

Saving for a Bright Future

A Manual for Efficient Lighting Procurement in UN agencies





CENTRE ON SUSTAINABLE CONSUMPTION AND PRODUCTION

A message from United Nations

"....I would like to make a public commitment. We are already moving towards making our Headquarters in New York climate-neutral and environmentally sustainable. I would like to see our renovated headquarters complex eventually become a globally acclaimed model of efficient use of energy and resources. Beyond New York, the initiative should include the other UN headquarters and offices around the globe.

We need to work on our operations too, by using energy more efficiently and eliminating wasteful practices. That is why, today, I am asking the heads of all UN agencies, funds and programmes to join me in this effort. And I am asking all staff members throughout the UN family to make common cause with me."



Ban Ki-Moon UN Secretary General

5 June 2007 World Environment Day New York

A message from UNEP

"Under the leadership of the Secretary General, Ban Ki-Moon, the UN is now engaged in demonstrating its 'sustainability credentials' by action on the ground and by good housekeeping at home. We are clearly determined to put global warming at the top of the global political agenda and to build the trust so urgently needed if we are to succeed in combating climate change.

Reviews are underway across all agencies and programmes to establish a strategy for a climate neutral UN and to make the refurbishment of the UN headquarters in New York a model of eco-efficiency."*

UNEP is committed to take part in the fight against climate change and in showing leadership. We are committed to become climate neutral by reducing our energy consumption and carbon footprint and by offsetting emissions.



Photo from iucn.org

Achim Steiner Executive Director, UNEP

* 8 October 2007 117th Assembly of the Inter-Parliamentary Union Geneva

This manual will help you...



Understand the context for green lighting



Gain an overview of current UN practices



Discover the potential to save energy & money



Understand technical options for green lighting



Acquire practical implementation advice

What's in this manual?

- 1 Climate change & green lighting
- 2 The use of lighting in UN agencies
- 3 Challenges faced by procurement officers
- 4 Reasons Why green lighting?
- 5 Green lighting options
- 6 Tips for implementation
- 7 Good practices in UN agencies

8 Useful tools for green lighting (with Appendices)

9 Other helpful information





*Dr. Pachauri, IPCC Chairman, Ahmedabad Nov. 2007

Millions of people, from Bangladesh to Florida, live less than a meter above sea level. Most of the world's major cities, from Shanghai to Buenos Aires, are near the sea Source: Red Cross (2005)

1 Climate change & green lighting <u>2 3 4 5 6 7 8 9</u>

Climate change and poverty





Vulnerability to climate change exacerbates existing stresses: endemic poverty, limited access to capital, ecosystem degradation, disasters and conflicts,*

Because of climate change Africa, Asia and Latin America are suffering from aggravation of malnutrition, water stress and health problems*







More people are now displaced by environmental disasters than by war. 50 million people will likely be displaced by 2010

Dr. Pachauri, IPCC Chairman, Ahmedabad Nov. 2007

Buildings are key to stop climate change

The built environment is responsible for up to 40% of total energy use. A more aggressive energy efficiency policy could realise CO₂ emission reduction close to three times that agreed under the Kyoto Protocol.

In Europe, about **20%** of present energy consumption and up to 45 million tonnes of CO₂ could be saved annually by 2010 by applying more ambitious standards to new and existing buildings.

Source: UNEP (2007)

Saving potential from green lighting

Energy consumption in office buildings (OECD countries)

> 45% Lighting

34% Office equipment

6% Air conditioning

> 15% Other



<u>2</u>

<u>3 4 5 6</u>

A total global switch to compact fluorescent light bulbs would deliver slightly over half of the Kyoto reduction

target by 2010.

Some 30-70% of lighting electricity consumption can be reduced by applying commercially available green lighting options.

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7

Some 15-30% of total electricity consumption can be reduced by applying green lighting.

Source: CADDET (1995)

1 Climate change & green lighting



The use of lighting in UN agencies

We conducted a survey of the current application of lighting at the following UN agencies.

Vienna International Centre (VIC)

- 6,000 staff
- 5 UN agencies (UNOV, IAEA, UNIDO, CTBTO, UNODC)

Floor space: 230,000m

5.0 million kWh/year

FAO

- 2,700 staff
- 6-building compound in Rome
- Floor space: 96,000m²
- 4.2 million kWh/year





UNEP Paris Office

85 staff

•

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- Rent one floor
- Floor space: 1,700m²
- 126,000 kWh/year





World Bank

- 9,000 workstations
- 4 Buildings in Washington DC
- Floor space: 279,000m²
- 27.5 million kWh/year





Photos from iaea.org, dgvn.de, uneptie.org, commons.wikimedia.org

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The use of lighting in UN agencies (cont'd)

Note that there is a wide geographical variance in use of lighting. Data was not available from agencies in developing countries partly due to periodic electrical service interruptions.

