

University of Mumbai



Report on preliminary energy audit (some departments at Kalina Campus)
for university of Mumbai

September 2019

Disclaimer

The views presented in this report are those of the authors and may not represent or reflect the views of University of Mumbai.

PREFACE

The energy audit report is a study of selected existing infrastructural facilities namely C. D. Deshmukh Bhavan, Anna Bhau Sathe Building, Nanotechnology Building, Green Technology Building, Phirojshah Mehata Bhavan, Savitribahi Phule girls hostel and Zandu Building at Kalina Campus to determine how and where energy is getting used and to suggest possible way/methods for energy savings. This report is just one step and next step would be to implement the suggestions and methods by the University towards energy savings. We would also like to emphasize that an energy audit is going to be a continuous process.

Any suggestions to further enhance the quality of this report are always welcome.

Authors



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Commitments for Energy Audits

Energy Audit: **Systematic, documented verification of objectively obtained and evaluated energy/electricity consumption evidence**

Aim : To establish the overall picture of the potential of energy savings through visual inspection of the premises which includes air conditioning system, lighting, metering, building automation, building maintenance and other factors which may affect the total usage of the electricity/energy. Energy audit involves in-depth investigations into how the energy is currently being consumed, current performance of the existing systems and identification of various potential Energy Conservation Measures(ECMs).

Objective : To set minimum standards for undertaking energy audit

Type of audit : Preliminary energy audit will be carried out with a team depending on the size, complexity of the building.

Apparatus used: Clamp amp meter
(To measure the current ratings of various equipment's, supply cables and feeders)
Thermometer
(To measure indoor and outdoor ambient air temperature)
Hygrometer (humidity meter)
(To measure indoor and outdoor humidity)
LuxMeter
(To measure the light intensity of lit areas)

Reports :

- Verification, monitoring and analysis report of the use of Electricity/energy.
- Technical report with recommendations for improving energy efficiency
- An action plan to reduce the energy consumption

Data Collection: Requirements

- **Particulars about the building**

- Architectural drawing (built drawings)

- Lighting circuit drawings (as per building drawings)

- Information of light systems

- Plot of lighting load profile (kW)

- Air conditioning system drawings and manuals (as per building drawings)

- Information of air conditioning systems

- Details about chillers (mass flow rate)

- Details about cooling tower fab

- Details about air handling units (AHU)

- Plot of load profile (kW)

- Details about load control systems (as per building drawings)

- Other Electrical equipment's

- Information of electrical equipment's

- Plot of electrical equipment load

- Building maintenance status

- **Excluded energy consumption**

- Details about previous energy consumption at least for last twelve months

- **Determination of the total energy consumption**

Introduction:

The University of Mumbai (known earlier as University of Bombay) is one of the oldest and premier University in India. Over the years, there has been significant progress at University of Mumbai in all academic and research activities, and a parallel improvement in facilities and infrastructure, to keep it on par with the best institutions in the world. Today, University of Mumbai has its campuses of area 230 acres and 13 acres in Mumbai city. The largest campus of University situated in Kalina Santacruz (E) in suburban Mumbai which includes various buildings (with 1.25 million square feet of built-up area), Class Room facilities (22 thousand sq. feet), etc. Rest of the space is reserved for the development of future disciplines. The student strength of the institute is about XXXX, with faculty strength of about XXX and supporting staff of about 1500 over an area of about 230 acres.

Objective for energy audit:

It has been observed that University of Mumbai spends around few corers of rupees per month on its electricity bill during these years. Hence it is necessary to get a detailed idea about the various end use energy consumption activities and to identify, enumerate and evaluate the possible energy savings opportunities/options. The target proposed herewith is to achieve savings in the electrical energy consumption to the extent of 20%. The audit was also aimed to understand the practical problems and difficulties in carrying out energy audits. The supporting staff of listed buildings, teaching staff, university engineering section, IQAC coordinator and higher authorities from University of Mumbai enthusiastically participated in the endeavor.

