CRITERIA 7.1.6

1. GREEN AUDIT, ENVIRONMENT AUIDT & ENERGY AUDIT REPORTS

2. CERTIFICATION OF AUDITING AGENCY

3. AWARDS AND RECOGNITIONS

4. BEYOND CAMPUS ENVIRONMENT PROMOTION ACTIVITIES

CRITERIA 7.1.6

GREEN AUDIT, ENVIRONMENT AUIDT & ENERGY AUDIT REPORTS

a) Audit Report 2020
b) Audit Report 2018
c) Audit Report 2015

ENERGY , GREEN AND ENVIRONMENTAL -AUDIT – 2020

SAHRDAYA COLLEGE OF ENGINEERING AND TECHNOLOGY
Kodakara, Thrissur
Kerala

EXECUTED BY

ATHUL ENERGY CONSULTANTS PVT LTD
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January 2020

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ACKNOWLEDGEMENTS

We express our sincere gratitude to the **Sahrdaya College of Engineering and Technology** for giving us an opportunity to carry out the project of Green, Energy Audit and Environmental. We are extremely thankful to all the staffs for their support to carry out the studies and for input data, and measurements related to the project of audits.

1. Executive Director
2. Principal
3. Staff
4. Students

Also congratulating our Energy audit team members for successfully completing the assignment in time and making their best efforts to add value.

ELECTRICAL SAFETY & ENERGY AUDIT TEAM

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   Registered Energy Auditor of Bureau of Energy Efficiency (BEE – Govt. of India)
   Accredited Energy Auditor No – EA 7597

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   Registered Energy Manager of Bureau of Energy Efficiency (BEE – Govt. of India)
   Energy Manager No – EA 25612

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ATHUL ENERGY CONSULTANTS PVT. LTD.
THRISSUR
680 020

Yours faithfully

Managing Director
Athul Energy Consultants Pvt Ltd

EXECUTIVE SUMMARY

1. ANNUAL ENERGY CONSUMPTION

Annual cost for energy consumption during last 12 months (Feb-2019 to Jan-2020).

Particulars	Unit	Quantity	Average Cost (Rs Lakhs)
Electricity	kWh	510697	49.20

TABLE 1: ANNUAL ENERGY COST

2. ENERGY SAVING PROPOSALS

The following table shows the energy saving proposals

Sl. no	Energy conservation measures	Annual Energy Savings	Annual Financial Savings	Investment	Simple payback period
		kWh	**Rs**	**Rs**	**Months**
1	Improving the power factor		142074	20000	02
2	Replacement of ceiling fans with BLDC fans	5880	39455	250000	76
3	Replacement of Fluorescent tubes with energy efficient LED lights	17136	114983	750000	79
Total		**23016**	**296512**	**1020000**	

TABLE 2: ENERGY SAVING PROPOSALS

3. AUDIT SUMMARY - ACTIONS

The actionable summary of the audit report is given in the table below.

Sl No:	Particulars	Location	Action to be taken	Remarks
1	Power factor improvement	Main distribution panel	Replace the faulty capacitors in the APFC panel	Which results in increasing the rate of incentives as well as reduce the demand charges
2	Replacement of ceiling fans with BLDC fans	Classrooms, Staff rooms	Change the existing old ceiling fans with BLDC fans	Energy consumption will come down
3	Replacement of old split AC with New 5 star rated ones	Computer Labs, Office Rooms	Change the old existing ACs with 5 star ACs.	Energy consumption will come down
4	Replacement of old split AC with new Inverter AC	Server Room	Change the existing AC to Inverter type AC for less power consumption	In Server room AC is working continuously and the payback period will immediate
5	Replacement of Fluorescent lights with LED	Class rooms, Staff rooms	Replace with LED lights.	Energy consumption will come down

TABLE 3: ENERGY AUDIT SUMMARY – ACTIONS

4. ENERGY AUDIT SUMMARY & RECOMMENDATIONS

The summary of the report with respect to each section is as follows.

1. Electricity consumption analysis:

- **Demand analysis:** The demand analysis gives an output that recorded maximum demand in the last 12 months was always above the minimum value which is 75% of the contract demand. In some months it came as above the contract demand and having the excess demand charges.

- **Power factor analysis:** For last month, the pf was found to be low and the rate of getting incentives becomes low. Before that the pf was maintained as 0.99 or unity.

2. Electricity performance

- **Voltage:** The Voltage found to be low at the time of audit and unbalance was observed.
- **Capacitors:** From the analyzation of active and reactive power with Power factor, the present installation method of capacitors at the transformer end, is not satisfactorily maintained. By replacing the existing inline capacitors with APFC panel at the Main Switch board in both transformers, will optimize the PF to near unity.
- **Air conditioners:** Replacement of old AC's with new energy efficient star rated AC's.
- **Light loads:** Majority of the lighting fixtures are fluorescent type (T12). By replacing these loads with LED light fittings will reduce the overall power consumption.
- **Ceiling fan loads:** Ceiling fans are installed in majority of the areas by replacing it with Brushless DC fans which consumes in the range of 25 to 30W at full speed, instead of 70W in normal fans, will reduce the power consumption considerably. Also while purchasing new fans priority should be given for BLDC.

5. ENERGY PERFORMANCE INDEX (EPI)

EPI was based on the energy consumption in Feb-19 to Jan-20. The futuristic energy consumption after the implementation of energy saving proposals is given in the tables below.

Parameters	Values
Present Annual Electricity Consumption (kWh/year)	5,10,697
Present Specific Electricity Consumption (kWh/M^2)	97.63
After Energy Saving Implementation	
Annual electricity consumption (kWh/year)	4,87,681
Present Specific Electricity Consumption (kWh/M^2)	93.22
Electricity Savings in %	4.51
Total cost Savings in %	**6.03**
Reduction in CO_2 emission through electricity optimisation (Tons/annum)	**11.51**

TABLE 4: ENERGY INDEX

6. GENERAL DETAILS

The general details of the Sahradaya College are given below in table.

Sl.No:	Particulars	Details
1	Name of the College	Sahrdaya College of Engineering & Technology
2	Address	Kodakara , PB No: 17 Thrissur - 680684
3	Contact Person	Vini Jose
4	Contact Phone numbers & Fax	0480-2726630, 2759275 0480-2726634 (Fax)
5	E-mail ID	info.sahrdaya@gmail.com
6	Website Details	www.sahrdaya.ac.in
7	Type of Building	Educational Institution
8	Annual Working Days	210
9	No: of Shifts	Day Shift (One) (9AM -4PM)
10	Total Build up Area	56303 SQ,FT

TABLE 5: GENERAL DETAILS

7. ENERGY AUDIT

OBJECTIVES

An energy audit is a key to assessing the energy performance of facility and for developing an energy management program. The typical steps of an energy audit are:

- Preparation and planning
- Data collection and review
- Plant surveys and system measurements
- Observation and review of operating practices
- Data documentation and analysis
- Reporting of the results and recommendations

1.1. Definition of energy auditing

In the Indian Energy Conservation Act of 2001 **(BEE 2008)**, an energy audit is defined as: **"The verification, monitoring and analysis of the use of energy and submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energyconsumption."**

1.2. Objectives of Energy Auditing

The objectives of an energy audit can vary from one plant to another. However, an energy audit is usually conducted to understand how energy issued within the plant and to find opportunities for improvement and energy saving. Sometimes, energy audits are conducted to evaluate the effectiveness of an energy efficiency project or program. In Royal College of Engineering and Technology as per the request, we have assessed the energy consumption and saving opportunities at present scenario.

Methodology for the study

The methodology adopted for energy audit starts from historical energy data analysis, power quality analysis, monitoring of operational practices, system evaluation, cost benefit analysis of the energy conservation opportunities, and prepare plan for implementation. The proposals given in the report includes economical energy efficiency measures to reduce facilities unnecessary energy consumption and cost. The energy conservation options, recommendations and cost benefit ratio, indicating payback period are included in this report.

Details Work

The Scope of Work includes:

1. Historical energy data analysis.
2. Electrical, Mechanical and Thermal energy analysis.
3. Power Quality Analysis.
4. Identification of Energy saving opportunities.
5. Cost Benefit Analysis.

SAHRUDAYA COLLEGE

Irinjalakuda Diocese was established in the year 1978, and His Excellency Mar James Pazhayattil took over the reins as the first Bishop of this Diocese. Irinjalakuda Diocese is doing an excellent service meeting the needs of Education, Health and Social responsibilities. Considering the demands on the necessity of value based higher technical education, the people of the Diocese decided to establish an Engineering college to mark The Episcopal Silver Jubilee Year of His Excellency Bishop Mar James Pazhayattil and Silver Jubilee of the formation of the Diocese of Irinjalakuda. The Irinjalakuda Diocesan Educational Trust was formed and registered on 23-07-2001 with Reg. No: 138/IV 2001 at Irinjalakuda registration office with His Excellency Mar James Pazhayattil as Chairman, Rev. Msgr. Sebastian Ezhekadan as President, Rev. Fr. Joseph Thekkethala as Secretary, Rev.Fr. Pius Chirapanath as Finance Officer. With land holding about 40 acres, the Trust submitted the application form for establishing Sahrdaya College of Engineering and Technology at Kodakara, to the Government of Kerala, University of Calicut and AICTE, New Delhi through the Regional Office. By the Grace of God, the AICTE, New Delhi in its letter dated 06-06-2002, sanctioned the establishment of **Sahrdaya College** at Kodakara, to run the four B. Tech Degree courses leading to Electronics and Communication Engineering, Computer Science and Engineering, Biomedical Engineering and Biotechnology (Engineering) with an intake of 60 students in each of the courses from the academic year 2002-2003.

The Government of Kerala included the **Sahrdaya College** as one of the engineering colleges to which the students have to be admitted by the Commissioner of Entrance Examination from the year 2002-2003 in the four branches sanctioned by the AICTE. On 21st November 2001 His Excellency Mar James Pazhayattil laid the foundation stone for central building of Sahrdaya College. Architects Mayphils from Ernakulam prepared the master plan for the college and detail plan for the individual buildings. On 22/02/2002 His Excellency Mar James Pazhayattil laid the foundation stone for the workshop and hostel building in the campus. In a short span of seven months the central building, workshop and hostel block were completed in all respects.

Vision of College

Evolve as a leading technology institute to create high calibre leaders and innovators of global standing with strong ethical values to serve the industry and society.

Mission of College

Provide quality technical education that transforms students to be knowledgeable, skilled, innovative and entrepreneurial professionals. Collaborate with academia and industry around the globe, to strengthen the education and research ecosystem. Practice and promote high standards of professional ethics, good discipline, high integrity and social accountability with a passion for holistic excellence.

Quality Policy of College

Sahrdaya are committed to provide quality technical education through continual improvement and by inculcating moral and ethical values to mould vibrant engineers with high professional standards.

They impart the best education through the support of competent and dedicated faculty, excellent infrastructure and collaboration with industries to create an ambience of excellence

Departments

- Civil Engineering
- Mechanical Engineering
- Computer Science and Engineering
- Electrical and Electronics Engineering
- Electronics and Communication Engineering
- Applied Science and Humanities Department
- Biomedical Engineering
- Biotechnology Engineering

SINGLE LINE DIAGRAM

The following figure shows the basic single line diagram of the Sahrdaya College.

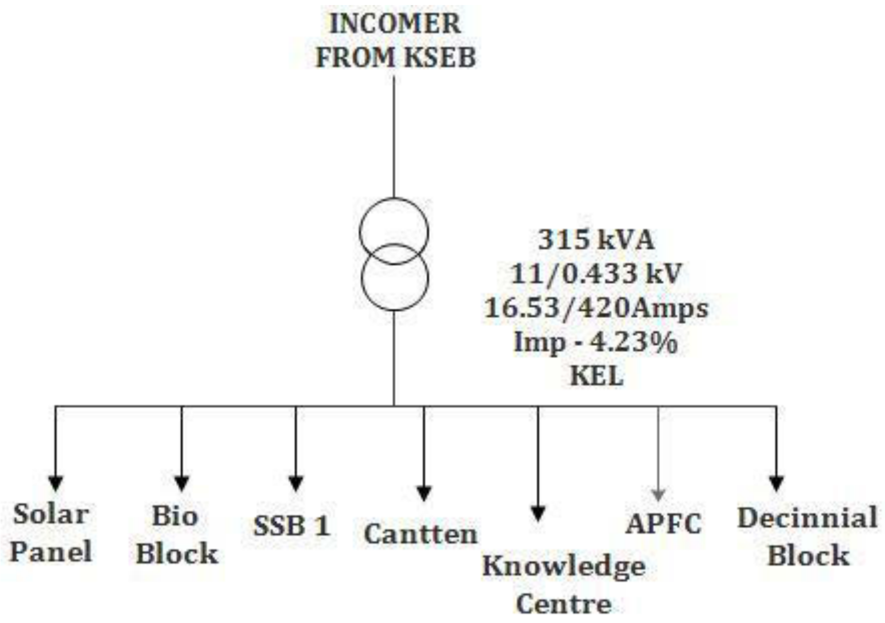


FIGURE 1: SINGLE LINE DIAGRAM

CONNECTED LOAD DETAILS

SL.No:	Location	Power (kW)
1	Decennial Block	27.9
2	Main Block	25.63
3	Biotechnology Block	26.9
4	Mens Hostel	70.5
5	Ladies Hostel	32.5
6	Knowledge Centre	25.6
7	Audi + Campus	15.2
8	PG Hostel	20.5
TOTAL		244.73

ELECTRICITY CONSUMPTION ANALYSIS

1. BASELINE DATA & CONSUMPTION: 12 MONTHS

Base Line Data (Based on last 12 months – Feb -19 to Jan 20)			
1	Electricity provider	KSEBL	
2	Supply Voltage	11 kV	
3	Tariff	HT 11(B) General	
4	Consumer No:	1356540002958	
5	Contract demand (kVA)	150	
6	Maximum demand registered (kVA)	258 (OCT 19)	
7	Average monthly electricity consumption (kWh)	42558	
8	Average demand charges (Rs/month)	68949	
9	Average power factor	0.93	
10	Average power factor incentive (Rs/month)	12115	
11	Average power factor penalties (Rs/month)	9960	
12	Average Tariff rate for energy consumption, (Rs / kWh)	Normal – 7.20 Peak – 10.80 Off Peak – 5.40	Average – 7.80
13	Demand charge (Rs / kVA)	440	
14	Average monthly electricity cost (Rs)	410078	

TABLE 6 : BASELINE DATA

Inference

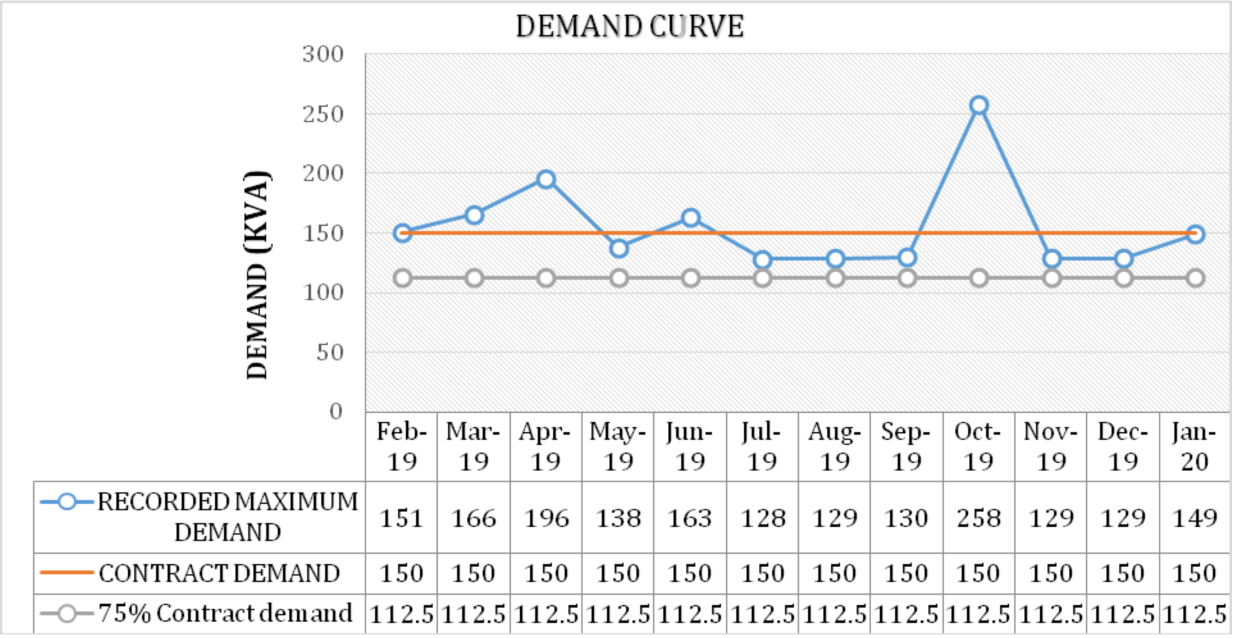
i. Power factor found to be average of 0.93 in which present tariff receives penalties.

ii. Recorded maximum demand during past 12 month was **258 kVA** and which is more than the contract demand.

iii. The RMD comes more than the minimum billing demand, where the pf is also low. In this condition the demand charges will higher.
iv. For last year the pf not comes more than 0.95.

2. DEMAND ANALYSIS

This section analyses the trend for the maximum demand versus the Contract Demand (CD) over a 12-month period (Feb 2019 to Jan 2020).



	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
RECORDED MAXIMUM DEMAND	151	166	196	138	163	128	129	130	258	129	129	149
CONTRACT DEMAND	150	150	150	150	150	150	150	150	150	150	150	150
75% Contract demand	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5

FIGURE 2: DEMAND ANALYSIS

Inference

i. Average demand charges came as **Rs. 68,949** per month.

ii. The recorded maximum demand came above 75% in all most all months

Suggestion

i. The savings on demand charges after improving the pf is given in the Annexure

3. ELECTRICITY DEMAND IN VARIOUS TIME ZONES

The variations of demands in the time zones are given below in figure.

