

Guide to Sustainable Office Lighting

Helping commercial tenancies to adopt sustainable lighting technologies, designs and practices



About the project

This guide has been prepared to provide information to office building tenants, building owners and facility managers, about sustainable lighting. It is not intended to be a detailed how-to document, rather to provide sufficient information to encourage sustainable office lighting projects. Preparation of the guide has been sponsored by the Department of Sustainability and the Environment, ICLEI and the City of Melbourne under the Local Economic Development Program, and developed by Sustainable Business Practices.

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About ICLEI- Local Governments for Sustainability

ICLEI - Local Governments for Sustainability is an international, not for profit, membership-based association of local governments. With support from the Victorian Government, ICLEI Oceania's Cities for Climate Protection® (CCP®) Australia Program: Victoria has worked with the City of Melbourne as a participant in the CCP Victorian Local Economic Development (LED) Project. For more information please visit: www.iclei.org/oceania

About the City of Melbourne

The City of Melbourne is pleased to promote this Guide to Sustainable Office Lighting. We encourage all commercial building owners, managers and tenants to review and use this guide as a model for achieving benefits by reducing their environmental footprint. Please visit: www.melbourne.vic.gov.au/environment

About Sustainable Business Practices

Sustainable Business Practices works for Australian corporations who want to improve their competitive advantage by embracing sustainability principles as a core business strategy. It is a specialist multidisciplinary consulting firm that provides leading edge sustainability advisory and project services. For more information please visit: www.sbpractices.com

Disclaimer

The purpose of this publication is to provide guidance around implementing sustainable lighting and to provide examples of companies that have successfully adopted sustainable lighting technologies and practices. In presenting this information neither the City of Melbourne nor Sustainable Business Practices are giving official endorsement to the practices cited in publication, the companies or company's products.

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Meeting Room, CH2
City of Melbourne



Meeting Room, CH2
City of Melbourne

Introduction

Lighting represents approximately 25% of greenhouse gas emissions from the commercial sectorⁱ. This also presents an opportunity to reduce costs and demonstrate action in response to climate change risks.



HASELL studio,
Melbourne
Photographer: Earl Carter
Designer: HASELL

Lighting accounts for approximately 67% of the average commercial tenant's direct energy costsⁱⁱ. In addition, inefficient lighting produces more heat leading to increased cooling and water consumption. In particular three key drivers of sustainable lighting are outlined as follows:

- o Bottom line benefits
Companies can save about 40 to 80% of their lighting energy costs by adopting sustainable lighting practicesⁱⁱⁱ. In addition to direct savings, it can also be a way to hedge against future rises in energy costs
- o Corporate Reputation
Lighting efficiencies present a company with an opportunity to take up a leadership approach in the area of corporate sustainability and climate change. Taking such proactive steps can lead to better market positioning and improved relations with stakeholders
- o Increased Productivity
Research^{iv} has demonstrated that optimum lighting levels can significantly enhance productivity and wellbeing of the staff. Thus adopting efficient lighting practices has the spin-off effect of improving quality of the working environment and increased staff morale and productivity. The effects of this can significantly multiply the energy savings.

Sustainable Lighting

The approach to sustainable energy use is a two pronged one:

- o Energy conservation
- o Energy efficiency

Energy conservation advocates avoiding or lowering reliance on energy while energy efficiency advocates a better utilisation of energy. Thus sustainable lighting systems can be understood as a function of the use of most efficient technologies, good lighting designs and sound organisational practices.



Breakout Areas,
Sustainability Victoria

Sustainable Lighting

Sustainable lighting can be described as minimising energy consumption and carbon emissions while still maintaining suitable illumination on an economically satisfactory basis.

The optimum lighting levels vary for different activities as outlined by the Australian Standards in Table 1. Sustainable lighting programs implemented should achieve these recommended illuminance levels for the different tasks.

The following items need to be assessed when considering a sustainable lighting program:

- 1 Lighting Technology
- 2 Lighting Design
- 3 Practices: Organisational Behaviour.