Energy Audit:

The methodology adopted for this audit was

- Identify the specific areas and end use
- Visual inspection followed by data collection
- Inspection towards the general condition of the infrastructural facilities as well as equipment and its quantification.
- Verification of energy consumption by measurements
- Calculations, analyses and assumptions
- Potential energy saving opportunities

Details of electricity audit executed at selected building

CASE 1

Name of the Building	C. D. Deshmukh Bhavan
Operation hours (day, week, moths)	9 am to 5 pm (5 Days a week)
Number of Staff	15
Electricity tariff category	LT II (A)
Building Age	10 Years
Building Function	Academic purpose
No of floors	Ground + 1
Gross floor area (m²)	
No. of blocks per floor	
Gross floor area air conditioned (m²)	
Server area (m²) if any	N.A.
Parking area if any (m²)	N.A.
Designed occupant load	
Actual occupant load	

- Electricity bill history (at least a year)

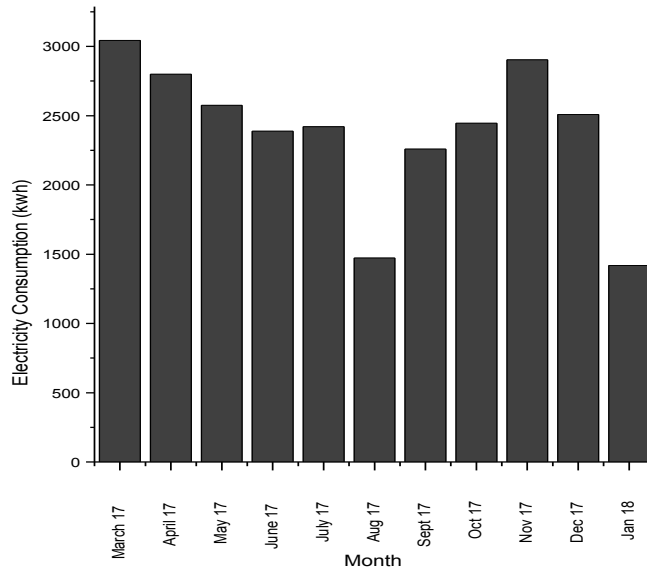


Figure (1) Energy Consumption per month

- **Lighting load details**

Floor	Room No.	LTG. Power (W)	No. of Light	Total KW	Lux Level	Place of Use (Sq Ft)	
Ground	1	20	9	0.18	150	120	
	2	20	1	0.02	152	120	
	3	20	1	0.02	160	120	
	5	20	8	0.16	350	300	
	6	20	4	0.08	200	150	
	7	20	2	0.04	136	150	
	8	40	2	0.08	140	150	
	9	40	2	0.08	280	600	
			18	22	0.396		
	10,11	40	14	0.56	260	300	
	13	40	2	0.08	140	150	
	14	40	3	0.12	145	150	
	15	40	2	0.08	150	150	
	16	40	2	0.08	140	120	
	17	40	2	0.08	146	120	
	Passage	40	18	0.72			
	wash room	40	8	0.32			
1 st Floor	101	18	16	0.288	300	300	
	103	18	16	0.288	150	225	
	104	40	2	0.08	140	120	
	105	40	2	0.08	140	120	
	106	40	17	0.68	280	300	
	107	40	4	0.16	135	150	
	108	40	7	0.28	140	150	
	110	40	3	0.12	145	150	
	111	40	3	0.12	140	150	
	112	40	3	0.12	150	150	
	113	40	6	0.24	155	300	

- **Air Conditioning load details**

Floor	Room No.	AC Name	Power (W)	No. of Equip.	Total KW
Ground	1	Split	1.5	1	5.25
	9	Split	1.5	5	26.25
1 st Floor	103	Split	1.5	3	15.75
	112	Split	1.5	1	5.25
	113	Split	1.5	1	5.25

