Walk-Through Energy Audit

INTRODUCTION

K S School of Engineering and Management (KSSEM) has evolved and encompassed a unique sense of pride in providing excellence in engineering and management education system in India.

Today, the institution is proudly recognized as one among the top Ranked Engineering Colleges in Bangalore. It has an atmosphere to encourage new research and development areas in pursuit of engineering and managerial excellence in a highly competitive environment.

Established in 2010, K S School of Engineering and Management, Bengaluru, located off Kanakapura Road, provides high level of teaching, research and extension activities in the field of Civil, Mechanical, Electrical, Electronics, Computer Science and Management education.

KSSEM being one of Bengaluru's best ranked Engineering Colleges has staunch commitment towards excellence in education with an Exuberant green campus and Best Infrastructure. The institution has well-equipped Labs, Research Centres, Library, Basketball Court and other Excellent Sports Infrastructure to help in attaining highest standards in academics, research and professional excellence.

KSSEM has focused on its mission:

- Establish state-of-art infrastructure to facilitate effective dissemination of technical and Managerial knowledge.
- Provide comprehensive educational experience through a combination of curricular and experiential learning, strengthened by industry-institute-interaction.
- Pursue socially relevant research and disseminate knowledge.
- Inculcate leadership skills and foster entrepreneurial spirit among students.

The vision of KSSEM is

"*To impart quality education in engineering and management to meet technological, business and societal needs through holistic education and research*"

The objectives of KSSEM are

- To provide world class education in the field of engineering and management.
- To train students to face challenges in corporate and industries.
- To inculcate the attitude of research in engineering and management students.
- To bridge gap between institutions and industries through research and consultancy programmes.

Courses offered in K S School of Engineering and Management are

UG Courses

- Civil Engineering
- Computer Science & Engineering
- Electronics & Communication Engineering
- Electrical & Electronics Engineering
- Mechanical Engineering

PG Courses

- M.Tech- Structural Engineering
- MBA – Master Of Business Administration.

HOSTEL

With the quality of education drawing students from distant places, KSSEM provides residential facilities for both Boys & Girls students. Boy's hostel is in the KSSEM campus itself whereas the girl's hostel is near the KSIT college. Reading room, recreation centre, Wi-Fi facility, weekend movies, celebrating festivals etc all make the stay enjoyable. The Hostels are also provided with solar heater and good Cooking accessories. There is a warden appointed to look after the day-to-day working of the Hostel and the discipline of boarders. They will work under the general guidelines of the Director/Principal, who has the discretion to refuse admission to any student, if they are not satisfied with the conduct and progress of the particular student. The number of students in boy's hostel is listed below.

Facility	No. Of Rooms	No. Of Students
Boys Hostel	110	370

ENERGY CONSERVATION GROUP

KSSEM is green and very environment conscious. Keeping in view of environment policy and need to conserve energy it has set up energy conservation group. The main role of energy conservation group is to conduct energy audit and suggest suitable measures to conserve energy and promote the use of renewable energy.

WALK THROUGH ENERGY AUDIT

Walk through energy audit was carried out to understand the electrical energy usage in different parts of the KSSEM. The campus consists of 7 acres and houses K S School of Engineering and Management, K S School of Architecture and K S Boys Hostel. K S School of Engineering and Management consist of two block namely Main block and Visveswaraya block (New block). Walk through energy audit is carried out for KSSEM, Boys hostel and Estate. It consist of Principal and administrative office, Department of Civil Engineering, Department of Computer Sciences and Engineering, Department of Electrical and Electronics Engineering, Department of Mechanical Engineering, Department of Business administration, Department of Basic Sciences,

associated labs, class rooms and library. Amenities include canteen, basketball court, indoor badminton courts and parking area. To carry out energy auditing following points where decided to be considered

1. Identification of various departments.
2. To identify different types of loads.
3. Collection of data relating to the loads in various departments.
4. Tabulation of collected information department wise.
5. Computation of connected loads and energy consumed department wise.
6. To understand Electric energy usage pattern by analysing electricity bills for the period August 2020 and July 2021.
7. Identification of energy conservation opportunities.
8. Suggestions and recommendations.

