

L.S RAHEJA COLLEGE OF ARTS & COMMERCE
Energy Audit Report 2019-20



ENERGY AUDIT REPORT 2019-20

Prepared for:

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L.S RAHEJA COLLEGE OF ARTS & COMMERCE

Energy Audit Report 2019-20

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1. Introduction

Sadhana Education Society's L. S. Raheja College of Arts & Commerce is a premier educational institute situated in the heart of Mumbai's suburbs, Santacruz (West). It is a Gujarati-speaking linguistic minority institution offering quality-oriented education from higher secondary to doctoral program.

Its parent body Sadhana Education Society was established in 1961. Since its inception, the Society is dedicated to the cause of education. With the mission to spread education in all its aspects and phases, across various sections of the society and to promote research and nurture the Gujarati culture, the Society founded its first institute – Smt. Kapila Khandvala College of Education in 1961. Thereafter, it instituted Malti Jayant Dalal Primary School and Malti Jayant Dalal High School in 1968. In 1975, the Society also instituted Malati Jayant Dalal Nursery School and S.B. Kindergarten. Subsequently, to promote the all-round development of students and to facilitate education from K.G. to Ph.D. under one banner, the Society instituted L. S. Raheja College of Arts & Commerce in 1980.

1.1 Energy audit objective

The National Assessment and Accreditation Council, New Delhi (NAAC) has made it mandatory that all Higher Educational Institutions should submit an annual Energy Audit Report and it is aimed at obtaining a detailed idea about the various end use energy consumption activities and identifying, enumerating and evaluating the possible energy savings opportunities.

1.2 Specific Energy Consumption (SEC)

The Specific Energy Consumption (SEC) is defined as the energy consumption per unit of product output. The specific energy consumption considering students, faculty, staff members were calculated which forms the institute SEC and was taken as reference for comparison.

1.3 Segmentation

The segmentation of the energy audit has been done floor/facility wise.

2. Energy audit

2.1 Energy audit methodology

The methodology adopted for this audit was:

- **Formation of audit groups for specific areas and end use**
- **Visual inspection and data collection**
- **Observations on the general condition of the facility and equipment and quantification**
- **Calculations, analyses and assumptions**
- **Potential energy saving opportunities**
- **Implementation**

2.2 Grouping and strategy

The following groups were formed with specific target areas and end use assigned.

Group 1: Ground Floor

Group 2: First Floor

Group 3: Second Floor

2.3 Benchmarking

The institution houses over 71 rooms. The rooms have been classified into various categories depending on the nature of activity conducted in the room and the number of hours for which the electrical/ electronic appliances are used.

- **Classroom**
- **Special room**
- **Office**
- **Common area**
- **Gymkhana**
- **Library**
- **Computer lab**
- **Washroom**

3. Quantification

3.1 Floor wise energy consumption:

Ground Floor

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1.	LED Tubelight	72	Library	22W	6	9.5
2.	Fan	42	Library	71W	6	17.8
3.	PC	13	Library	153W	6	11.9
4.	Spilt A/C (1 ton)	2	Library	1025W	4	8.2
5.	Spilt A/C (2 ton)	2	Library	1765W	4	14.12
6.	Window A/C (2 ton)	1	Library	1650W	4	6.6
7.	Printer	1	Library	250W	2	0.5
8.	LED Tubelight	15	Ground floor office	22W	10	3.3
9.	Fan	12	Ground floor office	71W	10	8.52
10.	Printer	1	Ground floor office	1100W	6	6.6
11.	Printer (HP)	6	Ground floor office	250W	6	9
12.	PC	14	Ground floor office	153W	8	17.1
13.	A/C Split	1	Principal Cabin	1025W	6	6.15
14.	A/C Window	1	Principal Cabin	1650W	2	3.3
15.	Microwave	1	Principal Cabin	1150W	0.5	0.57
16.	LED Tubelight	16	Principal Cabin	22W	6	2.1
17.	Fan	1	Principal Cabin	71W	6	0.4
18.	CPU	2	Principal Cabin	306W	6	3.6
19.	A/C split	1	Board Room	1400W	4	5.6
20.	Fan	5	Board Room	71W	4	1.42
21.	Xerox machine	2	Exam Room	175W	4	1.4
22.	Jio Wi-Fi Setup	1	Ground Floor Office	24W	24	0.5