Energy use for lighting in 4 agencies



2 The use of lighting in UN agencies

1

<u>3 4 5 6 7 8 9</u>

Challenges faced by procurement officers

We conducted telephone interviews with procurement officers at 10 UN agencies. Some common difficulties were reported in implementing green lighting procurement.

Lack of top commitment & systematic approach

"We don't get enough support from other staff and top management." "We don't have green procurement guidelines or environmental criteria."

Lack of technical knowledge & assistance

"It's difficult to understand the technical aspects of green lighting." "How can I integrate environmental criteria into the selection process and bidding evaluation?"

Challenges faced by procurement officers (cont'd)

Decision making is dispersed.

"Unlike other office goods, facility management decides lighting systems and renovation opportunities." "Small agencies / regional offices rent space and outsource building management, so we have little influence on the procurement of lighting."

A strong financial case is required.

"The UN budget is allocated on an annual base, large efficiency improvement projects with long pay-back time are difficult to realise." "I have to make sure that senior management understands that green lighting is not only environmentally sound, but also makes sense financially."

Reasons - Why green lighting?

Green lighting is an easy "low-hanging fruit" for the public sector to make a contribution to resource efficiency and combating climate change. Reasons supporting a green lighting programme include:

1. Save on energy bills

- Green lighting is one of the most costeffective and quick-to-implement ways to reduce energy consumption.
- Although the initial purchase price is higher than conventional options, the life-cycle cost of green lighting equipment is significantly lower.
- Depending on the budget, there are a wide range of available green lighting options.

Reasons - Why green lighting? (cont'd)

2. Reduce your carbon footprint

- Lighting accounts for 19% of global electricity consumption.
- This leads to annual CO₂ emissions of 1,900,000,000 t (1.9 Gt), 70% that of the emissions of light passenger vehicles.
- Electricity consumption for lighting is growing by 1.5% per year globally with the most rapid increases being in the emerging economies

Source: IEA (2006)

Reasons - Why green lighting? (cont'd)

3. Purchasing power can transform the market

- The public sector consumes as much as 40% of all electricity produced.
- The UN procures over **\$3 billion** of goods and professional services annually.
- The value of business opportunities linked to UN direct and indirect spending is estimated at \$30 billion annually.
- Increasing the demand for sustainable products and services will support greater scale economies and price competitiveness as well as serve as a role model for other public authorities.

Green lighting options

Changing light bulbs is not the only way to improve the use of lighting. Below are some examples of the many other options that you may want to consider.



Diverse examples of green lighting

<u>2 3 4</u>

Green lighting options (cont'd)

5 Green lighting options

The diversity of green lighting options can be categorised into 4 levels according to the required investment and implementation efforts. The levels do not imply any order for implementation and different options can be combined according to your circumstances.



Level 1: Reduce usage

It may not involve any additional cost to start a green lighting programme. Let's start from reducing the use of unnecessary lighting.

Remove unnecessary lamps

Some spaces may be unnecessarily lit or have excessive lighting levels. It is possible to reduce lighting levels by simply removing some lamps from fittings without any cost at all.

Turn off lights when not in use

A campaign can be organised to encourage staff to get into the habit of turning lights off when leaving rooms or when enough natural light is available. Where light switches are not installed, rewiring may be required to provide switches in individual work area.



<u>1 2 3 4</u>

Level 1: Reduce usage (cont'd)

Optimise use of lighting

A room may be lit at a uniform level but those working in the room may not have sufficient light for their specific tasks. By optimising the balance between ambient lighting and task lighting in the room, the total energy consumption may be significantly reduced while more lights are available for necessary work tasks.



Avoid decorative lighting

Lighting used for aesthetic and display purposes can be minimised. Up-lighters and floor lamps that use incandescent or halogen lamps are very inefficient means of providing ambient lighting.

Level 1: Reduce usage (cont'd)

Good practice in Level 1

In 2001, Adobe, a California-based software maker, took simple green lighting measures.

Activities

- Employees were encouraged to turn off unnecessary lights.
- De-lamping whenever possible
- Incandescent lamps were switched to CFLs.

Results

- Cost: \$11,000
- Saving: \$105,000 every year

Source: Efficiency Partnership (2007)



Photo from answers.com

<u>1 2 3 4</u>

Level 2: Change lamps and equipment

The most obvious way to implement a green lighting programme is to exchange existing lamps and lighting equipment with more energy-efficient alternatives.

Use energy-efficient lamps

In the adjacent table you can find a variety of energy-efficient lamps and a list of lamps you should consider changing or phasing out.



