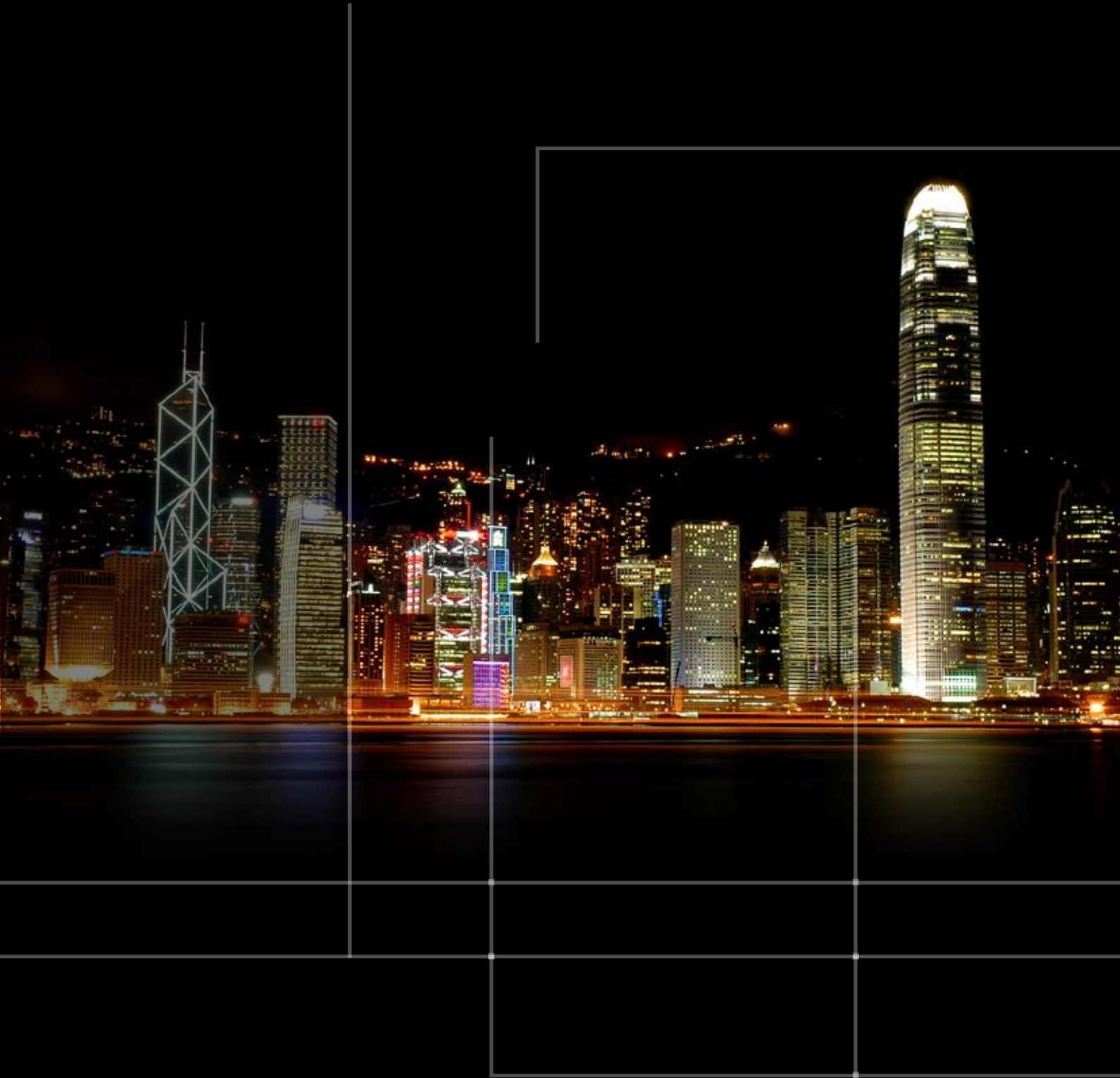

The PLDA Statement on Sustainability

PLDA

Images of Hong Kong displaying the lighting difference, following agreements made with building owners, to reduce the amount of office lighting left on.