1. Lighting Technology

Energy efficient lighting technologies like fluorescent lamps can help lower greenhouse gas emissions and also significantly lower the running costs. Outlined below are the different types of lights and light fittings based on the information presented in the Tenant Energy Management Handbook and the Australian Greenhouse Office website.

Recommended lighting levels for interior lighting

Activity	Type	Recommended Illuminance
Typing, Reading, Writing	Background	160
	Task	320
Computer work	Keyboard	160
	Reference Material	240-600
	Background	160
Drawing	Drawing Board	600
	Reference Material	320-600
	Background	240
Meeting rooms, training rooms, boardrooms		240-320
Photocopy rooms	General	160
	Collating	240

Source: Australian Standards, AS 1682.2.2- 1994

Fluorescent tubes^{vi}

- +
 - o Useful life 130000-160000 hours
 - o High energy efficiency
 - o Commonly Used: T5 and T8
- - o Tubes are cheaper than CFL's but require special light fittings

Compact Fluorescent lamps (CFLs)

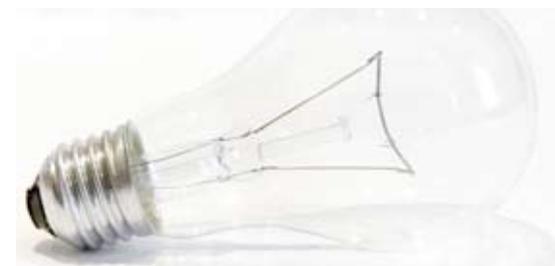
- +
 - o Useful life: 8000 hours
 - o High energy efficiency
 - o Can be dimmed to 10% of their lighting output
- - o Expensive to buy compared to the incandescent and halogen bulbs but their long life makes them more efficient than the other two

Halogen Lamps

- +
 - o Useful life: 2000 hours
 - o More efficient compared to incandescent bulbs
- - o Slightly more expensive than incandescent bulbs
 - o Require special light fittings

Incandescent bulbs

- +
 - o Inexpensive to buy
- - o Useful life: only 1000 hrs
 - o Least energy efficient: Convert about 95% of the electrical energy used into heat.
 - o Federal government has announced the phase out inefficient light bulbs by 2010^{vii}



Tips

- o Replace incandescent bulbs with more efficient alternatives
- o Use halogen lamps in places of infrequent and short period of use
- o Use fluorescent lamps and tubes in high usage areas such as workplace stations

Light fittings

(a) Ballasts are devices used to start and control the voltage in fluorescent lamps. Some CFLs have ballasts built into them while others come with a separate tube and ballast. Electronic ballasts are more efficient compared to magnetic ones and should be used for frequent use lamps.

(b) Reflectors help redirect light to the targeted areas and ensure maximum utilisation of the light emitted by the lamps. Specular mirror reflectors are more efficient than the standard flat white reflectors. These reflectors are especially efficient when used in retrofits along with T5 tubes and electronic ballasts in cutting energy costs by up to 50%. These reflectors are available as adhesive films and metal fittings.



HASELL studio,
Melbourne
Photographer: Earl Carter
Designer: HASELL

2. Lighting Design

Good lighting designs are essential to ensure that these technologies are able to reach their maximum potential. An effective and efficient design takes into consideration the available efficient lighting technologies, design constraints imposed by the base building; and most importantly meets user needs and preferences.

Tip:

- o Colour of walls and ceilings: The colour of the walls, ceilings and furnishings should be kept light so that it reflects more light to the workspace areas
- o Lighting layouts should be developed taking in consideration the different lighting zones within the workspace.

Daylighting

Daylighting is the most easily available, renewable source of energy. Harvesting daylight for outside lighting, atria lighting can help save considerable amount of energy and also uplift the mood of the workers. Sky lights, full length windows and light shelves can be used to maximise light penetration.