Lamp types to be replaced	Recommended lamp types
Incadesecent lamps	Compact fluorescent lamps (CFLs)
T12 fluorescent lamps	T8 fluorescent lamps (tri- phosphor)
T8 fluorescent lamps (haro- phosphor)	T5 fluorescent lamps
Tungsten halogen lamps	Metal halide lamps
Mercury halogen lamps	Low-pressure sodium lamps (for street lighting)
	High-pressure sodium lamps (for street lighting & large indoor areas)
	Light emitting diodes (LEDs)



A comparison of life-cycle costs between a incandescent lamp and a CFL



Source: Energy Saving Trust (2006)

While the initial purchase of energy efficient lamps can be 5 to 20 times more than regular lights, they not only offer immense savings in electrical costs, but also have a much longer lifespan and require far less maintenance.

Use efficient control gears

Ballasts are essential for all discharge lamps to create conditions to initiate the required discharge as well as to regulate voltage and current.

• Less efficient magnetic ballasts should to be replaced with modern electronic ballasts.

• Electronic ballasts not only offer reduced internal power loss but also increase operational efficacy of lamps, help longer lamp life and provide dimming options.



Use appropriate luminaires

There is no point in putting an energyefficient lamp in an inappropriate fitting. The wrong light fitting can **reduce lighting performance by as much as 20-50%**.

Efficient **reflectors** which will reduce glare. **Light diffusers** should be widely spaced and highly reflective.

Good practice in Level 2

Casino, a French supermarket chain, renovated 15 stores with a total floor area of $130,000 \text{ m}^2$.

Activities

• 400W mercury vapour lamps were replaced by T5 fluorescent lamps.

Results

- Energy saving: 9.5 million kWh
- Cost savings: \$540,000 every year

Source: Bertoldi and Ciugudeanu (2005)



Photo from groupe-casino.fr

Good practice in Level 2

One of the Europe's largest covered car parks in Portugal next to a shopping mall took green lighting measures.

Activities

• Magnetic ballasts attached to fluorescent lamps were replaced with electric ballasts.

Results

- Energy saving: 11.5%
- Cost savings: \$31,000 every year

Source: Bertoldi and Ciugudeanu (2005)



Photo from commons.wikimedia.org

Level 3: Use lighting controls

Since people often forget to turn lights off when leaving rooms, automatic lighting controls can make a large impact on energy consumption.

Key tag switches

Key tag switches require an electronic key to turn lights on. This device can restrict the use of lighting to authorised staff alone.

Time switches

Time switches can pre-set the time when lights are to be on and off. They are useful when lighting is required for certain periods of a day or a week.

Occupancy sensors

Occupancy sensors can be used in areas that only need to be lit when occupied such as conference rooms, offices, toilets, storage areas, elevators, warehouses and corridors.



Level 3: Use lighting controls (cont'd)

Dimming devices

Dimming devices allow lighting levels to be reduced when daylight is available. Photo-sensor switches automatically adjust lighting levels in response to the detected illumination in a room or area.



Timer switches

Timer switches automatically turn lights off after pre-determined time. These devices are useful where use of lights is limited to short periods of time such as storage areas.

Building automation systems

Building automation systems manage overall energy use including lighting from centralised control facilities depending on building use patterns.

Level 3: Use lighting controls (cont'd)

Good practice in Level 3

Statoil, a Norwegian petroleum company, took green lighting measures in its research centre in 2001.

Activities

 Occupancy sensors were installed throughout the centre instead of having lights in all rooms on during the entire day.

Results

- Energy saving: 74% of lighting electricity
- Cost savings: \$17,000 every year
- Payback time: less than 2.5 years



Photo from statoil.com

Source: European Commission (2002)

Level 4: Use natural light

Making use of natural light can be an excellent way to reduce lighting energy consumption although this option is at times more expensive than other options.

New building design

- Designing new offices in a way to maximise the use of natural light is an excellent way to minimise artificial lighting requirements and reduce energy consumption.
- Daylight can be guided into rooms through for instance windows, skylights, sawtooth roofs, dormers.
- Building designs where daylight is incorporated typically use 40-60% less lighting electricity than conventional buildings.
- The challenge of building design is to integrate as much daylight as possible without negative side effects such as glare and overheating.



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Level 4: Use natural light (cont'd)

Renovate buildings

- Although potential for energy savings may be less than that of newly designed buildings, renovating existing buildings can also provide significant opportunities to integrate natural light.
- Windows can be made larger and skylights can be installed.
- Glass walls can be installed inside buildings and the colour of interior walls can be brightened.
- Where blinds are used on windows to avoid glare and heat, application of energy saving films can enable the use of natural light.