Departments

For the purpose of energy auditing following departments are identified

1. Principal office – Office of the principal.
2. Admin Section – This includes accounts, exam section and admissions.
3. Basic Sciences – This includes HOD chamber, staff rooms, class rooms and labs
4. Department of Civil Engineering – This includes HOD chamber, staff rooms, class rooms and labs
5. Department of Computer Science and Engineering - This includes HOD chamber, staff rooms, class rooms and labs.
6. Department of Electrical Engineering - This includes HOD chamber, staff rooms, class rooms and labs.
7. Department of Electronics and Communication Engineering - This includes HOD chamber, staff rooms, class rooms and labs.
8. Department of Mechanical Engineering - This includes HOD chamber, staff rooms, class rooms and labs.
9. Department of MBA - This includes HOD chamber, staff rooms, class rooms and labs.
10. Boys Hostel
11. Canteen
12. Estate

Types of Electrical Loads

To compute department- wise connected load, the load where classified into following categories.

1. Illumination: This includes all type of lighting fixtures
2. HVAC: This includes all fans and ACs.
3. Computer and peripherals: This includes CPU, monitor, printer and projector.
4. Electronic devices and Lab equipments: This includes all electronics lab equipments like CROs, function generator, power supplies, trainer kits, different types of motors used in different labs and campus

Table 1 Major types of Loads in campus

Sl No.	Type of Load	Ratings
1	Tubelight	40 W, 36 W, 20W
2	LED	15 W
3	Computer with LCD monitor	100 W
4	Ceiling fan	75 W
5	Water pumps	15 hp, 7.5 hp, 5hp
6	Lab equipments	Various ratings

Type of Nature of power supply

There are two sources of power for the campus 1) BESCOM Supply and 2) Captive Diesel Generator Unit.

The BESCOM power comes to substation situated between Main block and Visveswaraya block. It consists of step down transformer 11KV/415V. This is also the metering point for the BESCOM.

The captive diesel generator plant is also situated near the substation. Its capacity is 3-phase, 415 V, 200 kVA, 160KW. These generator is used when BESCOM supply is not available.

Collection of Data

Table 2 Collected data from different departments of KSSEM

Sl. No	Department	Illumination (Load in kW)	HVAC (Load in kW)	Computers &Peripherals (Load in kW)	Lab equipments (Load in kW)	Total load in kWh (for 1 hr)
1	EEE	6.60	4.95	1.50	167.00	180.05
2	ECE	3.48	5.40	2.70	3.40	14.98
3	CSE	3.92	6.82	17.60	1.50	29.84
4	Civil	14.20	11.17	2.10	50.00	77.47
5	Mechanical	8.48	8.55	10.00	105.00	132.03
6	Basic Science	2.40	4.28	0.70	3.00	10.38
7	MBA	1.40	1.00	3.00	4.00	9.40
8	Boys hostel				30.00	30.00
9	Library	4.00	4.00	2.00		10.00
10	Principal office	0.10	0.10	0.20		0.40
11	Admin Office	0.60	0.60	3.00		4.20
13	Estate	2.5				2.5
14	Lift				45.00	45.00
	Total kWh	47.18	42.87	39.30	363.90	563.75

The major connected loads in KSSEM Campus are classified into 5 major categories namely illumination, HVAC, Computers and peripherals and Lab equipments as shown in fig 1.