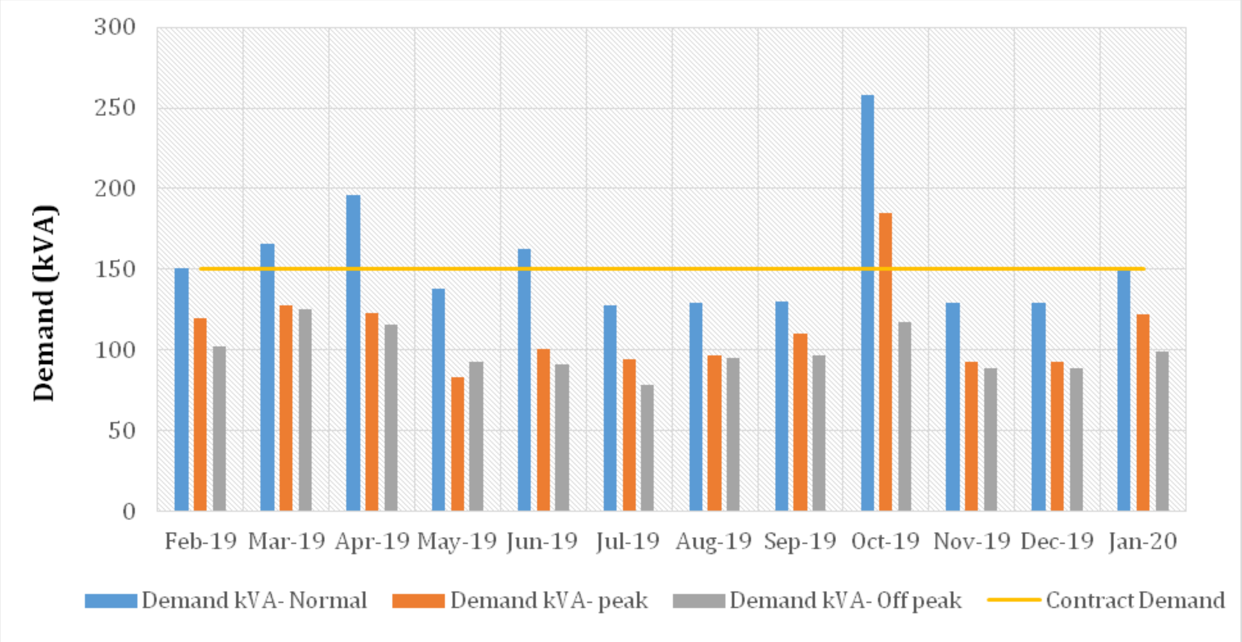


FIGURE 3: DEMAND IN VARIOUS TIME ZONES

Inference

i. The average maximum demand in the normal, Peak and off peak period registered at Sahrdaya College with respect to the contract demand is 104%, 74.67% and 66% respectively.

ii. The percentage of maximum demand in the normal, Peak and off peak period registered at Sahrdaya College with respect to the contract demand is 172%, 123.33%, and 83.33% respectively.

Suggestion

i. It is better to install a maximum demand controller in the circuit

4. POWER FACTOR ANALYSIS IN KSEB BILL

The Power factor is the ratio of Active power (kW) and apparent power (kVA).

$$PF = Active\ energykWh/Apparentenergy\ (kVAh)$$

The power factor variations in past one year is given below in figure.

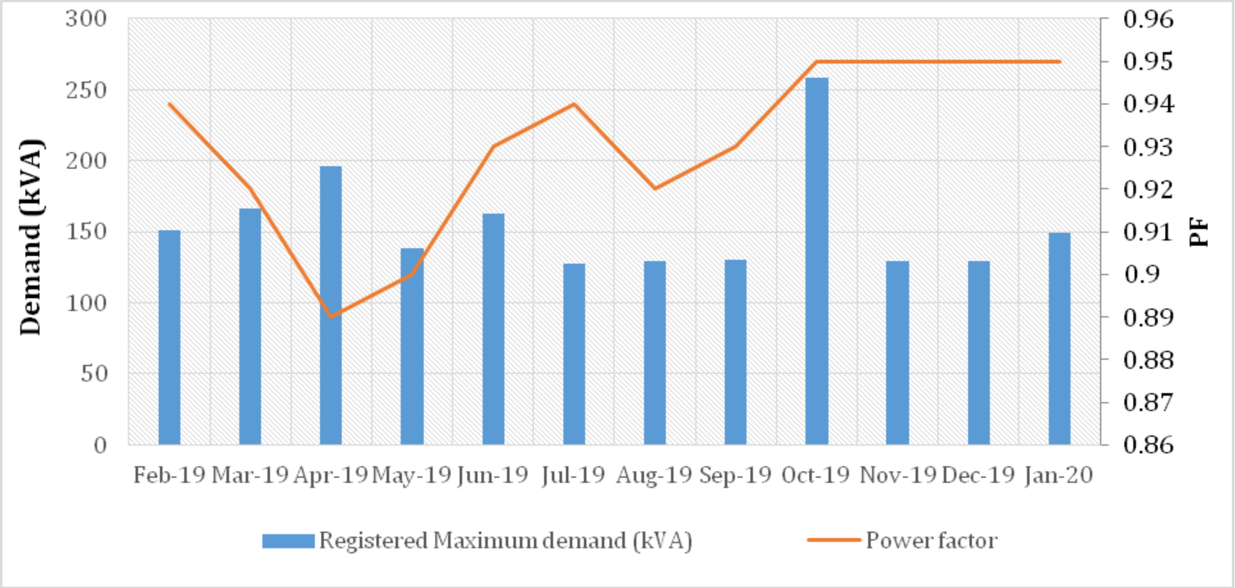


FIGURE 4: POWER FACTOR ANALYSIS

Inference

i. Average power factor during the past one year is found to be 0.93.

ii. From the figure, we get the inference that most of the some of the capacitors that placed at the load end were not working well.

Suggestion

i. By improving the PF, the incentives will increase.

5. TARIFF RATES ANALYSIS

The average monthly energy and demand charges for the period Feb 2019 to Jan 2020 is represented in Figure below.

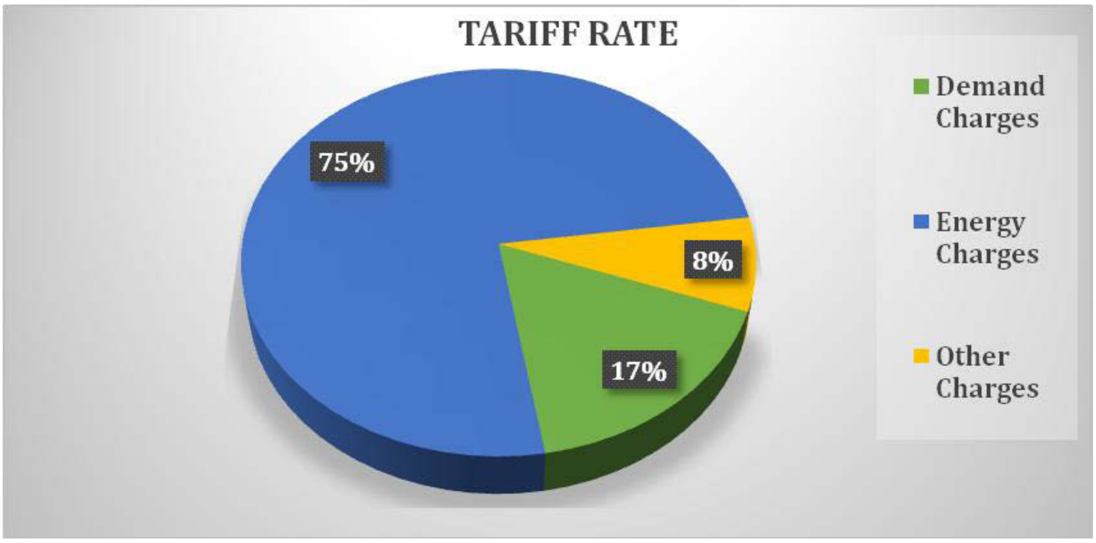


FIGURE 5: TARIFF RATE

Inference

i. Average demand charges for the past one year was Rs 68,949/ **per month** and energy charges was Rs 3,09,314/ per month**.**

ii. The energy charges came about **75%** of the total bill.

iii. The Sahradaya College tariff band is **not good** because 25% spend for demand and other charges.

6. SPECIFIC ELECTRICITY CONSUMPTION (kWh/M²)

The electricity consumption from Feb 2019 to Jan 2020 has taken for the benchmarking in the Sahrdaya College in the regression analysis method. Here the comparison is done with electricity consumption (KSEB) and the building area, which is in Square meters.

The below table shows the specific electricity consumption of Sahrdaya College.

Month	Unit Consumption	Total Build-up Area	Specific Electricity
	kWh	M²	kWh/ M²
Feb-19	49644	5231	9.49
Mar-19	55658	5231	10.64
Apr-19	43842	5231	8.38
May-19	43280	5231	8.27
Jun-19	44620	5231	8.53
Jul-19	37808	5231	7.23
Aug-19	36002	5231	6.88
Sep-19	39280	5231	7.51
Oct-19	37910	5231	7.25
Nov-19	37910	5231	7.25
Dec-19	33411	5231	6.39
Jan-20	51332	5231	7.98
Avg	**42558.08**	**5231**	**7.98**

TABLE 7: SPECIFIC ELECTRICITY CONSUMPTION – kWh/M²

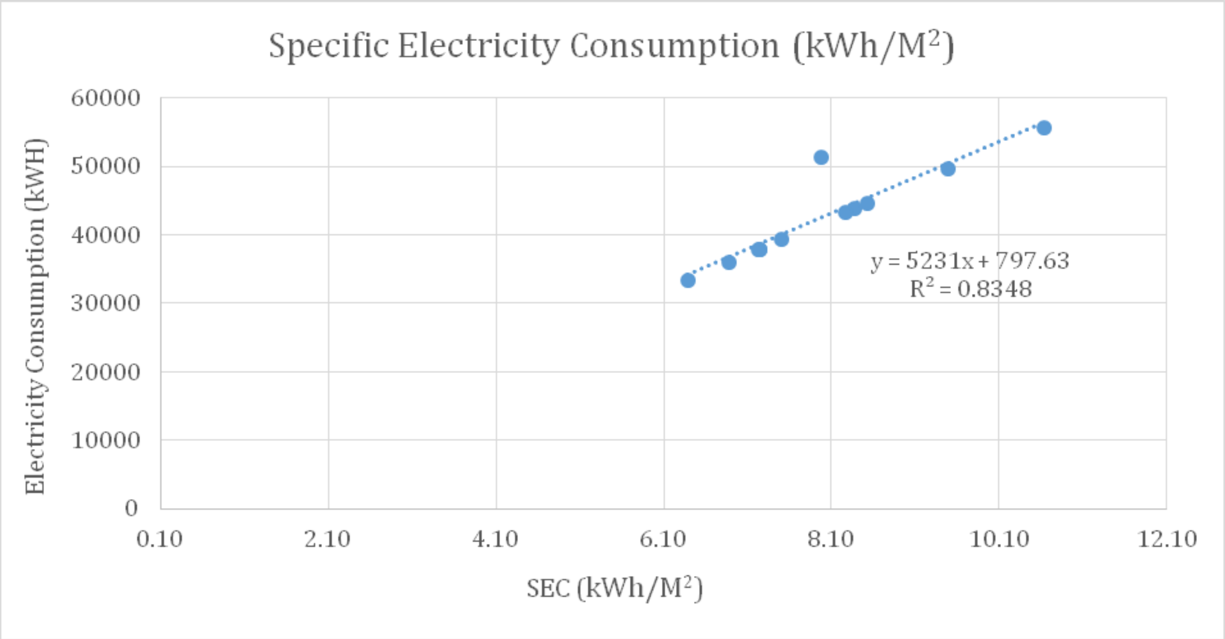


FIGURE 6: **SPECIFIC ELECTRICITY CONSUMPTION – kWh/M²**

- A positive trend line shows here in the equation as y = 5231x + 797.63, where x is the specific energy consumption and y is the electricity consumption.

- There is a plot between unit consumption and production for **LAST 3 FINANCIAL YEAR**.

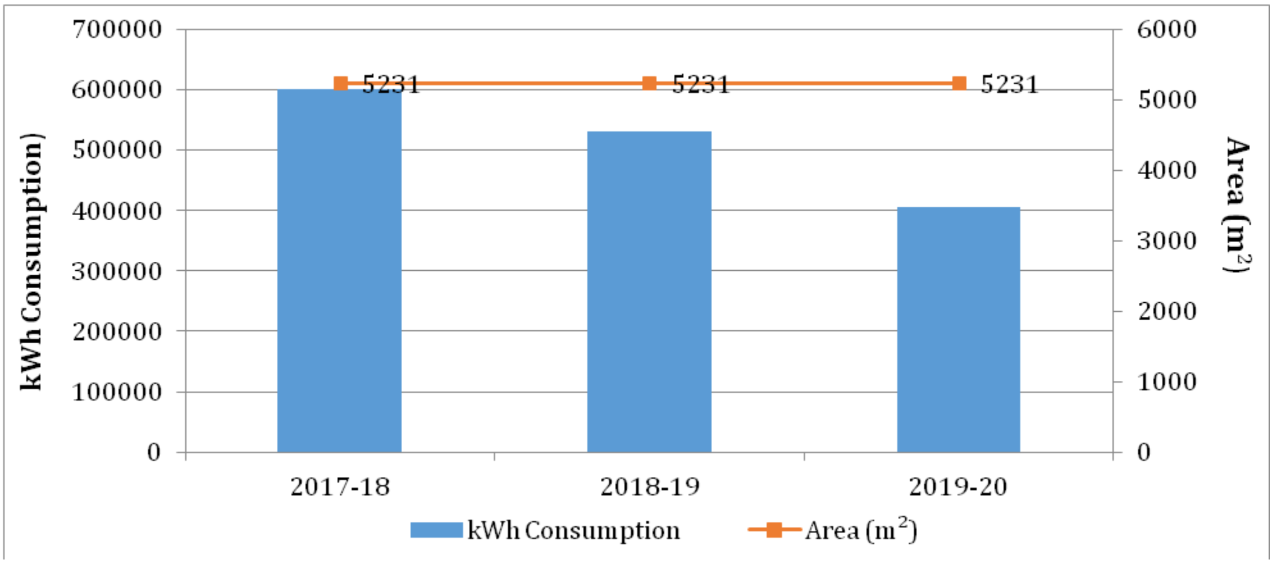


FIGURE 7: EFFICIENCY ANALYSIS OF LAST 3 FINANCIAL YEARS

❖ In the year 2017-18 the consumption.

ELECTRICITY PERFORMANCE

The objective of this section is to establish how the facility is performing in terms of energy consumption.

TRANSFORMER SECONDARY LOGGING

The LT side of the transformer was logged using power quality analyser Krykard ALM 35 for 24 hours and given in following table. The measurement was done in 17th February 2020 to 18th February 2020. The measurement-averaging period was 10 minutes. The Measurement details of the transformer are given below:

Make			**KEL**	
Rating	**kVA**		315	
Voltage ratings	**kV**		11/0.433	
Current ratings	**A**		16.53/420	
Volt impedance	**%**		4.23	
Measurement values – LT side				
Actual Energy for 24 Hrs	kWh		**1606**	
Apparent Energy for 24 Hrs	kVAh		**1689**	
Power Factor			**0.95**	
Particulars	**Units**	**Minimum**	**Maximum**	**Average**
Active Power	kW	**42.26**	**88.60**	**68.84**
Apparent Power	kVA	**47.13**	**92.60**	**72.38**
Reactive Power	kVAr	**2.14**	**35.61**	**18.63**
Voltage phase	Volts	**221.90**	**247.90**	**236.74**
Current	Amps	**56.60**	**156.60**	**101.89**
THD V	%	**0.60**	**2**	**1.34**
TDD A	%	**3.40**	**12**	**6.92**
Voltage Imbalance	%	**0**	**0.50**	**0.25**
Current Imbalance	%	**0.70**	**30.30**	**14.69**

TABLE 8: TRANSFORMER LOGGING

Inference

i. The maximum demand registered during the period of measurement is 92.60 kVA, in 10 minutes' interval, and the corresponding PF was 0.95 that shows the importance of PF improvement.

ii. The variation of voltages found at the time of audit. (221.9 to 247.9V)

iii. The average loading of transformer is only about less than 30%.

iv. Current imbalances were found to be higher (Maximum of 30.30%)

1. ANALYSIS: VOLTAGE VARIATION

The Voltage profile at the LT side is plotted below in figure.

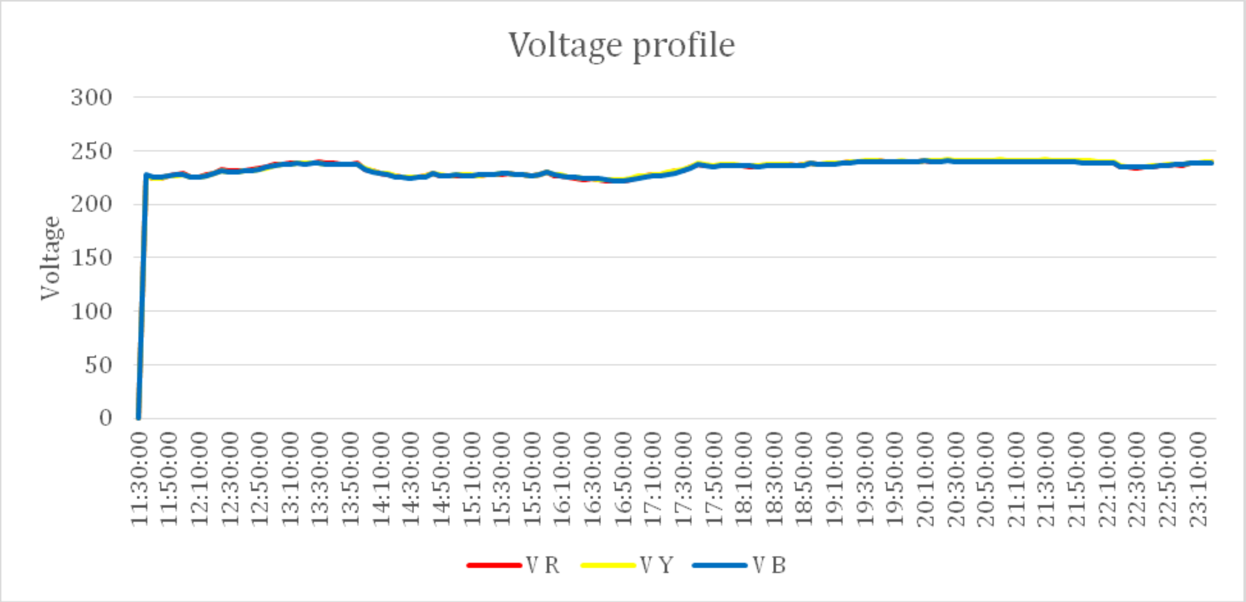


FIGURE 8: VOLTAGE PROFILE

Inference

i. The figure shows the minimum voltage imbalance and supply voltage variation.

ii. The maximum and minimum supply voltage were during the normal operational period, excluding the power failure, is 247.90 and 221.90 respectively with an average phase voltage of 236.74 V.

iii. The high voltage will increase the power consumption and increases the capacitance value in the system.

2. ANALYSIS: CURRENT VARIATIONS

This section carries the current variations during the 24-hour measurement period with the power analyser.

The figure below gives the current profile of the phases at the LT side.