Level 4: Use natural light (cont'd)

Good practice in Level 4

Harmony Library in Fort Collins, Colorado, USA, was built to integrate natural lighting.

Activities

- The north-south orientation and long shape were chosen to capture daylight at a maximum while avoiding glare from direct sunshine.
- Artificial lighting inside operates automatically with photo-sensors that response to natural daylight levels.

Results

- These measures contribute to a comfortable lighting situation.
- The photo-sensors alone effectively reduced energy consumption by 36%.





Source: Rensselaer Polytechnic Institute (2004)

Tips for implementation

Engage different stakeholder groups to support a green lighting procurement programme. Stakeholders can be internal or external. Suggested roles for internal stakeholders are provided as "tips" in this section.



Roles of stakeholders

Different internal departments can be involved in lighting procurement. The following pages provide some targeted advice on the specific responsibilities of relevant staff. The responsibilities of 3 key stakeholder groups are mentioned below.

Environment officers where applicable

Co-ordinate the environmental management of the organisation across different departments

Facility managers

- Define needs
- Develop evaluation criteria
- Supervise contract performance
- Certify that goods and services have been delivered

Procurement officers

- Communicate needs to suppliers
- Determine and supervise evaluation of offers
- Determine prices
- Develop contractual agreements
- Award contracts
- Make changes to the contracts as required

Tips for Environment Officers

For environmental officers in office settings, green procurement should be among the highest priorities to improve internal environmental performance. If there is no environmental officer, conscious procurement officers can take the lead.

Tip 1: Showcase

Green lighting is easy to start and offers a large potential for energy savings. If you would like to initiate a green procurement programme, green lighting is an obvious high value option to pursue. Lighting among the most visible aspects of office buildings and improvement in lighting systems will be immediately noticed by staff and visitors.

Green lighting will project a positive image and will demonstrate your agency's commitment to 'walking the talk'.

Tip 2: Team Up

In public sector organisations responsibility for lighting management is often split between facility managers (or caretakers), who maintain and upgrade lamps and lighting fixtures, and procurement officers, who bear responsibility for purchasing lighting equipment.

Cross-functional teams of relevant internal stakeholders with backing from senior decision makers can be very effective or even critical to success.

Tips for Environment Officers (cont'd)

Tip 3: Benchmark and targets

It is important for environment officers to establish benchmarks and targets for energy efficiency as well as a defined plan. **Slides 57-58** provide **3 important benchmarks** for energy efficiency in lighting and buildings.

Since lighting guidelines have a large variation between countries due to differences in climate and cultural preferences, you will need to carefully consider which standards are right for your organisation and region. Try to **set short-term, mid-term and long-term targets** according to identified priority actions in consultation with your team. Short-term targets (e.g. 1-3 years) should be realistically achievable, solid and detailed, while long-term targets (e.g. 10-20 years) can be significantly more ambitious, for instance, "xx% reduction in lighting energy consumption by the year 20xx".



Tips for Environment Officers (cont'd)



Tip 4: Integrate into EMS

It is important to implement a green lighting procurement programme in a systematic manner to ensure environmental elements are included throughout the procurement processes.

The procedures within a formalised **environmental management system (EMS)** can help to establish green purchasing objectives and targets, develop operational controls, monitor the progress and enable reviews of the process (Plan-Do-Check-Act).

To date, the only UN agency which has an **ISO 14001 certificate** is UN University in Tokyo¹. You may refer to the US Environmental Protection Agency's guidance on how to integrate green procurement into an EMS².

Tips for Procurement Officers

A core challenge procurement officers are facing is a need for technical support and financial evidence to convince senior decision-makers of the value of green lighting.

Tip 1: Training

First of all, you need to understand the environmental aspects of the goods and services you procure and how you can integrate environmental criteria into existing procurement procedures. Information and training for sustainable procurement is provided by **UNEP** in collaboration other key UN agencies (ILO; UNDP, etc.) (see **Slide 61**).



Tips for Procurement Officers (cont'd)

Tip 2: Work with facility managers

Once you decide to procure green lighting, you first need to **achieve buy-in from the facility management** and discuss how they might help you. If you rent offices, discuss your lighting desires with the building management. Facility managers are familiar with technical aspects of lighting and they can provide specific advice concerning tender documents and assessment of supplier bids (see **Slide 60**).



Tips for Procurement Officers (cont'd)

Tip 3: Cost vs Benefit

To persuade decision-makers, you need to communicate the **financial case** that the **lifecycle cost** of green lighting options is lower than that of conventional choices. A **costbenefit analysis** will help you to compare the life-cycle costs of different options and determine pay-back periods of initial investment (see **Slide 59**).



Tips for Procurement Officers (cont'd)

Tip 4: Persuade

A good amount of information has been provided in this manual to help you persuade decision makers. Language can be important. When presenting your case, try to use the expressions such as...

