. Hence our eyes get confused when everything is evenly lit. There are no interest points. Lighting produces these interest points by generating focal hierarchy –creating contrasts and directing light. Our brains sense any new space in a particular order. When exploring a new space the first thing that will attract our attention is people, the next is movement, then brightness, followed by high contrast, vivid colours and strong pattern. Of course, this will be overpowered by the meanings and combinations of the above (adapted from *Light: The Shape of Space*, by Lou Michel, John Wiley and Sons, USA, 1996, 62) For e.g. moving people will be looked at before the static ones, among a sea of people if someone of the crowd has meaning (someone is known to the viewer) then that person will be seen first; a faster moving object will be noticed before a slow moving one and so on.

To choreograph light it is important to remember to use more than one light source, more than one effect

(create relevant synergy), lighting from more than one level (avoiding the conventional ones as far as possible –like why not generate ambient lighting for the passage way by giving wash on the wall or the floors rather than putting light sources on the ceiling) and directions and layers. To light the space for more than one task so that multiple effects can be generated in the given space. While doing this, care should be taken so that the light source is not in direct or indirect view (the suspense should not be leaked), as far as possible, and no unwanted glares and reflections are produced. Of course, choreographing light does not mean using all the latest gizmos in the most complex and exuberant display of technical and financial extravagance, but about directing light meaningfully and purposefully to where it is required in the most requisite and optimal way. This can most often be achieved in the most simplistic of ways with minimum of technology and finance. In fact, the most masterly test of expertise of a lighting choreographer is to be able to use single crude and cheap light source (like a torch) and yet light a delight, still create a fête. Play wild, but never lose the sight of the thin line between light and delight, between illumination and lighting.

The above contrasts and manipulation can be achieved by employing some of the following lighting effects and functions. The effects mentioned here are indicative only and it is beyond the scope of this article to get into the subtleties, finer nuances, interactions and permutations and combinations of each of them.

Synergistic Effects:

Mix light –natural + artificial etc.

Multi-Layering

Multi-level lighting

Multi-tasking

Physical Effects:

Reflect

Scolloping (all types and forms)

Filters

Optical Effects

Transmission

Projection (projection and mirror)

Focal Glow

Disperse

Diffract

Refraction

Polarization

Projecting light and patterns

Bounce

Light Beam types (Pin spot, Spot, Accent, Flair, and Flood)

Skylight

Textures, Patterns, Gradation

Unconventional applications

Directional and Angular Effects:

Wash (all types)

Flood

Glance

Graze

Spill

Sparkle/Glitter/Shimmer

Accent lighting

Task lighting

Spot lighting

Fill lighting

Back light

Silhouette

Up light

Down light

Measuring the quality of lighting

Most lighting practitioners are used to measure the lumens and are happy with the results if the lighting meets the required lumen levels. To them that's a job well done with glorious success. Lighting is not that dry and human perception not that easy to address, that its performance can be adjudged so easily. Lumens do not measure the psychological and biological effects that the light is having on the human mind, it does not tell whether the lighting is stimulating enough for the person to perform the given task or is relaxing enough to produce rejuvenation.

One further way of measuring the success of lighting is by going through all the words mentioned above under good lighting and see how many of them are fulfilled. Some scientific minded people have even coined some softer measurements like the Visibility and Comfort factor, the Delight factor, the Drama factor, the Display factor, the Serenity factor, the Functional Ease factor and so on. These basically measure the said feelings of the audience generated by the given lighting on a scale from 0-10 or 0-100.

The other way to measure is –did it wow you, with the top line to the bottom line being -will you want to experience that space again, did it engulf you in its drama, did you identify with it, did it become a part of you, did it delight you enough, did it make you feel and experience the celebration?

Some Provocations

Will you be lighting or illuminating?

Are conventional light sources to be used conventionally only?

Are unconventional light sources to be used unconventionally only?

Should stage lighting be limited to the stage only? Isn't the entire world a stage?

Should LASER lights only be used as lines?
Should LED lights only be used to check on-off, or that
your disk is busy?
Are tube-lights the only office/home lights?
Is lighting the last coat of paint?
What is a bigger social responsibility –illumination or
choreographing light?

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R & D UPDATE

New Phosphors for Efficient White-light LEDs

Two approaches are available for making white light LEDs. One is combining red, green and blue from LEDs emitting the re-spective colours to produce white light. This is complicated as individual controls are required for the different coloured LEDs.

An alternative approach is to use phosphors to produce red and green under a blue LED which together result in white light. Wolfgang Schnick and his team at the university of Munich used two new phosphors called nitridosilicates, which when doped with europium, emit red and green light under blue light, to produce white light. The phosphors are chemically and thermally stable.

The LED fabricated by them using the newphosphors and a blue emitting LED gave white light of excellent quality and good colour rendering. The efficiency of the white light LED with the new phosphors was 25 lumens per watt, much higher than that of incandescent lamp. They expect that the efficiency can go up by a factor of 2 to 4. The materials used present, according to the team of scientists, no environmental hazards during production, service, and disposal. It is expected that that this new LED would be a low cost and low energy replacement for incandescent and fluorescent lighting.

Light-emitting Nanoantennas

The efficiency of antennas to receive or radiate electromagnetic radiation depends on the matching of antenna dimensions with the wavewlength of the radiation. It is easy to do this for long radio waves. For light waves with wavelengths in the nanometer range it is now possible to fabricate nanoantennas with nano-technology.

A team of scientists at the university of Basel and the Federal Institute of Technology in Switzerland fabricated optically resonant antennas using patches of gold on an indium-tin substrate and illuminated them

with 8-ps pulses from an 830 nm laser repeated at 80 MHz. They observed emission of white light continuum which covered a wavelength range from 400 to 800 nm at an optimum input power of 110 microwatts. Two large peaks were also noticed at 560 nm (close to the sensitivity maximum of human eye) and 750 nm.

However, it turned out that the output peaked when the length of the antenna was 255 nm, quite unrelated to the wavelength of the input light. An unexplainable variation in the output was also noticed for different antennas of the same length. It was reported that further research was needed to understand this output variation for antennas of the same length. The developments in this field should interest lighting engineers as they might lead to another light source for lighting.

V.D.P. Sastri

WEBWATCH

Can LED Makers Learn a Lesson from Edison?

Who would think that, in the year 2005, we would look to the inventor Thomas Alva Edison to help us think about how to introduce LEDs to the world?

Makarand “Chips” Chipalkatti for one.

At the LEDs 2005 conference recently, Chipalkatti—Osram Sylvania’s corporate innovation manager—challenged an audience of LED professionals to imagine how they can speed the adoption of a disruptive technology.

“For Edison, there was no electric lighting. The infrastructure supported gas lighting, which was the incumbent,” Chipalkatti told the 400+ professionals who gathered in San Diego to discuss the future of the LED industry in lighting.

read full story here:<http://www.lighting.com/content.cfm?id=585&sid=9&page=/>

Philippine Department Develops Energy Efficient Lighting Standards

MANILA, Oct 17 Asia Pulse - The Philippine Department of Trade and Industry’s Bureau of Product Standards (DTI-BPS) is developing 21 new standards to make lighting products sold in the local market more energy efficient in light of the global energy crisis.

Under the Philippine Efficient Lighting Market Transformation (PELMAT) Program, a five-year project of the Department of Energy (DOE) to promote the energy efficient lighting (EEL) system in the country, the BPS is