PLDA

EXECUTIVE SUMMARY

This document details the various elements that the PLDA believe are involved in achieving truly sustainable lighting design. These can be summarised into the following commitments that are considered holistically within the design process:

- The Lighting Designer shall strive to provide (only) the right light in the right place at the right time.
- The Lighting Designer shall consider the energy in use to operate the lighting scheme and shall seek to minimise this. Energy in use is to be measured in terms of 'LENI' - the amount of lighting power used per square meter of floor per year described in kWh / m2 / Annum.
- The Lighting Designer shall consider the non-visual, biological and health-based aspects of lighting and prioritise these in their design.
- The Lighting Designer shall endeavour to work with architects and engineers to develop and prioritise the use of daylight of buildings.
- The Lighting Designer shall strive to ensure that the minimum resources are used to produce the lighting scheme and equipment, with minimal negative environmental impact.
- Above all, the Lighting Designer shall consider the needs of end user of the space and their ability to control the lighting within it.

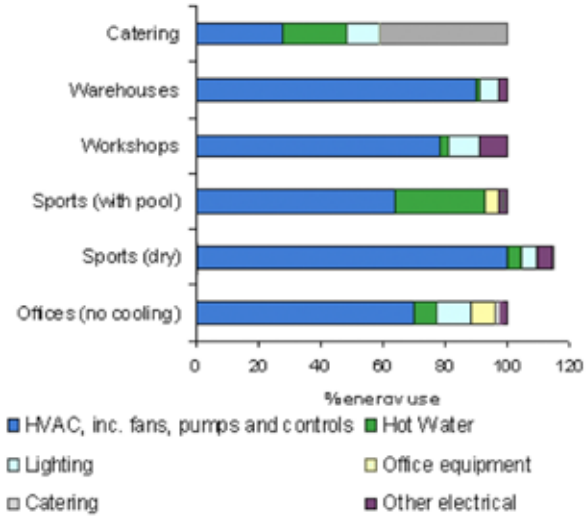

Fig 1: UK Department of Energy Study on actual energy use indicating the relatively small proportion used in lighting.

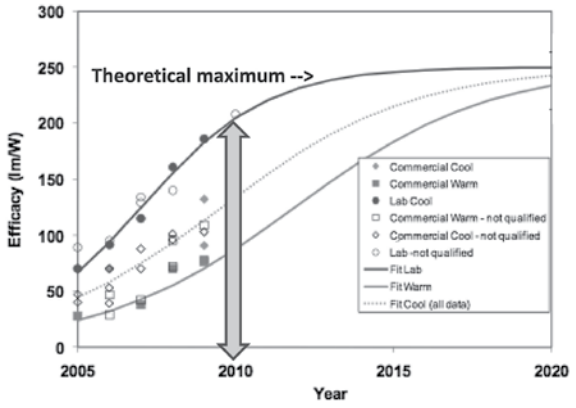

Fig 2: US Department of Energy review of white LED efficiencies indicating limits to the theoretical maximum efficiency.

THE CURRENT SITUATION

The profession of Lighting Design is presently being challenged by many new regulations throughout the world. Legislation including UK Building Regulations, European Energy-Using Products, and the USA's Security of Supply, as well as an increasing number of voluntary schemes such as BREEAM and LEED are aiming to reduce the energy use in buildings. The universal focus of these is solely the reduction of energy in use of lighting equipment and the power density of a lighting installation. The PLDA does not believe that this approach is effective in the production of holistically sustainable lighting.

Broadly speaking, the approach taken in this legislation stems from a publication by the International Energy agency in 2006, titled "Light's Labour's Lost" and is based on a single dogma:

"If you increase the efficiency of a lamp you will create a consequent, demonstrable, equivalent saving in energy in use for every application"

This is a wholly incorrect simplification, and it is unfortunate that this document has become the basis for legislation for the past 5 years.

To understand the problem we need to critically examine how lighting efficiency is measured. The value used for the assessment of lamps and luminaires is the lumen (light flux produced) per Watt (of energy used) (lm/W). The problem in using this measure alone is that it does not allow for any consideration of luminaire performance in terms of light distribution. Inevitably, the more control of the light source that is required through the use of reflectors and optics, the less efficient a particular luminaire is deemed to be, regardless of the fact that it may still be the most appropriate choice for the specific lighting task in question.