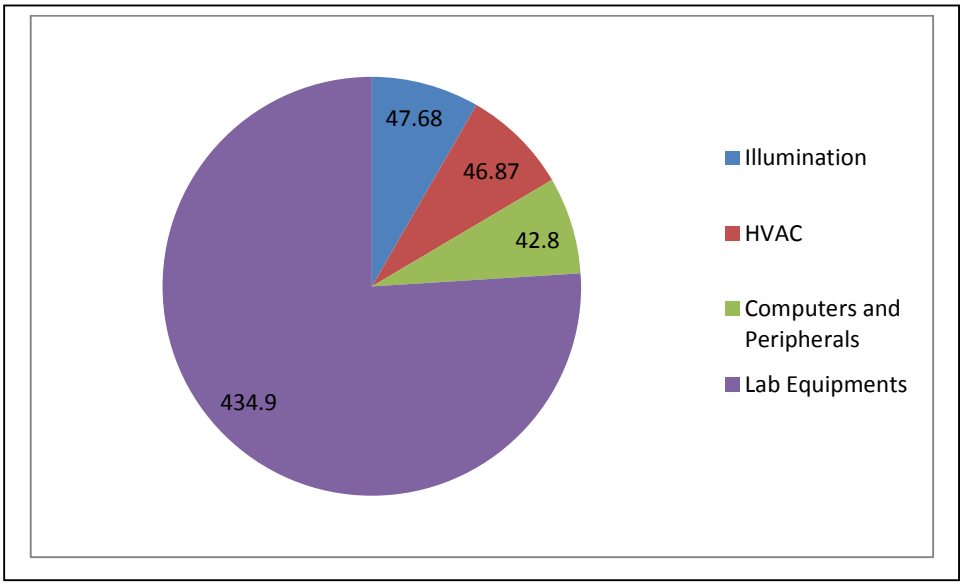


Fig: 1 Pictorial representations of loads connected in different departments

Principal Office

Table 3: Energy consumed by various loads in **Principals office**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	0.1	6	0.6	23	13.8
2	HVAC	0.1	4	0.4	23	9.2
3	Computers and Peripherals	0.2	4	0.8	23	18.4
4	Lab equipments				23	0
	Total	0.4		1.8	23	41.4

Admin Section

Table 4: Energy consumed by various loads in **Admin section**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	0.6	3	1.8	23	41.4
2	HVAC	0.6	2	1.2	23	27.6
3	Computers and Peripherals	1.2	7	8.4	23	193.2
4	Lab equipments			0	23	0
	Total	4.2		11.4	23	262.2

Department of Electrical and Electronics Engineering

Table 5: Energy consumed by various loads in **Department of EEE**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	6.6	1	6.6	23	151.8
2	HVAC	5	2	10	23	230
3	Computers and Peripherals	2	3	6	15	90
4	Lab equipments	167	1	167	5	835
	Total			189.6		1306.8

Department of Electronics and Communication Engineering

Table 6: Energy consumed by various loads in **Department of ECE**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	3.5	3	10.5	23	241.5
2	HVAC	5.4	4	21.6	23	496.8
3	Computers and Peripherals	2.7	3	8.1	23	186.3
4	Lab equipments	3.4	3	10.2	23	234.6
	Total	14.98		50.4		1159.2

Department of Computer Science and Engineering

Table 7: Energy consumed by various loads in **Department of CSE**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	4	3	12	23	276
2	HVAC	7	4	28	23	644
3	Computers and Peripherals	17.6	3	52.8	23	1214.4
4	Lab equipments	1.5	3	4.5	23	103.5
	Total			97.3		2237.9

Department of Civil Engineering

Table 8: Energy consumed by various loads in **Department of Civil Engineering**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	14.2	3	42.6	23	979.8
2	HVAC	11.2	2	22.4	23	515.2
3	Computers and Peripherals	2.1	3	6.3	15	94.5
4	Lab equipments	50	1	50	5	250
	Total	77.5		121.3		1839.5

Department of Mechanical Engineering

Table 9: Energy consumed by various loads in **Department of ME**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	8.5	3	25.5	23	586.5
2	HVAC	8.6	2	17.2	23	395.6
3	Computers and Peripherals	10	3	30	15	450
4	Lab equipments	105	1	105	5	525
	Total	132.1		177.7		1957.1

Department of Basic Science

Table 10: Energy consumed by various loads in **Department of BS**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	2.4	3	7.2	23	165.6
2	HVAC	4.3	4	17.2	23	395.6
3	Computers and Peripherals	0.7	3	2.1	23	48.3
4	Lab equipments	3	3	9	23	207
	Total	10.4		35.5		816.5

Department of Master of Business Administration

Table 11: Energy consumed by various loads in **Department of MBA**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	1.4	3	4.2	23	96.6
2	HVAC	1	4	4	23	92
3	Computers and Peripherals	3	3	9	23	207
4	Lab equipments			0	23	0
	Total	5.4		17.2		395.6