Tips:

- o Window glazing is useful in controlling the glare of sunlight as well as in controlling the excessive heat
- o Blinds can be used to deflect and control the amount of natural light.



Daylighting at
workstation, CH2,
City of Melbourne

Sustainable Lighting



Task Specific Lighting:

Lighting efficiency can be increased by maintaining background lighting levels of 160-220W throughout the office area. This can be supplemented by using localised desk lighting to provide the required illuminance for specific tasks. Eg. work stations near the windows require less artificial lighting as compared to stations in the centre.

Occupancy sensor controls

Energy consumption can also be reduced through sophisticated lighting control systems. Motion detectors can be installed in rooms, supplying light only when required.

Tips:

- o Choose sensors which meet the requirements of the area to be monitored
Eg sedentary sensors are more suited to monitor occupancy near work desks since these are sensitive to even the slight finger movements of a person
- o Sensors also need to be positioned accurately to avoid significant blind spots

Integrated Lighting systems

These are intelligent lighting systems which consist of sensors which communicate directly with the ballasts to dim or switch off light lamps. These sensors include motion detectors as well as light sensors to analyse the level of natural light available. The more sophisticated systems integrate the lighting, air conditioning and indoor air quality controls.

3. Practices: Organisational behaviour

Office lighting systems have been proven to have physical and psychological effects on employee satisfaction and productivity. For changes in lighting systems to work, it is essential to engage with and educate employees on the need for the change and the benefits of the new systems. Sound organisational practices around lighting can include:

- o Educating and training of employees to gain commitment to the lighting project
- o Automatic shutdown of lights after 6 or 7 pm, beyond which local task lights can be used.
- o Negotiating cleaning contracts for day time, so that all lights can be switched off after office hours
- o Reinvigorating any existing campaigns supporting good practices in lighting
- o Integrating sustainable lighting strategies into the company's procurement policies and practices
- o Switching to green power to meet an organisation's energy needs
- o Offsetting lowered emissions through carbon credits and other alternative arrangements.

Tip:

- o People often resist change of any kind in their work place environment. To ensure that new lighting systems also boost productivity it is necessary to engage with and educate staff and gain their commitment to any new lighting project



CFL's used in reception area
Sustainability Victoria



Task lighting at CH2,
City of Melbourne

Best Practice Lighting Case Studies

Sustainability Victoria

Level 28, Urban Workshop,
50 Lonsdale Street, Melbourne

Sustainability Victoria helps Victorians to act on climate change and shows them how to live and work in more sustainable ways in order to protect and preserve the environment and to secure a growing economy for all Victorians. The green fit out of their new tenancy was undertaken as a way to demonstrate and lead the way in Australian best practice energy efficient office lighting.



Daylighting in work areas
Sustainability Victoria

Features of Sustainable Lighting

- o The fittings installed are T5 fluorescents (base building installation) managed by a lighting control system that maximises natural lighting (motion and day light sensors) and sets optimal Lux levels for overhead lighting at 220 Lux. This is supplemented with task lights (desk lamp per work setting) with 11 Watt compact fluorescent lamps
- o All workstations settings have been positioned in close vicinity with perimeter windows, to maximise natural day light
- o Each light in the general office space has a sensor which enables individual comfort and best practice zoning. Occupants are able to control overhead lights to best suit their needs, in most cases this is to completely dim overhead lights for health associated reasons. By providing individual control the indoor environment quality can be adjusted to suit the needs of the occupants
- o The Managed Lighting System (MLS) consists of sensors which communicate directly to DSI ballasts in the luminaries to both switch and dim the lighting. Each MLS sensor contains both a motion detector and a photocell. Lighting is switched on and off based on motion detection. Lighting is dimmed in response to natural ingress light by the photocell

Outcomes

The fit out has been designed to achieve an energy saving of 47.5% in lighting as compared to a business as usual fit out (new fit out design). It also assists Sustainability Victoria with reaching its environmental targets (5 star ABGR, 6 star Green Star office fit out and EMS energy target (292 MJ per sq per year).