"Lighting is one of the most visible part in our office. Visitors will judge our commitment to the environment based on the lighting we apply." "The total (life-cycle) cost of an efficient lamp is xx% cheaper than conventional lamps and the initial cost outlay can be recouped within xx years."

"If we change all light bulbs to efficient ones, we can reduce electrical costs by no less than xx% and CO_2 emission by xx%."

"With green lighting, we can show leadership and commitment to sustainable development."

Tips for Facility Managers

Facility managers are key players to make green lighting procurement happen. They should work together with procurement officers and share roles according to your organisational needs.

Tip 1: Inventory

Do you know how many lamps there are in your buildings and how much electricity they consume? Make an inventory of lamps and fittings in each space (use the template in **Slide 56**). Ask local staff about usage patterns and estimate the hours the lights turned on. Such information will not only enable you to estimate electricity consumption and costs but will also serve as a basis to identify improvement options. As this task does not require technical knowledge, you can **involve local staff** in providing information about their work areas.



Tips for Facility Managers (cont'd)



Tip 2: Audit

Carry out a simple lighting audit of each workspace or area with a lux meter which is commonly available at electronic shops. Take a walk through each space and measure lighting levels at different points with a special focus on task areas. Compare with the defined illuminance levels (see Slides 57-58) and check if the area is provided with appropriate levels of lighting. Calculate light power density (LPD) from aggregating wattages of lamps applied in the space (use the template in Slide 56) and check if lighting energy use in that space is not excessive. Make a list of areas that do not meet requirements.

Tips for Facility Managers (cont'd)

Tip 3: Compare

Draw up a list of options to improve energy efficiency in the areas identified by the lighting audit with reference to the options in this manual (Slides 18-34). Compare the options by taking into consideration the balance between efficiency gains and investment costs using a cost-benefit analysis (see Slide 59) together with procurement officers. Always remember that changing lamps is not the only option and you can look to innovative cost-effective solutions even in absence of a large budget. Local electrical providers or lighting professionals may also offer lighting audits and services to assist with identifying options in your facilities.



Tips for Facility Managers (cont'd)

Tip 4: Innovative Schemes

In public sector organisations budgets for equipment and operations tend to be separated, which can create incentives to minimise initial investment costs at the expense of operating costs. It is critical to **coordinate budget lines with your financial department** to enable consideration of life-cycle cost.

Another way to overcome budgetary constraints is to take advantage of third-party financing schemes such as **energy performance contracting** provided by energy service companies (ESCOs). An alternative in-house solution is a **public internal performance commitment** ³(PICO). A PICO enables energy efficiency investments via internal contracts between different departments within an organisation.



Tips for Other Staff

Anybody can make a meaningful contribution to initiating a green lighting programme. It is not only a job for procurement officers or facility managers and there is no reason for waiting until professionals take action on green lighting.

Tip 1: Join the force

As seen the example of the UN Office at Nairobi (**Slide 54**), any staff member can organise or join a **group of like-minded staff** who would like to make their agency more environmentally sound. Such activities can make a real difference - The UNEP's Executive Director has now personally committed to greening the agency and to reach Carbon neutrality. The efforts in this direction have been largely supported by the Step by Step group.



Tips for Other Staff (cont'd)



Tip 2: Start with yourself

There are many small improvements you can make even in the absence of a formal green lighting programme at your agency. Whenever you leave rooms, turn off lights. Try to utilise natural light as far as possible.

Once you have succeeded in your efforts, **spread your message** among your colleagues and supervisors. Once people recognise changing behaviour is not difficult or uncomfortable, they will follow you!

Tips for Other Staff (cont'd)

Tip 3: Propose

Do not wait for professionals to take action on green lighting. Use this manual to understand what improvement is possible in your workplace and propose actions to procurement officers or relevant colleagues. They may be willing to improve energy efficiency in your agency but may be desperately looking for support from other internal staff to convince senior managers of the value of extra investment. Your action will be appreciated!



Tips for Other Staff (cont'd)



Tip 4: Apply in projects

The global demand for artificial light is expected to increase 80% by 2030. On the other hand, 1.6 billion people around the world still do not have access to electrical grids and are forced to rely on combustion fuel-based lighting. If you or your agency conduct development projects, you may develop projects for improving access to affordable energy-efficient lighting technologies (CFLs, LEDs, etc.) or ensure procurement of green lighting in your projects. The IFC/GEF's Efficient Lighting **Initiative**⁴ is one good example.

Good practices in UN agencies

In our survey we identified green lighting procurement good practices. The following summarises 4 leading programmes.

