How to make workplace lighting more effective

James Brittain, director of the Discovery Mill, has teamed up with his associate _Kristina Allison_ from Lighting Enterprises to explain what is meant by lighting health-checks to help organisations answer some key questions.

There are two key questions that organisations have to ask about their lighting. The first is: Do you know how good your existing lighting performance is? And the second is: How much more potential do you have to improve it?

When the answers to these questions are known, "where you need to be" can be compared with "where you are at the moment", and a lighting improvement strategy and action plans can be positioned to help close the gap and deliver more energy-effective lighting in the workplace.

Lighting typically accounts for 10–30% of the total energy consumption cost of buildings.

Lighting health-checks can be used as part of an Energy Savings Opportunity Scheme (ESOS) type energy audit, an ISO50001 energy review, or as a general performance check for the working environment to identify where energy performance improvement opportunities exist.

Energy effective lighting: think win-win

We define "energy effective" lighting as the optimum level of lighting service that delivers best overall value to the organisation and its business plan. This represents "where you need to be."

This typically takes into account the impact on work productivity, reasons for enhanced lighting, security and safety requirements, operation and maintenance costs and overall energy and environmental performance.

By undertaking the health-check against this measure, we can easily identify ineffective lighting installations and thus recognise the opportunities to improve lighting performance overall to deliver increased energy savings, reduced costs and to generally give a better overall working environment.

This often translates into multiple business benefits, a win-win for the organisation.

High level assessment using LENI

A quick initial assessment of "where you are at the moment" can be done by comparing your metered lighting energy consumption to industry benchmarks measured in kWh/m2 per year. This requires dedicated electrical sub-metering on lighting circuits, which, quite often, isn't installed.

An alternative technique is to make use of a LENI (Lighting Energy Numerical Indicator) calculation. LENI is also measured in kWh/m^2 per year. It was originally introduced by the European Standard for lighting energy performance in buildings, BS EN 15193 in 2007. There are "quick" and "comprehensive" LENI methods available that give an indicator of the efficiency of an entire lighting installation, including its controls. The LENI number for each functional space can be compared to industry benchmarks or prescribed limits provided by requirements such as the Building Regulations UK Part L (BRUKL).

For example, a 10,000m² HQ type office building, located near London, spends £60,000 a year on energy for lighting (12% of its total energy bill). This building is used for approximately 3000 hours a year with an average illuminance of 300–500 lux across the treated floor area. For this level of use, the actual "in-use" consumption of 60kWh/m² per year is quadruple the industry benchmark of 15kWh/m² based on modern lighting standards — costing the organisation £45,000 a year more than current good practice.

We find this to be quite typical of many buildings. By truly understanding lighting performance and lighting requirements, many organisations can deliver significant energy savings and other benefits from improving their lighting systems.

Counting the people factors

There are two simple tests we use to assess the people factor requirements for buildings.

First, we look to measure the actual utilisation of the space by using people or occupancy counters. This can be done relatively simply by introducing temporary monitoring into buildings as part of the health-check review.

Even though our buildings are available for use 365 days a year, in practice many are only used from Monday to Friday during core working hours. The 3000 hours a year for our example office building is equivalent to 125 days a year, which equates to 34% overall utilisation for the building. When we take into account the fact that average total occupancy at any one time for this type of building is typically 45–65%, this utilisation falls to less than 20%. This means that, on average, our lighting systems in the UK are needed for less than 20% of the total time. Often, we find that lighting systems are left "on" for significantly longer periods than needed.

Second, we also look to speak directly to building users, whenever possible, to ask for their feedback on what they think about their lighting; this often includes asking about the levels of artificial lighting, day lighting and about opportunities to improve the system overall. We do this through simple discussions and interviews or further investigations, if required, by using a simple batch-type questionnaire.

During a recent building user questionnaire survey at an airport, lighting was identified as the most liked aspect of the working environment. The airport recognises that its buildings are critical to delivering their business plan but they need to save more on running costs. Lighting has been targeted as the next key opportunity to make significant energy savings. We estimate that there are over £200,000 of energy savings available through replacement and upgrading the fittings and by introducing better lighting controls. We believe that many of these projects will repay the money invested in them over a period of between 1 and 3 years.