Sensor controlled
lighting in
meeting rooms
Sustainability Victoria

Best Practice Lighting Case Studies

Transfield Services

311 Glenferrie Road, Malvern

Transfield Services is a leading international provider of operations, maintenance, asset management and project management services across diverse industries, including mining and process, hydrocarbons, roads, rail and public transport, water, power, telecommunications, facilities management and defence.

The key objective of the project was to build an environmentally responsible building that Transfield would be proud to showcase to its clients. Transfield aimed to transform their lighting installation into a state of the art automated system that would prevent the lighting from remaining on for 24 hours a day, and sometimes 7 days a week, as had been the case with this building for some time.

Features of Sustainable Lighting

- o The existing light fittings were T8 fluorescents with standard iron-core ballasts and ULB diffusers. These were not replaced due to the high payback period associated with new fittings
- o The lighting systems consists of motion detectors installed across the whole office area to ensure lights are only turned on when and where required and more importantly turned off when the area was no longer occupied
- o Approximately every four luminaires in the general office space have a dedicated motion sensor which controls the lighting based on motion in its local area
- o Occupants are able to control overhead lights to best suit their needs
- o In order to keep disruption to the operation to a minimum the system was installed and wired after hours effectively over two weekends, using a soft wiring system

Outcomes

- o Transfield reduced their annual lighting energy consumption by 63% as a result of this installation
- o They reduced ongoing energy and maintenance costs by \$18,000 per annum within a payback period of 2.4 years



Illustration of Technologies Transfield Services

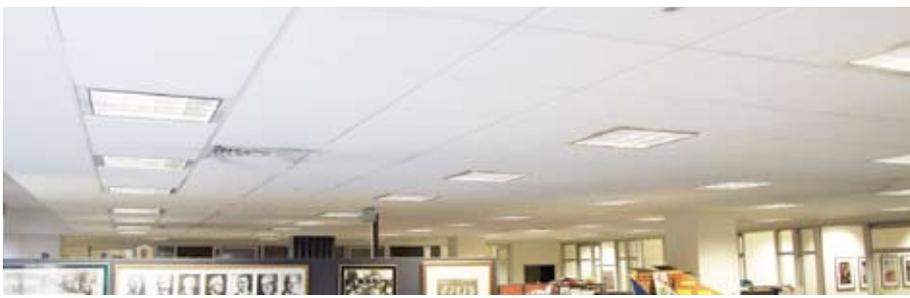


Illustration of Technologies Transfield Services

HASSELL

61 Little Collins Street, Melbourne

HASSELL is a multidisciplinary architecture and design firm located throughout Asia and Australia. The objective for the HASSELL Studio base building was to achieve high daylight levels throughout the tenancy areas to ensure the lighting system efficiencies could be maximised and also to contribute positively to psychological and emotional conditions within the workplace relating to occupant wellbeing.



HASSELL studio,
Melbourne
Photographer: Earl Carter
Designer: HASSELL

Features of sustainable Lighting

- o During the base building warehouse refurbishment, light wells and voids were created through the centre of the tenancy and window openings were increased to ensure increased levels of natural daylight (to a factor of 2.5% as referred to in the Green Star rating tool) were achieved to an average 60% of the tenancy (NLA)
- o Given the higher ceiling heights of 4 meters, suspended lighting beams are placed 1300mm (directly) above workstation clusters using high efficiency fluorescent lamps
- o Due to the high levels of natural lighting, the workstation clusters provide a range of Lux levels between 220 – 320 Lux at desk levels for all desks and dimmer control per cluster of desks. This allows their designers to control their specific environment within a grouping of 6 -8 staff whilst minimising product usage. Individual task lighting is not required
- o Employee education process to ensure employees understand the benefits in glare reduction; occupant control and energy efficiencies of the design
- o Obtained employee feedback through the initial 12 month period and conducted employee training in the use of the lighting systems and the studio operations