1. Vienna International Centre (VIC)

Since 1999, the centre's building management services has put issues of energy efficiency and considerations of overall environmental performance at the top of its mandate.

Activities

- Replacing 45,000 lamps for about €10 million until 2010
- Renew old lighting (130 W) with new equipment (60 W)
- The renewal of lights is undertaken hand-in-hand with the VIC's plans to remove asbestos.

Results

- Lighting electrical consumption was reduced by about half.
- Improved lighting characteristics
- Savings of €250,000 every year
- Less waste (longer bulb lifespan)
- Better compliance with recent work norms



Inside the VIC



After new lamps were installed

Good practices in UN agencies (cont'd)

2. World Bank, Washington, DC

Since 2001, sustainable procurement has constituted a key part of the World Bank's work on corporate social responsibility. A team within the General Services Department is devoted entirely to sustainable procurement programmes and training of procurement officers.

Activities

- All types of fluorescent lamps were replaced with highly efficient lamps.
- Over 8,000 occupancy sensors were installed in all rooms.
- When staff start a bank PC, an information article explaining the initiative appears automatically.
- "Light sweeps" are undertaken twice every evening to ensure lights in all unoccupied rooms are switched off.
- 3% of total energy is procured from renewable sources.

Goals

 Joined the US Environmental Protection Agency's Climate Leaders programme and committed to reduce GHG emissions by 7% between 2006 and 2011.



Photo from creativecommons.org

Good practices in UN agencies (cont'd)

3. UN Office at Nairobi

In 2002 concerned individual staff, procurement officers and facility managers at UNEP, UNDP and UN-HABITAT jointly established a voluntary group **"Step By Step"**. The group has developed proposals for senior management on how to improve environmental performance within the UN compound.

Activities

- Most incandescent lamps were replaced with CFLs.
- The installation of **occupancy sensors** in all toilets is underway.
- There are plans to install a building automation system.
- Awareness among other staff has been raised by providing advice on available green alternatives, organising energy saving campaigns and circulating articles within internal newsletters.
- Drafting of UNON Sustainable Procurement Guidelines



Step By Step's campaign poster

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Good practices in UN agencies (cont'd)

4. FAO, Rome

During every renovation of the FAO buildings, facility management takes action to ensure energy saving aspects are taken into consideration. To date, 25% of the buildings have been equipped with a range of energy saving measures including green lighting.

Activities

- 200 energy-efficient lamps such as T5 fluorescent lamps have been installed together with electronic ballasts.
- Energy saving films have been applied on many windows.
- Offices have been fitted with brighter colours on walls and dimming devices.
- The lights in corridors are equipped with timers that turn off after working hours.
- Development of environmental policy during 2007 that made environmental considerations mandatory in its facility management.



Photo from commons.wikimedia.org

Useful tools for green lighting

This section provides 4 useful tools referred in the tips section. Sample spreadsheets to apply the tools are provided in the Appendices.

Lighting inventory

Making this inventory is the first step to undertake a lighting audit and identify the best suited lamp types. Since this task is not technical, ordinary staff can be engaged to measure lighting in their work areas.

Office Data		Lamp Data			Illumina				
Space	Area (m²)	Lamp type	Wattage	Number of lamps	Total Wattage	Lighting power density (W/m ²)	llluminan ce at a task place	Notes	
Meeting Room A	100	T12 fluorescent lamp	36	20	1,220,	12.20	400	*****	••
		Magnetic ballast	7	20		**************************************	* * *		ſ
		Incandesce nt lamp	60	6					[-
Office B						•			•••
	Office I Space Meeting Room A Office B	Office DataSpaceArea (m²)Meeting Room A100Office BI	Office DataLamp DataSpaceArea (m²)Lamp typeMeeting Room A100T12 fluorescent lampMagnetic ballastMagnetic ballastOffice BI.S. (Magnetic)	Office DataLamp DataSpaceArea (m²)Lamp typeWattageMeeting Room A100T12 fluorescent lamp36Meeting Room A100T12 fluorescent lamp36Meeting Room A100T12 fluorescent lamp36Meeting Room A100T12 fluorescent lamp36Meeting Room A100T12 fluorescent lamp36Meeting Room A100T12 fluorescent lamp36Meeting B100T12 fluorescent lamp36Office BI.I.I.	Office DataLamp DataSpaceArea (m²)Lamp typeWattageNumber of lampsMeeting Room A100T12 fluorescent lamp3620Magnetic ballast720Magnetic ballast606Office BI.I.I.I.I.I.	Office DataLamp DataIlluminaSpaceArea (m²)Lamp typeWattageNumber of lampsTotal WattageMeeting Room A100T12 fluorescent lamp36201,220Magnetic ballast7201Magnetic ballast6061Office BIncandesce nt lamp606Incandesce	Office DataLamp DataIlluminance / WSpaceArea (m²)Lamp typeWattageNumber of lampsTotal WattageLighting power density (W/m²)Meeting Room A100T12 fluorescent lamp36201,22012.20Magnetic ballast720112.2012.201Office BIonIonIonIonIonIonIonOffice BIonIonIonIonIonIonIon	Office DataLamp DataIlluminance / WattsSpaceArea (m²)Lamp typeWattageNumber of lampsTotal WattageLighting power density (W/m²)Illuminan ce at a task placeMeeting Room A100T12 fluorescent lamp36201,22012.20400Magnetic ballast72010012.20100100100Office BImageImage606Image100100100Office BImageImageImageImageImageImageImageOffice BImage<	Office DataLamp DataIlluminance / WattsSpaceArea (m²)Lamp typeWattageNumber of lampsTotal WattageLighting power densityIlluminan ce at a task placeNotesMeeting Room A100T12 fluorescent lamp36201,22012.20400Magnetic ballast72012.20100100100100Magnetic ballast720100100100100100Office BImageImageImageImageImageImageImageOffice BImage