23.	Network Switch	2	Ground Floor Office	20W	24	0.96
24.	Router	1	Ground Floor Office	6W	24	0.14
25.	Window A/C	1	Exam Room	1650W	6	9.9
26.	LED Tubelight	5	Exam Room	22W	10	1.1
27.	Fans	3	Exam Room	71W	10	2.1
28.	CPU	1	Exam Room	153W	4	0.61
29.	LED Tubelight	43	Ground Floor lobby	22W	4	3.7
30.	Fan	3	Ground Floor lobby	71W	4	0.85
31.	CCTV SMPS	4	Ground Floor lobby	225W	24	21.6
32.	LED Tubelight	4	Security cabin	22W	15	1.3
33.	LED Tubelight	1	Pump Room	22W	12	0.2
34.	Water pump	2	Pump Room	700W	1	1.4
35.	LED Tubelight	1	Meter Room	22W	12	0.2
36.	LED Tubelight	14	Outside Gymkhana	22W	4	1.23
37.	Fan	10	Outside Gymkhana	71W	4	2.84
38.	A/C	1	Outside Gymkhana	1625W	1	1.65
39.	LED Tubelight	4	Vice Principal Cabin	22W	6	0.5
40.	Fan	1	Vice Principal Cabin	71W	6	0.4
41.	CPU	1	Vice Principal Cabin	153W	4	0.6
42.	Projector	1	Auditorium	282W	2	4.83
43.	Music system	1	Auditorium	60W	2	7.2
44.	Central A/C Duct	1	Auditorium	5000W	2	100
45.	Music Mixer	1	Auditorium	30W	2	3.6
46.	LED Tubelight	51	Auditorium	22W	2	44
47.	Cooler	1	Canteen	450W	24	10.8
48.	Microwave	1	Canteen	1200W	2	2.4
49.	Griller	1	Canteen	3048W	5	15.2
50.	A/C split	4	Canteen	1625W	4	16.9
51.	LED Tubelight	18	Canteen	22W	10	3.9

52.	Fan	10	Canteen	71W	10	7.1
53.	Refrigerators	3	Canteen	180W	24	43.2
54.	LED Tubelight	13	Gym khana	22W	4	1.14
55.	Fan	12	Gym khana	71W	4	3.40
56.	LED Tubelight	16	Toilet	22W	10	3.5
57.	Fan	6	Toilet	71W	10	4.2
Energy consumption						460.83

Area (on ground floor)	Energy consumption (KWh)
Common area	42.67
Gymkhana	4.54
Canteen	99.5
Admin room	47.62
Special Room	22.13
Library	68.62
Auditorium	159.63
Principal cabin	16.12
Total energy consumption	460.83

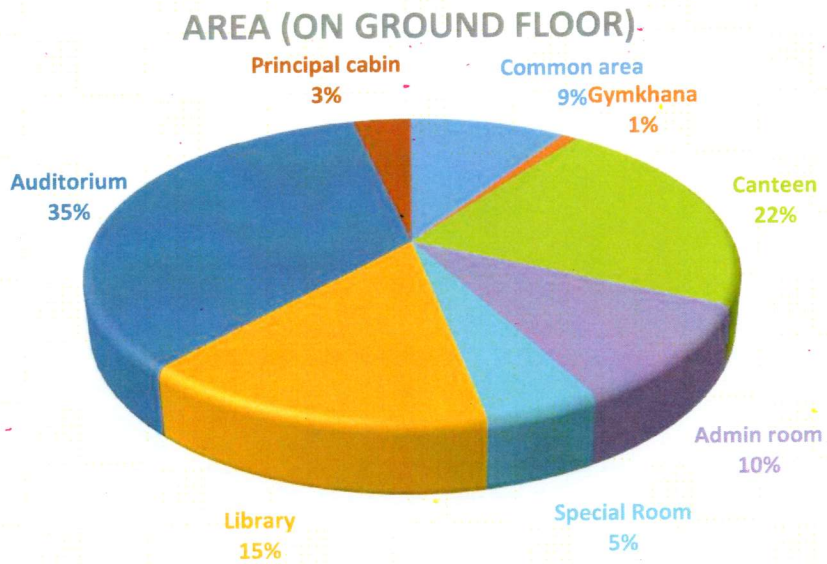


Fig 1: Electricity consumption per day on ground floor.