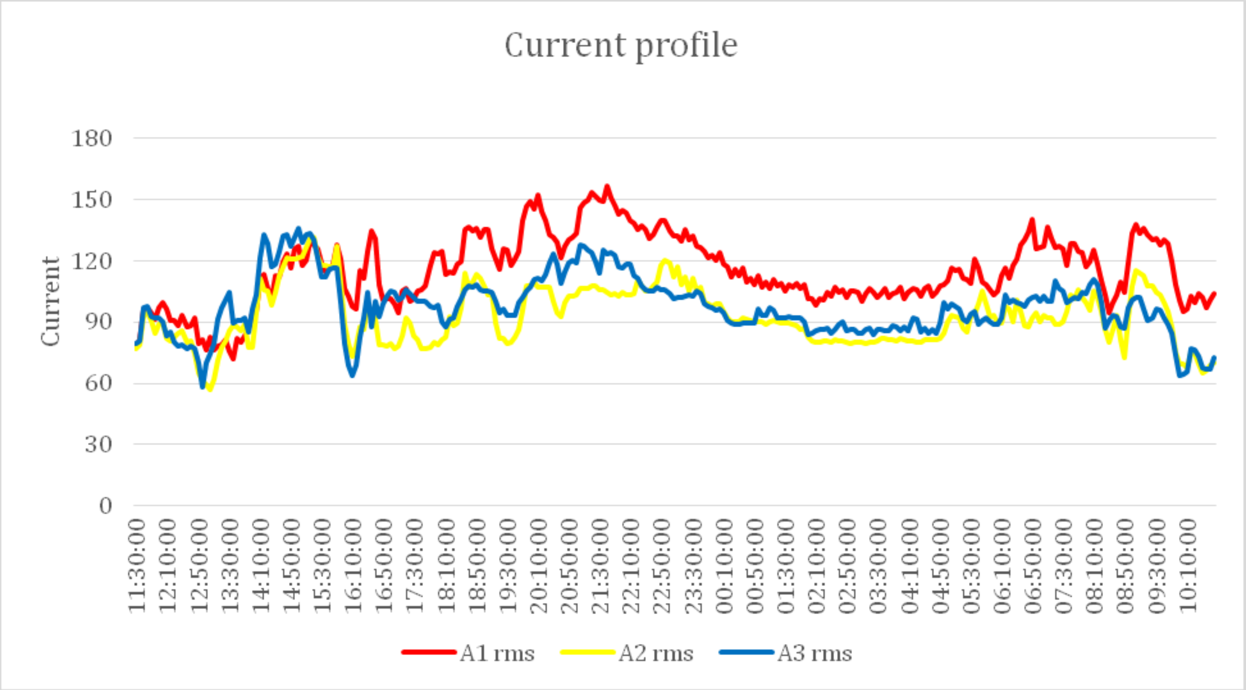


FIGURE 9: CURRENT VARIATIONS

Inference

i. Figure 9 denotes current variations at the LT side.

ii. The maximum current occurred during the Peak period at 153.70A and minimum during normal period with 58.20A.

iii. The current varies between 13.86 to 36.60% of the rated current of the transformer at the secondary side.

3. LOAD FACTOR

The load factor is the ratio of the energy consumed during a given period (in the audit period or in last 12 months) to the energy, which would have been consumed if maximum demand had been maintained throughout the period.

$$\text{Load factor (\%)} = \frac{\text{Energy used during the period (kWh)} \times 100}{\text{Maximum demand (kW)} \times \text{Time under consideration (hr)}}$$

Load factor calculated from the 24-hour logging at the LT side during the period of audit is given in table below:

Total kWh	Max kW	Time (Hrs)	Load factor (%)
1606	88.60	24	75.52

TABLE 9: LOAD FACTOR – TRANSFORMER

Inference

i. The higher the load factor means higher utilisation efficiency of the electrical system.

4. ANALYSIS: POWER FACTOR

The section provides an overview of the power factor variations at the LT side. The Power factor variation with respect to the active and reactive power are given in table.

	Time	PF	kW	kVA	kVAr	Remarks
Normal period						
Minimum PF	10:35:00	0.851	46.08	54.10	27.69	Lagging
Maximum PF	06:05:00	0.995	67.75	68.07	4.22	Lagging
Peak period						
Minimum PF	21:15:00	0.95	87.32	91.87	27.87	Lagging
Maximum PF	18:35:00	0.982	82.73	84.19	14.33	Lagging
Off peak period						
Minimum PF	22:05:00	0.956	83.63	87.42	24.70	Lagging
Maximum PF	00:45:00	0.995	70.31	70.61	2.40	Lagging

TABLE 10: PF VARIATIONS

Inference

- There is no leading found at the time of audit.
- The PF was found to be very low in some time intervals.

Recommendations Replace the faulty capacitors with new capacitors to improve the power factor.

The below figure shows the kW and PF variations.

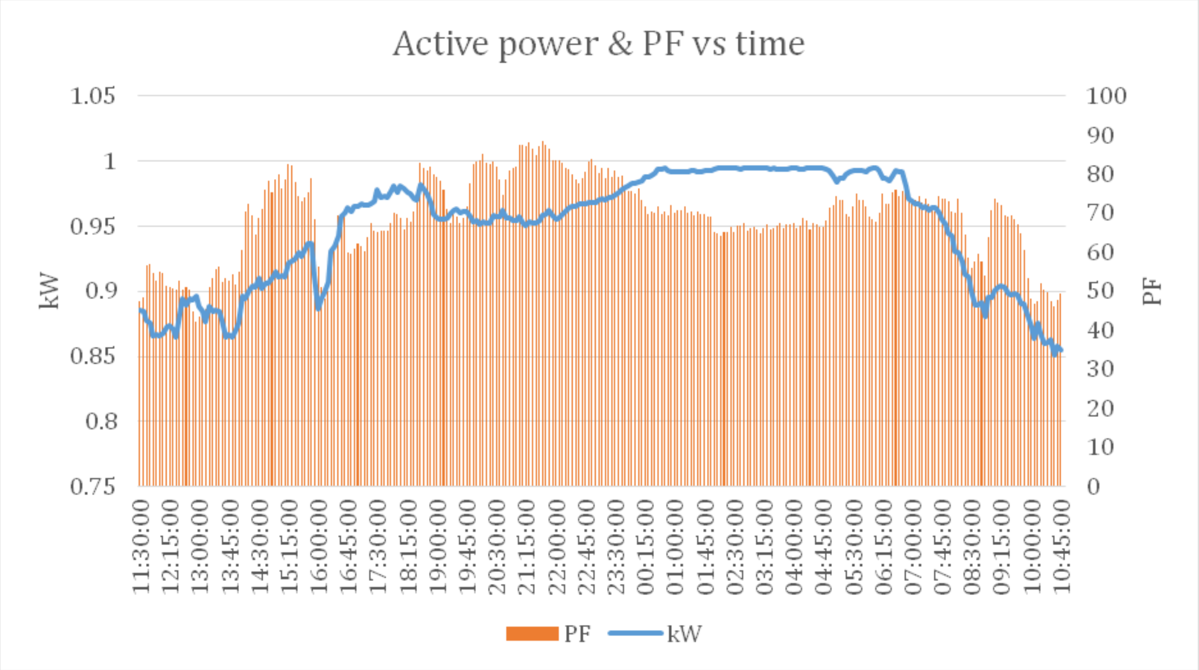


FIGURE 10: KW, & PF VARIATIONS

5. ANALYSIS: CURRENT IMBALANCE

This section carries out the current imbalance at the LT side during the logging period. The current imbalance with respect to the ampere in three phases are given below:

	TIME	R PHASE	Y PHASE	B PHASE	UNBALANCE
NORMAL TIME					
MAX. CURRENT	15:15:00	**129.9**	**130.6**	**133.7**	1.8
MIN. CURRENT	12:55:00	**81.4**	**61.2**	**58.2**	21.6
CURRENT AT MAX. UNBALANCE	10:30:00	102	65.1	67.7	**30.3**
CURRENT AT MIN. UNBALANCE	15:40:00	115.6	116.8	115.6	**0.7**
PEAK TIME					
MAX. CURRENT	21:20:00	**153.7**	**107.4**	**124.1**	19.7
MIN. CURRENT	18:10:00	**113.3**	**82.4**	**87.7**	19.9
CURRENT AT MAX. UNBALANCE	19:30:00	125.4	79.2	93.1	**26.4**
CURRENT AT MIN. UNBALANCE	20:25:00	132.8	107.3	119	**10.9**
OFF PEAK TIME					
MAX. CURRENT	22:55:00	**139.7**	**120.2**	**105.6**	14.7
MIN. CURRENT	02:10:00	**98.1**	**80.3**	**85.7**	11.4
CURRENT AT MAX. UNBALANCE	04:35:00	107.7	81.3	84.3	**18.2**
CURRENT AT MIN. UNBALANCE	05:50:00	108.4	98.8	92	**8.7**

TABLE 11: CURRENT UNBALANCE

Inference

- The current imbalance (30.30%) occurred on Normal period. I.e. at 10.30 hrs morning which is above the standard of 10%.
- The average current imbalance measured was 14.69%, which is well within the specified standard limit (10%).
- The variation of current unbalance in Normal time zones are given below:

The current imbalance at the Transformer secondary side are given below:

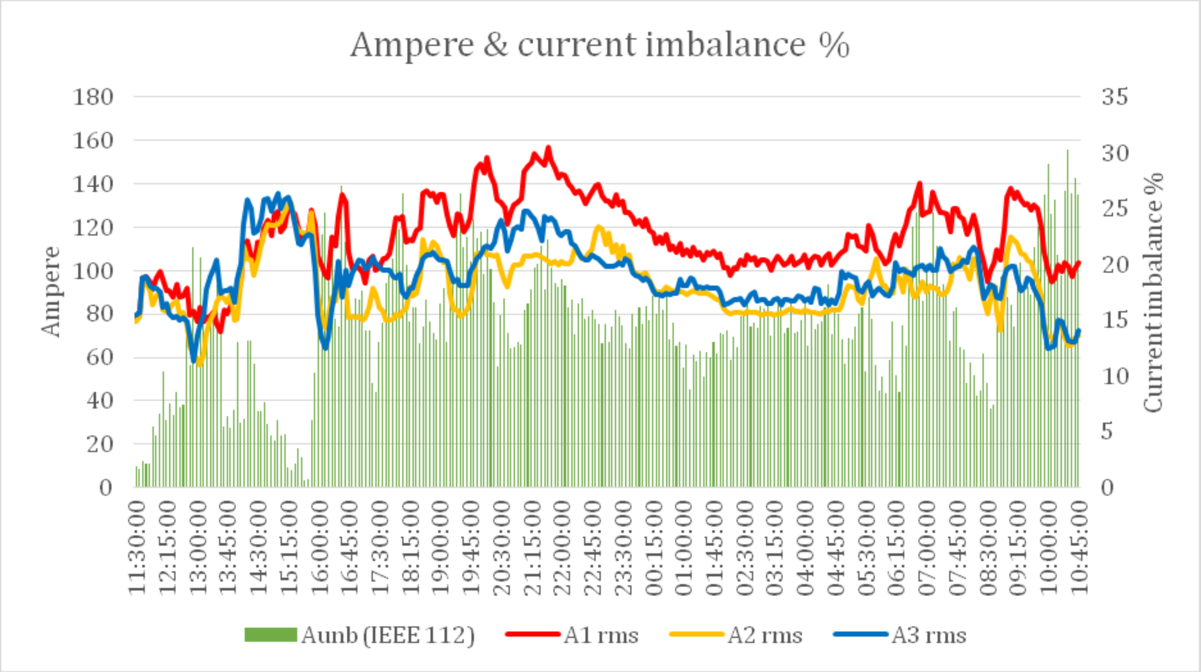


FIGURE 11: AMPERE VS IMBALANCE GRAPH

Suggestion:

- The current unbalance is creating in morning time and in R-phase current rating is more. Check the routine of switching on of the electrical system for reducing the unbalance.

6. ANALYSIS: COMPARISON OF LOADS IN DIFFERENT TIME ZONES

This section provides an overview of the total electricity consumption, split across the 3 different time zones as defined by the Kerala State Electricity Board (KSEB):

Time Zone 1: Normal: 6.00 Hrs. to 18.00 Hrs.

Time Zone 2: Normal: 18.00 Hrs. to 22.00 Hrs.

Time Zone 3: Normal: 22.00 Hrs. to 6.00 Hrs.

Electricity consumption according to the time of use, as calculated from the 24-hour logging.

Particulars	Zone-1 (6am - 6pm) (kWh)	Zone -2 (6pm-10pm) (kWh)	Zone-3 (10pm-6am) (kWh)	Total (kWh)
	Normal	**Peak**	**Off-peak**	
Unit consumption	716.43	316.52	573.05	**1606**
Average kWh in each period (normal/12, peak/4, off peak/8)	**59.70**	**79.13**	**71.63**	

TABLE 12: ZONE WISE KWH CONSUMPTION

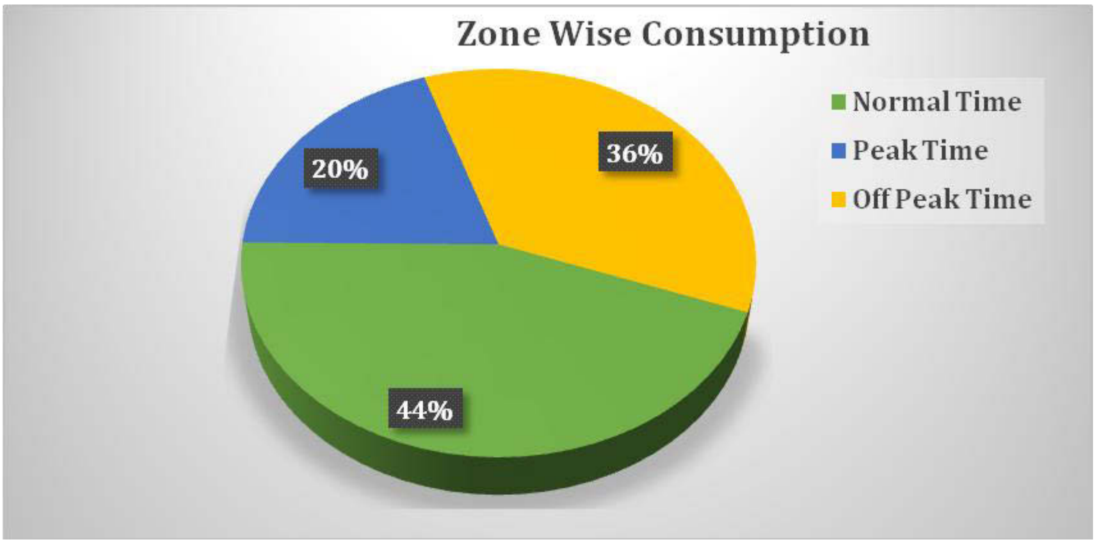


FIGURE 12: ZONE WISE KWH CONSUMPTION

According to KSEB, the energy charges in each time zone is calculated as follows:

In Time Zone 1(EC1): Consumption in Zone 1* Rate

In Time Zone 2(EC2): Consumption in Zone 2* Rate* 1.5

In Time Zone 3(EC3): Consumption in Zone 3* Rate* 0.75

Majority of the unit consumption occurs during the normal period, which is **44%**.

7. HARMONIC STUDY

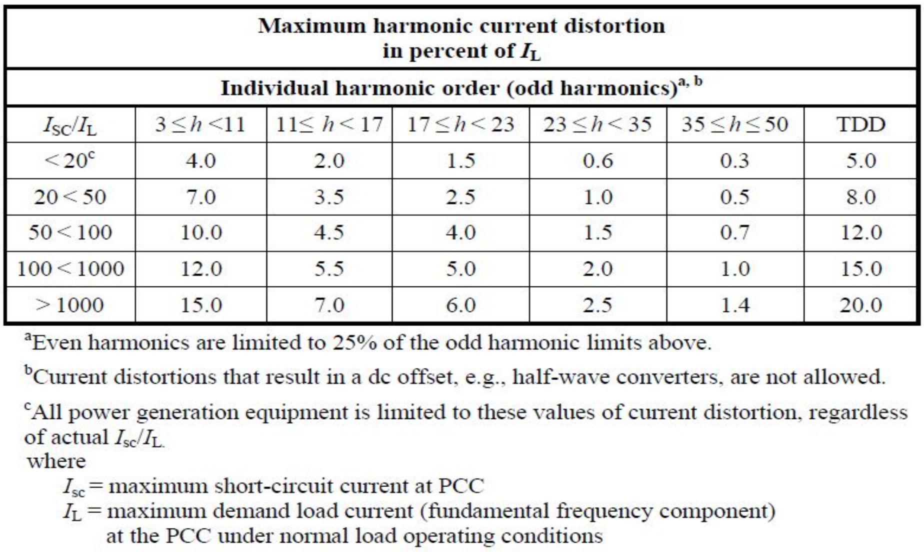
Harmonics study revolves around the use of non-linear loads that are connected to electric power systems including static power converters, arc discharge devices, saturated magnetic devices and to a lesser degree, rotating machines. Static power converters of electric power are the largest non-linear loads and are used in industry for a variety of purposes such as electro- chemical power supplies, adjustable speed drives, and uninterruptible power supplies. These devices are useful because they can convert ac to dc, dc to dc, dc to ac, and ac to ac. Non-linear loads change the sinusoidal (a succession of waves or curves) nature of the ac power current (and consequently the ac voltage drop) thereby resulting in the flow of harmonic currents in the ac power system that can cause interference with communication circuits and other types of equipment. Classification, effects and standards are given below:

	1st order	2nd order	3rd order	3rd order	4th order	5th order	6th order
Frequency Hz	50	100	150	200	250	300	350
Sequence	+	-	0	+	-	0	+

TABLE 13: HARMONICS CLASSIFICATION

Effect on - Motor & generator	-Transformers	- Cables	- Electronic equipment	- Metering
Rotor heating, causes Reverse rotating magnetic field, causes pulsating torque output, Mechanical oscillations, increases Cogging & Crawling	Increase in copper & stray losses, increase in iron losses, transformer heating	Voltage stress & corona, I^2R losses increases	Voltage notching, Electromagnetic interference, Shifting of the voltage zero crossing	Erroneous reading

TABLE 14: EFFECTS OF HARMONICS (IEEE 519)



Maximum harmonic current distortion in percent of I_L						
Individual harmonic order (odd harmonics)[a, b]						
I_{SC}/I_L	$3 \leq h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h \leq 50$	TDD
$< 20^c$	4.0	2.0	1.5	0.6	0.3	5.0
$20 < 50$	7.0	3.5	2.5	1.0	0.5	8.0
$50 < 100$	10.0	4.5	4.0	1.5	0.7	12.0
$100 < 1000$	12.0	5.5	5.0	2.0	1.0	15.0
> 1000	15.0	7.0	6.0	2.5	1.4	20.0

[a] Even harmonics are limited to 25% of the odd harmonic limits above.

[b] Current distortions that result in a dc offset, e.g., half-wave converters, are not allowed.

[c] All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L.

where

I_{sc} = maximum short-circuit current at PCC

I_L = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions

TABLE 15: CURRENT HARMONICS LIMIT (IEEE 519-2014)

Voltage distortion limits		
Bus voltage at PCC	**Individual voltage distortion %**	**Total voltage harmonics distortion %**
V ≤ 01 kV	**5.0**	**8.0**
01 kV < V ≤ 69 kV	3.0	5.0
69.001 kV < V ≤ 161 kV	1.5	2.5
161.001 kV and above	1.0	1.5

TABLE 16: VOLTAGE HARMONICS LIMIT (IEEE 519-2014

HARMONICS DATA SHEET

Location:	**Main Control Panel (LT Side)**						
Total harmonic distortion as per CEA standard TDDi limit is 8% and THDv limit is 8% at 400V level as per Short circuit analysis							
Total Harmonic Distortion - TDD %		**Voltage %**	**Current %**	**Remarks**			
		2	12	Voltage harmonics is within limit But Current Harmonics' is more			
Individual Harmonic%							
Particulars	3rd	5th	7th	9th	11th	13th	15th
Voltage %	0.6	1.3	1.5	0.3	0.6	0.4	0.1
Current %	8.4	6.1	5.4	3	3.1	3.7	1.6

TABLE 17: HARMONICS ANALYSIS

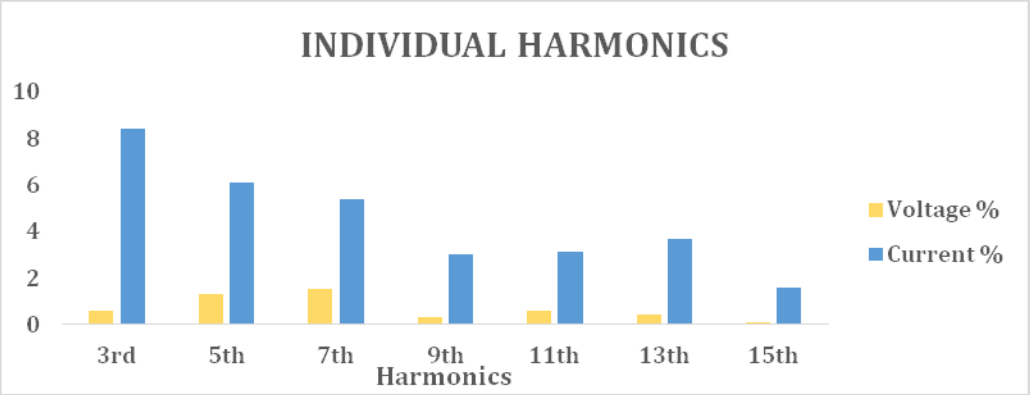


FIGURE 13: HARMONICS ANALYSIS

Inference

i. The table gives the input that the individual and total current harmonics are higher than the specified limit of 8%.

ii. The table also gives the fact that the voltage harmonics are within the limit of 8%.