Hostel

Table 12: Energy consumed by various loads in **Hostel**

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	2.5	6	15	30	450
2	HVAC	5.4	7	37.8	30	1134
3	Computers and Peripherals	3.5	3	10.5	30	315
4	Kitchen equipments	25	5	125	30	3750
	Total	36.4		188.3		5649

Estate

Table 13: Energy consumed by various loads in Estate

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	2.5	10.0	25.0	30	750
2	HVAC			0	30	0
3	Computers and Peripherals			0	30	0
4	Water Pump motors	13.0	3	39.0	30	1170
	Total			64.0	120	1920

Canteen

Table 14: Energy Consumed by various loads in Canteen

Sl No.	Type of load	Connected Load in kW	Duration of use in hours per day	Energy Consumed in KWh	Number of days of Usage in a month	Energy Consumed per month in KWh
1	Illumination	3	7	21	23	483
2	HVAC			0		0
3	Computers and Peripherals			0		0
4	Kitchen Equipments	17	6	102	23	2346
	Total	20		123		2829

Consolidated Energy consumption

Table 15: Consolidated Energy Consumed for a month

Sl No.	Department	Illumination load in KWh	HVAC load in KWh	Computers and Peripherals KWh	Lab equipments load in KWh	Total load in KWh
1	Principal Office	13.8	9.2	18.4	0	41.4
2	Admin Section	41.4	27.6	193.2	0	262.2
3	Department of EEE	151.8	230	90	835	1306.8
4	Department of ECE	241.5	496.8	186.3	234.6	1159.2
5	Department of CSE	276	644	1214.4	103.5	2237.9
6	Department of CV	979.8	515.2	94.5	250	1839.5
7	Department of ME	586.5	395.6	450	525	1957.1
8	Department of BS	165.6	395.6	48.3	207	816.5
9	Department of MBA	96.6	92	207	0	395.6
10	Hostel	450	1134	315	3750	5649
11	Estate	750	0	0	1170	1920
12	Canteen	483	0	0	2346	2829
	Total	4236	3940	2817.1	9421.1	20414.2

Considering 23 working days in a month the energy consumed in various departments are shown in Table 3 to Table 14. Table 15 gives the consolidated statement of the energy consumed from the various departments. Figures 2 to 7 gives the load distribution in various departments.