First Floor:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1.	LED Tubelight	88	Classroom	22W	4	7.74
2.	CFL	27	Staff room	40W	6	6.48
3.	LED Tubelight	13	Girls common room	22W	4	1.14
4.	LED Tubelight	7	Boy Toilet	22W	4	0.6
5.	LED Tubelight	5	Stat Lab	22W	6	0.66
6.	LED Tubelight	14	Lobby	22W	2	0.61
7.	LED Tubelight	3	Server room	22W	24	1.58
8.	LED Panel light	1	Server room	15W	6	0.09
9.	Fan	58	Classroom	71W	4	16.4
10.	Wall Fan	2	Staffroom	53W	4	0.42
11.	Fan	1	Staffroom	45W	6	0.27
12.	Fan	2	Stat Lab	71W	6	0.85
13.	Fan	3	Girls common room	71W	4	0.85
14.	Fan	1	Boys Toilet	71W	4	0.28
15.	Fan	2	Lobby	71W	4	0.56
16.	Projector	10	Classroom	326W	1	3.26
17.	Water purifier	1	Staff room	20W	6	0.12
18.	AC	2	Staff room	1765W	4	14.12
19.	Microwave	1	Staff room	1200W	0.5	0.6
20.	AC	1	Server room	3282W	8	26.25
21.	AC	1	Server room	1765W	24	42.36
22.	SMPS	4	Server room	225W	24	21.6

23.	Firewall	1	Server room	400W	24	9.6
24.	Network switch	1	Server room	740W	24	17.7
25.	PC	2	Server room	145W	8	2.32
26.	Server	2	Server room	750W	24	36
27.	IBM xenon	1	Server room	750W	24	18
28.	Printer	1	Server room	20W	2	0.04
29.	Tata Mux	1	Server room	3W	24	0.072
30.	AC	10	Classroom	1765W	2	35.3
31.	AC	1	Stat Lab	1730W	4	6.92
32.	Projector	1	Stat Lab	326W	2	0.6
33.	PC	1	Stat Lab	153W	6	0.91
34.	Water cooler	1	Common lobby	750W	6	4.5
35.	Water purifier	1	Common lobby	20W	6	0.12
Energy consumption						278.86

Area (on first floor)	Energy consumption (KWh)
Classroom	62.7
Common room	1.99
Staff room	22.01
Common area	6.67
Lab	9.94
Server Room	175.55
Total energy consumption	278.86

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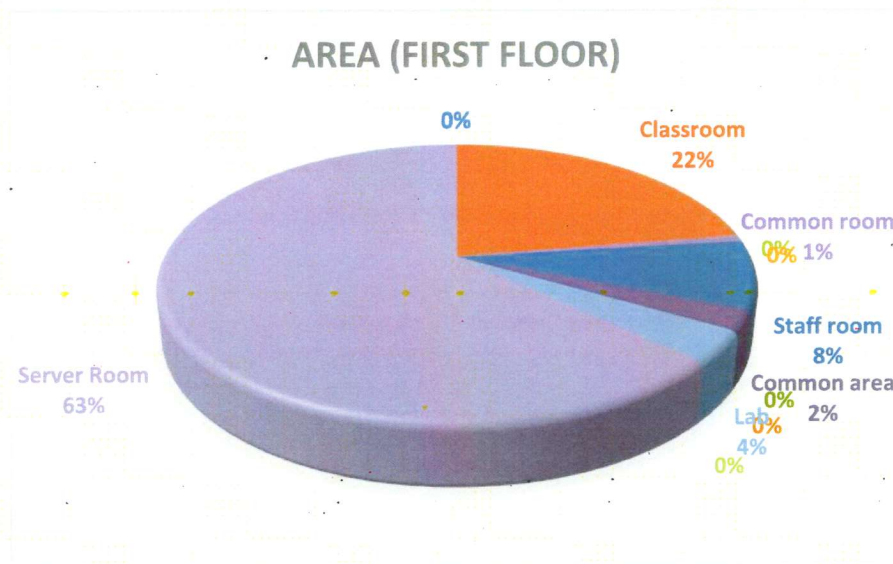