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Lamp and luminaire checks

Once we have analysed the people factors, we move on to look more at the lamps and luminaires, initially in terms of the service that's been provided.

We know the types of lamps used can significantly impact on occupant health, wellbeing and productivity.

Offices are now quite often re-lamped with cooler bluer-coloured fluorescent lamps or LED luminaires. This is because research has shown that this increases the perception of brightness resulting in increased alertness and mood. This is related to the "colour temperature" of the lighting and is measured in degrees Kelvin.

The amount of, and quality of, light delivered is also a key factor. We look to take measurements using a "lux" meter at various points on the working plane and consider the results in terms of the task being undertaken and the people doing that task.

People in their forties, for example, may need twice as much light as those in their twenties to work at their optimum productivity. Some tasks need a good reproduction of colour and so lamps and luminaires with better colour rendering characteristics need to be employed.

Having reviewed the service levels, we can then assess performance in terms of efficiency and costs. To do this, there are a number of factors we need to take into account.

- Any overprovision of light levels means that the system is working harder and producing more light than it needs to.
- Consider the overall design approach using general and task lighting as appropriate.
- The type of lamp, luminaire and associated control gear or drivers will significantly impact on energy consumption and performance.
- The effective useful life of the installation is determined by "lamp life" (fittings failing outright) or "lumen life" (the degradation of light output below effective levels).
- The light-output ratio of the luminaire is a factor. If the reflectors, for example, don't surround the lamp adequately, this can lead to significant losses in effective light output.
- The frequency of cleaning and dust left on luminaires also impact on effective light output maintenance costs of re-lamping and cleaning regimes.
- Are there opportunities for greater harnessing of natural daylight, for example, by using daylight blinds?

Even though the use of LED is often compelling, we don't believe that a "blanket approach" should be taken for replacing existing systems with LED. A stated life of 50,000 hours is significantly more than the average 12,000 hours for a standard fluorescent lamp. It is important to think about useful life and the length of time the LEDs will maintain at least 70% of their rated lumen output (L70). Retrofitting for LED needs to be carefully thought about and a whole life cost assessment of the differing options, using the same timescales, can be an important part of the health-check review.

On-demand energy performance

"Energy effective" lighting is a pragmatic measure of performance based on current requirements, assumptions and technology.

We often think of ultimate energy performance as being the point when we are absolutely confident that a system is only using what it needs — we call this ultimate level of service and performance "on-demand". It's the ideal scenario and is very hard to reach, and is about pushing boundaries and finding new ways of doing things.

By understanding the potential "on-demand" energy performance of a lighting system, we can further analyse how much more potential there may be to save energy and think about the actions that will help to deliver even better value, both tactically in the short term and strategically in the medium to long term.

The opportunity to get closer to "on-demand" levels is often related to the use and performance of lighting controls.

A health-check would normally look to map the lighting zones within a building with a schedule of the controls, sensors and settings employed and would include a review of their appropriateness and performance. This is a useful output of a health-check in itself.

Aspects of controls we look at would normally include the following.

- Sufficient levels of switching to enable luminaires to be switched on and off, as well as their ability to control specific areas being illuminated. Often assigning responsibility is a good way to ensure lighting is switched off in shared spaces when they're not in use.
- The ease of use of available switches, looking at their positioning in terms of accessibility and proximity to lighting circuits. A multi-switch panel should have clearly labelled individual switches to avoid lights being turned on by mistake or when not needed.
- The use of programmable time switches to switch lighting and lamps off when it is anticipated that there is sufficient daylight or when space is normally unoccupied.
- The use of light sensors to monitor lighting levels and automatically switch off or dim down lights when they're not required. Constant illuminance control can be an effective way of controlling light levels in a space that benefits from good daylighting. Intelligent lighting controls should be user friendly and easy to use.

- The use of presence detectors and occupancy sensors to avoid lighting being left on when a space is unoccupied. Depending on operational requirements, it may be more appropriate for lighting to dim down to a set-back level if no-one is present in the space at the time. Systems may include passive infrared (PIR), temperature and/or microwave sensors.

