

ENERGY AUDIT

STUDY PERIOD (TWO YEARS) 2021 - 2022 & 2022 - 2023

Sustainability study

AUDIT REPORT

Studied for

Bombay Suburban Art and Craft Education Society's

L. S. Raheja

School of Architecture

Raheja Education Complex, Plot no. 341,

Kher Nagar, Bandra East,

Mumbai – 4000051

Studied in the capacity of

Accredited and Certified

Green Building Professional



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Disclaimer

The Audit Team has prepared this report for the **Bombay Suburban Art and Craft Education Society's L. S. Raheja School of Architecture** located at Raheja Education Complex, Plot no. 341, Kher Nagar, Bandra East, Mumbai – 4000051 based on input data submitted by the Institute analysed by the team to the best of their abilities.

The details have been consolidated and thoroughly studied as per the various guidelines for Green Buildings available in National and International Standards; the report has been generated based on comparative analysis of the existing facilities and the prerequisites formulated by various standards. The inputs derived are a result of the inspection and research. These will further enhance and develop a Healthy and Sustainable Institution.

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Developing Healthy and Sustainable Environments

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Acknowledgement

The Audit Assessment Team extends its appreciation to the **Bombay Suburban Art and Craft Education Society's L. S. Raheja School of Architecture, Maharashtra** for assigning this important work of Energy Audit. We appreciate the cooperation extended to our team during the entire process.

Our special thanks are extended are due to everyone from the Management.

Our heartfelt thanks are extended to the Chairperson of the entire process **Ar. Principal Mandar Parab**, (Principal and Member Secretary).

We are also thankful to Institute's Task force who have played a major role in data collection.

- Faculty members – **Ar. Uttara Nalawade, Ar. Meghana Patil, Ar. Charvi Kamat and Ms. Bhakti Sawant**
- Non-teaching staff members – **Mr. Avinash Dhabade and Mr. Sachin Pitale**
- Admin staff members – **Ms. Jyoti Parab, Mr. Prashant Maingade, Mr. Ghanshyam Khanal and Mr. Ashish**

We appreciate the cooperation of the **entire Teaching, Non-teaching, and Admin staff** for their support while collecting the data.

Sustainable Academe

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1. Introduction

1.1 About the Institute

The Institute aims to be a renowned learning community engaged in exemplary teaching and research; by creating entrepreneurs who have been trained in understanding design as a broad humanistic and scientific discipline with technical skills complemented by personal vision and ethical perception.

The Mission of the Institute includes - To create a dynamic institution of learners through creative and critical thinking and dedication to high standards; To produce leaders that meet the demand of a globally challenging profession through sound training; To prepare students to evolve with the ever changing world by offering comprehensive, high quality programs and services that respond to the need of the industry; To strive for excellence and foster the spirit of professionalism by creating a culture of constant improvement through measuring learning across the institution and To support diversity thereby adopting a holistic approach through the process of lifelong learning.

1.2 Assessment of the Institute

1.2.1 Affiliation

The courses provided by the Institute received affiliation through the **University of Mumbai**, a public state university in Mumbai, Maharashtra.

1.2.2 Certification

The Institute has received the code under **All India Survey of Higher Education (AISHE)** wherein the code is C-33788.

1.2.3 Approval

The courses by the Institute have received approval through

- **Council of Architecture (COA), New Delhi**
- **Directorate of Technical Education, Maharashtra**
- **University Grants Commission (UGC) (2f), New Delhi**

2. Overview

2.1 Summarised Populace analysis for 2022-2023

2.1.1 Students data

The data (shared by the Institute) shows there were **367 students**.

2.1.2 Staff data

S. No.	Type	Male	Female	Total
1	Admin staff	07	05	12
2	Teaching staff	20	15	35
3	Non-Teaching staff	09	01	10
Total Staff Members		36	21	57

Table 1: Staff data of the Institution for 2022-2023

The staff data shows the Institute premises had **57 Staff Members**.

2.2 Summarised Populace analysis for 2021-2022

2.2.1 Students data

The data (shared by the Institute) shows there were **361 students**.