Illuminance can be measured by a lux meter available from electrical shops

Lighting power density = Total Wattage / Area

Total Wattage = Number of lamps x Wattage (of all lamps combined)

An example of lighting inventory table (Appendix 1 provides a template for your use.)

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Benchmarks to measure efficiency

Below are 3 important benchmarks against which you should evaluate the appropriateness and efficiency of lighting use. The examples provided here can be reference points for setting your organisation's own benchmarks, though you need to take into consideration regional differences. Be sure to comply with regulations or standards relevant to the country where your organisation is based.

Benchmark A: lux

Lighting guidelines that set the minimum or recommended illuminance levels for specific environments

Benchmark B: W/m²

Building codes in which specify maximum lighting power density (LPD) in specific environments

Benchmark C: kWh/m²

Building energy performance requirements or certifications which define the building's overall energy intensity by energy consumption per unit area

Minimum Illuminance (lux)	Task difficulty and examples
40	Corridors, walkways
80	Change rooms, loading bays, bulky storage
160	Simple tasks. Waiting rooms, rough bench work, general fabrication
240	Moderately easy tasks. Food preparation areas, medium woodworking
320	Moderately difficult tasks. Routine office work
400	Moderately difficult tasks. Fine woodwork
600	Difficult tasks. Drawing boards, inspection tasks, fine machine work, fine painting, colour matching
800	Very difficult tasks. Fine inspections tasks, colour matching of dyes
1200	Extremely difficult tasks. Graphic arts inspection, extra-fine bench work
1600	Exceptionally difficult tasks. Jewellery, watch-making

Benchmark A example:

Australian Standard AS 1680.1 - Recommended Maintenance Illuminances for Various Tasks, Activities or Interiors

Benchmarks to measure efficiency (cont'd)

Room or place	LPD (W/m²)	Illuminance (lux)	
	Current	Target		
Normal office	11	9	300	
Luxurious office, technical drawing	18	15	500	
Meeting room	11	9	300	
Business room	13	11	300	
Filing, copying, circulating room	11	9	300	
Archive room	8	7	200	

Benchmark B example:

Maximum lighting power density defined in Chinese Standard GB 50034-2004 for office buildings



Benchmark C example:

Energy-efficiency classes applied in buildings in Germany by the Energy Passport scheme

Cost-benefit analysis

A cost-benefit analysis will help you to evaluate with respect to energy efficiency and cost savings and help you to determine the best course of action.

Electricity use / year (kWh) =

Wattage x Hours of usage / year x Number of lamps / 1,000

Electricity cost / year =

Electricity consumption / year x Electricity cost (per kWh)

CO₂ emissions / year =

Electricity consumption / year x GHG emissions factor (per kWh)

Total average cost / year =

Electricity cost / year + Average lamp cost / year

							******				1	*****
	Lamp Data			Electricity and CO ₂		Lamp Costs			Total			
Option	Lamp type	No. of lamps	Wattag e	Hours of usage / year	Electricity use / year	Electricity cost / year	CO ₂ emissions / year	Lamp purchasi ng cost	Life- time (years)	Average lamp cost / year (per lamp)	Average lamp cost / year (total)	Total average cost / year
Old	Incandesce nt Lamp	6	60	2,000	720 kWh	\$ 115.20	388.8 kg	\$ 0.60	1.5	\$ 0.40	\$ 2.40	\$ 117.60
New	CFL	6	14	2,000	168 kWh	\$ 26.88	90.72 kg	\$ 3.50	5	\$ 0.70	\$ 4.20	\$ 31.08
Saving						\$ 88.32 77%	298.08 kg 77 %					\$ 86.52 74%

An example of cost-benefit analysis table (Appendix 2 provides a template for your use.)