Suggestions

i. While purchasing nonlinear controlling devices such as UPS and loads such as LED, DC fans, more care should take to ensure the output harmonics values and specification should contain the IEEE/CEA standard limit which mentioned in the above table.

ii. This will reduce the overall effect of harmonics in the equipment and supply system.

DIESEL GENERATORS

Sahrdaya College uses Two Diesel generators, which gives the backup supply to the MSB, works in auto mode, according to the load during the power failure in which the details are given below:

DG-kVA	250	250
Engine	Kirloskar	Supernova
Generator	Kirloskar	Supernova

TABLE 18: DG DETAILS

CAPACITOR PANEL

To reduce kVAr, partial kVAr must be supplied by capacitors which in turn will reduce the burden of kVAr on the utility supply system. The capacitor acts as a kVAr generator. The power factor correction can be static correction where capacitors are connected to each starter, or it can be bulk correction where capacitors are connected at the distribution boards.

In Sahrdaya College, APFC panel is provided with parallel to MSB. The performance of individual capacitors in the APFC panel are given below:

Name	Rated kVAr	Design Voltage	Measured Voltage	Measured kVAr	kVAR wrt to Volts	% of deterioration
	A	B	C	E	F= A*(C/B)	G= (F-E)*(100/F)
C1	20	440	394	16.45	17.91	8.15
C2	20	440	394	Not Working		
C3	20	440	394	Not Working		
C4	20	440	394	16.8	17.91	6.19
C5	20	440	394	16.68	17.91	6.86

TABLE 19: CAPACITOR DETAILS

Inference

i. From the table above, most of the installed capacitors are damaged or degraded.

ii. Due to the damage of capacitors, the pf will come down.

Suggestions

i. Periodic checking of capacitors should be done once in two weeks analysing the ampere rating taken after the new installation as the base value.

ii. Replace the faulty capacitors with new capacitors for the maintaining of power factor.

iii. Install APFC panel in parallel to the Main switch board to optimise the power factor to unity, for the present varying loads the PF is 0.98 only.

AIR CONDITIONING

The details of Air conditioners installed in the college are given below:

Sl.No:	Location	Rated Capacity	Quantity	Rated Power	Total Power
		TR	Nos	KW	KW
1	Decennial Block	2	4	2.3	9.2
2	Main Block	1	22	1.2	26.4
3	Biotechnology Block	1.5	4	1.7	6.8
		1.2	1	1.7	1.7
4	Knowledge Centre	1	14	1.2	16.8
		1.5	1	1.3	1.3
		40	1	14	14
5	Audi + Campus	1	1	1.2	1.2
6	PG Hostel	1	7	1.3	9.1
		1.5	3	1.65	4.95
TOTAL			**91.45 KW**		

TABLE 20: AIR CONDITIONING DETAILS

Inference

- Majority of the AC's are split AC's.
- Only few AC's are star rated AC's

Suggestions

- Run AC's at 25 to 28 degree Celsius.
- Try to insulate the rooms from all sides.
- Check its star ratings for energy consumption. For future purchase prefer the 5-star AC's.
- Every degree below 26 increases energy consumption of AC.
- Clean the filter of the AC's regularly as it can help to reduce energy consumption.
- If prefer the lower temperature, it would be wiser to use the AC along with a ceiling fan.
- For continues working and no openings then prefer the inverter AC's. Then the energy consumption cost can be reduced by one third. It can be effective for server rooms.

LIGHTING AND FAN LOADS

The details of Lighting and Fan loads installed in the college are given below:

Sl.No:	Location	Total kW
1	Decennial Block	25.99
2	Main Block	23.47
3	Biotechnology Block	26.38
4	Men's Hostel	65.63
5	Ladies Hostel	27.41
6	Knowledge Centre	27.22
7	Audi + Campus	12.6
8	PG Hostel	19.52
TOTAL KW		**228.22**

TABLE 21: LIGHT DETAILS

Inference

- There are around **228.22 kW** of lighting loads are installed.
- Majority of the light fittings are Fluorescent tubes.
- LED lights are installed in some areas also.

Suggestions

- Replace the Fluorescent tubes with LED lights.
- Maximize the use of sunlight in classrooms.
- Switched off the lights after the use.
- Provide Timer controllers for Board lights.
- Provide proper labelling for the electrical panels.

COMPUTER AND ACCESSORIES

The details of Computer and Accessories in the college are given below:

Sl.No:	Particulars	Power Rating	Quantity	Total Power
		Watts	Nos	kW
1	PC LCD	90	604	54.36
2	PC CRT	120	29	3.48
3	Laser Printer	450	7	3.15
4	Projector Small	400	16	6.4
5	Projector Big	650	1	0.65
6	Xerox Machine	500	3	1.5
7	Laptop	80	2	0.16
TOTAL			**69.7 KW**	

TABLE 22: COMPUTER AND ACCESSORIES

Inference

- All the loads are connected to the UPS and the capacity comes 400kVA.
- Around 69.70 KW comes for computer loads

GREEN AND ENVIRONMENTAL AUDIT

The whole world is on the road to a sustainable development, and the environment conservation is the top priority among the list as every human activity has its effect on their surroundings, which is the environment. Hence be it a house, a commercial building, an industrial building, or any other construction will disturb the balance of the environment. It is very important to do a detailed study about the effects on the environment. This is conducted under the name of *Green Audit*, which can be defined as *the official examination of the effects a company or other organization has on the environment, especially the damage that it causes*. The objectives of the green audit can be listed as follows:

- Including participants from every section of the organization in the auditing process.
- Understanding the environment by drawing a simple sketch of the total area.
- Identifying the activities in the premises and listing them.
- Calculating the resource consumption like the land and water.
- Assessing the waste management and disposal.
- Study the energy usage pattern.
- Identify the good practices.
- Suggest the viable solutions to improve the sustainable nature of the organization.
- Compile the report with the above-mentioned details.
- Conduct a walkthrough audit to check the suggestions implemented by the institution and suggest for further improvements
- Verify all the points with actual measurements is it is meeting the performance and gave suggestions for improvement

1. WATER RESOURCES

The requirement of water for the college, hostels and gardening etc are met by 4 main ponds located in different parts of college. Ponds nearer to canteen and ground side is recharged with well-connected rainwater collection pipes from nearby buildings. Another one spare pond is filled by water from nearby canal.

The treated water from ETP is reused in watering grass in the ground and various ares of campus trees and garden through piping network.

The details of Water distribution system in the college are in this section:

Around 605000 litres of water is used daily for the requirements and the details are given below:

Water ponds are protected using fencing and this water is pumped to overhead tanks passing through sand filters and carbon filters for removing suspended solids and foul smells. The water which is used for drinking and cooking will separately treated again using **RO plant.**

The water from different ponds are checked in a accredited laboratory in time to time as its is maintaining its potable quality by authorities.

The water spray provision is done with the pump for increasing its oxygen content in the pond.

Fish pond water also checked for its quality and this water is used for gardening and its very manoeuvre because of ammonia content generated from fish crate.

The rain water from building tops are passed through sand filtering for removing its mud content and for generating the hydraulic pressure for feeding into ground ..

The details of water consumption of all buildings and its pump and motor details are given below.

Approximate water consumption details are given below.

Sl.No:	Location	Capacity of Water Tanks	Quantity	Total Capacity	Tank Filling	Consumption per day
		Liters	Nos	Litres	Times	Litres
1	Hostels	30000	2	60000	2	120000
2	Biotechnology Block	30000	1	30000	2	60000
3	Biotechnology Block	5000	3	15000	2	30000
4	Administrative Block	30000	1	30000	2	60000

5	Decennial Block	40000	1	40000	2	80000
6	Staff Quarters	25000	1	25000	1	25000
7	Knowledge Centre	20000	1	20000	1	20000
8	Canteen	10000	2	20000	3	60000
9	Canteen	50000	1	50000	3	150000
TOTAL LITERS					**605000**	

TABLE 23: WATER CONSUMPTION DETAILS

The details of the pumps which is installed in various places of college

Sl.No:	Name	Rated Power	Quantity
		HP	Nos
1	Main Motor	7.5	1
2	Ladies Hostel	5	1
3	Canteen	5	1
4	Men's Hostel	2	1
5	Gardening	7.5	2
6	Submersible Pump	2	4
7	Sump	5	1
8	Bore well	5	1
9	Wastewater Pumps	5	4

TABLE 24: WATER PUMP DETAILS

ENVIRONMENT OF CAMPUS

Trees are the major source of the oxygen we breath and receiver of the carbon dioxide we exhale. The sustainability of an ecosystem depends on the number of plants and trees in and around the surroundings. There is well maintained garden and ponds inside of the college.

The entire greenery of the campus can be divided into landscaped terraces of vast meadows, extensive flower gardens and orchards of fruit bearing trees. Bamboo lends the natural glow of yellow to the campus. The campus has the gift of a stream running across the entire breadth of the area. 3 big ponds are existed in college campus for catering the requirements of water and for watering the plants. In addition to that other small ponds and wells and water authority canal is also passing through campus. This will keep the campus live and full of energy in all sense.

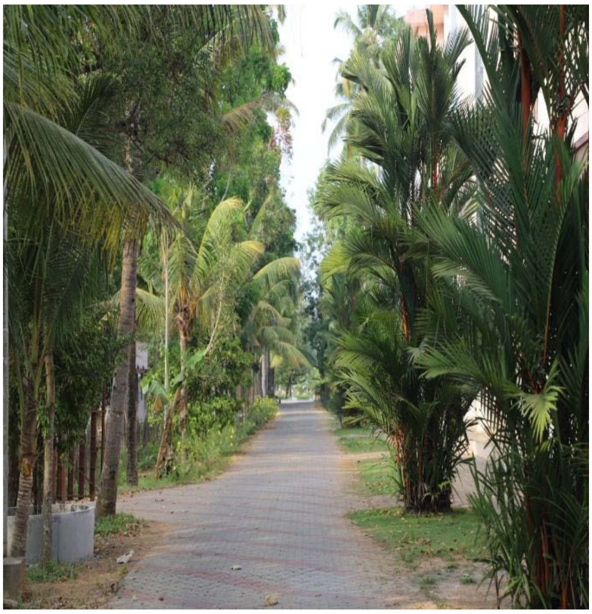
The speciality of college campus the balance area after the buildings, and water bodies and ground is also filled with variety of trees(flowering, fruit trees) and orchids, variety of grass, bamboo etc. Herbal garden is another speciality of college campus. Due to variety of species attracting lot of birds and butterflies to the campus

In addition to this fishpond is also created in water bodies. The leaves of trees and buffalo dung will create the fertiliser requirement for the plants in the college.

Tree gallery is also created in te ground and pathways to various buildings are also covered with trees.

Scientific studies are proved that the nature can able to cure any diseases and this will reduce the stress among students during theirs studies and also increase the compassion among them and to nature

Ultimately the campus is maintaining natural equilibrium trees, birds and cattles and water bodies with human beings.



2. WASTE MANAGEMENT

Waste is generally termed as 'a resource at the wrong place'. The college authorities are aware of the possible methods and have installed waste management measures like the vermicompost and biogas systems. The waste clearance measures associated with different types of wastes are briefly given below.

BIODEGRADABLE WASTES

The biodegradable wastes are mainly from the college canteen and hostel. The bio- slurry is used as manure to the plantation.

- **College canteen**

One of the main sources of bio degradable food generated from canteen is feed into bio gas plant and taking outside for using as a feed for pigs. The other wastes such as biscut packets covers etc are incinerated in tge incinerator. The water from wash basin , cleaning utensils are taking into ETP or for feeding into nearby plants and trees. Approximately 15 kg of biodegradable waste is generated fro canteen .

- **College Hostel:** A biogas plant is installed which uses the food waste as a resource. The stationary and other wastes are incinerated. The gas is consumed in the kitchen as per the available production.

Other wastes like those from the toilets are disposed through septic tank at locations situated away from water sources.

NON-BIODEGRADABLE WASTE

Non-recyclable wastes are collected and burned once in a month. The recyclable wastes are sorted out into categories and supplied it to the collecting units.

Incinerator

The incinerator is used for incinerating non-biodegradable waste such as paper, plastic, sanitary napkins etc. The ash generated are as for manoeuvre after mixing with cow dung for plants. The ash generated from plastic will be treated separately.

The ash generated from canteen were wood is used as a fuel is used as manoeuvre for plants. . The college campus promoting biodegradable packaging and reducing the consumption of plastic to a large extent.

ELECTRONIC WASTE

The college e-waste includes mainly of damaged computer parts. The auditors found that they are stored safely in a building room. These can be given away to the e-waste collecting units.

Effluent treatment plant

The effluent treatment plant located in the back yard of college. The effluent water from different areas such from toilets, canteen, washing areas etc are collected through piping net work and collected in a collection tank. Chemicals are added into this water for maintain the PH and water is feeding aerator and to clarifier. The pure water is checked for its TDS level, PH and oxygen content etc. This pure water is used for gardening in different parts of college campus through well designed piing network. The sludge generated are used as manoeuvre after mixing with cow dung.

STUDENT ACTIVITIES FOR ENVIRONMENTAL CONSERVATION

NATURE CLUB

Trees are the major source of the oxygen we breath and receiver of the carbon dioxide we exhale. The sustainability of an ecosystem depends on the number of plants and trees in and around the surroundings. There is well maintained garden and pond inside of the college.

- College nature club conducting various programmes on environmental day June-5. Protecting the pond and garden is the duty of nature club.
- Conducted a training programme named CLEAN MY VILLAGE in Kodakara Panjayath by NSS unit of college to local families on October -2 2019.
- New initiative as College conducted Free water tesing of wells in flood affected areas of Thrissur District.
- Training Programmes for Local schools and Kudumbasree units as LED bulb assembly as extension of technology to the community.
- Repairing of motors and electrical installations in te flood affected area of Local area Kodakara Panjayath and Chalakudi Municipality.
- NSS unit of collge conducted PUNARJANI camp in Pudukadu Thaluk Hospital and in Mattathur Community health center.
- Conducted district level seminar and competition in association with KSEB for other engineering colleges in the Thrissur District.

RENEWABLE ENERGY

Solar plant: College installed 100kW solar power plant in its facility showing their dedication to sustainability and environmental protection.

Bio gas plant: For treating the bio degradable food wastes from college and hostels canteens. The biogas plant convert food wastes into methane gas and usable bio fertilizers which will used for plants.

E charging : College is agreed in principle to install a E- charging station in college , which shows the advance level of thinking .

ANNEXURE-1

ENERGY SAVING PROPOSALS - 1

IMPROVING THE POWER FACTOR

Background

By referring the last year electricity bills, the pf was found to be low and in some months there is penalties for this.

Proposal

By improving the pf to 0.99 by replacing the capacitors in APFC panels will improve overall pf as well as the demand charges will come down.

Particulars	Unit	Values
Present Condition		
Present PF		0.95
Total Incentives	Rs	12115
Total Penalties	Rs	9960
Annual Financial Savings	Rs	2155
Proposed Condition		
Proposed PF		0.99
Total Incentives/Month	Rs	7732.85
Total Incentives/Year	Rs	92794.2
Investment	Rs	20000
Simple Payback Period	Months	2.59

TABLE 25: EC PROPOSAL 1

ENERGY SAVING PROPOSALS - 2

REPLACEMENT OF CEILING FANS IN THE OFFICE WITH ENERGY EFFICIENT BLDC FANS

Background

A BLDC fan takes in AC voltage and internally converts it into DC using SMPS. The main difference between BLDC and ordinary DC fans is the commutation method. A commutation is basically the technique of changing the direction of current in the motor for the rotational movement. In a BLDC motor, as there are no brushes, so the commutation is done by the driving algorithm in the Electronics. The main advantage is that over a period, due to mechanical contact in a brushed motor the commutators can undergo wear and tear, this thing is eliminated in BLDC Motor making the motor more rugged for long-term use. To explain, BLDC technology in simpler terms, BLDC uses a combination of Permanent Magnets and Electronics to achieve the kind of efficiency and performance, it delivers. A BLDC fan composes of 3 main components: - 1. Stator 2. Rotor 3. Electronics

Proposal

Replace the ceiling fans with BLDC in the as per preference of operating hours as office areas., staff rooms and in security cabin and in hostels The calculation for the savings is given in the table below.

Existing Ceiling Fans	Watts	70
Proposed BLDC Fans	Watts	35
Difference in Wattage	Watts	35
Avg No: of working hours/day	Hrs	8
No: of working days per year (Average)	Nos	210
No: of working hours per annum	Hrs	1680
Number of Fans operating	Nos	100
Annual Consumption for Ceiling Fans	kWh	11760
Annual Consumption for BLDC Fans	kWh	5880
kWh Saving per Annum	Rs	5880
Cost per kWH (Average)	Rs	6.71
Annual Financial Savings	Rs	39454.8
Cost of BLDC Fans	Rs	2500
Investment for BLDC Fans	Rs	250000
Simple Payback period	Months	76.04

TABLE 26: EC PROPOSAL 2

ENERGY SAVING PROPOSALS – 3

REPLACEMENT OF FLUORESCENT TUBES WITH ENERGY EFFICIENT LED LIGHTS

At present LED lights are used in very few areas. Replacement of Fluorescent lights to be done in phase manner with LED lights.

Existing Fluorescent lights	Watts	52
Proposed LED light	Watts	18
Difference in Wattage	Watts	34
Avg No: of working hours/day	Hrs	8
No: of working days per year (Average)	Nos	210
No: of working hours per annum	Hrs	1680
Number of Lights operating	Nos	300
Annual Consumption for Fluorescent lights	kWh	26208
Annual Consumption for LED lights	kWh	9072
kWh Saving per Annum	Rs	17136
Cost per kWh(Average)	Rs	6.71
Annual Financial Savings	Rs	114982.6
Cost of LED light	Rs	2500
Investment for LED lights	Rs	750000
Simple Payback period	Months	78.27

TABLE 27: EC PROPOSAL 3

ANNEXURE-2

LED specification

The Department of Electronics and information technology issued “Electronics and information Technology goods order 2012” on 3rd October 2012 the following standards for LED lamps are covered.

1. IS 15885 (Part -2/section 13)
2. IS 16102 (Part-1): 2012

As per this order LED manufactures to get their product tested from BIS recognised labs.