Fig 2: Electricity consumption per day on first floor

Second Floor:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1.	LED Tubelight	81	Classroom	22W	4	7.12
2.	LED Panel light	9	Research room	15W	4	0.54
3.	CFL	16	ENCT	40W	4	2.56
4.	Bulb	16	AV Room	12W	2	0.384
5.	LED Tubelight	1	Coordinator room	22W	6	0.132
6.	CFL	8	Coordinator room	40W	6	1.92
7.	LED Tubelight	9	Boys Toilet	22W	6	1.18
8.	LED Tubelight	12	Lobby	22W	6	1.58
9.	Fan	61	Classroom	71W	4	17.32
10.	Fan	2	Coordinator room	71W	6	0.852

11.	Fan	1	Boys Toilet	71W	4	0.28
12.	Fan	3	Lobby	71W	2	2.13
13.	Projector	9	Classroom	326W	1	2.93
14.	Projector	1	AV Room	326W	6	1.95
15.	A/C	1	Research Room	1730W	1	1.73
16.	Printer	1	Research Room	250W	8	0.25
17.	PC	1	Research Room	145W	8	1.1
18.	TV	1	Research Room	4800W	3	14
19.	A/C	2	ENCT Lab	1765W	4	14.1
20.	Window A/C	1	Coordinator room	1280W	4	5.12
21.	A/C	1	Coordinator room	1765W	4	7.06
22.	Music system	1	AV Room	725W	2	1.45
23.	A/C	2	AV Room	1765W	2	7
Energy consumption						92.68

Area (on second floor)	Energy consumption (KWh)
Special room	45.06
Classroom	27.37
Common area	20.25
Total energy consumption	92.68

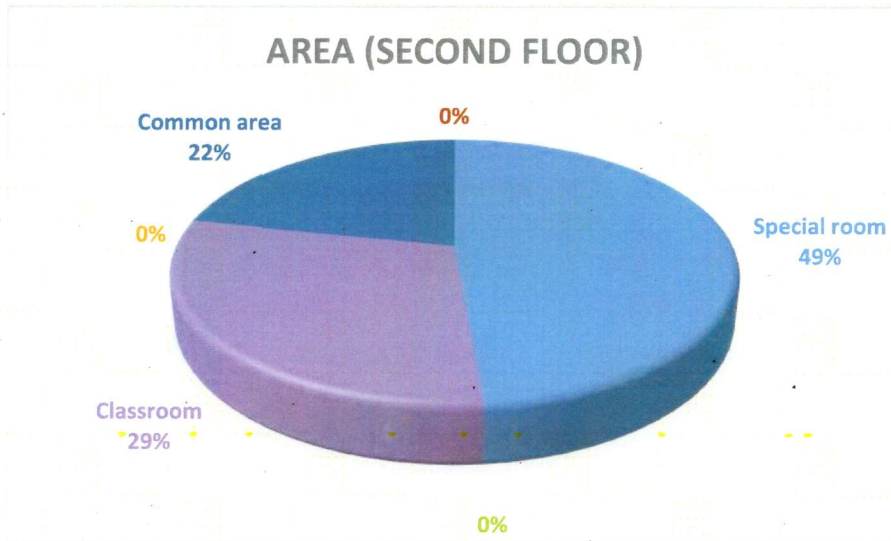


Fig 3: Electricity consumption per day on second floor.

Listed below is the area wise power requirement:

Classroom:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1	LED Tubelight	88	Classroom	22W	4	7.74
2	Fan	58	Classroom	71W	4	16.4
3	Projector	10	Classroom	326W	1	3.26
4	AC	10	Classroom	1765W	2	35.3
5	LED Tubelight	81	Classroom	22W	4	7.12
6	Fan	61	Classroom	71W	4	17.32
7	Projector	9	Classroom	326W	1	2.93
Energy consumption						90.07