Another commonly used measure for lighting system efficiency is the installed load. This is measured in Watts (of energy used) per square of floor area. This measure is much used in the voluntary building assessment schemes such as LEED and BREEAM. From a lighting designer's perspective, this approach has major drawbacks, largely because the targets for energy use over a given floor area have been developed on the basis of achieving illuminance values on the horizontal plane at working height, or at floor level. In reality, the apparent brightness of a space is dependent on the illuminated vertical surfaces as much, if not more so, than the horizontal planes. Unfortunately, the majority of lighting standards and recommendations are also based on these target illuminances in the horizontal plane, and where ceilings and walls are mentioned at all, they are referred to in percentages of this horizontal illuminance. This approach had some relevance historically, when electric light was expensive and it was difficult to provide enough light on the horizontal task area, let alone elsewhere. The fact that there has been a steady increase in recommended light levels was also logical when visual tasks revolved around paper-based communications created on typewriters, and these documents often consisted of indistinct carbon copies. Today we question the relevance of these lighting levels in an environment where the majority of work is done on self-illuminating screens, and that which is committed to paper is output in crisp text direct from high resolution laser or inkjet printers, and copies come from photocopiers. We at PLDA feel strongly that we are at a stage where we must reconsider the whole basis for lighting standards. What we need is a measure that allows us to design schemes that:

Provide the right light at the right place at the right time.

This will inherently provide holistic sustainable solutions; and:

A measure that will enable designers to create schemes that deliver the right light in the right place at the right time does exist. It is termed the Lighting Energy Numeric Indicator, usually known as LENI.

The details of this measure are set out in BS/EN 15193. LENI determines the amount of lighting power used per square meter of floor per year and is described in kWh / m2 / Annum. The document makes this appear a very complicated measure to calculate, but in fact it is very logical and with a little study it becomes clear that this is a real answer to future energy legislation. As we are heading towards much more detailed metering of commercial electricity supplies, the information will be readily available to determine the actual energy use attributable to lighting. From the Lighting Designer's perspective it is possible, with little work, to pre-determine the likely lighting energy use providing the building owner provides reliable data for occupancy and space use.

USING THE APPROPRIATE CONTROL

The use of LENI helps to underscore the notion that if we are to reduce lighting energy use there is much more to be gained by switching lights off or running them at very reduced power when they are not required, than by attempting to restrict the selection of individual light fittings or by slavishly trying to achieve pre-determined illuminance targets on the horizontal plane.

Humans have evolved with very high levels of light in the daytime. Darkness or low light was a threat reducing the time available to hunt and gather and increasing the threat from predatory animals. Fire provided light and warmth at night and therefore comfort, safety and security. Since those times we are hardwired to believe that bright equals good. It is not surprising then that we naturally try to increase light levels whenever we can. Equally, if darkness represents a threat we are often not comfortable in making areas dark by switching off lights even if we are not actually using them. Understanding this fundamental aspect of psychology enables the Lighting Design professional to address it in a sensitive manner.

The Lighting Designer needs to provide a means of controlling light, however this must be done in a way that does not make people feel either inconvenienced, or lacking in control over their environment. The sudden switching of light (on or off) in our field of peripheral vision is a major distraction. Just as we are programmed to respond to light or dark, our peripheral vision is programmed to detect change and movement so we immediately focus on that this happens frequently we will have real difficulty maintaining concentration. It follows that if lights are switched on and off according to changes in daylight availability the same distractions will occur.

The solution is as follows:

"We must make it easier for people to do the right thing and switch off or dim lights where practical and possible. When we are doing it for them we must do it so that it is not noticeable otherwise they will feel they are being imposed upon and/or not in control of their own environment."

The ideas behind this are not restricted to internal office lighting. As more controllable light sources (LEDs) are used for outdoor public area lighting, such as streets, similar techniques can be applied.