- **Equipment load details**

Floor	Room No.	Equip. Name	Power (W)	No. of Equip.	Total KW
Ground	5	PCs	150	2	0.3
		Printer	150	4	0.6
	6	PCs	150	2	0.3
		Printer	150	1	0.15
	8	PCs	150	1	0.15
		Printer	150	1	0.15
	9	Projector	200	1	0.2
	14	PCs	150	1	0.15
1 st Floor		Printer	150	1	0.15
	105	PCs	150	2	0.3
		Printer	150	1	0.15
	106	Projector	200	1	0.2
	108	Projector	200	1	0.2
	110	PCs	150	1	0.15
		Printer	150	1	0.15
	111	PCs	150	1	0.15
		Printer	150	1	0.15
	112	PCs	150	1	0.15
		Printer	150	1	0.15
		TV	500	1	0.5
	113	PCs	150	6	0.9
	Printer	150	1	0.15	
	Water cooler	200	4	0.8	

The percentage energy consumption distribution considering facilities (light fittings, computers, etc.) and equipments installed C. D. Deshmukh Bhavan can be summarized as bellow,

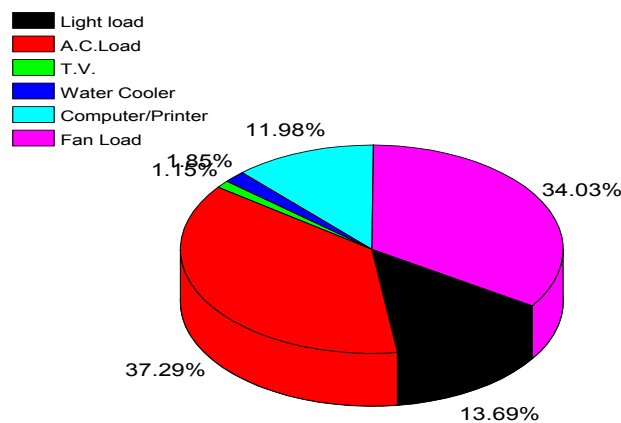


Figure (2) Percentage energy consumption distribution considering facilities such as light fittings, fans, computers, etc.

Remark:

In many cases, the utilization of the area has changed when compared with the building plans. The building has about 159 Fluorescent tube lights in different rooms, corridors, etc. Total numbers of 100 fans are installed in various rooms consuming 34.04 % of electricity of the total power consumption. The major portions of electrical consumption (37.29 %) are due to refrigeration load. The savings could not be quantified due to difficulties in taking measurements. However, considerable potential for energy savings may exist by replacing old air conditioning systems/fans with latest rated and efficient system supplied by the manufacturers. It is estimated that a power managed computer consumes less than half the energy of a computer without power management.

CASE 2

Name of the Building	Zandu Building
Operation hours (day, week, moths)	7.30 am to 9 pm (5 Days a week)
Number of Staff	13
Electricity tariff category	LT IX(A)
Building Age	25 Years
Building Function	Academics, training and research
No of floors	Ground
Gross floor area (m²)	
No. of blocks per floor	
Gross floor area air conditioned (m²)	
Server area (m²) if any	N.A.
Parking area if any (m²)	N.A.
Designed occupant load	
Actual occupant load	

