Technical Brief on Sustainable Energy

LIGHTING SYSTEMS

SWITCH GARMENT

PROMOTION OF SUSTAINABLE ENERGY PRACTICES IN THE GARMENT SECTOR IN CAMBODIA

switchasia GRANTS PROGRAMME

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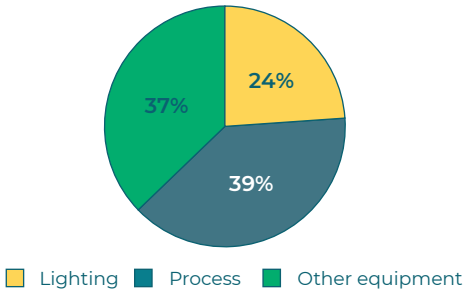
LIGHTING USE IN INDUSTRY

Lighting is used to compensate the lack of natural light in the factory. To be able to work efficiently, an optimum levelof illumination is needed on the workstation and can vary depending on the task. Respecting the recommendation (p03) can improve both productivity and wellbeing of the employees.

Appropriate lighting for industrial applications depends on both the type of activity and the configuration of the premises. Industrial applications require efficient, safe and robust lighting that can withstand an often demanding environment. Operation costs can be significantly reduced by using new and more efficient technologies, combined with appropriate management. Appropriate lighting quality and illumination also improves working conditions

Electricity consumption in the Cambodian Garment Industry



Source : Energy efficiency NAMA in the garment industry in Cambodia

Lighting sources 1

Natural Light

The most common source of natural light is the sun. It covers all colors spectrum, and its intensity varies during the day.

Advantages

- Free and abundant resource;
- Respect circadian rhythm (day/ night cycle);
- Better productivity and accuracy;
- Quality of the lighting for health.

Disadvantages

- Irregular source of light:
  - Cloudy weather / Night time;
  - Building design or layout might not let enough natural light into the premises when needed
- Solar radiation can cause excessive heat in a building.

Artificial Light

This is the light that is generated with a source of energy. Depending on the lamps used, the quality of the lighting can differ.

Advantages

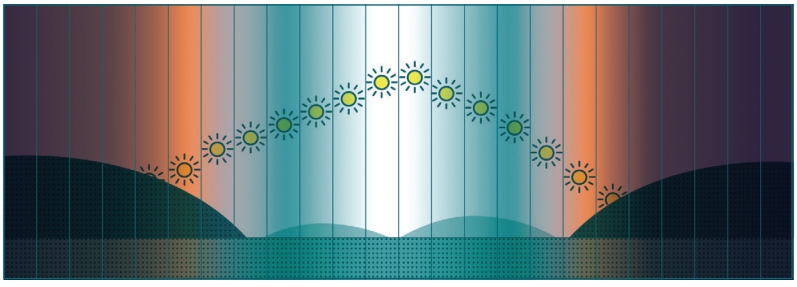
- Compensate for the lack of Natural light in a building;
- Wide variety of shapes, sizes, color, levels of brightness, efficiency.

Disadvantages

- Costs:
  - Requires energy to operate;
  - Limited life time;
- Affect sleeping pattern;
- If not designed properly:
  - Requires energy to operate;
  - Affects productivity and accuracy.

Proper balance between both is needed

A proper equilibrium between daylight and artificial light is needed to maintain optimal lighting to workers in an efficient manner.



Health and Lighting 2

The importance of an efficient lighting system for health is often underestimated: deficiencies in the illuminance system can result in worker discomfort, headaches and visual disorders which are common in the workplace but can be avoided by optimizing the lighting system and conforming to national standards.