THE BIOLOGICAL EFFECTS OF LIGHTING

Recent research has been done into the processes involved in the circadian cycles impacting sleepiness and wakefulness. Amongst other things, this is helping to explain the causes of Seasonally Effective Disorder and other clinical conditions. For Lighting Designers the significance of this research is high.

We must do our utmost to understand the biological effects of light and ensure that our designs provide healthy living conditions and certainly do not inflict or exacerbate unnecessary suffering and disease.

USE OF DAYLIGHT

Daylight is a much under-used resource for building lighting. Over the past century, development has grown outward and outward in an effort to maximise the lettable or saleable floor area of a building. At the same time, floor to ceiling heights have been reduced to minimise building envelope costs. The development of lighting technology and energy pricing policies has made electric lighting cheaper and brighter. Coupled with these facts, currently daylight availability is being constrained by energy legislation aimed at reducing heat loss and gain through glazing. Often, architects are not primarily designing facades to optimise the use of daylighting in interiors.

It is the Lighting Design profession's challenge to work with the architects and engineers to develop the use of daylighting in buildings, which is the most inherently sustainable light source of all.

INFLUENCE ON THE PRODUCT DESIGN AND MANUFACTURE PROCESS

When you consider that lighting equipment currently being specified will typically remain in use for as long as 30 or 40 years, it becomes obvious that it is actually the environmental impact of the electricity used over the life of equipment that will need to be radically reduced if any of the targets for CO2 emissions are to be met. It is therefore critical that all other aspects of the environmental impacts of lighting are considered at the design stage, and that energy in use should not be the sole determining factor in the choice of lighting equipment and system design.

Approximately two-thirds of energy used for electricity generation is wasted in the generation process and through transmission losses. No matter what we can achieve in lighting design it is very obvious that, to meet the current targets to reduce CO2 emissions there must be significant changes to the generating mix and distribution systems.
From the Lighting Designers perspective it is important that we understand the effects that the Power Factor of the lighting equipment we specify has on the supply and generating losses. We can influence the design of lighting products through specification to encourage manufacturers to improve this aspect of lighting equipment performance.

Manufacture of new lighting equipment consumes considerable natural resources, not the least of which is aluminium. Bauxite, the mineral from which aluminium is extracted, is one of the most plentiful minerals in the world however there are serious environmental impacts to consider. To extract aluminium from bauxite requires massive amounts of electricity in big electric furnaces. Transporting the raw materials and semi finished aluminium around the world from where it is mined to where it is smelted, then to where products are manufactured, and finally to where they are installed and used, comes at a significant environmental cost.

The Lighting Designer must pressure manufacturers to ensure sufficient use has been made of recycled materials in the lighting equipment specified.

Aluminium is easily recycled and the energy required to turn recycled aluminium into light fittings is a fraction of that required to create new aluminium.

Glass is also heavily recycled. Once again the raw material for new glass is abundant, the energy required to turn sand into glass is much more than that required to recycle glass.

Plastics can also be recycled, however many that are used in lighting equipment use brominated fire retardants making them non re-useable. Plastics are largely petrochemicals made from newly won oil, so reducing the content of non-recycled plastics would be an important reduction in the environmental impact of lighting equipment.

We must make it clear to manufacturers that if we are going to replace lighting equipment, we expect the old equipment to be re-cycled, and in turn create demand for recycled material in new equipment by requesting it in our specifications.

Re-use is even better than recycling. This is a big challenge to the lighting industry as there is currently a preference for new equipment being purchased. Many manufacturers will not support the repair of existing equipment. Lighting designers must encourage the development of a market for specialist lighting refurbishment. It is clear that the cost of new will not always be less than the cost of quality refurbishment, however the environmental benefit is substantial. It is a concern that no credits are given by LEED or BREAM for re-use of equipment in refurbishment schemes. As a Lighting Design community we must lobby for this.

Lighting Designers also have a responsibility to consider the use of materials known to create environmental problems. Foremost among these is mercury. Currently mercury is being banned from almost every use except lighting. In conjunction with this the EU has banned the export of mercury. Other materials used in lighting can also be detrimental to the general environment. A thorough knowledge of the materials and processes used in lighting equipment manufacture is required so that the Lighting Designer can push lighting manufacturers to produce this information.