- **Electricity bill history (at least a year)**

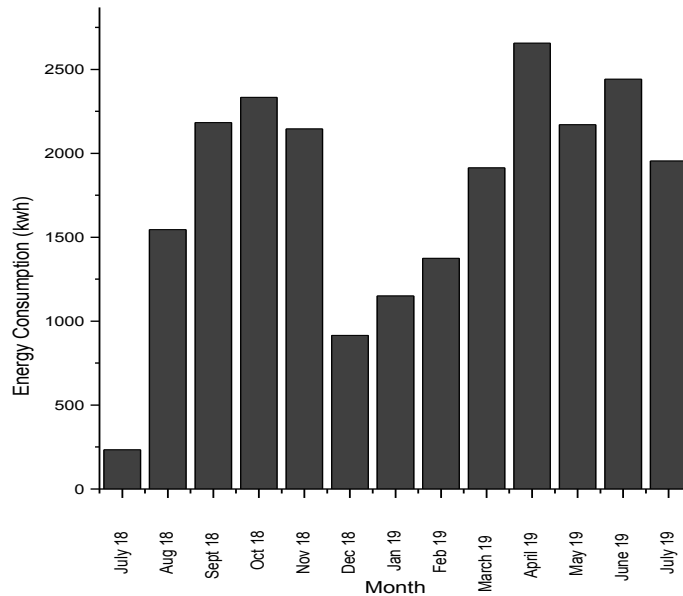


Figure (3) Energy Consumption per month

- **Lighting load details**

Floor	Room No.	LTG. Power (W)	No. of Light	Total KW	Lux Level
Ground	Lab 1	40	8	0.32	150
	Lab 2	20	8	0.16	155
	Lab 3	20	6	0.12	150
	Lab 4	80	2	0.16	150
	MSC Lab	80	4	0.32	150
	Office	80	3	0.24	155
	11	18	32	0.576	160
	12	80	3	0.24	155
	HOD Cabin	20	5	0.1	155
	wash room	40	2	0.08	160
	Passage	20	10	0.2	190

- **Fan load details**

Floor	Room No.	Fan Power (W)	No. of Fan	Total KW
Ground	Lab 1	150	2	0.3
	Lab 2	150	1	0.15
	Lab 3	150	3	0.45
	Lab 4	150	2	0.3
	MSC Lab	150	4	0.6
	Office	150	2	0.3
	11	150	6	0.9
	12	150	1	0.15
	HOD	150	2	0.3

- **Air Conditioning load details**

Floor	Room No.	AC Name	Power (W)	No. of Equip.	Total KW
Ground	Lab 1	Split	1.5	1	1.2
	Lab 2	Split	2	1	2.2
	Lab 3	Split	2	1	2.2
	Lab 4	Split	1.5	1	1.1
	11	Split	1.5	2	3.2s
	HOD	Split	1.5	1	1.2

- **Equipment load details**

Floor	Room No.	Equip. Name	Power (W)	No. of Equip.	Total KW
Ground	Lab 1	Freedge	500	2	1
		Deep Freezer	3000	1	3
	Lab 2	PCs	150	3	0.45
		Assistant	250	1	0.25
		Spectrometer	250	1	0.25
		Tenser M/C	250	1	0.25
	Lab 3	PCs	150	4	0.6
	Lab 4	PCs	150	4	0.6
		Printer	150	3	0.45
	MSC Lab	Big Oven	3000	1	3
		Small Oven	1000	1	1
		auto clave	500	2	1
	Office	PCs	150	2	0.3
		Printer	150	1	0.15
	11	Projector	200	1	0.2
	HOD	PCs	150	1	0.15
		Printer	150	1	0.15
		Water cooler	200	1	0.2

The percentage energy consumption distribution considering facilities (light fittings, computers, etc.) and equipments installed at Zandu building can be summarized as bellow,

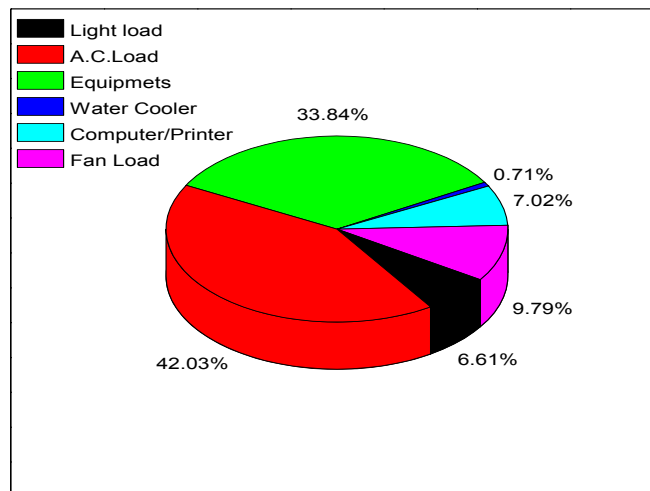


Figure (4) Percentage energy consumption distribution considering facilities such as light fittings, fans, computers, etc.