Recommendation and legislation:

Depending on the work to do, recommendation is different. Cambodian Legislation is defining the level light needed:

	Average Illumination (Lux)	
Textile	300	Combing and extrusion of yarn
	500	Spinning of yarn
	750	Weaving, knitting and embroidery
	500	Dyeing
	100	Drying room
	500	Auto Printing room
	1000	Colour inspection
Garment Industry	750	Embroidery
	750	Cutting
	1500	Linking
	1000	Sewing
	300	Ironing
	1000	Final inspection
Administration Building, Office	500	Writing, reading, data processing
	500	Computer room
	1000	Technical drawing
	500	Meeting room
	300	Reception Desk
	200	Archive

Definitions

Luminous flux

In **lumens (lm)**: the amount of visible light emitted by the source.

The higher the lumen value, the brighter the bulb.

Luminous efficacy

In **lumens per watt (lm/W):** ratio of luminous flux emitted to the electric power absorbed: 2 lights of 30 W may have a different luminous efficacy. They consume the same amount of energy but light up differently.

Average rated life

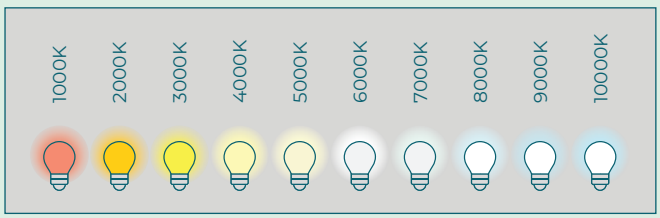
In **hours (h)**: statistical measure (or estimate) of how long a product is expected to perform its intended functions under a specific set of environmental, electrical and mechanical conditions. *Ex: 40000 h (L90/B20) = 40000 hours of operation, the source still provides 90% of the initial luminous flux, except for 20% of them.*

Color Rendering Index (CRI)

Quantitative measure about the capacity of the lamp to reveal natural colors of objects (scored on a scale from 0 to 100, with 100 being the best).

Correlated Color Temperature (CCT)

In **kelvin (K)** : qualifies the lighting atmosphere of the illuminated space. Most light bulbs will range from 2700K (warm, incandescent color) to 5000K or higher (crisp, white daylight color).



Energy savings in lighting

Maintenance | Modification | Habits | Daylight Use

Investment | Labour Time | Savings

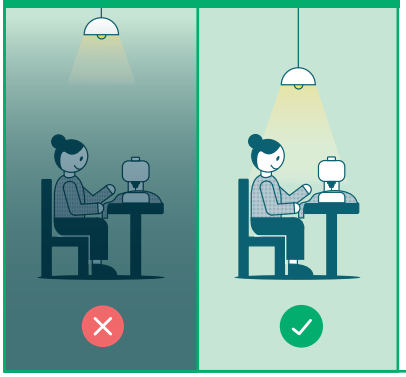
1. Optimize configuration

1. Sometimes only adjusting the height of lamp is sufficient to provide enough lighting at the workstation.

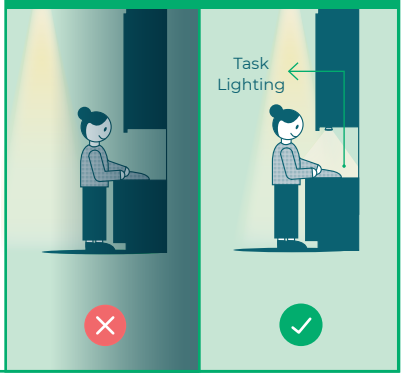
- Low bay (installed lower than 5 m)
- Medium bay (installed between 5 – 7 high)
- High bay (installed higher than 7 m)

2. Sometimes, only adjusting the position of the lamp can drastically improve the level of light at workstation.

Lamp height



Lamp placement



2. Light Control

By providing flexibility to the use of light, savings can be made by not using light when not needed.

1. Install seperate on-off switch to divide lighting control per area instead of one general on-off switch

2. Install motion sensors in the circulating areas to avoid useless use of light.

3. Install daylight sensors pilot lighting and avoid lights being turned on when daylight is sufficient.

3. More efficient technologies

More efficient technologies are now cost competitive with conventional lighting technologies providing the same or better quality results while using less energy to operate.