For a more detailed analysis, you may also need to include additional other factors such as a **discount rate**, **ancillary devices** (e.g. ballasts), **maintenance costs**, **indirect change in energy use** (e.g. air conditioning), etc.

This is calculated based on the below assumptions.					
	Electricity cost	\$ 0.16 / kWh			
	Greenhouse gas (CO ₂ -e) emissions	540g / kWh			

7

Technical Specification

To call for tender, you need to draw up technical specifications that define the characteristics of the goods required to be purchased. Below is an example of a specification for fluorescent lamps. You can also apply the specifications defined for eco-labels such as

Energy saving fluorescent light tubes specification

Supply energy saving fluorescent tubes with specifications listed below.

Tube length	2 feet	4 feet	5 feet			
Voltage (V)	240	240	240			
Frequency (Hz)	50	50	50			
Wattage (W)	18	36	58			
Lumens (Lm)	1,050	2,500	4,000			
Lifespan (hrs)	10,000	10,000	10,000			
Colour temperature	4,000	4,000	4,000			
Light colour	Daylight Daylight Daylight					
Features	Long life					
	High efficiency					
	Optimum daylight colour temperature					
	Environmentally friendly light					



An example of technical specification of fluorescent light tubes used by UN Office at Nairobi

<u>1 2 3 4 5 6 7</u>

Other helpful information to start green lighting

Among a range of publicly available information, we have selected a few useful initiatives and organisations for your information.

UN links

Inter-agency Environmentally and Socially Responsible Procurement Working Group

Some UN agencies and MDBs created this group in 2001 to share experiences and find synergies for standard-setting and capacity building.

www.sustainableprocurement.net

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Buying for Better World training manual

This manual on sustainable procurement was developed for training Ghanaian officials by UNEP, IAPSO and World Bank in 2004. For details, ask UNEP-DTIE sc@unep.fr



Environment Management Group (EMG) and the Sustainable United Nations Initiative are both working to promote sustainable procurement and building management within the UN. For details, ask UNEP sun@unep.fr; www.unep.fr/scp/sun

Other helpful information (cont'd)

Tools for green lighting

Smart Energy Toolbox

The Government of Western Australia provides useful data and literature on energy saving technologies. www.energysmart.com.au



EU GreenLight Programme

This voluntary initiative encourages public and private organisations to commit to applying green lighting as well as provides successful examples. www.eu-greenlight.org



US National Lighting Product Information Program

This website distributes timely, manufacturer-specific information on green lighting products with fact sheets. www.lrc.rpi.edu/programs/NLPIP



Buy Bright Initiative

The European Lamp Companies Federation (ELC) and other partners provide public authorities with practical guidance and technical information for green lighting procurement.

buybright.elcfed.org



Other helpful information (cont'd)

Green procurement platforms

EU Green Public Procurement The website provides comprehensive background information and guidance including *Buying Green!* handbook, research, guidelines and product specifications.

http://ec.europa.eu/environment/gpp



ICLEI Europe

The organisation has organised a wide range of projects in the area of green public procurement in local authorities including procurement of sustainable buildings and internal performance contracting. ICLEI also organises training for procurement officers. www.iclei-europe.org



International Green Purchasing Network (IGPN)

This global network hosted by Japan provides tools, links and network opportunities for both public and private organisations. www.igpn.org





US Energy Star Program

The website provides technical specifications to qualify the label and tools to estimate energy and cost savings of green lighting options.

www.energystar.gov



Other helpful information (cont'd)

French

Institut de l'energie et de l'environnement de la Francophonie (IEPF) lists different lighting equipment and other measures to improve lighting efficiency with calculation tools and case studies. www.iepf.org



German

Initiative EnergieEffizienz Dielstleistungen, which is organised by German energy companies, provides practical information on efficient lighting in office buildings as well as a database of building/energy consultants. www.energieeffizienz-imservice.de



Spanish

Spanish government's **Instituto para la Diversificacion y Ahorro de la Energia (IDAE)** provides technical information on efficient lighting including minimum illuminance levels and guide to integrate natural light into buildings with case studies. www.idae.es



Chinese

China Green Lights Project jointly organised by Chinese government, UNDP and GEF promotes raising quality and lowering prices of lighting products made in China as well as converting the domestic marketplace to efficient lighting. www.cn-greenlights.gov.cn



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Footnotes

- 1 http://www.unu.edu/ISO14001/unu-initiative.html
- 2 http://www.epa.gov/epp/pubs/ems.htm
- 3 http://www.iclei-europe.org/index.php?id=800
- 4 http://www.efficientlighting.net/

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