2.2.2 Staff data

S. No.	Type	Male	Female	Total
1	Admin staff	07	06	13
2	Teaching staff	19	17	36
3	Non-Teaching staff	09	01	10
Total Staff Members		35	24	59

Table 2: Staff data of the Institution for 2021-2022

The staff data shows the Institute premises had **59 Staff Members**.

The numbers given above are all core full time faculty

3. Research

3.1 Institute Infrastructure

3.1.1 Establishment

The Institute was established on **1959**

3.1.2 Spatial Organisation

The infrastructure facilities of the campus include:

RESOURCES:

Learning Resources - The college boasts a grand, spacious and well planned campus. The Institute is centrally located and is easily accessible by all modes of public transport. We strive to provide a healthy, safe and encouraging, learning environment to all our students.

Studios - The premise has well lit and airy studio spaces. Studio spaces have independent working tables and storage facilities for each student. The walls of the studios are lined with vibrant soft boards for displaying students' work. The space is efficient and encourages students to use it flexibly and make it their own.

Lecture Halls - Each lecture hall has smart projector facilities and a public address system. This imparts flexibility in teaching and learning methods and encourages healthy interaction amongst faculty and students.

Library - The college library is a knowledge haven which enriches teaching, learning and research experience for the students and staff. It is well stocked with more than 6000 books, 350 e-books, several design magazines and E- journal subscription on varied subjects like Design, Graphics, Construction, Interiors, Landscape, Architectural Theories and several others. The Institute takes continual efforts to keep this compilation updated and maintained

Computer Lab - The Institute encourages students to envisage, develop and represent their ideas in innovative ways. To support this vision, the Computer lab has forty computers equipped with the latest design and visualization softwares.

Staffroom - The staffroom is a comfortable space for the faculty. It also accommodates cabins for the Principal and senior faculty. The Principal's cabin and staffroom are always open for students. Students can approach for additional guidance or any other concerns.

CO-CURRICULAR FACILITIES

Multipurpose Hall - A fully air conditioned multipurpose hall becomes an integral part of a student's journey in the institute, from Orientation day to the Convocation ceremony. This hall is aereate, well-furnished and fitted with a state of the art public address system, making it a perfect setting for several co-curricular and extracurricular events through the year

Seminar Hall - A hundred seater seminar hall is also available for various lectures and seminars conducted for the students throughout the year.

Material Bureau - Along with theoretical knowledge, to ensure a well-rounded education a material bureau has been set up. The Bureau has latest material samples, catalogues, application brochures and joinery prototypes. Being able to see materials upclose, gives students better visualization and understanding of all it's possible applications.

Surveying Lab - The surveying lab has equipment to train the students on various methods of land survey. These land surveys are used by students to create site drawings before design can begin.

Climatology Lab - The climatology lab is equipped with instruments to measure temperature, humidity, solar radiation, wind flow, wind direction, etc. This enables the students to understand the environmental factors and its impact on design.

Carpentry Workshop - The college has a wood and a metal workshop with necessary machines and tools. This gives an opportunity to students to explore various techniques, materials and also gain valuable hands-on experience.

Construction yard - The construction yard becomes the site of several creative endeavors and workshops. This space is used by students to create awe inspiring installations, life scale arches, creative wall bonds, prototypes of roofs, modifiable furniture and many more such interventions.

ALLIED FACILITIES

Canteen and Gym – The facility is provided to common to all shared campuses

Medical Assistance - The Institute cares for its students wellbeing. Along with basic first aid being available on campus, a general physician visits the institute every afternoon. The institute also has a psychologist visit once every week. Students who need assistance can make appointments and avail this free of charge facility.

Common rooms - The campus also has separate boys and girls common rooms, accessible to all students. This a space meant only for students. They use this space for group activities, co-curricular and extra-curricular participation, student council initiatives and many more.

Universal Access - The institute strives to provide its students universal access. The building is planned to give a barrier free access to all its spaces for physically challenged students. There is provision for ramps, elevators, wide lobbies and doors to ensure ease of movement. The driveway till the entrance of the institute allows access by all vehicles. This ensures easy approach and exit in case of any emergency.