Thus the following electrical parameters and standards should ensure while purchasing LED in future based on the BIS standards. These are the minimum technical requirements for the acceptance of LED. Also the LED test certificates as per the various standards mentioned below should be examined while purchasing.

Sl no	Parameters	Requirements	Applicable IS
1	Light source	SMD LED chip	LM 80/IS 16106
2	System Efficacy	>= 110 lumen /watt	IS 16106:2012
3	LED Driver Efficiency	Minimum 85%	
4	**Harmonics**	**Maximum 10%**	**IS 16102-2-2012**
5	**Power factor**	**Minimum 0.95**	**IS 16102-2**
6	Frequency	50 Hz ±3%	LM-79 report
7	Operating voltage	110V – 320V	LM 79 report
8	Surge voltage	>4 kV	LM 79 report
9	Ambient temp	-10 to 50 deg C	LM 79 report
10	Degree of protection	IP 66	IS 10322
11	CRI	Minimum 70	IS 16102 - 2

TABLE 28: LED SPECIFICATION

ABBREVIATIONS

APFC : Automatic Power Factor controller
AVG : Average
BDV : Breakdown voltage
BEE : Bureau of energy efficiency
CEA : Central electrical authority
CFL : Compact fluorescent lamp
CFM : Feet cube per minute
DB : Distribution Board
DG Set : Diesel Generator Set
EC : Energy Conservation
FD : Forced draft
HPSV : High-pressure sodium vapour
HT : High Tension
ID : Induced draft
IEC : International electro technical commission
IEEE : The Institute of electrical and electronics engineers
IS : Indian Standard
KG : Kilogram
KVA : Kilo Volt Ampere
KVAH : Kilo volt Ampere Hour
KVAR : Kilo volt-ampere
KW : Kilo Watts
KWH : Kilowatt-hour
LED : Light emitting diode
MAX : Maximum
MH : Metal halide
NEMA : National Electrical Manufacturers Association
OLTC : On load tap changer
ONAN : Oil natural air natural
PCC : Point of common coupling
PSI : Pound square inch
RMD : Registered Maximum demand
SEC : Specific electricity consumption
SFU : Switch Fuse Unit
SLD : Single Line Diagram
TDD : Total demand distortion
THD : Total harmonics distortion
TOE : Tonne of oil equivalent
UPS : Uninterruptible power supply
VFD : Variable frequency drive

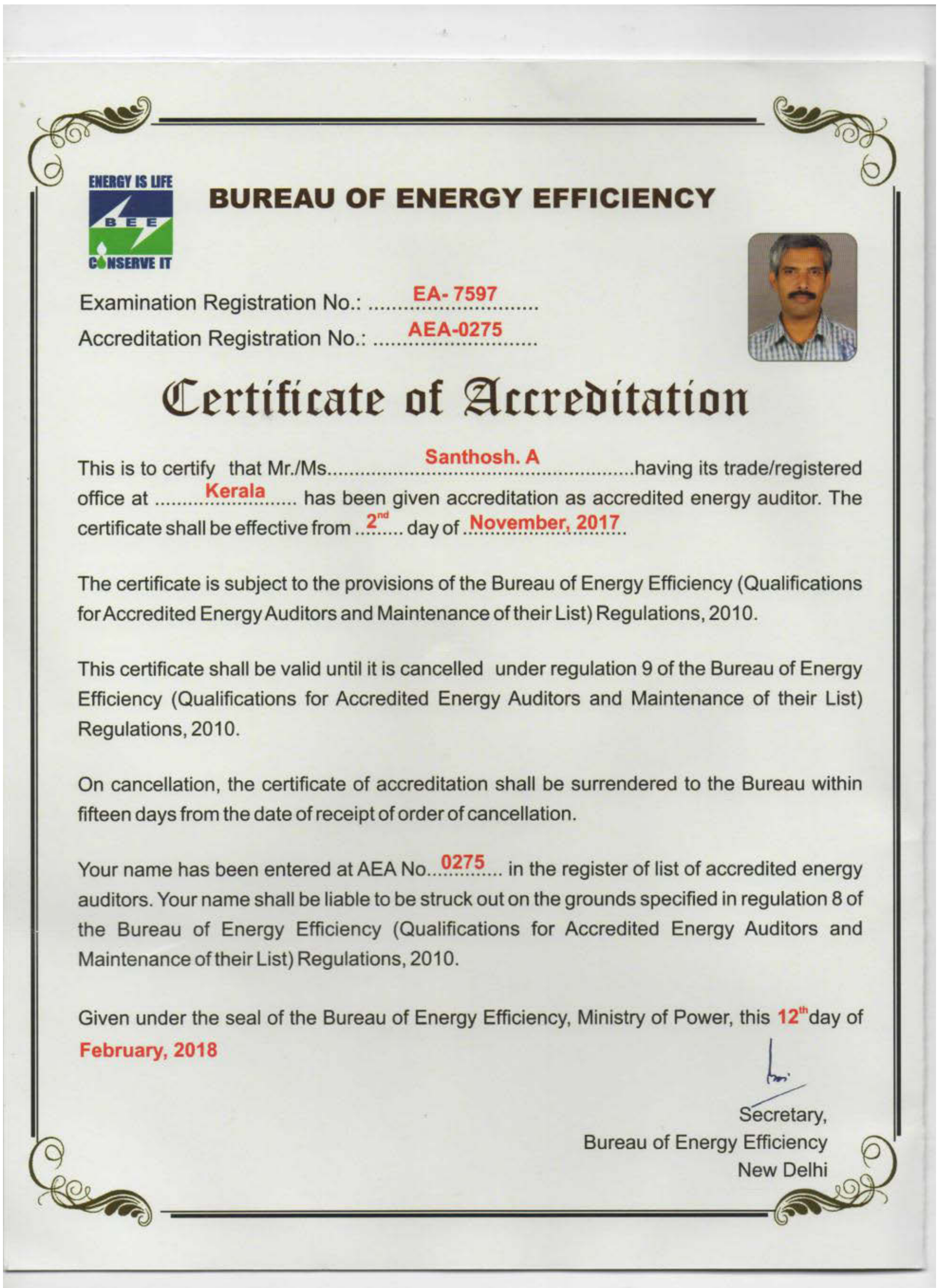
INSTRUMENTS USED

SL.NO	EQUIPMENT DESCRIPTION	MAKE & MODEL
1	Power energy & harmonic Analyser	Krykard ALM 35
2	Thermal Imager	FLIR E50

TABLE 29: INSTRUMENTS USED

REFERENCES

1. BEE energy audit books
2. CEA regulations of grid connectivity-2007
3. IEEE Std. 519-1992.
4. National lighting code - 2010



ENERGY IS LIFE
BEE
CONSERVE IT

BUREAU OF ENERGY EFFICIENCY

Examination Registration No.: EA- 7597
Accreditation Registration No.: AEA-0275

Certificate of Accreditation

This is to certify that Mr./Ms. Santhosh. A having its trade/registered office at Kerala has been given accreditation as accredited energy auditor. The certificate shall be effective from 2nd day of November, 2017

The certificate is subject to the provisions of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

This certificate shall be valid until it is cancelled under regulation 9 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

On cancellation, the certificate of accreditation shall be surrendered to the Bureau within fifteen days from the date of receipt of order of cancellation.

Your name has been entered at AEA No. 0275 in the register of list of accredited energy auditors. Your name shall be liable to be struck out on the grounds specified in regulation 8 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

Given under the seal of the Bureau of Energy Efficiency, Ministry of Power, this 12th day of February, 2018

Secretary,
Bureau of Energy Efficiency
New Delhi

ENERGY, GREEN AND ENVIRONMENTAL AUDIT – 2018

SAHRDAYA COLLEGE OF ENGINEERING AND TECHNOLOGY
Kodakara, Thrissur
Kerala

EXECUTED BY

ATHUL ENERGY CONSULTANTS PVT LTD
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February 2018

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ACKNOWLEDGEMENTS

We express our sincere gratitude to the **Sahrdaya College of Engineering and Technology** for giving us an opportunity to carry out the project of Energy Audit. We are extremely thankful to all the staffs for their support to carry out the studies and for input data, and measurements related to the project of Energy audit.

1 Executive Director
2 Principal
3 Staff
4 Students

Also congratulating our Energy audit team members for successfully completing the assignment in time and making their best efforts to add value.

ELECTRICAL SAFETY & ENERGY AUDIT TEAM

1. **Mr. Santhosh A**
   Registered Energy Auditor of Bureau of Energy Efficiency (BEE – Govt. of India)
   Accredited Energy Auditor No – EA 7597

2. **Mr. Ashok KMP**
   Registered Energy Manager of Bureau of Energy Efficiency (BEE – Govt. of India)
   Energy Manager No – EA 25612

3. **Mr. Jaideep P P,** Project Engineer - ME, Energy Engineering.

Yours faithfully

Managing Director
Athul Energy Consultants Pvt Ltd

EXECUTIVE SUMMARY

1. ANNUAL ENERGY CONSUMPTION

Annual cost for energy consumption during last 12 months (Feb 2017 - Jan 2018).

Particulars	Unit	Quantity	Average Cost (Rs Lakhs)
Electricity	kWh	599729	54.49

TABLE 1: ANNUAL ENERGY COST

2. ENERGY SAVING PROPOSALS

The following table shows the energy saving proposals

Sl. no	**Energy conservation measures**	**Annual Energy Savings**	**Annual Financial Savings**	**Investment**	**Simple payback period**
		kWh	**Rs**	**Rs**	**Months**
1	Improving the power factor		1,32,715	15,000	02
3	Replacement of Fluorescent tubes with energy efficient T5 tubes	12288	73728	128000	21
4	Installation of solar panel (50KW) Grid Tie mode system	73,000	4,38000	25,00,000	68
Total		**85288**	**644443**	**2643000**	49

TABLE 2: ENERGY SAVING PROPOSALS

3. ENERGY PERFORMANCE INDEX (EPI)

EPI was based on the energy consumption in Feb 17 to Jan 18. The futuristic energy consumption after the implementation of energy saving proposals is given in the tables below.

Parameters	Values
Present Annual Electricity Consumption (kWh/year)	5,99,729
Present Specific Electricity Consumption (kWh/M^2)	114.64
After Energy Saving Implementation	
Annual electricity consumption (kWh/year)	4,96,825
Present Specific Electricity Consumption (kWh/M^2)	94.98
Electricity Savings in %	17.16
Total cost Savings in %	**15.11**
Reduction in CO_2 emission through electricity optimisation (Tons/annum)	**51.45**

TABLE 3: ENERGY INDEX

4. GENERAL DETAILS

The general details of the Sahrdaya College are given below in table.

Sl.No:	Particulars	Details
1	Name of the College	Sahrdaya College of Engineering & Technology
2	Address	Kodakara , PB No: 17
		Thrissur - 680684
3	Contact Person	Vini Jose
4	Contact Phone numbers & Fax	0480-2726630, 2759275
		0480-2726634 (Fax)
5	E-mail ID	info.sahrdaya@gmail.com
6	Website Details	www.sahrdaya.ac.in
7	Type of Building	Educational Institution
8	Annual Working Days	210
9	No: of Shifts	Day Shift (One) (9AM -4PM)
10	Total Build up Area	56303 Sq,Ft

TABLE 4: GENERAL DETAILS

OBJECTIVE

An energy audit is a key to assessing the energy performance of facility and for developing an energy management program. The typical steps of an energy audit are:

- Preparation and planning
- Data collection and review
- Plant surveys and system measurements
- Observation and review of operating practices
- Data documentation and analysis
- Reporting of the results and recommendations

1.1. Definition of energy auditing

In the Indian Energy Conservation Act of 2001 **(BEE 2008)**, an energy audit is defined as: **"The verification, monitoring and analysis of the use of energy and submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energyconsumption."**

1.2. Objectives of Energy Auditing

The objectives of an energy audit can vary from one plant to another. However, an energy audit is usually conducted to understand how energy issued within the plant and to find opportunities for improvement and energy saving. Sometimes, energy audits are conducted to evaluate the effectiveness of an energy efficiency project or program. In Sahrdaya College of Engineering and Technology as per the request, we have assessed the energy consumption and saving opportunities at present scenario.

Methodology for the study

The methodology adopted for energy audit starts from historical energy data analysis, power quality analysis, monitoring of operational practices, system evaluation, cost benefit analysis of the energy conservation opportunities, and prepare plan for implementation. The proposals given in the report includes economical energy efficiency measures to reduce facilities unnecessary energy consumption and cost. The energy conservation options, recommendations and cost benefit ratio, indicating payback period are included in this report.

Scope of Work

The Scope of Work includes:

1. Historical energy data analysis.
2. Electrical, Mechanical and Thermal energy analysis.
3. Power Quality Analysis.
4. Identification of Energy saving opportunities.
5. Cost Benefit Analysis.

DESCRIPTION OF SITE

Irinjalakuda Diocese was established in the year 1978, and His Excellency Mar James Pazhayattil took over the reins as the first Bishop of this Diocese. Irinjalakuda Diocese is doing an excellent service meeting the needs of Education, Health and Social responsibilities. Considering the demands on the necessity of value based higher technical education, the people of the Diocese decided to establish an Engineering college to mark The Episcopal Silver Jubilee Year of His Excellency Bishop Mar James Pazhayattil and Silver Jubilee of the formation of the Diocese of Irinjalakuda. The Irinjalakuda Diocesan Educational Trust was formed and registered on 23-07-2001 with Reg. No: 138/IV 2001 at Irinjalakuda registration office with His Excellency Mar James Pazhayattil as Chairman, Rev. Msgr. Sebastian Ezhekadan as President, Rev. Fr. Joseph Thekkethala as Secretary, Rev.Fr. Pius Chirapanath as Finance Officer. With land holding about 40 acres, the Trust submitted the application form for establishing Sahrdaya College of Engineering and Technology at Kodakara, to the Government of Kerala, University of Calicut and AICTE, New Delhi through the Regional Office. By the Grace of God, the AICTE, New Delhi in its letter dated 06-06-2002, sanctioned the establishment of **Sahrdaya College** at Kodakara, to run the four B. Tech Degree courses leading to Electronics and Communication Engineering, Computer Science and Engineering, Biomedical Engineering and Biotechnology (Engineering) with an intake of 60 students in each of the courses from the academic year 2002-2003.

The Government of Kerala included the **Sahrdaya College** as one of the engineering colleges to which the students have to be admitted by the Commissioner of Entrance Examination from the year 2002-2003 in the four branches sanctioned by the AICTE. On 21st November 2001 His Excellency Mar James Pazhayattil laid the foundation stone for central building of Sahrdaya College. Architects Mayphils from Ernakulam prepared the master plan for the college and detail plan for the individual buildings. On 22/02/2002 His Excellency Mar James Pazhayattil laid the foundation stone for the workshop and hostel building in the campus. In a short span of seven months the central building, workshop and hostel block were completed in all respects.

Vision of College

Evolve as a leading technology institute to create high calibre leaders and innovators of global standing with strong ethical values to serve the industry and society.

Mission of College

Provide quality technical education that transforms students to be knowledgeable, skilled, innovative and entrepreneurial professionals. Collaborate with academia and industry around the globe, to strengthen the education and research ecosystem. Practice and promote high standards of professional ethics, good discipline, high integrity and social accountability with a passion for holistic excellence.

Quality Policy of College

Sahrdaya are committed to provide quality technical education through continual improvement and by inculcating moral and ethical values to mould vibrant engineers with high professional standards.

They impart the best education through the support of competent and dedicated faculty, excellent infrastructure and collaboration with industries to create an ambience of excellence

Departments

- Civil Engineering
- Mechanical Engineering
- Computer Science and Engineering
- Electrical and Electronics Engineering
- Electronics and Communication Engineering
- Applied Science and Humanities Department
- Biomedical Engineering
- Biotechnology Engineering

SINGLE LINE DIAGRAM

The following figure shows the basic single line diagram of the Sahrdaya College.

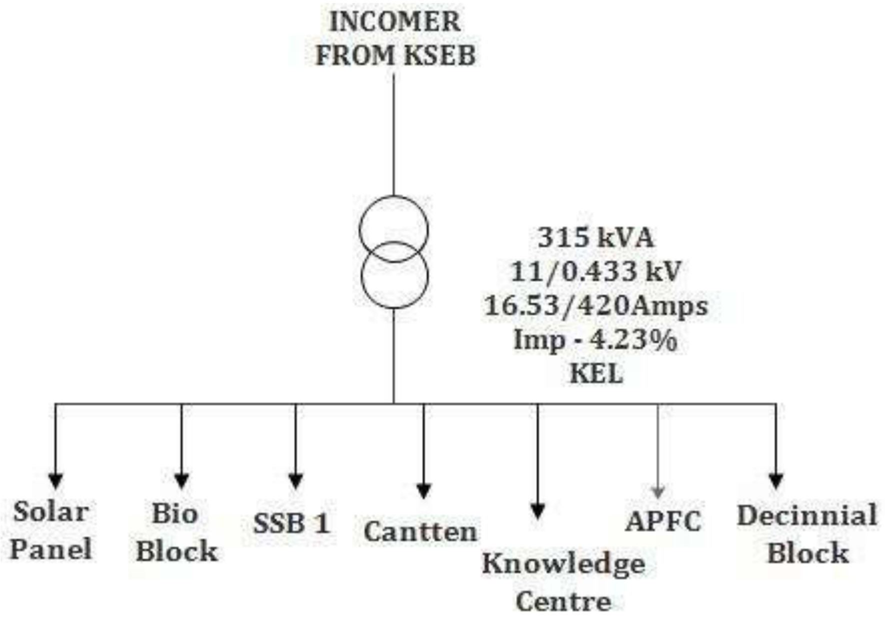


FIGURE 1: SINGLE LINE DIAGRAM

ELECTRICITY CONSUMPTION ANALYSIS

1. BASELINE DATA & CONSUMPTION: 12 MONTHS

Base Line Data (Based on last 12 months – Feb 17 to Jan 18)			
1	Electricity provider	KSEBL	
2	Supply Voltage	11 kV	
3	Tariff	HT 11(B) General	
4	Consumer No:	1356540002958	
5	Contract demand (kVA)	150	
6	Maximum demand registered (kVA)	187 (Jan 18)	
7	Average monthly electricity consumption (kWh)	49977	
8	Average demand charges (Rs/month)	64583	
9	Average power factor	0.945	
10	Average power factor incentive (Rs/month)	8019	
11	Average Tariff rate for energy consumption, (Rs / kWh)	Normal – 7.20 Peak – 10.80 Off Peak – 5.40	Average – 7.80
12	Demand charge (Rs / kVA)	400	
13	Average monthly electricity cost (Rs)	454093	

TABLE 5 : BASELINE DATA

Inference

i. Power factor found to be average of 0.945 in which present tariff receives incentives.