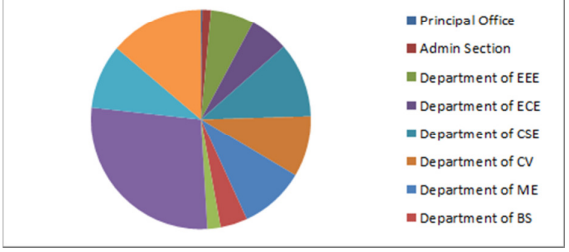


Fig 2

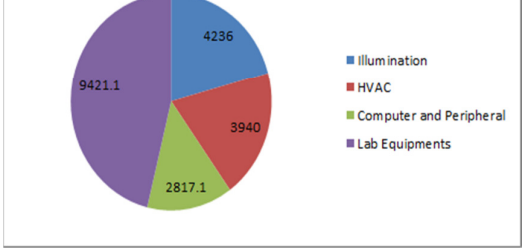


Fig 3

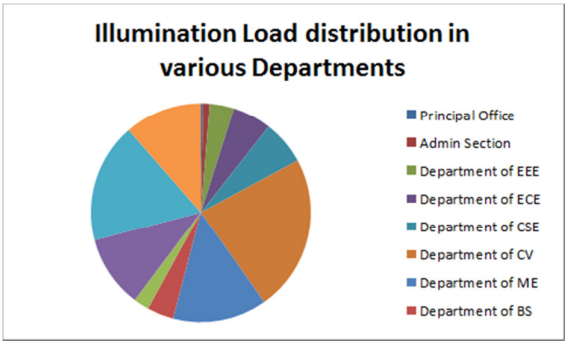


Fig 4

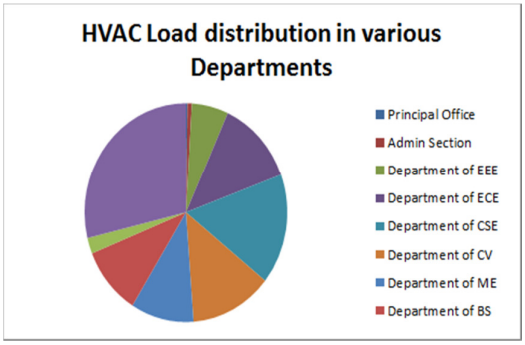


Fig 5

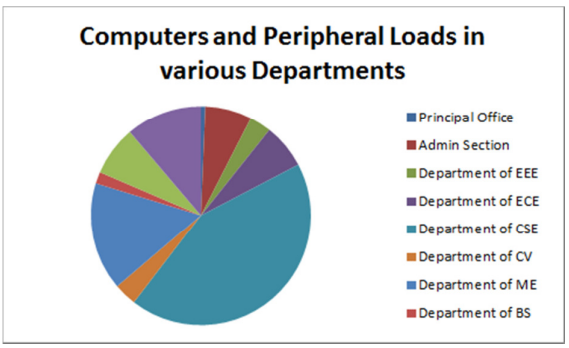


Fig 6

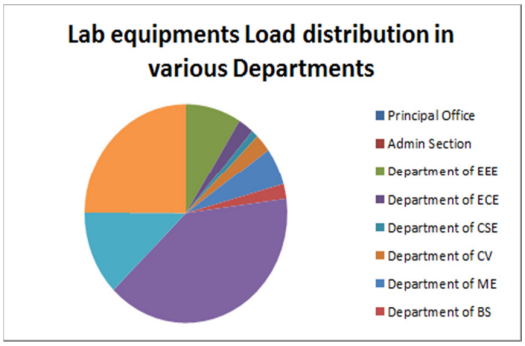


Fig 7

Table 15: Electricity billing data for the year 2020-21

Sl No.	Billing date	Month	Demand in KVA incurred	Demand Charges per KVA in Rs.	Recorded KVA	Total Demand Charges in Rs.	Energy Consumed in kWh	Energy charges per kWh in Rs.	Total Energy charges in Rs.	Power factor pf	Pf Surcharge	Total amount including tax in Rs.
1	1-08-2020 to 1-09-2020	August	128	210	71	26880	15985.5	7.85	125486.18	0.96		165678.00
2	1-09-2020 to 1-10-2020	September	128	210	86	26880	17582.25	7.85	138020.66	0.95		180236.00
3	1-10-2020 to 1-11-2020	October	128	210	71	26880	14993.25	7.85	117697.01	0.96		138866.00
4	1-11-2020 to 1-12-2021	November	128	220	64	28160	14027.25	8.10	113620.73	0.96		153829.00
5	1-12-2020 to 1-01-2021	December	128	220	76	28160	17009.25	8.10	137774.93	0.95		179695.00
6	1-01-2021 to 1-02-2021	January	128	220	94	28160	24.31.50	8.10	194655.15	0.95		242357.00
7	1-02-2021 to 1-03-2021	February	128	220	89	28160	27549	8.10	223146.9	0.94		273694.00
8	1-03-2021 to 1-04-2021	March	128	220	98	28160	31538.25	8.10	255459.83	0.92		306711.20
9	1-04-2021 to 1-05-2021	April	128	220	101	28160	28179	8.10	228249.9	0.89	845.37	277898.00
10	1-05-2021 to 1-06-2021	May	128	220	62	28160	18633	8.10	150927.3	0.85	2794.95	177469.00
11	1-06-2021 to 1-07-2021	June	128	240	69	30720	18313.5	8.20	150170.7	0.87	1648.21	186898.00
12	1-07-2021 to 1-08-2021	July	128	240	92	30720	23748.75	8.20	194739.75	0.88	1424.93	232637.00

As per the electricity billed by BESCOM for the year 2020-21 given in table 15, the contract demand is 150 KVA. The base demand for billing is 85% of the contract demand which is 128 KVA. It is observed that the energy consumption has never exceeded the base demand. For the month of August to October demand charges is Rs. 210/KVA. For the month of November to May the demand charges is Rs. 220/KVA. The energy charges for the month of August to October are Rs. 7.85 and for the month of November to May is Rs. 8.10. The pattern of energy consumed for the year 2020-21 is shown in fig 16.