Digital Campus - The entire campus has also been equipped with wireless internet access for its staff and students within the premises. This facilitates work and access to information wherever they are within the institute.

3.2 Operation and Maintenance of the premises

The interview session was held with the staff regarding the operation and working hours. The Institution is open from Monday to Saturday with the timings being 07:15 am to 19:00 hours.

4. Evidence



Plate 1: Discussion with the team and Principal of the Institute



Plate 2: Investigation of the fire & lie safety practices and internal spaces of campus



Plate 3: Discussion with the internal team about the facilities

5. Documentation

5.1 Primary sources of energy consumption

- **Electrical (Metered)** – Light, Fans, Equipments, Pumps comprise these sources.
- **Renewable energy** – There are '**no sources**' available.

5.2 Secondary sources of energy consumption

The appliances used as backup for administrative purposes denoted under this section.

S. No.	Name	Nos.
1	UPS	2

Table 3: Details of secondary sources of energy consumption

In our opinion, additional backup systems can be proposed for general purposes.

5.3 Actual electrical consumption as per bills

The details of the electrical consumption and amount spent state:

- Huge nos. of air conditioners add to the energy loads
- Long working hours utilise more of artificial electrical appliances instead of the natural sources of ventilation.
- Lack of renewable or alternate sources of energy add to the increased expenditure.

Overall, the study states that the Institute will have to adopt alternate sources of energy.

S. No.	Month	Year	Amount	(A) Total units consumed	(B) Solar units generated	(C = A-B) Gross units consumed after deduction
Academic year 1 2021- 22						
1	June	2021	61170.00	6,242	0	0
2	July	2021	81650.00	8,502	0	8,502
3	August	2021	81690.00	8,502	0	8,502
4	September	2021	80670.00	8,423	0	8,423

5	October	2021	113040.00	11,757	0	11,757
6	November	2021	111340.00	11,626	0	11,626
7	December	2021	155050.00	16,229	0	16,229
8	January	2022	81550.00	8,339	0	8,339
9	February	2022	119500.00	12,439	0	12,439
10	March	2022	183660.00	19,523	0	19,523
11	April	2022	184310.00	19,165	0	19,165
12	May	2022	134010.00	14,023	0	14,023
Academic year 2 2022-23						
13	June	2022	109520.00	14,043	0	14,043
14	July	2022	172010.00	15,930	0	15,930
15	August	2022	187390.00	17,229	0	17,229
16	September	2022	191980.00	17,629	0	17,629
17	October	2022	160170.00	14,822	0	14,822
18	November	2022	188680.00	17,564	0	17,564
19	December	2022	204000.00	18,354	0	18,354
20	January	2023	141650.00	12,912	0	12,912
21	February	2023	164790.00	14,939	0	14,939
22	March	2023	189990.00	17,299	0	17,299
23	April	2023	180590.00	16,467	0	16,467
24	May	2023	162190.00	14,518	0	14,518

Table 4: Details of the electrical consumption

5.4 Calculated Electrical Consumption as per inventory

The electricity bills provide actual consumption data. The following is the calculated consumption. It is done to understand the percentage of energy usage in the premises by various applications. It is based on the inventory collected and interviews with the staff.

The additional data such as wattage is taken from market research. In terms of electrical consumption, the main sources are lights, fans, air conditioner, and equipment. The inventory and data collection for sources of energy consumed in the premise is summarised in the following sections.

The following documentation is based on the consumption practice of the premises on a regular working day.