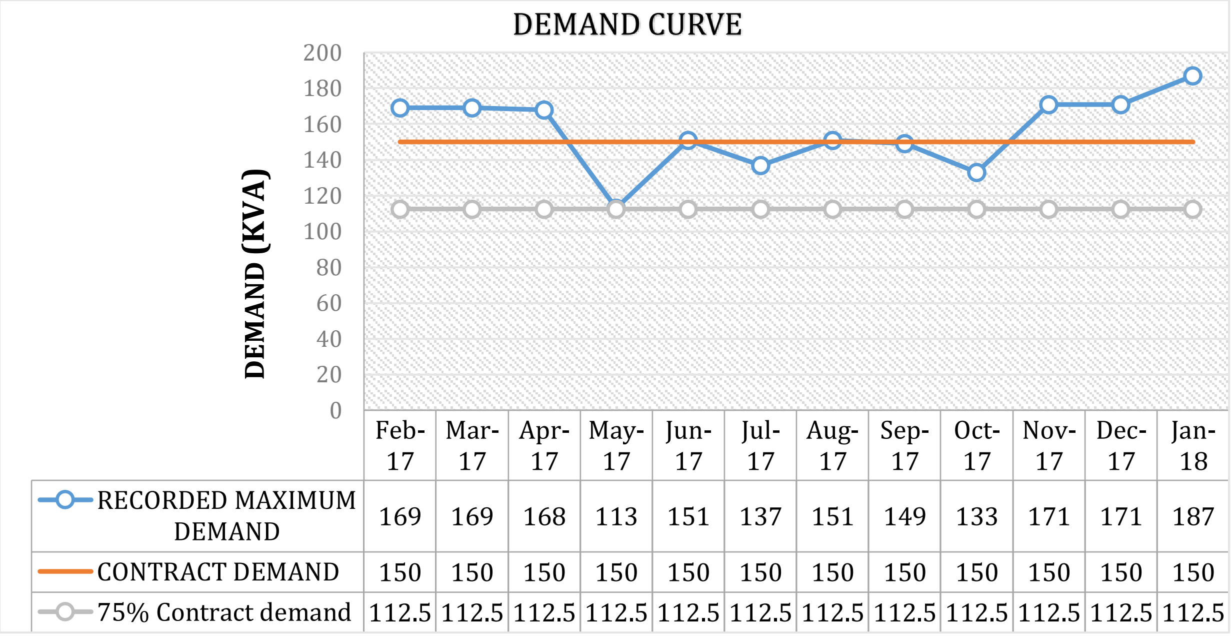
ii. Recorded maximum demand during past 12 month was **187 kVA** and which is more than the contract demand.

iii. The RMD comes more than the minimum billing demand, where the pf is also low. In this condition the demand charges will higher.

iv. For last year the pf not comes more than 0.95 in majority of the months.

2. DEMAND ANALYSIS

This section analyses the trend for the maximum demand versus the Contract Demand (CD) over a 12-month period (Feb 17 to Jan 18).



	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18
RECORDED MAXIMUM DEMAND	169	169	168	113	151	137	151	149	133	171	171	187
CONTRACT DEMAND	150	150	150	150	150	150	150	150	150	150	150	150
75% Contract demand	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5

FIGURE 2: DEMAND ANALYSIS

Inference

i. Average demand charges came as **Rs. 64,583** per month.

ii. The recorded maximum demand came above 75% in all most all months

Suggestion

i. The savings on demand charges after improving the pf is given in the Annexure

3. ELECTRICITY DEMAND IN VARIOUS TIME ZONES

The variations of demands in the time zones are given below in figure.

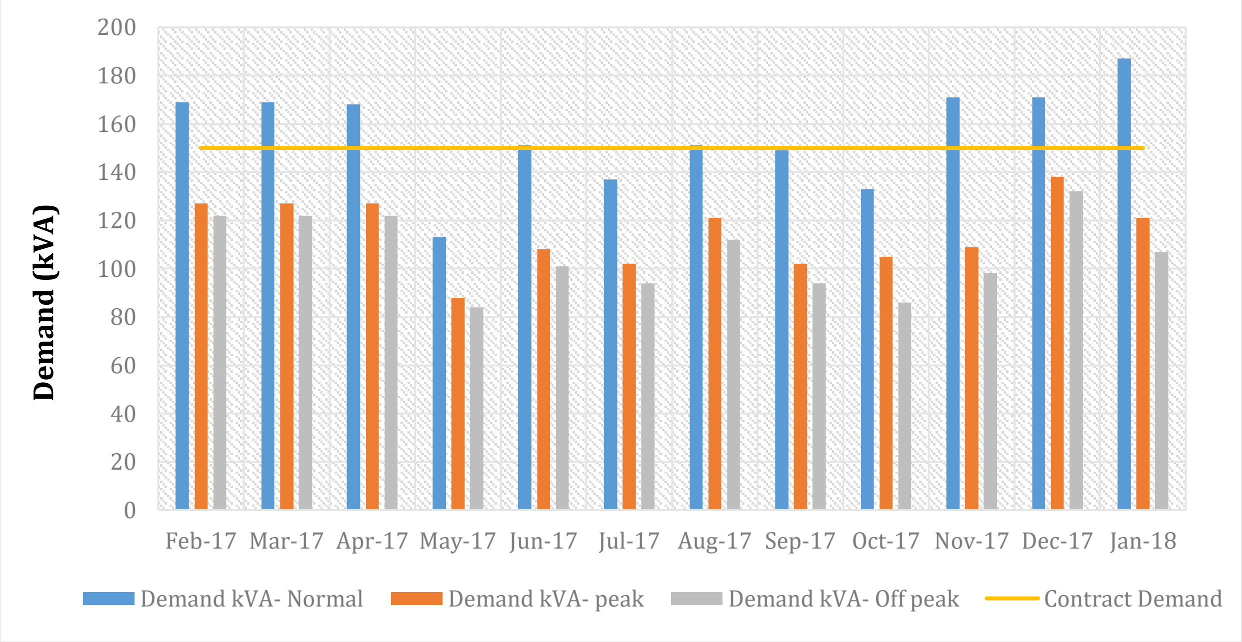


FIGURE 3: DEMAND IN VARIOUS TIME ZONES

Inference

i. The average maximum demand in the normal, Peak and off peak period registered at Sahrdaya College with respect to the contract demand is 103.83%, 76.39% and 70.77% respectively.

ii. The percentage of maximum demand in the normal, Peak and off peak period registered at Sahrdaya College with respect to the contract demand is 124.67 %, 92%, and 88% respectively.

Suggestion

i. It is better to install a demand controller.

4. POWER FACTOR ANALYSIS IN KSEB BILL

The Power factor is the ratio of Active power (kW) and apparent power (kVA).

$$PF \ = \ Active\ energykWh/Apparentenergy\ (kVAh)$$

The power factor variations in past one year is given below in figure.

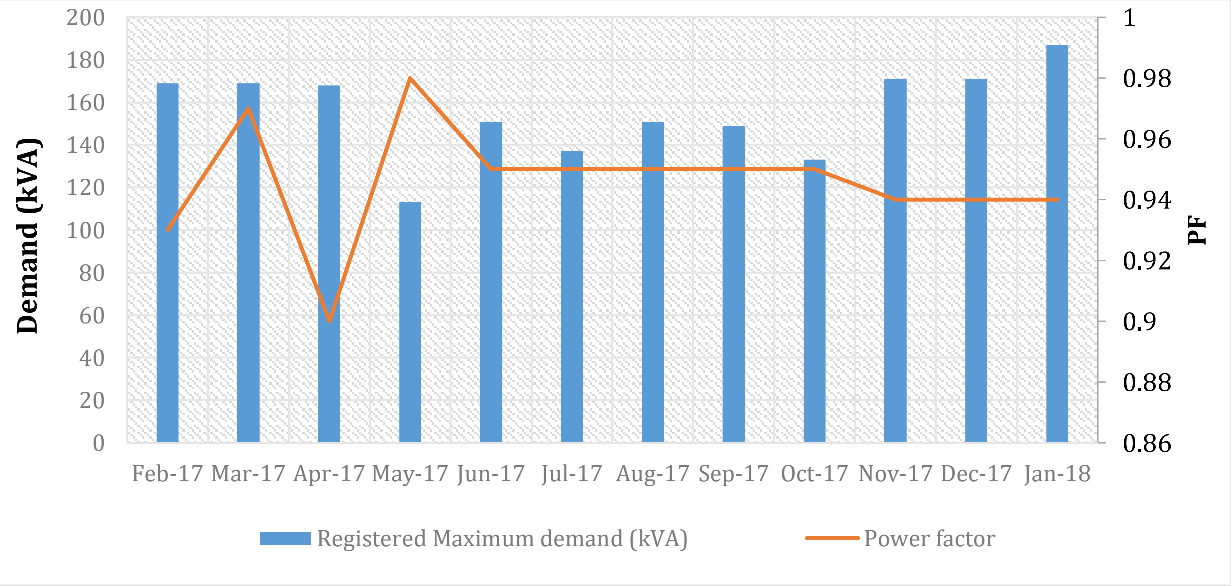


FIGURE 4: POWER FACTOR ANALYSIS

Inference

1. Average power factor during the past one year is found to be 0.945.
2. From the figure, we get the inference that most of the some of the capacitors that placed at the load end were not working well.

Suggestion

1. By improving the PF, the incentives will increase.

5. TARIFF RATES ANALYSIS

The average monthly energy and demand charges for the period Apr 17 to Mar 18 is represented in Figure below.

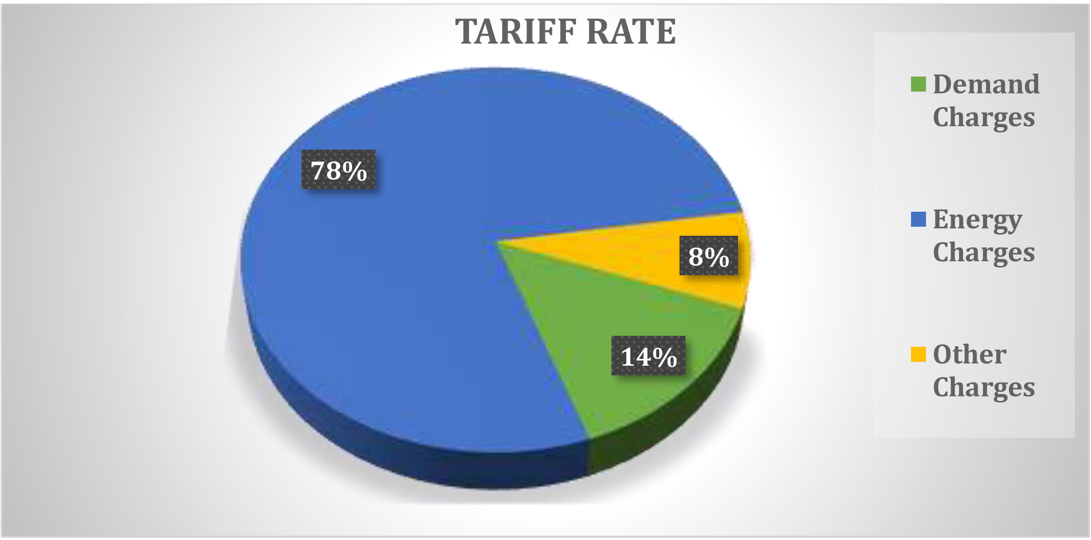


FIGURE 5: TARIFF RATE

Inference

i. Average demand charges for the past one year was Rs 64,583/ **per month** and energy charges was Rs 3,60,254/ per month**.**

ii. The energy charges came about **78%** of the total bill.

iii. The Sahrdaya College tariff band is **not good** because 22% spend for demand and other charges.

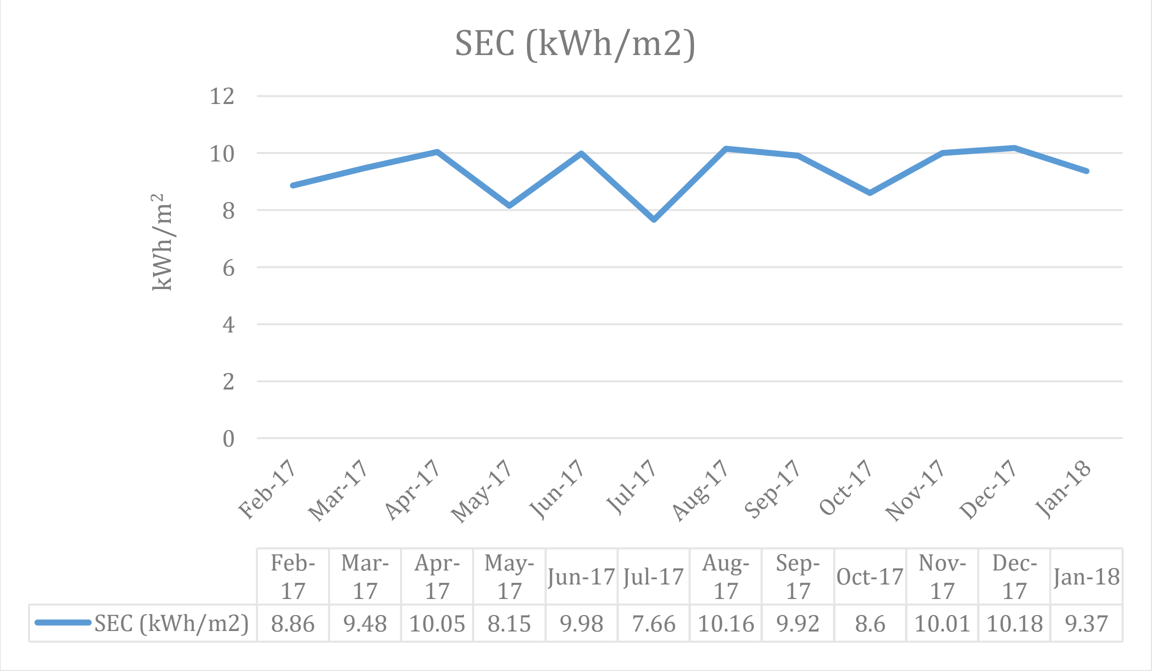
6. SPECIFIC ELECTRICITY CONSUMPTION (kWh/M²)

The electricity consumption from Apr 2017 to March 2018 has taken for the benchmarking in the Sahrdaya College in the regression analysis method. Here the comparison is done with electricity consumption (KSEB) and the building area, which is in Square meters.

The below table shows the specific electricity consumption of Sahrdaya College.

Month	Unit Consumption	Total Build-up Area	Specific Electricity
	kWh	**M²**	**kWh/ M²**
Feb-17	46334	5231	8.86
Mar-17	49584	5231	9.48
Apr-17	52578	5231	10.05
May-17	42628	5231	8.15
Jun-17	52217	5231	9.98
Jul-17	40078	5231	7.66
Aug-17	53148	5231	10.16
Sep-17	51916	5231	9.92
Oct-17	45012	5231	8.60
Nov-17	52358	5231	10.01
Dec-17	53226	5231	10.18
Jan-18	60650	5231	9.37
Avg	**49977.42**	**5231**	**9.37**
Total	**599729**	**5231**	**114.65**

TABLE 6: SPECIFIC ELECTRICITY CONSUMPTION – kWh/M²



	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18
SEC (kWh/m2)	8.86	9.48	10.05	8.15	9.98	7.66	10.16	9.92	8.6	10.01	10.18	9.37

FIGURE 6: SPECIFIC ELECTRICITY CONSUMPTION – kWh/M²

- There is a plot between unit consumption and production for **LAST 3 FINANCIAL YEAR**.

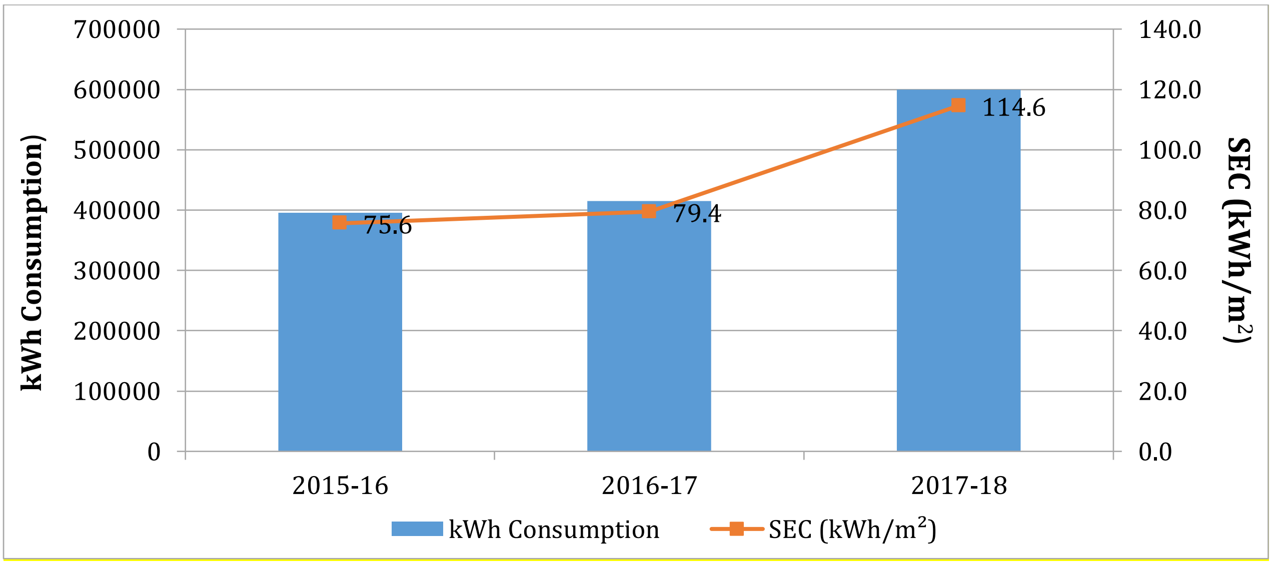


FIGURE 7: EFFICIENCY ANALYSIS OF LAST 3 FINANCIAL YEARS

ELECTRICITY PERFORMANCE

The objective of this section is to establish how the facility is performing in terms of energy consumption.

TRANSFORMER SECONDARY LOGGING

The LT side of the transformer was logged using power quality analyser Krykard ALM 35 for 24 hours and given in following table. The measurement was done in 7th Feb 2018 to 8th Feb 2018. The measurement-averaging period was 10 minutes. The Measurement details of the transformer are given below:

Make		**KEL**		
Rating	**kVA**	315		
Voltage ratings	**kV**	11/0.433		
Current ratings	**A**	16.53/420		
Volt impedance	**%**	4.23		
Measurement values – LT side				
Actual Energy for 24 Hrs	kWh	**1529**		
Apparent Energy for 24 Hrs	kVAh	**1626**		
Power Factor	**0.94**			
Particulars	**Units**	**Minimum**	**Maximum**	**Average**
Active Power	kW	**5.60**	**65.33**	**23.77**
Apparent Power	kVA	**6.69**	**67.93**	**25.96**
Reactive Power	kVAr	**-7.46**	**20.39**	**3.63**
Voltage phase	Volts	**193.60**	**253.80**	**240.28**
Current	Amps	**8.40**	**128.40**	**36.50**
THD V	%	**1.40**	**5**	**2.09**
TDD A	%	**7.90**	**66.20**	**22.20**
Voltage Imbalance	%	**0.20**	**1.10**	**0.72**
Current Imbalance	%	**0.20**	**43.10**	**13.14**

TABLE 7: TRANSFORMER LOGGING

Inference

i. The maximum demand registered during the period of measurement is 67.93 kVA, in 10 minutes' interval, and the corresponding PF was 0.915 that shows the importance of PF improvement.

ii. The variation of voltages found at the time of audit. (193.6 to 253.8V)

iii. The average loading of transformer is only about less than 10%.

iv. Current imbalances were found to be higher (Maximum of 3.1%)

1. ANALYSIS: VOLTAGE VARIATION

The Voltage profile at the LT side is plotted below in figure.