Remark:

In many cases, the utilization of the area has changed when compared with the building plans. The building has about 85 Fluorescent tube lights in different rooms, corridors, etc. Total numbers of 23 fans are installed in various rooms consuming 9.79 % of electricity of the total power consumption. The major portions of electrical consumption 42.03 and 33.84 % are due to refrigeration load and the equipments installed in building respectively. However, considerable potential for energy savings may exist by replacing old air conditioning systems/fans with latest rated and efficient system supplied by the manufacturers. It is estimated that a power managed computer consumes less than half the energy of a computer without power management. The savings could not be quantified due to difficulties in taking measurements.

CASE 3

Name of the Building	Phirojshah Mehata Bhavan
Operation hours (day, week, moths)	9 am to 5 pm (5 Days a week)
Number of Staff	24
Electricity tariff category	LT IX(A)
Building Age	15 Years
Building Function	Academic purpose
No of floors	Ground + 1
Gross floor area (m²)	
No. of blocks per floor	
Gross floor area air conditioned (m²)	
Server area (m²) if any	N.A.
Parking area if any (m²)	N.A.
Designed occupant load	
Actual occupant load	

- Electricity bill history (at least a year)

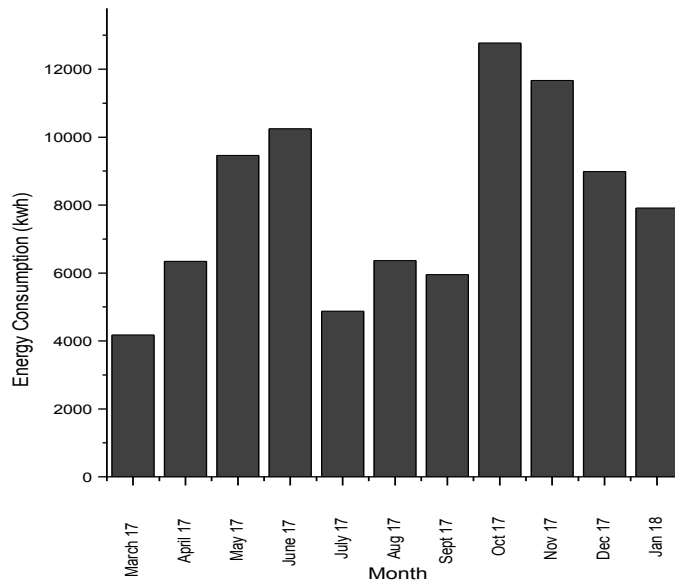


Figure (3) Energy Consumption per month

- Lighting load details

Floor	Room No.	LTG. Power (W)	No. of Light	Total KW	Lux Level	Place of Use (Sq Ft)
Ground	1	80	16	1.28	200	900
	2	80	7	0.56	160	225
	3	80	6	0.48	170	225
	4	80	6	0.48	165	225
	6	80	4	0.32	180	225
	7	80	2	0.16		150
	Auditorium	18	90	1.62	300	3000
		100	30	3		
	Library	80	76	6.08	380	3000
		18	70	1.26		
	12	80	2	0.16	140	120
	13	80	2	0.16	150	120
	15	80	2	0.16	145	225
		18	4	0.072		
	16	80	2	0.16	150	225
		18	4	0.072		
	17	36	8	0.288	155	225
	18	36	32	1.152	180	900
		100	7	0.7		
	Passage	18	90	1.62		
wash room	40	8	0.32			
	18	10	0.18			
1 st Floor	19	80	16	1.28	190	600
	20	80	4	0.32	160	225
	21	80	4	0.32	150	225
	22	80	1	0.08	135	120
		18	2	0.036		
	23	80	1	0.08	145	120
		18	2	0.036		
	25	80	1	0.08	140	120
	18	2	0.036			
	26	80	1	0.08	140	120
		18	2	0.036		
	27	80	1	0.08	145	120
	Conf. room	80	6	0.48	155	450
	34	80	2	0.16	150	120
		18	2	0.036		
	35	80	1	0.08	150	120
		18	2	0.036		
	36	80	1	0.08	155	120
		18	2	0.036		
	38	80	1	0.08	145	120
		18	2	0.036		
39	80	1	0.08	145	120	
	18	2	0.036			
	40	80	4	0.32	150	225
	41	80	4	0.32	150	225
	42	80	16	1.28	150	600