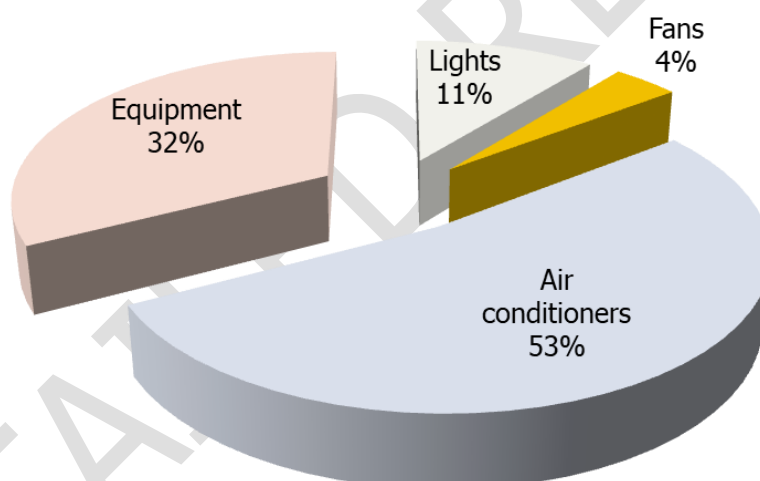


Figure 1: Summary of the calculated electrical consumption as per inventory

The above graph shows that air conditioners consume 53% whereas the equipment consume 32% while the lights consume 11% and the fans consume 4% of the total calculated electrical energy.

5.5 Lights

5.5.1 Types of lights based on the numbers

There are **1,238 lights on the premises**; the following table shows the various types of lights on the premises.

S. No.	Type	Nos.
1	LED lights (<i>Energy efficient appliance</i>)	859
2	CFL lights (<i>Non-Energy efficient appliance</i>)	73
3	Non-LED lights (<i>Non-Energy efficient appliance</i>)	306

Table 5: Summary of the types of lights on-premise

5.5.2 Types of lights based on the power consumption

The energy consumption of lights is **54,595 kWh** of energy.

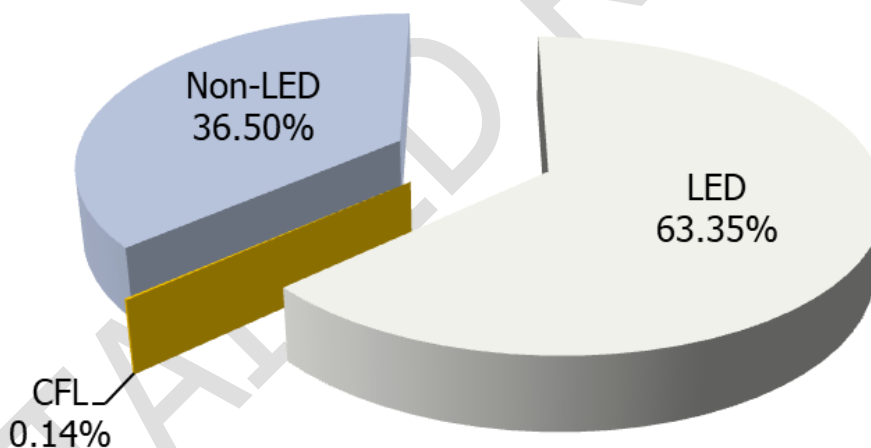


Figure 2: Energy consumed by types of lights in the premise based on the usage study

The analysis of the types of Lights on-premises shows **LED lights consume 63.35%** whereas the **Non-LED lights consume 36.50%** while the **CFL lights consume 0.14%** of the total power consumed by lights.

5.6 Fans

5.6.1 Types of fans based on the numbers

There are **249 fans** on the premises as follows:

S. No.	Type	Nos.
1	Large motor exhaust fans	225
2	Medium motor exhaust fans	2
3	Pedestal fans	12
4	Small motor exhaust fans	3
5	Table fan	2
6	Wall mounted fans	1

Table 6: Summary of the types of fans in the premises

5.6.2 Types of fans based on the power consumption

The energy consumption of fans is **19,798 kWh** of the energy.