Opportunities to save energy can often be found by challenging the existing control strategies and settings.

When we looked at the lighting performance of an underground railway station, we found a T8 florescent lighting scheme was running continuously 24 hours a day, consuming over 100,000 kWh of electricity a year. By using people counters we found that the average utilisation of the space was less than 20%. Taking into account opportunities for upgrading the lamps and controls, the potential short-term savings opportunity was estimated at 50%, with a further 25% available in the longer term through better control of lighting for the space.

We also often find modern lighting controls that are no longer performing to their original design intent. Specifying a continuous approach to system commissioning is a key part of the on-demand energy performance philosophy.

Lighting health-checks — the opportunity

The future of lighting is rapidly heading towards LED technology as the dominant source of artificial light used in buildings. New lamps and luminaires are being developed, increasing in light output and falling in price, making it a great opportunity to upgrade your lighting at the moment.

Because of the rapid pace of lighting product development, we now recommend that it is prudent to undertake a lighting system health-check at least every three to five years.

We can find that replacing an installation that is 10 years old with today's technology can potentially halve the overall operating costs, improve the lighting quality and may lead to payback in less than 3 years, at which point it begins to contribute to the bottom line.

As the total cost of lighting is usually a fraction of the cost of the wage bill, there are usually also people reasons to improve installations as well to improve the overall working environment.

Recommendations of a health-check are application specific and focus on the actions that will make the biggest difference. This should include delivering a continuous optimisation of energy performance in the longer term. The object is to make systems "fit" and then make sure those lighting systems stay fit.

Once you've undertaken a health-check, and made the changes as required, you can be confident that your systems are "energy effective" — fit for purpose, fit for your customers and fit for the planet. ■

James Brittain is an energy management consultant with over 20 years' experience in industry. As the Director of the Discovery Mill, he specialises in Energy management through people.

Sustaining success through supply chains

There are benefits, challenges and roadmaps for business sustainability. *Jon Herbert* looks at costs, hurdles and possibilities.

Sustainability is a journey involving the entire supply chain. For most organisations, it is a path-finding exercise of learning, changing and adapting in exchange for the rewards of extra efficiency, smaller environment footprints and social impacts, optimum resource use and greater profitability.

In principle, sustainability makes excellent sense. It has even been described as a lens for inspecting operational efficiency, innovating better products and capitalising on new markets.

Energy is an example. By raising energy efficiency and using more green energy along the supply chain, companies support legally binding government carbon reduction targets. At the same time they can cut their own fuel bills — although much depends on renewable energy being cheap enough.

Waste is another example, particularly when seen as a valuable resource. "Cradle-to-grave" sustainable supply chains are kinder to people and communities around the world. Why ravage the earth for raw materials when recycling and using attractive substitutes can result in better products, less disruption and a healthier bottom line?

The costs of sustainability

However, sustainability also has costs. As the world population continues to grow and consume, the question increasingly asked is whether true sustainability is achievable. Governments set ambitious legal frameworks to reach environment and social goals. These create level competitive playing fields on which everyone has to meet the same acceptable minimum standards. However, by raising the bar at all they increase basic costs.

An obvious example is where governments are currently spending heavily to kick-start renewable power sources on the assumption that green energy will become an established way of life.

When subsidies are finally removed, however, if costs remain high, will companies and countries slink back to their bad old polluting ways? Low oil prices are also making green energy less competitive. It may be very tempting to revert back to fossil fuels, including dirty coal in some parts of the world, if a new generation of wind and nuclear power prove to be too expensive.

Austerity could also alter the attitude of buyers. Customers may be unwilling to pay the added costs of sustainability on consumer goods.

But this is negative thinking. Companies have every good reason to pursue sustainable goals for the competitive edge and short- and long-term cost savings that they can bring.

Practical starting points

Almost all companies are part of a long supply chain that may have its raw material root in distant developing world countries. How can small-to-medium sized companies tackle sustainability, green their own supply chain, and become a competitive part of someone else's green supply chain?