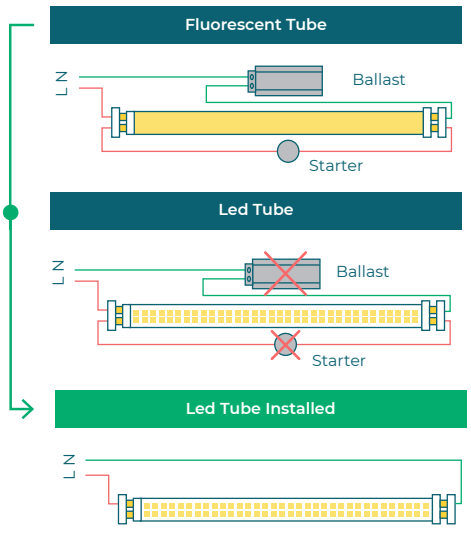
1. Install high frequency (HF) electronic ballasts in place of conventional ballasts for fluorescent lamps.

2. Replace conventional Metal Halide Bay light with LED Bay light. Indeed, LED need less electricity to operate, and have a better long life time. A particular attention will be needed on the CTT and CRI when selecting the LED, as LED range is very wide.

Conventional Metal Halide Bay light

LED Bay light

3. Install energy efficient LED lamps in place of "Conventional" fluorescent lamps.



4. Maintenance

Schedule, organize and record regular maintenance/ replacement/cleaning. Proper and regular maintenance of the equipment can maintain energy and cost savings.

5. Habits to reduce consumption

1. Avoid lighting unoccupied area and turn off the light when not needed.

2. Remove some lamps in the over lighted areas (glare, overconsumption), while ensuring consistent lighting and compliance with regulation.

6. Daylight use

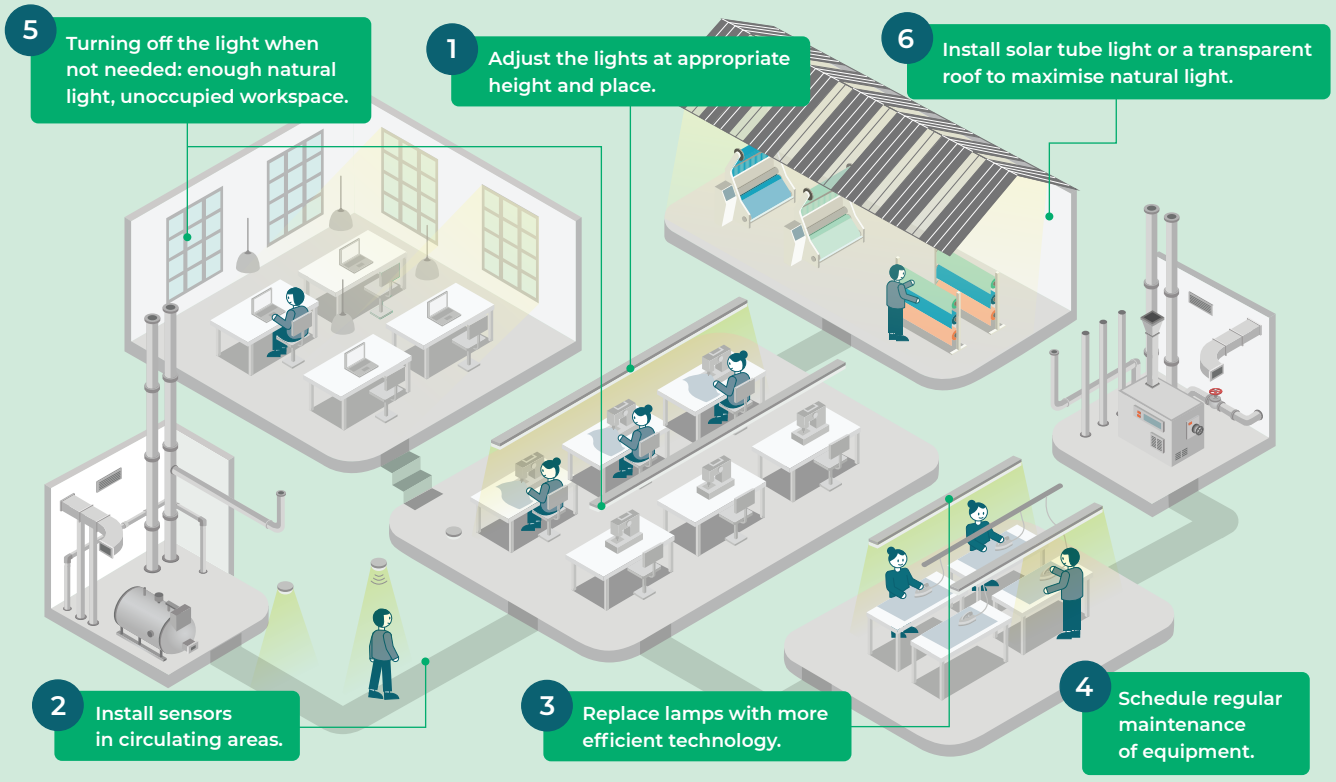
Some device exist to maximize daylight in an industrial building, without overheating the building.