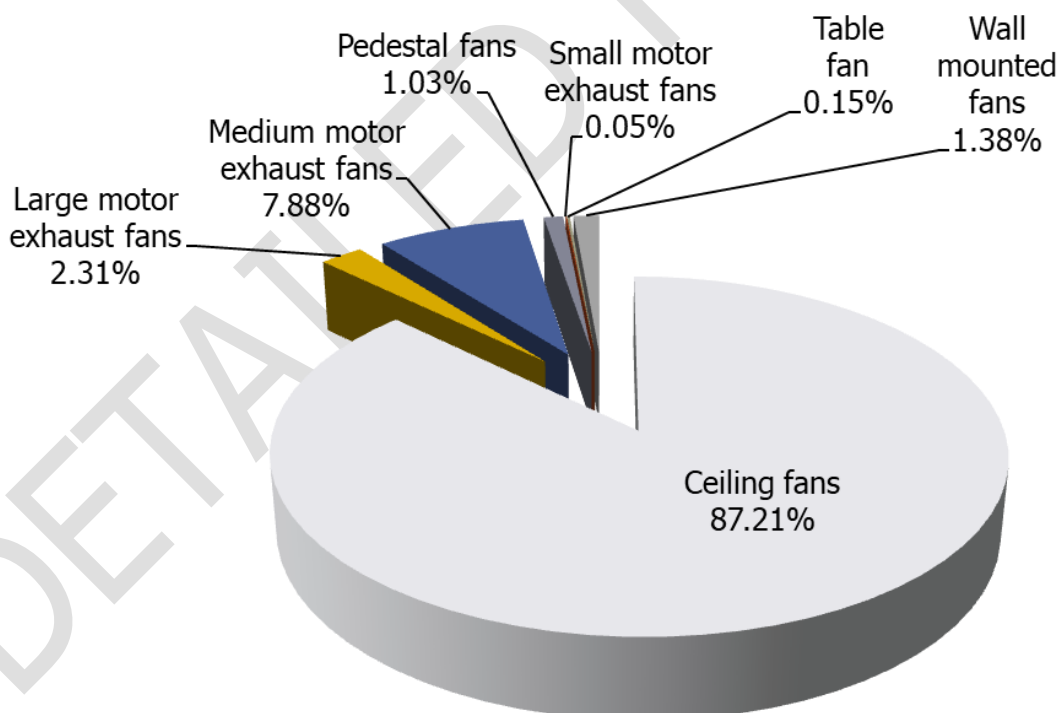


Figure 3: Types of fans based on power consumption

The above analysis shows **Ceiling fans consume 87.21%** whereas the **medium motor fans consume 7.88%** while **large motor fans consume 2.31%** the **wall-mounted fans consume 1.38%** the **pedestal fans consume 1.03%** the **table fans consume 0.15%** and **small motor exhaust fans consume 0.05%** of total power consumed by fans.

5.7 Air conditioners

5.7.1 Types of air conditioners based on the numbers

There are **25 air conditioners** in the entire premises.

5.7.2 Building-wise consumption analysis

The energy consumption of air conditioners is **2,65,992 kWh** of energy.

5.7.3 About the replacement of current air conditioners

- The current air conditioners are well maintained.
- Though there is not an immediate requirement for replacement.
- Whenever the Institute undergoes redevelopment there can be provisions for replacement with energy-efficient appliances or new air conditioners that require less power consumption.

5.8 Equipment

5.8.1 Types of Equipment

There are **253 nos. of equipment** in the Educational sector.

5.8.2 Types of equipment as per their energy contribution

The energy consumption of equipment is **1,64,918 kWh** of energy.