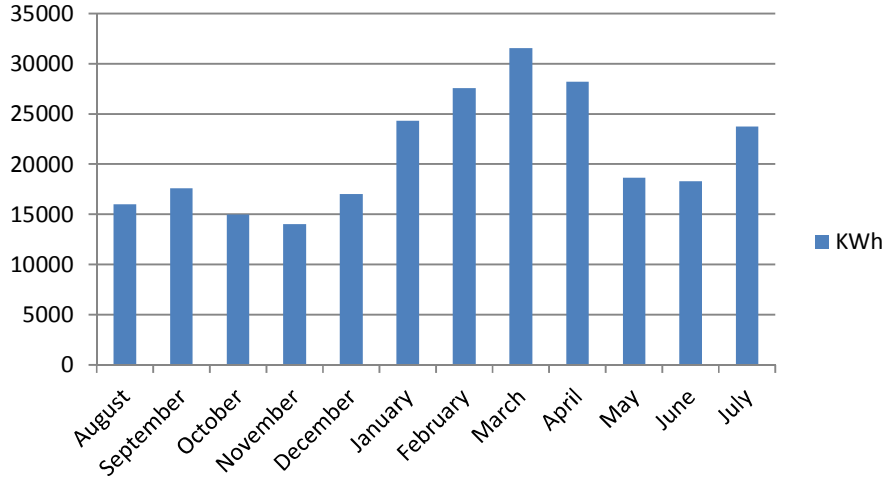


Fig 16 Energy consumed in kWh for the year 2020-2021.

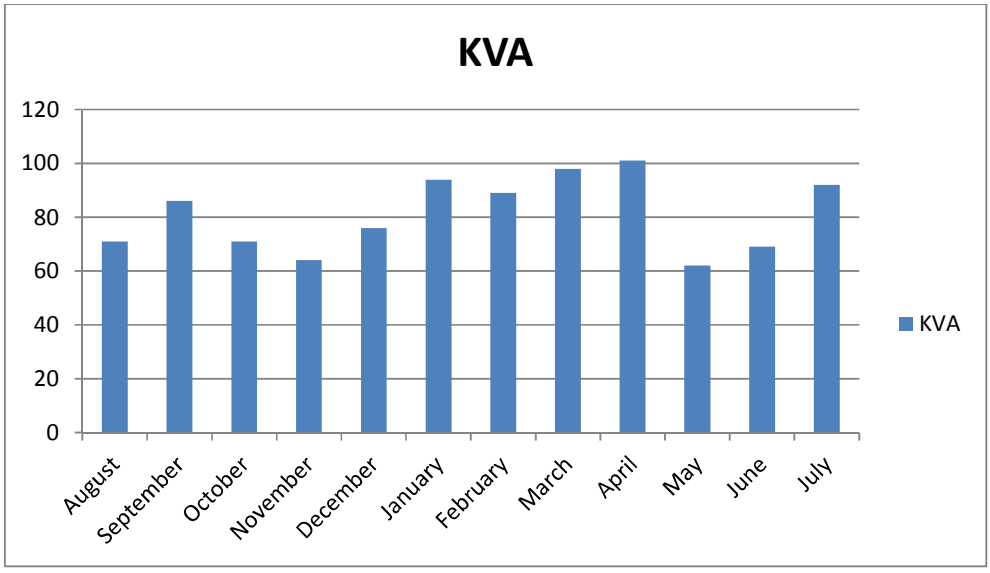


Fig 17 KVA demand for the year 2020-2021.