- Equipment load details

Floor	Room No.	Equip. Name	Power (W)	No. of Equip.	Total KW	
Ground	1	PCs	150	6	0.9	
		Printer	150	4	0.6	
	3	PCs	150	3	0.45	
		Printer	150	3	0.45	
	4	Projector	200	1	0.2	
	6	Projector	200	1	0.2	
	Auditorium	Projector	200	2	0.4	
	Library	PCs	150	8	1.2	
	13	Projector	200	1	0.2	
	15	PCs	150	2	0.3	
		Printer	150	3	0.45	
	16	PCs	150	2	0.3	
		Printer	150	3	0.45	
	17	PCs	150	2	0.3	
		UPS	5000	1	5	
	18	Projector	200	1	0.2	
	1 st Floor	19	Projector	200	1	0.2
		20	Projector	200	1	0.2
22		PCs	150	1	0.15	
		Printer	150	1	0.15	
23		PCs	150	1	0.15	
		Printer	150	1	0.15	
25		PCs	150	1	0.15	
		Printer	150	1	0.15	
26		PCs	150	1	0.15	
		Printer	150	1	0.15	
Confrence		Projector	200	1	0.2	
34		PCs	150	1	0.15	
		Printer	150	1	0.15	
35		PCs	150	1	0.15	
	Printer	150	1	0.15		
	38	PCs	150	1	0.15	
		Printer	150	1	0.15	
	39	PCs	150	1	0.15	
		Printer	150	1	0.15	
	42	Projector	200	1	0.2	
	Water cooler	200	4	0.8		

- **Air Conditioning load details**

Floor	Room No.	AC Name	Power (W)	No. of Equip.	Total KW
Ground	3	Split	1.5	1	5.25
	13	Split	1.5	1	5.25
	15	Split	1.5	1	5.25
	16	Split	1.5	1	5.25
	17	Split	1.5	3	15.75
	18	Casset AC	2	4	28
1 st Floor	22	Split	1	1	3.5
	23	Split	1	1	3.5
	25	Split	1.5	1	5.25
	Confrence	Split	1.5	1	5.25
	35	Split	1.5	1	5.25
	36	Split	1.5	1	5.25
	38	Split	1.5	1	5.25
	39	Split	1.5	1	5.25
	40	Split	1.5	1	5.25
	Voltas Unit 1	3 Phase	17	1	20.4
	Voltas Unit 2	3 Phase	17	1	20.4
	Voltas Unit 3	3 Phase	17	1	20.4
	Voltas Unit 4	3 Phase	17	1	20.4
	Voltas Unit 5	3 Phase	17	1	20.4
	Voltas Unit 6	3 Phase	8.5	1	10.2

- **Equipment load details**

The percentage energy consumption distribution considering facilities (light fittings, computers, etc.) and equipments installed Phirojshah Mehata Bhavan can be summarized as bellow,