Common area:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1.	Tubelight	43	Ground Floor lobby	22W	4	3.7
2.	Fan	3	Ground Floor lobby	71W	4	0.85
3.	CCTV SMPS	4	Ground Floor lobby	225W	24	21.6
4.	LED Tubelight	14	Lobby	22W	2	0.61
5.	Fan	2	Lobby	71W	4	0.56
6.	Water cooler	1	Common lobby	750W	6	4.5
7.	Water purifier	1	Common lobby	20W	6	0.12
8.	LED Tubelight	12	Lobby	22W	6	1.58
9.	Fan	3	Lobby	71W	2	2.13
10.	Tubelight	16	Toilet	22W	10	3.5
11.	Fan	6	Toilet	71W	10	4.2
12.	LED Tubelight	7	Boy Toilet	22W	4	0.6
13.	Fan	1	Boys Toilet	71W	4	0.28
14.	LED Tubelight	9	Boys Toilet	22W	6	1.18
15.	Fan	1	Boys Toilet	71W	4	0.28
16.	Projector	1	Auditorium	282W	2	4.83
17.	Music system	1	Auditorium	60W	2	7.2
18.	Central A/C Duct	1	Auditorium	5000W	2	100
19.	Music Mixer	1	Auditorium	30W	2	3.6
20.	Tubelight	51	Auditorium	22W	2	44
21.	Tubelight	14	Outside Gymkhana	22W	4	1.23
22.	Fan	10	Outside Gymkhana	71W	4	2.84
23.	A/C	1	Outside Gymkhana	1625W	1	1.65
24.	Tubelight	4	Security cabin	22W	15	1.3
25.	Tubelight	1	Pump Room	22W	12	0.2
26.	Water pump	2	Pump Room	700W	1	1.4
27.	Tubelight	1	Meter Room	22W	12	0.2

28.	LED Tubelight	1	Coordinator room	22W	6	0.132
29.	CFL	8	Coordinator room	40W	6	1.92
30.	Fan	2	Coordinator room	71W	6	0.852
31.	Window A/C	1	Coordinator room	1280W	4	5.12
32.	A/C	1	Coordinator room	1765W	4	7.06
Energy consumption						229.22

Gymkhana:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1.	Tubelight	13	Gym khana	22W	4	1.14
2.	Fan	12	Gym khana	71W	4	3.40
Energy consumption						4.54

Canteen:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1.	Microwave	1	Canteen	1200W	2	2.4
2.	Griller	1	Canteen	3048W	5	15.2
3.	A/C split	4	Canteen	1625W	4	16.9
4.	Tubelight	18	Canteen	22W	10	3.9
5.	Fan	10	Canteen	71W	10	7.1
6.	Refrigerators	3	Canteen	180W	24	43.2

7.	Microwave	1	Canteen	1200W	2	2.4
Energy consumption						91.1

Admin Room:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1.	Tubelight	15	Ground floor office	22W	10	3.3
2.	Fan	12	Ground floor office	71W	10	8.52
3.	Printer	1	Ground floor office	1100W	6	6.6
4.	Printer (HP)	6	Ground floor office	250W	6	9
5.	PC	14	Ground floor office	153W	8	17.1
6.	Tubelight	4	Vice Principal Cabin	22W	6	0.5
7.	Fan	1	Vice Principal Cabin	71W	6	0.4
8.	CPU	1	Vice Principal Cabin	153W	4	0.6
Energy consumption						46.02

Special Room:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hrs)	Energy consumption (KWh)
1.	LED Tubelight	5	Stat Lab	22W	6	0.66
2.	Fan	2	Stat Lab	71W	6	0.85

3.	AC	1	Stat Lab	1730W	4	6.92
4.	Projector	1	Stat Lab	326W	2	0.6
5.	PC	1	Stat Lab	153W	6	0.91
6.	A/C split	1	Board Room	1400W	4	5.6
7.	Fan	5	Board Room	71W	4	1.42
8.	Xerox machine	2	Exam Room	175W	4	1.4
9.	Window A/C	1	Exam Room	1650W	6	9.9
10.	Tubelight	5	Exam Room	22W	10	1.1
11.	Fans	3	Exam Room	71W	10	2.1
12.	CPU	1	Exam Room	153W	4	0.61
13.	LED Panel light	9	Research room	15W	4	0.54
14.	A/C	1	Research Room	1730W	1	1.73
15.	Printer	1	Research Room	250W	8	0.25
16.	PC	1	Research Room	145W	8	1.1
17.	TV	1	Research Room	4800W	3	14
18.	CFL	16	ENCT	40W	4	2.56
19.	A/C	2	ENCT Lab	1765W	4	14.1
20.	Bulb	16	AV Room	12W	2	0.384
21.	Projector	1	AV Room	326W	6	1.95
22.	Music system	1	AV Room	725W	2	1.45
23.	A/C	2	AV Room	1765W	2	7
Energy consumption						77.134