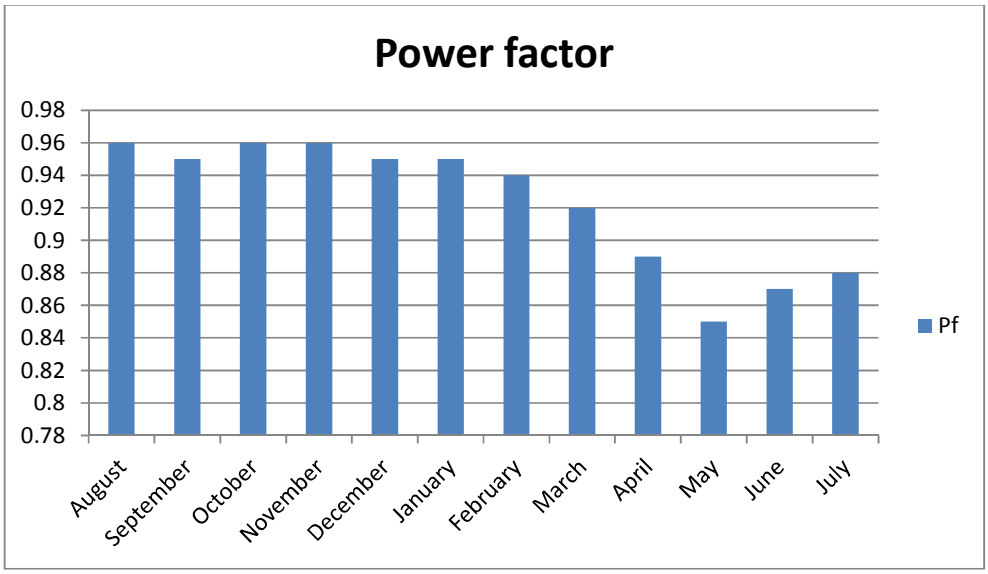


Fig 18 Variation of power factor for the year 2020-2021.

Figure 17 and 18 gives the variation of KVA and power factor for the year 2020 to 2021.

Energy Conservation Opportunities.

Lights

- Replace fluorescent bulbs with ENERGY STAR®LED bulbs.
- Use windows or skylights for daylight, with ways to control excessive light and/or glare.
- Turn lights off when you're not around, and let windows provide light where possible.
- Reduce the use of over head lighting where possible and use task lighting instead.
- Install occupancy sensors to shut off lights when rooms are not in use.

HVAC (Heating ventilating & Air Conditioning)

- Make sure doors and windows have tight seals. Keep them closed when running your air conditioning system.
- Turn off fans when the room is unoccupied.
- Check equipment regularly (burners, coils, air filters, duct, etc.) for proper operation and maintenance needs.
- Use ENERGY STAR qualified roofing material with high reflectance.
- When replacing heating or cooling systems, choose ENERGY STAR equipment.