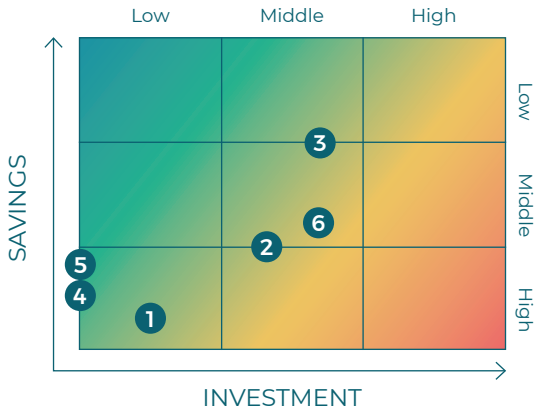
1. Installation of solar tube light (see image).

2. Installation of a transparent roof to maximize natural light.

Solar tube lights are more expensive, but are better to prevent from the risk of heating up the workspace area.

Summary & Recommendation





1. Optimise configuration
2. Light control
3. More efficient technologies
4. Maintenance
5. Habits to reduce consumption
6. Daylight use

Material available on the market

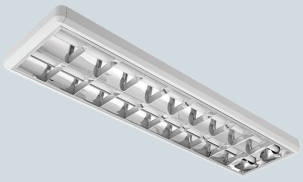
4

4.1 – Types of lamps and their features

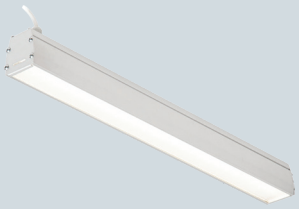
			Type of Lamp	Luminous Efficacy (lm/W)	CRI	Application	Typical Life (h)
Thermal Radiation Thermal Light Sources			Incandescent	8 – 18 (Avg: 14)	Excellent (100)	Home, restaurant, general, emergency lighting.	1000
			Halogen Lamps	18 – 24 (Avg: 20)	Excellent (100)	Display, flood light, stadium exhibition grounds, construction area.	2000 – 4000
Gas Discharge Discharge Lamps	Low intensity Discharge Lamps		Fluorescent Lamp	46 – 60 (Avg: 50)	Good W.R.T coating (67-77)	Office, shop, hospital, homes.	5000
			Compact Fluorescent Lamp (CFL)	40 – 70 (Avg: 60)	Very Good (85)	Hotel, shop, home, office.	8000 – 10000
	High intensity Discharge Lamps		High pressure mercury (HPMV)	44 – 57 (Avg: 50)	Fair (45)	General lighting in factory, garage, car park, flood light.	5000
			High pressure sodium (HPSV)	67 – 121 (Avg: 90)	Fair (22)	General lighting in factories, ware house, street lighting.	6000 – 12000
			Low pressure sodium (LPSV)	101 – 175 (Avg: 150)	Poor (10)	Road ways, tunnels, canals, street lighting.	6000 – 12000
			Metal halide lamps	75 – 125 (Avg: 100)	Good (70)	Industrial bays, spot lighting, flood light, retail store.	8000
Electroluminescence Semiconductor Light Sources			LED Lamps	50 – 130 (Avg: 90)	Very good (80)	Office, industry, outdoor, retail, hospital, etc.	45000
			Induction Lamps	65 – 90 (Avg: 75)	Very Good (80)	General lighting, factory, warehouse, street lighting, food lighting, etc.	80000