Principal Cabin:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1	A/C Split	1	Principal Cabin	1025W	6	6.15
2	A/C Window	1	Principal Cabin	1650W	2	3.3
3	Microwave	1	Principal Cabin	1150W	0.5	0.57
4	Tubelight	16	Principal Cabin	22W	6	2.1
5	Fan	1	Principal Cabin	71W	6	0.4
6	CPU	2	Principal Cabin	306W	6	3.6
Energy consumption						16.12

Staff Room:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1	CFL	27	Staff room	40W	6	6.48
2	Wall Fan	2	Staffroom	53W	4	0.42
3	Fan	1	Staffroom	45W	6	0.27
4	Water purifier	1	Staff room	20W	6	0.12
6	AC	2	Staff room	1765W	4	14.12
7	Microwave	1	Staff room	1200W	0.5	0.6
Energy consumption						22.01

Server Room:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1	LED Tubelight	3	Server room	22W	24	1.58
2	LED Panel light	1	Server room	15W	6	0.09
3	AC	1	Server room	3282W	8	26.25
4	AC	1	Server room	1765W	24	42.36
5	SMPS	4	Server room	225W	24	21.6
6	Firewall	1	Server room	400W	24	9.6
7	Network switch	1	Server room	740W	24	17.7
8	PC	2	Server room	145W	8	2.32
9	Server	2	Server room	750W	24	36
10	Tata Mux	1	Server room	3W	24	0.072
Energy consumption						157.57

Common room:

Sr. No	Equipment	No of units	Location	Wattage	Usage per day (Hours)	Energy consumption (KWh)
1	LED Tubelight	13	Girls common room	22W	4	1.14
2	Fan	3	Girls common room	71W	4	0.85
Energy consumption						1.99

Floor	Energy consumption (KWh)
Ground	460.83
First	278.86
Second	92.68
Total	832.37

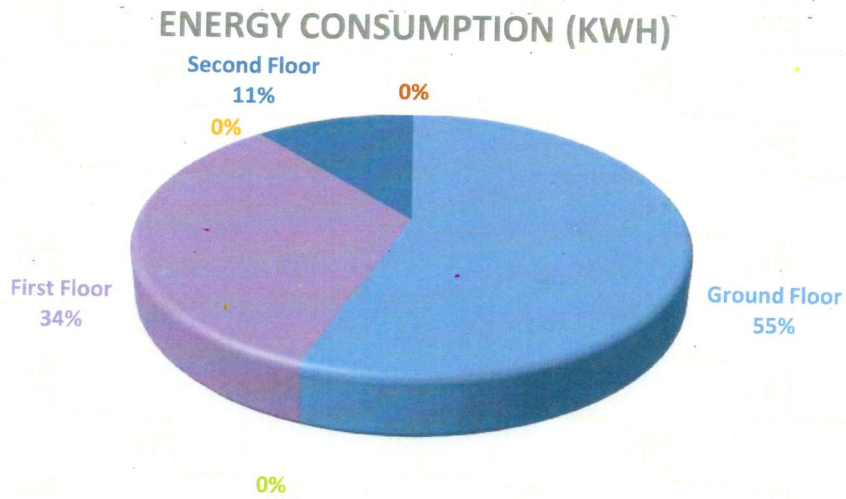


Fig 4. Floor wise electricity consumption

4. Analysis:

4.1 The share of annual lighting power requirements met through LED bulbs:

90% of the current lighting requirement is met through LED bulbs

The building is saving around 181% of the present consumption, with switching to LED's instead of CFL's.