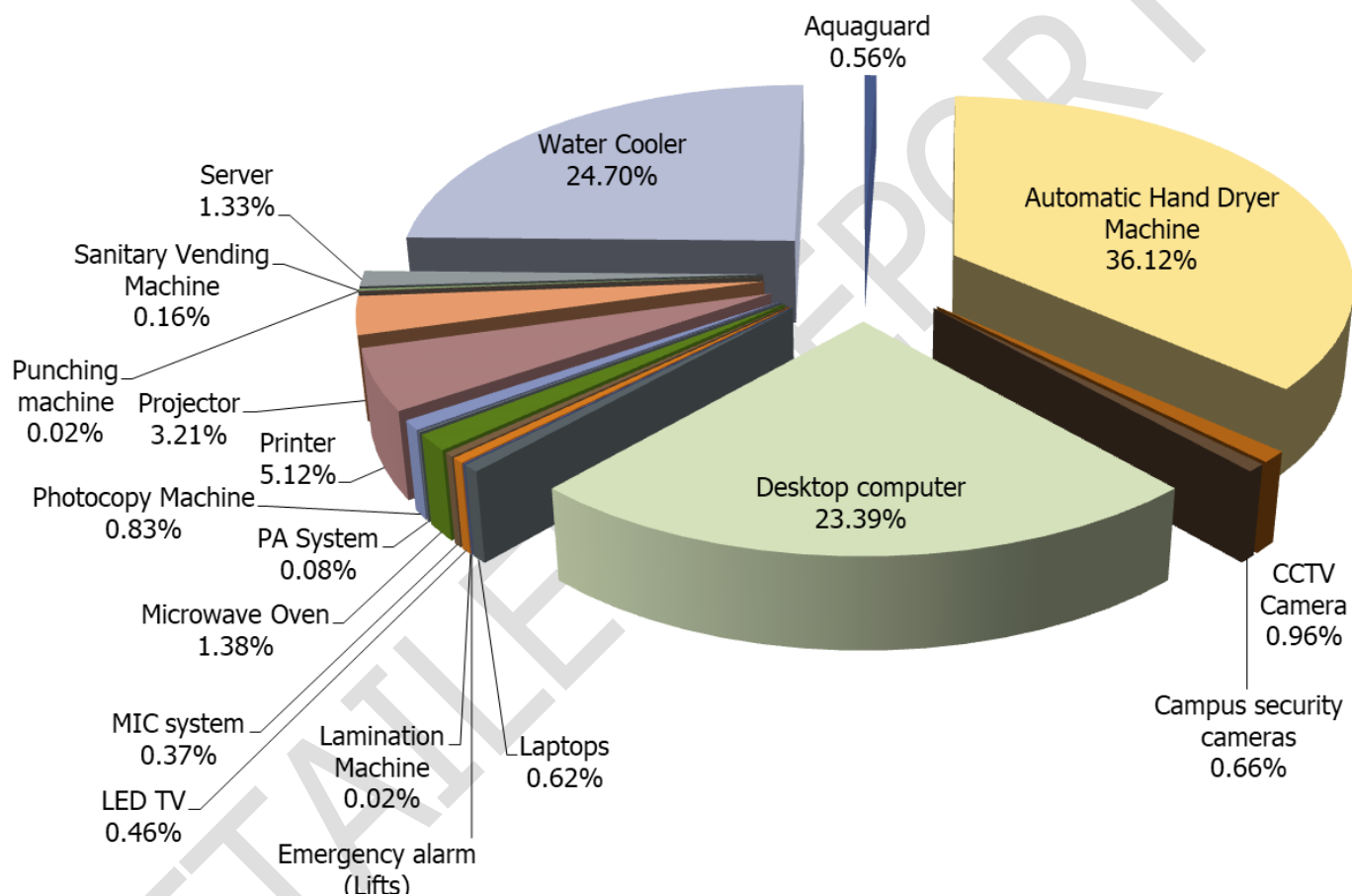


Figure 4: Energy consumed by types of equipment in the educational sector based on the usage study

The above summary shows that the **automatic hand dryer machine consumes more energy at 36.12%** while the **water cooler consumes 24.70%** whereas the **desktop computer 23.39%** and the **printer consumes 5.12%** these are the maximum consumers as compared to other equipment.

6. Suggestion

6.1 Section-wise suggestions

The following suggestions are to be considered as a ***first priority*** to be executed within the next 1.5 to 2.5 years from the date of the Report submission.

6.1.1 Electromechanical systems - Electrical and Lighting

Section 1 - Non-LED lights

The current light analysis shows that Non-LED lights consume anywhere between 50W to 54W and even more when in use; these should be replaced with LED lights which consume on an average 12-16W when in use.

Our technical research shows that there would be a reduction of an average of **67% reduction** in energy consumption if replaced with energy efficient appliance.

It will be suggested to either replace these now if the Institute can have certain plans else the replacement can be done when fans get damaged or are not in working condition.