4.2 – Lamp parts and Control gear

Fixture: is for containing an electric lamp that provides illumination. All light fixtures have a fixture body and one or more lamps.



Reflectors: Is equipped with a high quality internal mirror, which follows exactly the parabolic shape of the lamp.

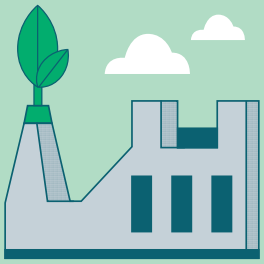


Diffusers: is a mechanism for scattering your light output. It reduces harsh shadows and balances your lighting effects, creating even, soft light (like a lampshade) on the targeted area.

Ballast: is used for countering negative resistance characteristics of any discharge lamps. There are 2 types, the conventional magnetic ballast and the modern electronic ballast (more energy efficient).

Energy Management Steps 5

A step-by-step approach for assessing energy efficiency of lighting system.



01. Current state of the installation

Inventory of the material and the use of the system. Knowing the components and requirements of the installation will help pre-identify potential improvement and prepare further analysis:

- Number and type of lamp
- Location
- Type and zone of use
- Rated power and efficacy
- Daily operating hours (h/day)
- Etc

02. Measurement

Taking detailed measurements of the installation is the starting point for improvement. Is my installation conform with regulation? Evaluate the quality of power supply:

- Measure and document the lux levels at various plant locations at working level;
- Measure and document the voltage, current, power factor and power consumption at various input points.

03. Data Analysis

Once measurement is done, compare the data collected against the Cambodian the regulation to know if the lighting level is conform:

- Compare the measured values with regulation requirements.

04. Equipment Analysis

Analyzing the individual components to identify potential improvements on the installation, understand the actual lifetime of the products, and monitor their quality.

- Collect and analyze the failure rates of lamps, ballasts and the actual life expectancy levels from the past data.

05. Implementation

Based on careful assessment and evaluation, identify improvement options, based on the result of the previous steps.

- Considering the info gathered in this technical brief, propose improvement (technical improvement, possible investment, energy management, etc.), indicate the potential savings (in energy and in $) or impacts and the priority given to the implementation of each improvement.

Raising Awarness among employees on lighting waste and use is also really important to improve energy effciciency.

In parallel, train employees in the efficient use of the lighting system.

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DEUTSCHE ZUSAMMENARBEIT

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Geres, the Global Green Growth Institute (GGGI) and the Textile, Apparel, Footwear & Travel goods Association in Cambodia (TAFTAC) are implementing the project "Promotion of Sustainable Energy Practices in the Garment Sector in Cambodia".

The project aims at increasing competitiveness and decreasing environmental impact towards sustainable production in the Cambodian garment industry and focuses on understanding the key barriers that inhibit the growth of the garment sector and will identify the opportunities that can help in the sustainable growth of the garment sector in Cambodia.

This will be achieved by providing hand-holding support to Garment manufacturing units in the country to identify and adopt sustainable energy practices.

This technical brief was produced with the inputs and extensive review provided by Global Green Growth Institute (GGGI) and Textile Apparel, Footwear & Travel Goods Association in Cambodia (TAFTAC).

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