POWER CONSUMPTION PER DAY (KWH)

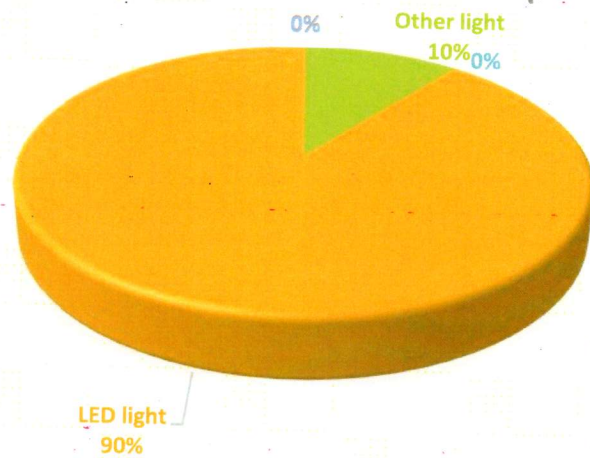
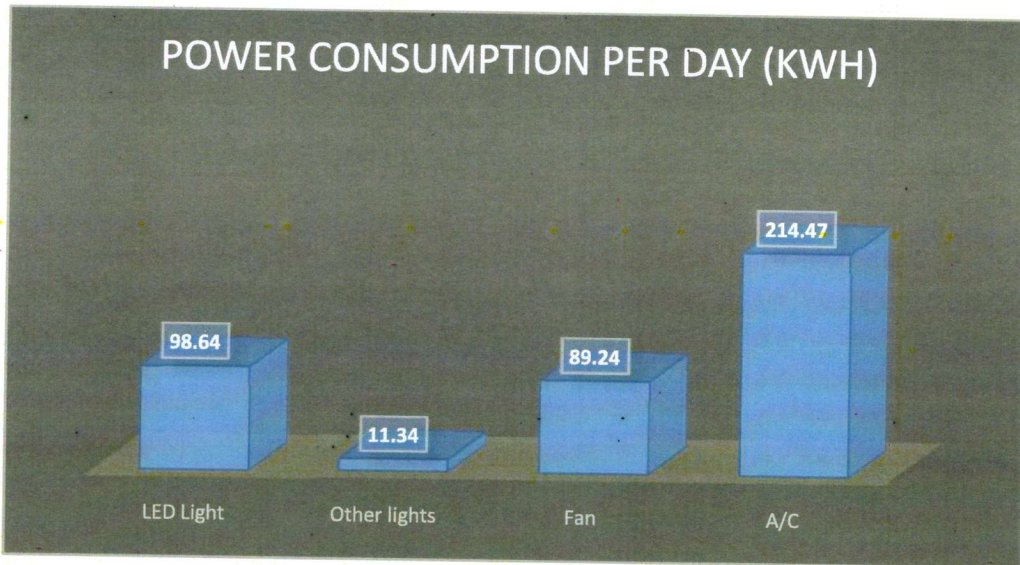


Fig 5. Share of annual lighting power requirement met through LEDs.

4.2 The utilities and their power consumption on a regular basis

Fig 6. Power consumption by utility equipment's



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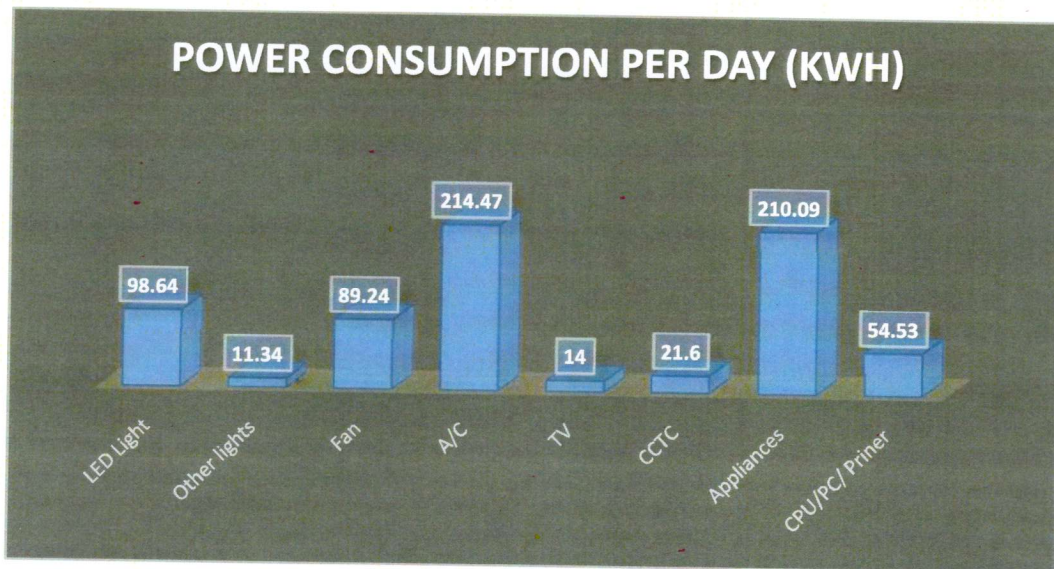