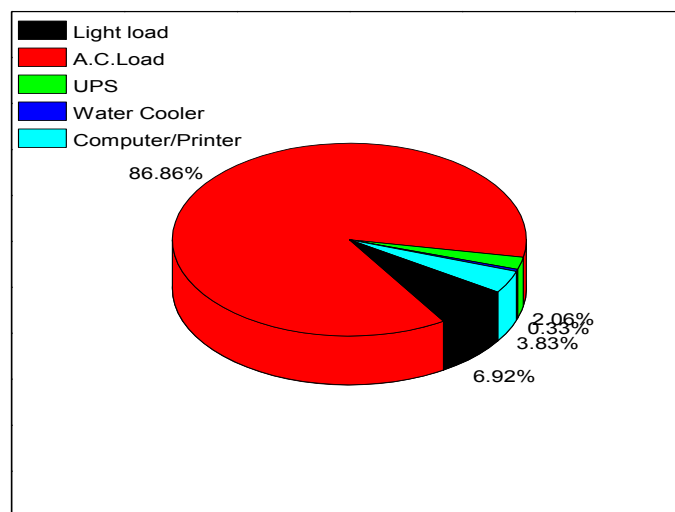


Figure (4) Percentage energy consumption distribution considering facilities such as light fittings, fans, computers, etc.

Remark:

In many cases, the utilization of the area has changed when compared with the building plans. The building has about 546 Fluorescent tube lights in different rooms, corridors, etc. Total numbers of XX fans are installed in various rooms consuming. The major portions of electrical consumption (86.86 %) are due to refrigeration load. The savings could not be quantified due to difficulties in taking measurements. However, considerable potential for energy savings may exist by providing centralized water cooled air conducting systems with latest rated and efficient system supplied by the manufacturers. Also it needed to replace the existing Fluorescent tube light fixtures with the LED, which will dramatically reduce the load shared.

CASE 4

Name of the Building	Savitribai Phule Building
Operation hours (day, week, months)	24 X 7 (Throughout the year)
Number of Staff	6
Electricity tariff category	LT IX(B)
Building Age	25 Years
Building Function	Hostel
No of floors	Ground+2
Gross floor area (m²)	
No. of blocks per floor	
Gross floor area air conditioned (m²)	
Server area (m²) if any	N.A.
Parking area if any (m²)	N.A.
Designed occupant load	
Actual occupant load	

- Electricity bill history (at least a year)

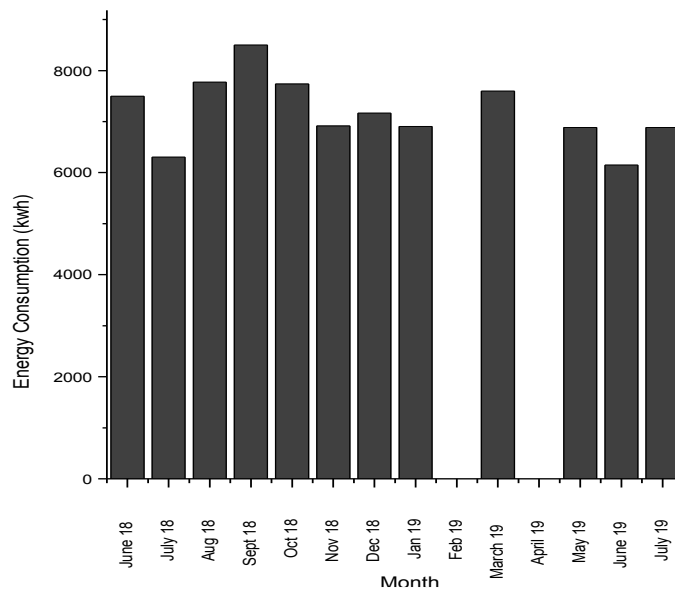


Figure (3) Energy Consumption per month

- **Lighting load details**

Floor	Room No.	LTG. Power (W)	No. of Light	Total KW	Lux Level
	1 to 80	20	2	3.2	140
	Bath room (1 to 10)	20	7	1.4	90
	Coridoor & Passage	20	50	1	85
	Terrace	60	10	0.6	110
	Mess	40	20	0.8	145
	MSC Lab	80	4	0.32	110
	Guest room	20	2	0.04	135