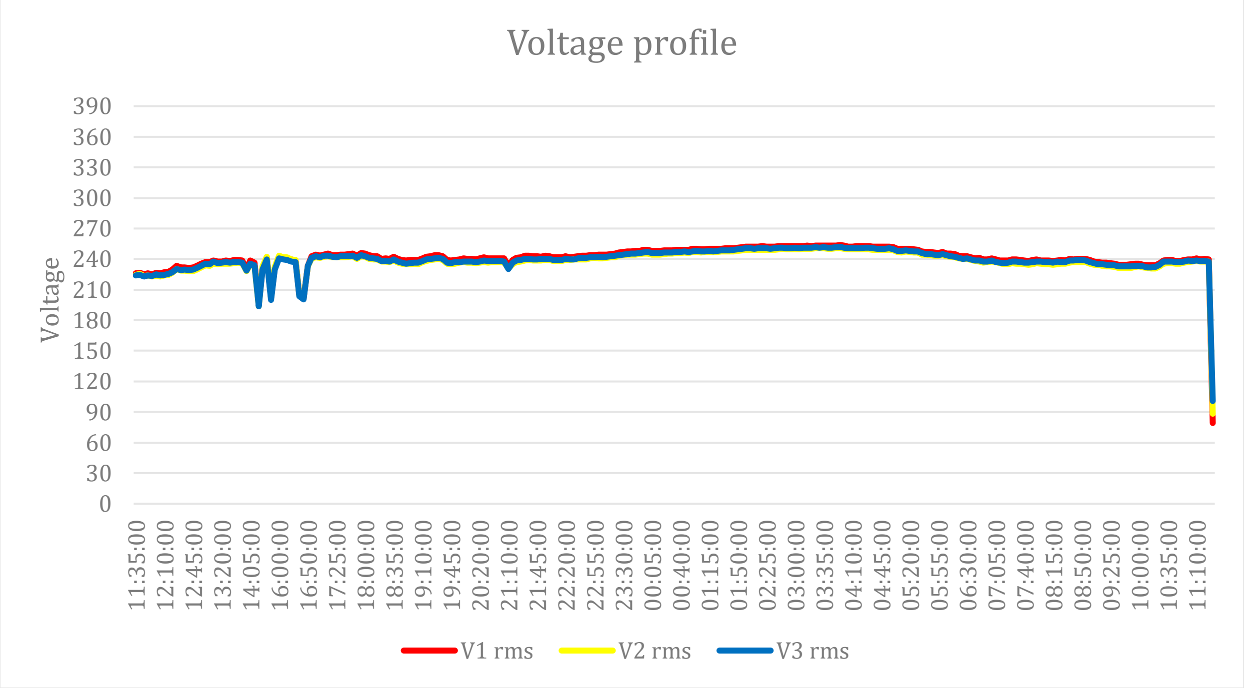


FIGURE 8: VOLTAGE PROFILE

Inference

i. The figure shows the minimum voltage imbalance and supply voltage variation.

ii. The maximum and minimum supply voltage were during the normal operational period, excluding the power failure, is 253.80 and 193.60 respectively with an average phase voltage of 240.28 V.

iii. The high voltage will increase the power consumption and increases the capacitance value in the system.

2. ANALYSIS: CURRENT VARIATIONS

This section carries the current variations during the 24-hour measurement period with the power analyser.

The figure below gives the current profile of the phases at the LT side.

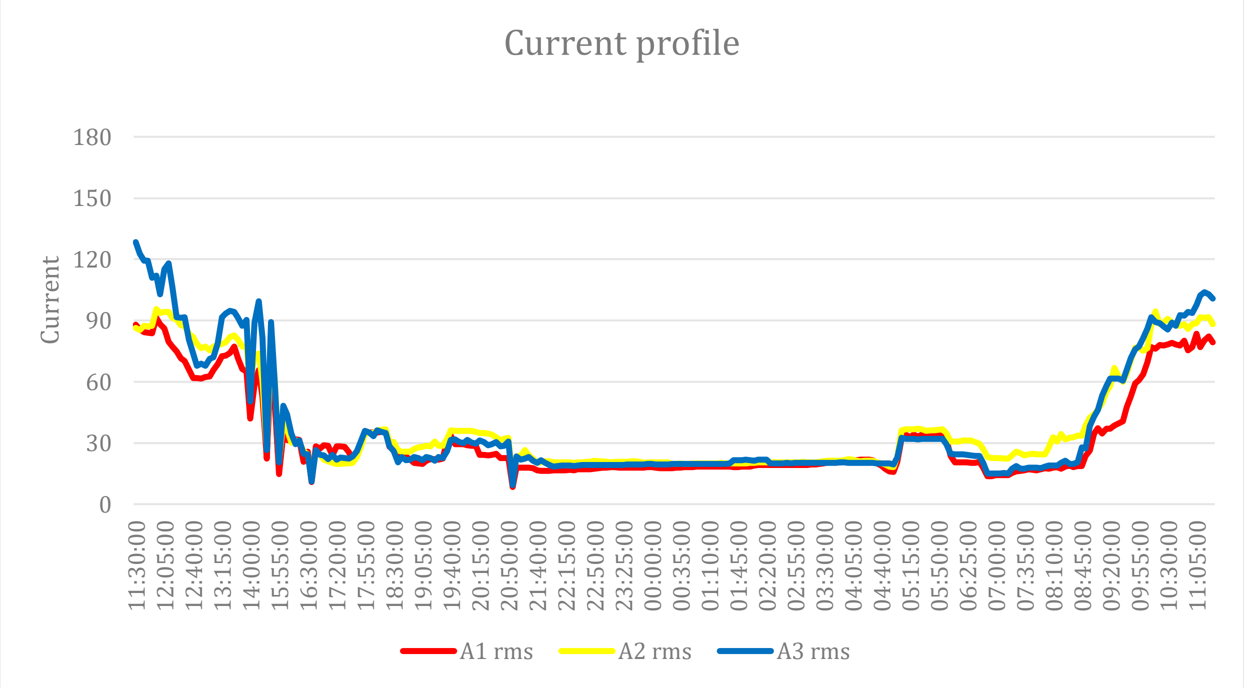


FIGURE 9: CURRENT VARIATIONS

Inference	
	i. Figure above denotes current variations at the LT side.
	ii. The maximum current occurred during the Normal period at 128.40A and minimum during peak period with 8.40A.
	iii. The current varies between 2 to 30.57% of the rated current of the transformer at the secondary side.

3. LOAD FACTOR

The load factor is the ratio of the energy consumed during a given period (in the audit period or in last 12 months) to the energy, which would have been consumed if maximum demand had been maintained throughout the period.

$$\text{Load factor (\%)} = \frac{\text{Energy used during the period (kWh)} \times 100}{\text{Maximum demand (kW)} \times \text{Time under consideration (hr)}}$$

Load factor calculated from the 24-hour logging at the LT side during the period of audit is given in table below:

Total kWh	Max kW	Time (Hrs)	Load factor (%)
1529	65.33	24	65.33

TABLE 8: LOAD FACTOR – TRANSFORMER

Inference

i. The higher the load factor means higher utilisation efficiency of the electrical system.

4. ANALYSIS: POWER FACTOR

The section provides an overview of the power factor variations at the LT side. The Power factor variation with respect to the active and reactive power are given in table.

	Time	PF	kW	kVA	kVAr	Remarks
Normal period						
Minimum PF	07:15:00	0.727	8.90	12.23	-7.01	Leading
Maximum PF	09:50:00	0.986	48.68	49.36	1.93	Lagging
Peak period						
Minimum PF	22:00:00	0.807	10.83	13.41	6.43	Lagging
Maximum PF	18:10:00	0.978	25.36	25.93	0.21	Lagging
Off peak period						
Minimum PF	04:20:00	0.695	11.10	15.96	8.66	Lagging
Maximum PF	05:10:00	0.981	25.05	25.53	1.10	Lagging

TABLE 9: PF VARIATIONS

Inference

- There is leading found at the time of audit in the normal period.
- The PF was found to be very low in some time intervals.

Recommendations

Replace the faulty capacitors with new capacitors to improve the power factor.

5. ANALYSIS: CURRENT IMBALANCE

This section carries out the current imbalance at the LT side during the logging period. The current imbalance with respect to the ampere in three phases are given below:

	TIME	R PHASE	Y PHASE	B PHASE	UNBALANCE
NORMAL TIME					
MAX. CURRENT	11:30:00	**87.8**	**86.3**	**128.4**	27.3
MIN. CURRENT	14:45:00	**8.3**	**10.6**	**10.6**	15.6
CURRENT AT MAX. UNBALANCE	08:20:00	17.3	34.3	20.3	**43.1**
CURRENT AT MIN. UNBALANCE	17:55:00	35.2	34.6	35.8	**1.7**
PEAK TIME					
MAX. CURRENT	18:10:00	**35.2**	**36.1**	**36.1**	1.7
MIN. CURRENT	21:10:00	**8.4**	**10.8**	**9.3**	13.7
CURRENT AT MAX. UNBALANCE	19:20:00	22.1	30.6	21.4	**23.9**
CURRENT AT MIN. UNBALANCE	18:10:00	35.2	36.1	36.1	**1.7**

OFF PEAK TIME					
MAX. CURRENT	04:55:00	**15.7**	**18.2**	**19.4**	11.6
MIN. CURRENT	05:20:00	**34.1**	**36.8**	**32**	7.3
CURRENT AT MAX. UNBALANCE	04:50:00	16	18.4	20	**11.8**
CURRENT AT MIN. UNBALANCE	04:35:00	19.9	20.6	20.1	**2**

TABLE 10: CURRENT UNBALANCE

Inference

- The current imbalance (43.10%) occurred on Normal period. I.e. at 8.20 hrs morning which is above the standard of 10%.
- The average current imbalance measured was 13.14%, which is well within the specified standard limit (10%).
- The variation of current unbalance in Normal time zones are given below:

The current imbalance at the Transformer secondary side are given below:

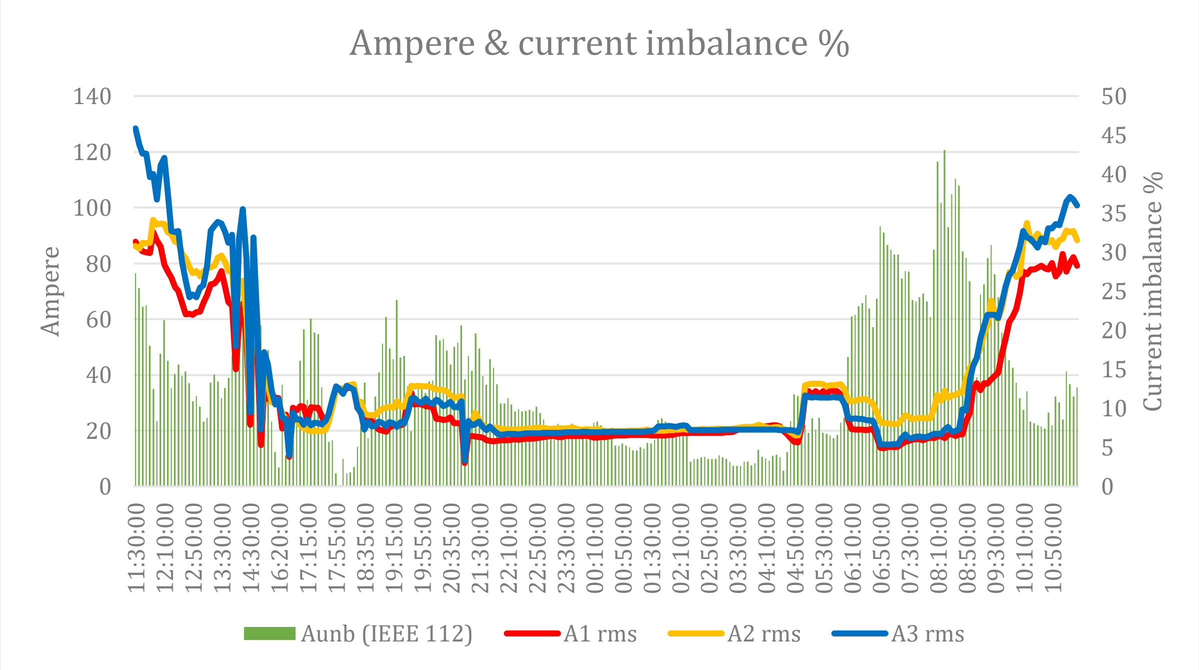


FIGURE 10: AMPERE VS IMBALANCE GRAPH

Inference

- The current unbalance is creating in morning time and in B-phase current rating is more. Check the routine of switching on of the electrical system for reducing the unbalance.

6. ANALYSIS: COMPARISON OF LOADS IN DIFFERENT TIME ZONES

This section provides an overview of the total electricity consumption, split across the 3 different time zones as defined by the Kerala State Electricity Board (KSEB):

Time Zone 1: Normal: 6.00 Hrs. to 18.00 Hrs.

Time Zone 2: Normal: 18.00 Hrs. to 22.00 Hrs.

Time Zone 3: Normal: 22.00 Hrs. to 6.00 Hrs.

Electricity consumption according to the time of use, as calculated from the 24-hour logging.

Particulars	Zone-1 (6am - 6pm) (kWh)	Zone -2 (6pm-10pm) (kWh)	Zone-3 (10pm-6am) (kWh)	Total (kWh)
	Normal	**Peak**	**Off-peak**	
Unit consumption	1040	183	306	**1529**
Average kWh in each period (normal/12, peak/4, off peak/8)	**86.67**	**45.75**	**38.25**	

TABLE 11: ZONE WISE KWH CONSUMPTION

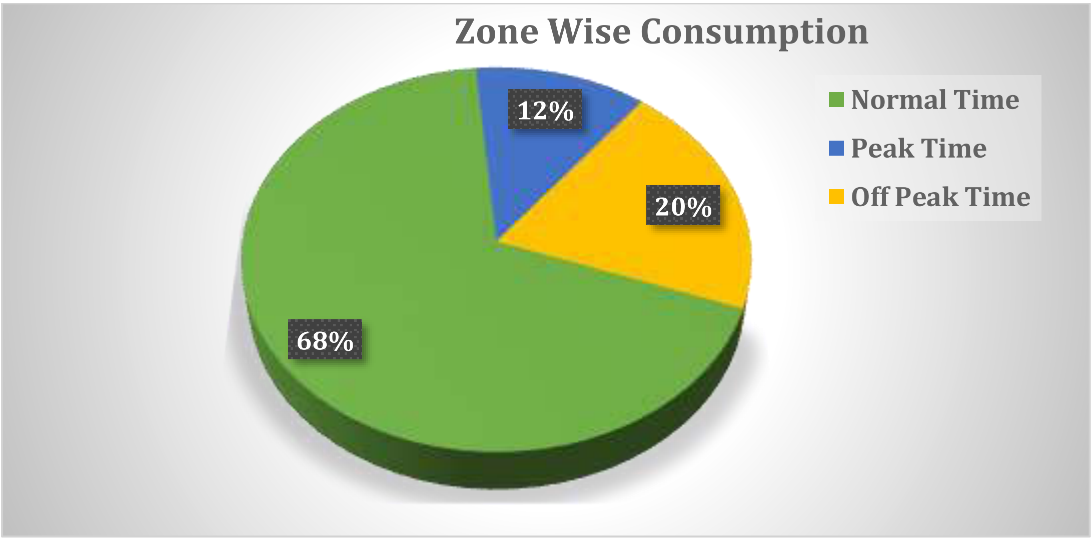


FIGURE 11: ZONE WISE KWH CONSUMPTION

According to KSEB, the energy charges in each time zone is calculated as follows:

In Time Zone 1(EC1): Consumption in Zone 1* Rate

In Time Zone 2(EC2): Consumption in Zone 2* Rate* 1.5

In Time Zone 3(EC3): Consumption in Zone 3* Rate* 0.75

Majority of the unit consumption occurs during the normal period, which is **68%**.

7. HARMONIC STUDY

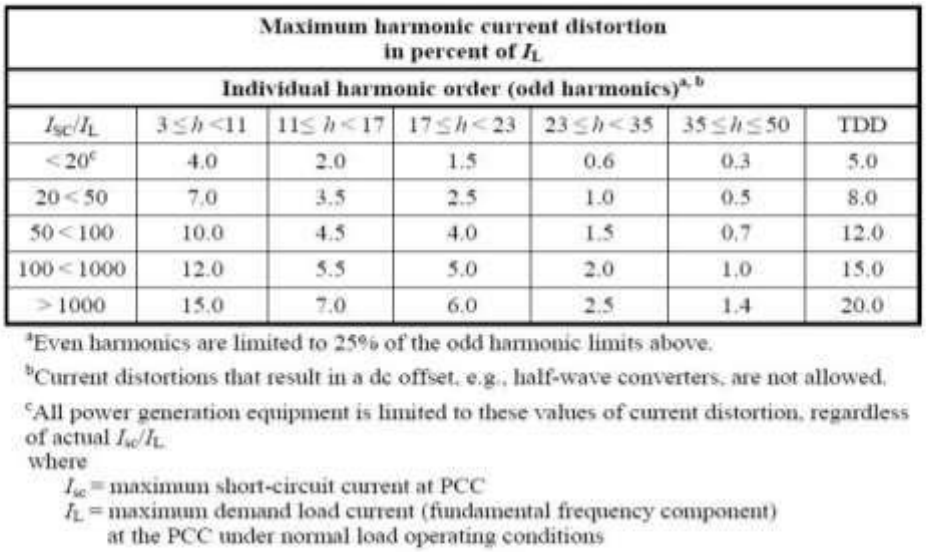
Harmonics study revolves around the use of non-linear loads that are connected to electric power systems including static power converters, arc discharge devices, saturated magnetic devices and to a lesser degree, rotating machines. Static power converters of electric power are the largest non-linear loads and are used in industry for a variety of purposes such as electro- chemical power supplies, adjustable speed drives, and uninterruptible power supplies. These devices are useful because they can convert ac to dc, dc to dc, dc to ac, and ac to ac. Non-linear loads change the sinusoidal (a succession of waves or curves) nature of the ac power current (and consequently the ac voltage drop) thereby resulting in the flow of harmonic currents in the ac power system that can cause interference with communication circuits and other types of equipment. Classification, effects and standards are given below:

	1st order	2nd order	3rd order	3rd order	4th order	5th order	6th order
Frequency Hz	50	100	150	200	250	300	350
Sequence	+	-	0	+	-	0	+

TABLE 12: HARMONICS CLASSIFICATION

Effect on - Motor & generator	-Transformers	- Cables	- Electronic equipment	- Metering
Rotor heating, causes Reverse rotating magnetic field, causes pulsating torque output, Mechanical oscillations, increases Cogging & Crawling	Increase in copper & stray losses, increase in iron losses, transformer heating	Voltage stress & corona, I^2R losses increases	Voltage notching, Electromagnetic interference, Shifting of the voltage zero crossing	Erroneous reading

TABLE 13: EFFECTS OF HARMONICS (IEEE 519)



Maximum harmonic current distortion in percent of I_L						
Individual harmonic order (odd harmonics)[a, b]						
I_{SC}/I_L	$3 \leq h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h \leq 50$	TDD
< 20[c]	4.0	2.0	1.5	0.6	0.3	5.0
20 < 50	7.0	3.5	2.5	1.0	0.5	8.0
50 < 100	10.0	4.5	4.0	1.5	0.7	12.0
100 < 1000	12.0	5.5	5.0	2.0	1.0	15.0
> 1000	15.0	7.0	6.0	2.5	1.4	20.0

[a] Even harmonics are limited to 25% of the odd harmonic limits above.