Section 2 - Ceiling fans

The current Fans are in proper working conditions and maintained well. The ceiling fans are in more quantity and consume at least 45W when in use. These should be replaced with energy efficient fans consuming 14W when in use.

Our technical research shows that there would be a reduction of an average of **69% reduction** in energy consumption if replaced with energy efficient appliance.

It will be suggested to either replace these now if the Institute can have certain plans else the replacement can be done when fans get damaged or are not in working condition.

6.2 General suggestions

The following are consolidated study related to 'entire Institute' should be considered as **second priority** once section wise recommendations are implemented.

Since the campus does not have any sources of alternate sources of energy, it would be highly suggestive to undertake certain measures to incorporate renewable sources of energy.

6.2.1 Alternatives towards Smart premises mechanisms

Facility management systems, controls

(Includes electromechanical systems – Electrical, Water)

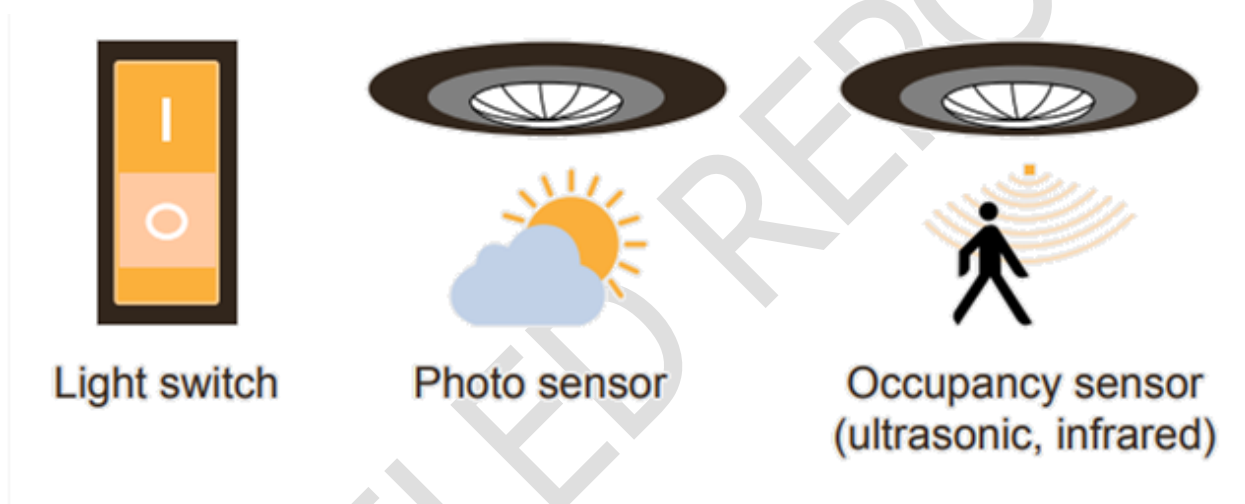


Plate 4: Understanding the lighting concepts

Source: https://seors.unfcc.int/applications/seors/attachments/get_attachment?code=NG125PFE4WHMWSYAK8TCAKIHMWX0F4QD

The above diagram provides a detailed study of how the system controls should be incorporated in the premises as far as lighting systems are considered. The suggestions for this sub-section are listed below.

7. Compilation

The study is based on the data collected, analyzed, rechecked, and confirmed through multiple modes. For the quality study, some standards/ notes have been referred to. These are listed and noted below. However, no direct references have been used anywhere. These are used as a base to analyze and study the data collected.

Specific references for study related to energy

- ➔ <https://www.energy.gov/eere/buildings/zero-energy-buildings>
- ➔ <https://www.dsaarch.com/zero-net-positive-energy>
- ➔ U.S. Energy Information Administration
- ➔ <https://www.happysprout.com/inspiration/what-is-smart-gardening/>
- ➔ <https://housing.com/news/smart-gardening/>
- ➔ Inference study reference image

https://seors.unfcc.int/applications/seors/attachments/get_attachment?code=NG125PFE4WHMWSYAK8TCAKIHMWX0F4QD