Equipment/ Devices

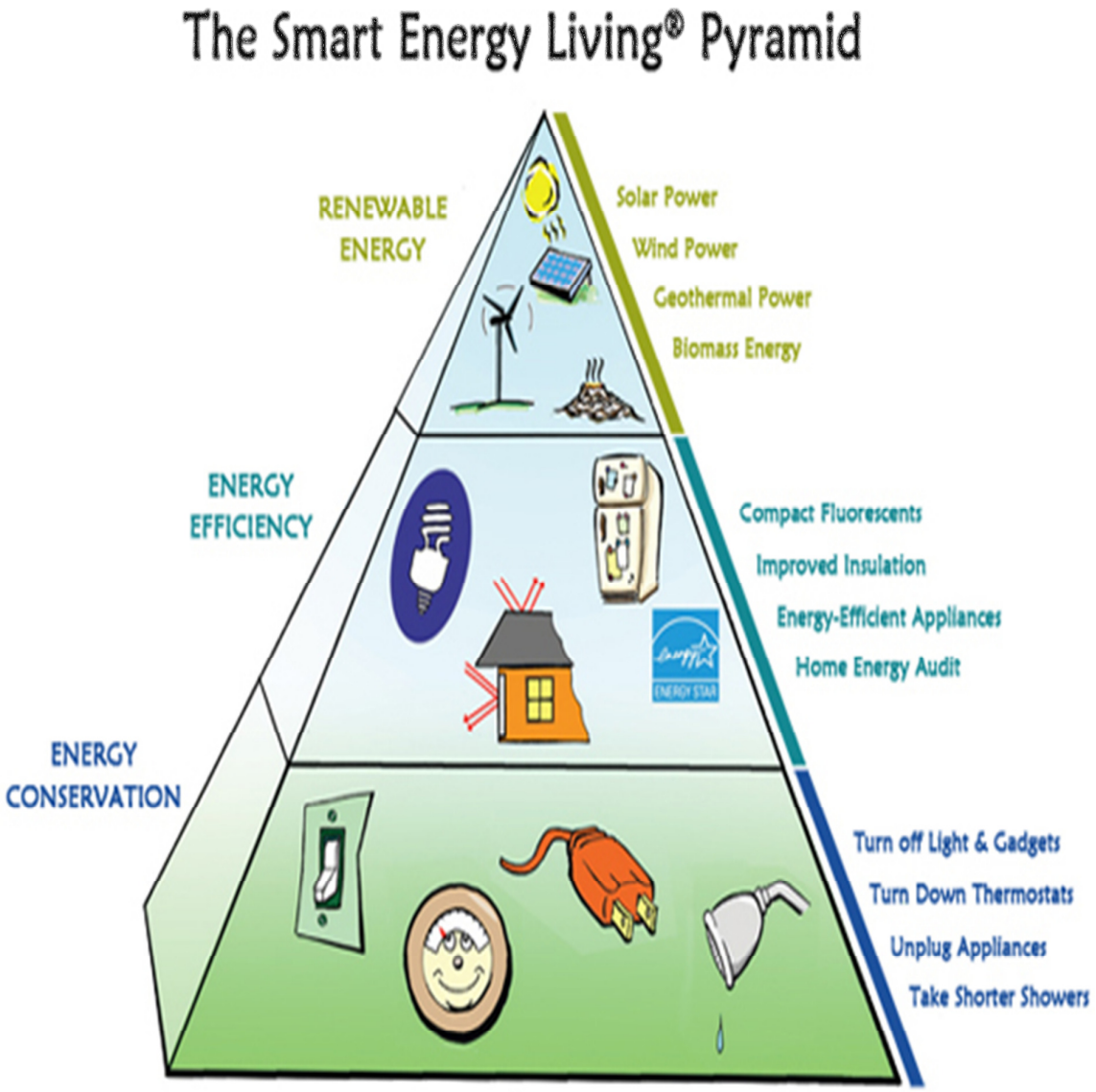
- Turn off printers, copiers, and coffee makers, etc., at the end of the day, and turn off desk lamps when not in use.
- Activate "sleep" mode on computers and monitors.
- An ENERGY STAR labelled laptop or desktop computer uses as much as 65% less electricity than computers without the ENERGY STAR label.

Motors & Pumps

- Energy-saving ENERGY STAR qualified commercial equipment is available for all types of motors & pumps appliances used for water pumping & Labs. The initial investment will typically be returned in savings quickly.

Suggestions and Recommendations.

- It is widely and commonly suggested to use **Star Rated or BEE** rated electrical equipments.
- **Advanced Power Strips**-When your electronics are off, they may still use power. And you pay for it. An Advanced Power Strip (APS) shuts off the power for you.
- **Sealing & Insulation**-Sealing and insulating the building is often the most cost effective way to improve energy efficiency and comfort in building.
- **Data Centres & IT**-Server rooms and classroom computer stations consume energy, even when not in use. Make a **smart switch** to energy-efficient options and state-of-the-art cooling methods to save on these "hidden costs".
- **Solar-Parking Area**- Solar Panels are used as a roof for the vehicles parking and the power generated by the solar panels can be used for outdoor lightings, by which we can reduce the maximum amount of lighting charges.
- **Solar Power Generation unit** can be made on the rooftops of the building; approximately around 250 KW of power can be generated by the usable roof space on the buildings. Further that power can be used for building load and the excess power can be fed back to the GRID/ BESCOM using NET Metering.
- **Solar Water Pumps -** Installation or Replacement of water pumps to solar water pumps for water pumping and other necessities.
- **Solar Street Lights** can be used for outdoor illuminations.
- UPS usage should be limited to Computers & peripherals only.
- For single phase load **off-line UPS** has to be used. Whereas, for three phase load **on-line UPS** should be preferred**.**



"A Country's progress is adjudged based on the per capita Consumption of Renewable Energy"