- **Fan load details**

Floor	Room No.	Fan Power (W)	No. of Fan	Total KW
	1 to 80	150	80	12
	Bath room (1 to 10)	150	10	1.5
	Coridoor & Passage	150	16	2.4
	Mess	150	10	1.5
	Gyser in Bath room	3000	20	60
	water cooler	200	3	0.6
	Freedge	500	3	1.5
	Induction M/C	2000	1	2

- **Air Conditioning load details**

Floor	Room No.	AC Name	Power (W)	No. of Equip.	Total KW
		Split	1.5/2	2	3.12

- **Equipment load details**

Floor	Room No.	Equip. Name	Power (W)	No. of Equip.	Total KW
		PCs	150	1	0.15
		Printer	150	1	0.15
		water cooler	200	3	0.6
		Gyser in Bath room	3000	20	60
		Freedge	500	3	1.5
		Induction M/C	2000	1	2

The percentage energy consumption distribution considering facilities (light fittings, computers, etc.) and equipments installed at Savitribai Phule girls hostel can be summarized as bellow,

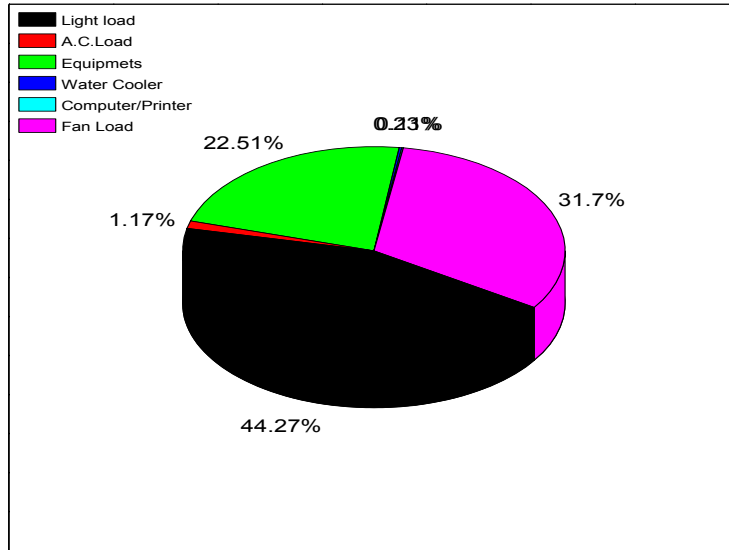


Figure (4) Percentage energy consumption distribution considering facilities such as light fittings, fans, computers, etc.

Remark:

In many cases, the utilization of the area has changed when compared with the building plans. The building has about 136 LED lights in different rooms, corridors, etc. Total numbers of 23 fans are installed in various rooms consuming 31.7 % of electricity of the total power consumption. The major portions of electrical consumption 22.51 % is due to water heaters installed. However, considerable potential for energy savings may be lower down by installing by installing efficient solar water heaters technology supplied by the well reputed manufacturers on the roof of the building. The savings could not be quantified due to difficulties in taking measurements.

- **Energy management recommendation**

In order to streamline the use of energy in the buildings/bhavans audited as well as to ensure its efficient utilization, we propose following possible energy management structures (Final decision of energy management structure suitable should be taken by the University authorities.)

- Appointment of energy manager for the institute in order to monitor day to day energy conservation activities. He will also perform the review of the energy performance of these buildings in order to quantify the savings shared by the electricity.
- Validate the efficient energy use on the campus by providing regular electrical maintenance, implementing energy conservation measures.
- Photo sensors/timers to be installed to trigger the lights provided in all these buildings to utilize the optimum day lighting.
- Natural lighting must be considered for corridors/passages.
- Depending on the utility type, area and the requirements remove the air conditioning systems installed if no longer required.
- Proper yearly servicing for the installed air conditioning systems is recommended.
- Replacement of old (more than 8-10 years) air conditioning systems is recommended.
- The heating load can also be reduced by reducing the consumption by other sources like lights, computers etc.
- Recommended to installed nonconventional energy generation resources (Solar Power Plan) at various areas within the university campus if possible, to minimize the energy bills drastically.