Fig 7. Major power consuming equipment's

4.3 Equipment demand for electricity.

The maximum energy is consumed by A/C in building and the least energy is spent on other lights and TV/CCTV.

High electric demand equipment's.	Power consumption per day (KWh)	Percentage of electricity consumed
LED lights	98.64	14%
Other lights	11.34	1%
Fans	89.24	13.7%
A/C	214.47	30%
TV/CCTV	35.6	5%
Computer/ Printer	54.53	8%
Appliances	210.09	29%

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% Power consumption by high demand equipment's

4.4 Percentage of power requirement of the institution met by renewable energy sources.

Solar system of 15 KVA has been installed on the terrace of the building. 15% of the annual power consumption is met by solar power.

Sr. No	Equipment	No of units	Location	System size	Average annual production (KWh)
1	Solar panels	60	Terrace	15 KVA	19000

Annual electricity consumption (KWh)	1,21,574
Annual electricity generation through solar (KWh)	19000
% Power supply by solar panels	15.62%

4.5 Alternate energy

4.5.1 Total power generated through solar panels- 19000 KWh

4.5.2 Energy gained and energy consumed- Data not found.

4.5.3 Electricity bill analysis- The connection of Canteen is Low Tension II (A) and the rest of the areas is Low Tension I (B). The per unit cost of Canteen is 11.99 INR and the per unit cost of other areas is 11.5 to 13.23 INR. The average consumption the building is around 10131.16 units. The lowest energy consumption is during the month of May and the highest energy consumption is during the month of September.

4.5.4 Total units consumed by each meter:

Account no	Total units
150820917	31,044
102077979	28,104
102034077	22,980
102034089	23,376
102093707	67,164
102093718	62,928

4.5.5 Total amount saved through alternate source of energy- 2,87,760 INR/year

4.5.6 Average power requirement is 10,131.16 units.

4.5.7 Total number of meters- 6

4.6 LED lights

4.6.1 Power consumed by LED lights- 2,564.64 Kwh/month

4.6.2 Total lighting through another sources- 294.84 Kwh/month

4.6.3 Total power required for lighting- 2,859.48 Kwh/month

4.6.4 Total number of LEDs –516 installations

4.6.5 Total number of Other lights- 67 installations

Recommendations:

- 1) Use of 5 stars rating electrical equipment for entire institution will help to save energy on power expenses.
- 2) Standardization of the vendor for procurement of AC's and other high consumption equipment's will help the institute to maintain and limit its power consumption.
- 3) Monitoring the losses in common areas and cutting down energy wastage will help to limit the overall energy expenditure.
- 4) Regular maintenance of all the electrical equipment like A/C and refrigerator is highly recommended for keeping a check on the rising electricity bills.
- 5) Installing dimmer switches in auditorium and offices will help cut down on energy wastage.
- 6) Changing/Replacing/Cleaning air filters at regular intervals will help to save electricity.
- 7) Reduce microwave use as much as possible.
- 8) Installing energy efficient windows will help to minimize energy losses.
- 9) Replacing filament bulb, CFL and other bulbs and tubes to LED will cut down on the electricity bills.
- 10) Using sleep mode in computers and Televisions to save up to 1% of energy.
- 11) Localizing the meter on every floor will help to track and cut down on energy losses.

NOTE: All the information mentioned in the report is provided through L.S.Raheja College of Arts and Commerce by verbal communication and relevant documents.