Outcomes

- o Lighting energy usage between 6 - 7 watts/m²; as compared to standard lighting energy calculations for commercial fit-out of between 10-15 watts/m²: approximate 30-60% energy saving
- o HASSELL has undertaken a Productivity Study on their previous tenancy and new studio environment which is due for completion mid 2007
- o Further refining of the lighting Lux levels will occur to provide the option for 180 Lux level and off settings, due to occupant feedback



HASSELL studio,
Melbourne
Photographer: Earl Carter
Designer: HASSELL

Best Practice Lighting Case Studies

RMIT UNIVERSITY

Building 51, 80 Victoria Street, Carlton

As part of reducing the environmental impact of their facilities, a major lighting upgrade was completed at one of many RMIT's city buildings. The upgrade was carried out on one of the older buildings, with outdated lighting technologies and no form of automatic lighting controls.

Features of Sustainable Lighting:

- o The fittings installed are T5 fluorescents managed by a lighting control system that maximises natural lighting (motion and day light sensors) and sets optimal Lux levels for overhead lighting at 320 Lux. Fittings were complete with DSI dimmable electronic ballasts and ULB diffusers
- o Incorporated in these fittings were Managed Lighting System detectors which automatically turned the lights on & off based on occupancy as well as regulating the light levels in response to the natural daylight levels
- o The unique daylight dimming enables the lighting to react to changes in ambient lighting levels contributing to significant reductions in base load
- o Approximately every two luminaires in the general office space have a sensor which enables individual comfort control and best practice zoning
- o The motion sensors were provided to the luminaire manufacturer, and were built into the face of selected luminaires (approximately one in two), and internally wired to the ballasts

Outcomes

The resultant benefits were substantial improvements to aesthetic and visual comfort levels for staff and students as well as significant reductions in overall energy consumption and greenhouse gas emissions. Light levels have increased; uniformity has improved adding to overall increased visual comfort levels.

- o Savings: 82,609 kWh
- o Percentage savings: 48.12%
- o CO2 reductions: 115 tonnes



Suspending ceiling lights, Building 51 RMIT



Daylighting in laboratory, Building 51 RMIT

Next Steps

Determine your lighting efficiency

Since lighting upgrades of office spaces often present split incentives to both owners and tenants, it is recommended that tenants collaborate with their property owner to implement a green fit-out. In its tenant checklist, in the Tenant Energy Management Handbook, the Department of Environment and Heritage advises tenants to assess the capacity for improving the environmental performance of base buildings.



Daylighting in meeting rooms, CH2
City of Melbourne

The City of Melbourne has also established the Sustainable Melbourne Fund which may assist tenants take up green fit-out for their tenancies.

Outlined below is step wise plan to help ensure successful adoption of sustainable lighting:

1. Obtain board and senior management understanding and commitment to the project
2. Establish a baseline for lighting performance – where you are now
3. Establish sustainable lighting objectives and strategies- where you want to be
4. Educate and motivate your staff to help them adapt to the changes in the office environment
5. Integrate these strategies into the purchasing and administration policies and practices
6. Communicate with lighting contractors to ensure that sustainable lighting technologies and designs are implemented as planned
7. Establish lighting energy measurement systems and develop group KPIs
8. Undertake regular performance monitoring and reporting.

Glossary

Illuminance:	The total amount of visible light illuminating a unit area
Lux:	The Standard Unit of measurement expressed as lumens per square meter
Watts:	The amount of electricity consumed (joules) per second by the lighting device

References

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- iv James, K. (1995). 'New Light on how lighting can improve white-collar productivity', Across the Board, 32, 1, p 24
- v Albany Research Studyn.d., Lighting Quality & Office Worker Productivity, Light Research Consortium, Albany NY, 28 March 2007, www.lighthouse.org/pdfs/LightQual-OWP_2003.pdf
- vi Photo Credit: Fluorescent Tube Photo by Jeff Tabaco
- vii [refer to i]

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