[b] Current distortions that result in a dc offset, e.g., half-wave converters, are not allowed.

[c] All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L.

where

I_{sc} = maximum short-circuit current at PCC

I_L = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions

TABLE 14: CURRENT HARMONICS LIMIT (IEEE 519-2014)

Voltage distortion limits		
Bus voltage at PCC	**Individual voltage distortion %**	**Total voltage harmonics distortion %**
V ≤ 01 kV	**5.0**	**8.0**
01 kV < V ≤ 69 kV	3.0	5.0
69.001 kV < V ≤ 161 kV	1.5	2.5
161.001 kV and above	1.0	1.5

TABLE 15: VOLTAGE HARMONICS LIMIT (IEEE 519-2014

HARMONICS DATA SHEET

Location: Main Control Panel (LT Side)							
Total harmonic distortion as per CEA standard TDDi limit is 8% and THDv limit is 8% at 400V level as per Short circuit analysis							
Total Harmonic Distortion - TDD %		**Voltage %**	**Current %**	**Remarks**			
		2.08	66.20	Voltage harmonics is within limit But Current Harmonics' is more			
Individual Harmonic%							
Particulars	3rd	5th	7th	9th	11th	13th	15th
Voltage %	1.5	3.3	2.1	5.2	0.8	0.7	2.4
Current %	13.5	44.3	37.6	13.5	17	11.9	3.9

TABLE 16: HARMONICS ANALYSIS

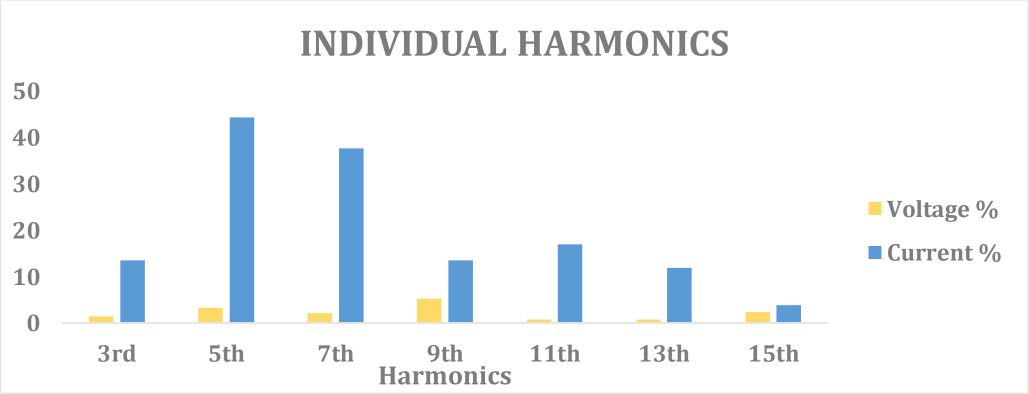


FIGURE 12: HARMONICS ANALYSIS

Inference

i. The table gives the input that the individual and total current harmonics are higher than the specified limit of 8%.

ii. The table also gives the fact that the voltage harmonics are within the limit of 8%.

Suggestions

i. While purchasing nonlinear controlling devices such as UPS and loads such as LED, DC fans, more care should take to ensure the output harmonics values and specification should contain the IEEE/CEA standard limit which mentioned in the above table.

ii. This will reduce the overall effect of harmonics in the equipment and supply system.

DIESEL GENERATORS

Sahrdaya College uses Two Diesel generators, which gives the backup supply to the MSB, works in auto mode, according to the load during the power failure in which the details are given below:

DG-kVA	250	250
Engine	Kirloskar	Supernova
Generator	Kirloskar	Supernova

TABLE 17: DG DETAILS

CAPACITOR PANEL

To reduce kVAr, partial kVAr must be supplied by capacitors which in turn will reduce the burden of kVAr on the utility supply system. The capacitor acts as a kVAr generator. The power factor correction can be static correction where capacitors are connected to each starter, or it can be bulk correction where capacitors are connected at the distribution boards.

In Sahrdaya College, APFC panel is provided with parallel to MSB. The performance of individual capacitors in the APFC panel are given below:

Name	Rated kVAr	Design Voltage	Measured Voltage	Measured kVAr	kVAR wrt to Volts	% of deterioration
	A	**B**	**C**	**E**	**F= A*(C/B)^2**	**G= (F-E)*(100/F)**
C1	20	440	394	17.55	17.91	2.01
C2	20	440	394	16.98	17.91	5.19
C3	20	440	394	11.2	17.91	37.46
C4	20	440	394	10.2	17.91	43.05
C5	20	440	394	15.2	17.91	15.13

TABLE 18: CAPACITOR DETAILS

Inference

i. From the table above, most of the installed capacitors are damaged or degraded.
ii. Due to the damage of capacitors, the pf will come down.

Suggestions

i. Periodic checking of capacitors should be done once in two weeks analysing the ampere rating taken after the new installation as the base value.
ii. Replace the faulty capacitors with new capacitors for the maintaining of power factor.
iii. Install APFC panel in parallel to the Main switch board to optimise the power factor to unity, for the present varying loads the PF is 0.98 only.

AIR CONDITIONING

The details of Air conditioners installed in the college are given below:

Sl.No:	Location	Rated Capacity	Quantity	Rated Power	Total Power
		TR	Nos	KW	KW
1	Decennial Block	2	4	2.3	9.2
2	Main Block	1	22	1.2	26.4
3	Biotechnology Block	1.5	4	1.7	6.8
		1.2	1	1.7	1.7
4	Knowledge Centre	1	14	1.2	16.8
		1.5	1	1.3	1.3
		40	1	14	14
		1.5	3	1.65	4.95
TOTAL			**81.15 KW**		

TABLE 19: AIR CONDITIONING DETAILS

Inference

- Majority of the AC's are split AC's.
- Only few AC's are star rated AC's

Suggestions

- Run AC's at 25 to 28 degree Celsius.
- Try to insulate the rooms from all sides.
- Check its star ratings for energy consumption. For future purchase prefer the 5-star AC's.
- Every degree below 26 increases energy consumption of AC.
- Clean the filter of the AC's regularly as it can help to reduce energy consumption.
- If prefer the lower temperature, it would be wiser to use the AC along with a ceiling fan.
- For continues working and no openings then prefer the inverter AC's. Then the energy consumption cost can be reduced by one third. It can be effective for server rooms.

LIGHTING AND FAN LOADS

The details of Lighting and Fan loads installed in the college are given below:

Sl.No:	Location	Total kW
1	Decennial Block	32.9
2	Main Block	26.65
3	Biotechnology Block	32.02
4	Men's Hostel	88.5
5	Ladies Hostel	38.5
6	Knowledge Centre	25.6
8	PG Hostel	28.05
TOTAL KW		**272.2**

TABLE 20: LIGHT DETAILS

Inference

- There are around **272.2 kW** of lighting loads are installed.
- Majority of the light fittings are Fluorescent tubes.
- LED lights are installed in some areas also.

Suggestions

- Replace the Fluorescent tubes with T-5 lights.
- Maximize the use of sunlight in classrooms.
- Switched off the lights after the use.
- Provide Timer controllers for Board lights.
- Provide proper labelling for the electrical panels.

COMPUTER AND ACCESSORIES

The details of Computer and Accessories in the college are given below:

Sl.No:	Particulars	Power Rating	Quantity	Total Power
		Watts	**Nos**	**kW**
1	PC LCD	90	604	54.36
2	PC CRT	120	29	3.48
3	Laser Printer	450	7	3.15
4	Projector Small	400	16	6.4
5	Projector Big	650	1	0.65
6	Xerox Machine	500	3	1.5
7	Laptop	80	2	0.16
TOTAL			**69.7 KW**	

TABLE 21: COMPUTER AND ACCESSORIES

Inference

- All the loads are connected to the UPS and the capacity comes 400kVA.
- Around 69.70 KW comes for computer loads

GREEN AND ENVIRONMENTAL AUDIT

We fully realize that adoption of environmentally sound industrial and agricultural technologies, reforestation, and ecological restoration are crucial elements in creating an equitable and sustainable future life for mankind in harmony with nature. Colleges and Universities have a major role in the education, research, policy formation, and information exchange necessary to make these goals possible. We realize that higher education institutions must initiate and support mobilization of internal and external resources to respond to this urgent challenge. We, therefore, pledge unanimously to:

1. Increase Awareness of Environmentally Sustainable Development- Use every opportunity to raise public, government, industry, foundation, and university awareness by openly addressing the urgent need to move toward an environmentally sustainable future.
2. Create an Institutional Culture of Sustainability- Encourage all higher education institutions to engage in education, research, policy formation, and information exchange on population, environment, and development to move toward global sustainability.
3. Educate for Environmentally Responsible Citizenship- Establish programs to produce expertise in environmental management, sustainable economic development, population, and related fields to ensure that all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens.
4. Foster Environmental Literacy for All- Create programs to develop the capability of engineering students to teach the common man environmental primacy in life.
5. Practice Institutional Ecology- Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations.
6. Involve All Stakeholders- Encourage involvement of government, foundations, and industry in supporting interdisciplinary research and multidisciplinary programs in environmentally sustainable development.
7. Expand our community extension and reach-out activities to assist the local bodies and NGOs in their effort to find solutions to environmental problems.
8. Enhance Capacity and establish partnerships with primary and secondary schools to help develop the capacity for interdisciplinary teaching on population, environment, and sustainable development.

WATER AUDIT

Introduction

The College gets its water from its own one-acre-pond and the monsoon rains. It has adequate s storage facilities and water filtration plants. A stream runs across the entire breadth of the campus but during summer it grows slim and lean. The College has rainwater harvesting system and a wastewater recycling plant. Altogether these arrangements can well take care of the needs of the college. In order to conserve water, however, the College should monitor water consumption with meters in every building and install more efficient showerheads and toilets. This can considerably reduce water usage and help conserve water, the most precious of nature's gifts.

The details of Water distribution system in the college are in this section:

Around 605000 litters of water is used daily for the requirements and the details are given below:

Sl.No:	Location	Capacity of Water Tanks	Quantity	Total Capacity	Tank Filling	Consumption per day
		Litres	**Nos**	**litres**	**Times**	**litres**
1	Hostels	30000	2	60000	2	120000
2	Biotechnology Block	30000	1	30000	2	60000
3	Biotechnology Block	5000	3	15000	2	30000
4	Administrative Block	30000	1	30000	2	60000
5	Decennial Block	40000	1	40000	2	80000
6	Staff Quarters	25000	1	25000	1	25000
7	Knowledge Centre	20000	1	20000	1	20000
9	Canteen	50000	1	50000	3	150000
TOTAL LITERS					**545000**	

TABLE 22: WATER CONSUMPTION DETAILS

Details of water pumps

The details of the pumps which is installed in various places of college

Sl.No:	**Name**	**Rated Power**	**Quantity**
		HP	Nos
1	Main Motor	7.5	1
2	Ladies Hostel	5	1
3	Canteen	5	1
4	Men’s Hostel	2	1
5	Gardening	7.5	2
6	Submersible Pump	2	4
7	Sump	5	1
8	Bore well	5	1
9	Wastewater Pumps	5	4

GREEN CAMPUS

The whole world is on the road to a sustainable development, and the environment conservation is the top priority among the list as every human activity has its effect on their surroundings, which is the environment. Hence be it a house, a commercial building, an industrial building, or any other construction will disturb the balance of the environment.

Scientific studies are proved that the nature can able to cure any diseases and this will reduce the stress among students during theirs studies and also increase the compassion among them and to nature. College is nurtured and developed and maintained greenery campus for their students.

The entire greenery of the campus can be divided into landscaped terraces of vast meadows, extensive flower gardens and orchards of fruit bearing trees. Bamboo lends the natural glow of yellow to the campus. The campus has the gift of a stream running across the entire breadth of the area.

KERALA FLORA AND HERBAL GARDEN

Sahrdaya college maintained more than 1009 trees in their campus. Few lists is given below.

Sl No:	Name	Numbers
1	Chempakam	45
2	Ilanji	36
3	Red Palm	108
4	Chethi	74
5	Junipress	10
5	Jasmin	165
6	Royal Palm	50
7	Bottle Brush	36
8	DVDV	26
9	Aanappana	02
10	Kanikonna	08
	TREES	
1	Mango Trees	76
2	Coconut Trees	758
3	Jack fruit trees	05
4	Jaathi	123
5	Manimaruthu	21
6	Postal Palm	15
7	Mahagani	1300
8	Teak	77
9	Bamboo bunches	26

Herbal Garden

They maintain 225 varieties of medicinal plants in the garden. In total 3acres of land is dedicated for herbal garden. Rare species such as Paradise of Plant (Lax mitaru) and noni plants are maintained by Sahrdaya college.

WASTE MANAGEMENT

Sewage:

The college maintains a (description of the plant) wastewater treatment plant with 50000litres per day passing through it. The cost of this project and the savings it brings are yet to be calculated. The water treatment plant will have to be upgraded in its efficiency in future to meet the growing demands of campus life.

Food wastes are treated as bio degradable which they converted to bio maneuver by vermicomposting. 4 areas are canteen backyard, hostel, and few areas in the college vermicomposting is done.

Each building on the campus is equipped with recycling bins on each floor. Glass, plastic, and aluminium recycling is standard with paper recycling in every public computer lab and professor's office. Recycling is more extensive in dormitory buildings with one room per building housing glass, plastic, aluminium, newspaper, white paper, magazine, and cardboard recycling as well as general trash waste cans. It is our hope in the future to install permanent glass, aluminium, and plastic .

Bio nondegradable are incinerated in a incinerator

ANNEXURE-1

ENERGY SAVING PROPOSALS - 1

IMPROVING THE POWER FACTOR

Background

By referring the last year electricity bills, the pf was found to be low and getting the incentives/month is low.

Proposal

By improving the pf to 0.99 by replacing the capacitors in APFC panels will improve overall pf as well as the demand charges will come down.

Particulars	Unit	Values
Present Condition		
Present PF		0.94
Total Incentives	Rs	96222
Proposed Condition		
Proposed PF		0.99
Savings in Demand Charges/Year	Rs	34400
Total Incentives/Year	Rs	194537
Savings in Incentives/Year	Rs	98315
Annual Total Financial Savings/Year	Rs	132715
Investment	Rs	15000
Simple Payback Period	Months	1.36

TABLE 23: EC PROPOSAL 1

ENERGY SAVING PROPOSALS – 2

REPLACEMENT OF FLUORESCENT TUBES WITH ENERGY EFFICIENT T-5LIGHTS

At present T-5 lights are used in very few areas. Replacement of Fluorescent lights to be done in phase manner with T-5 lights.

Particulars	Units	Value
Existing Fluorescent lights	**Watts**	**52**
Proposed T-5light	Watts	28
Difference in Wattage	Watts	24
Avg No: of working hours/day	Hrs	8
No: of working days per year (Average)	Nos	200
No: of working hours per annum	Hrs	1600
Number of Lights operating	Nos	320
kWh Saving per Annum	Rs	12288
Cost per kWh (Average)	Rs	6
Annual Financial Savings	Rs	73728
Cost of T-5light	Rs	400
Investment for T-5 lights	Rs	128000
Simple Payback period	Months	21

TABLE 24: EC PROPOSAL 2

ENERGY SAVING PROPOSALS – 3

INSTALLATION OF SOLAR PANEL (50 kW) GRID TIE MODE SYSTEM

The Sun is an inexhaustible, reliable and non-polluting source of power. Since the inception of life on earth, the only energy that was available came from the sun. The time is now approaching when mankind will again depend upon the sun as dominant energy source. We are aware that fossil fuels are not going to last forever. A growing worldwide concern for conservation of energy has reignited our interest in ecologically sustainable materials, processes and sources of energy.

Of the numerous renewable sources of energy known to mankind, Solar Photo Voltaic or SPV is one that has the potential to supply power for our future needs:

Solar radiation is the largest renewable energy source

- The solar energy is more evenly distributed in the world than wind or bio-mass.
- It is well proven and demonstrated technology
- It promises to be most cost effective renewable power at high volumes.

The solar energy potential in India is immense due to its convenient location near the Equator. India receives nearly 3000 hours of sunshine every year, which is equivalent to 5000 trillion kWh of energy. Solar Grid Tie mode system of 30 kW system installation details are given in the section:

Calculations:

Particulars	Units	Value
Proposed system	**KW**	**50**
Average unit generation in a day	KWH	200
Average kwh/year	KWH	73000
Average utility electricity cost	Rs	6
Annual financial savings	Rs	438000
Investment (subsidized)	Rs	2500000
Simple payback period	Months	68

TABLE 25: EC PROPOSAL 3

ABBREVIATIONS

APFC	:	Automatic Power Factor controller
AVG	:	Average
BDV	:	Breakdown voltage
BEE	:	Bureau of energy efficiency
CEA	:	Central electrical authority
CFL	:	Compact fluorescent lamp
CFM	:	Feet cube per minute
DB	:	Distribution Board
DG Set	:	Diesel Generator Set
EC	:	Energy Conservation
FD	:	Forced draft
HPSV	:	High-pressure sodium vapour
HT	:	High Tension
ID	:	Induced draft
IEC	:	International electro technical commission
IEEE	:	The Institute of electrical and electronics engineers
IS	:	Indian Standard
KG	:	Kilogram
KVA	:	Kilo Volt Ampere
KVAH	:	Kilo volt Ampere Hour
KVAR	:	Kilo volt-ampere
KW	:	Kilo Watts
KWH	:	Kilowatt-hour
LED	:	Light emitting diode
MAX	:	Maximum
MH	:	Metal halide
NEMA	:	National Electrical Manufacturers Association
OLTC	:	On load tap changer
ONAN	:	Oil natural air natural
PCC	:	Point of common coupling
PSI	:	Pound square inch
RMD	:	Registered Maximum demand
SEC	:	Specific electricity consumption
SFU	:	Switch Fuse Unit
SLD	:	Single Line Diagram
TDD	:	Total demand distortion
THD	:	Total harmonics distortion
TOE	:	Tonne of oil equivalent
UPS	:	Uninterruptible power supply
VFD	:	Variable frequency drive

INSTRUMENTS USED

SL.NO	EQUIPMENT DESCRIPTION	MAKE & MODEL
1	Power energy & harmonic Analyser	Krykard ALM 35
2	Thermal Imager	FLIR E50

TABLE 26: INSTRUMENTS USED

REFERENCES

1. BEE energy audit books
2. CEA regulations of grid connectivity-2007
3. IEEE Std. 519-1992.
4. National lighting code - 2010

SAHRDAYA COLLEGE OF ENGINEERING & TECHNOLOGY
KODAKARA 680 684 THRISSUR DISTRICT, KERALA STATE

Reduce, Reuse, and Recycle for a more sustainable campus

CAMPUS GREEN AUDIT
AN ENVIRONMENTAL CONSERVATION INITIATVE OF

GREEN LEAF
THE CAMPUS COMBINE FOR ECOLOGICAL INIATIVES

We fully realize that adoption of environmentally sound industrial and agricultural technologies, reforestation, and ecological restoration are crucial elements in creating an equitable and sustainable future life for mankind in harmony with nature. Colleges and Universities have a major role in the education, research, policy formation, and information exchange necessary to make these goals possible. We realize that higher education institutions must initiate and support mobilization of internal and external resources to respond to this urgent challenge. We, therefore, pledge unanimously to:

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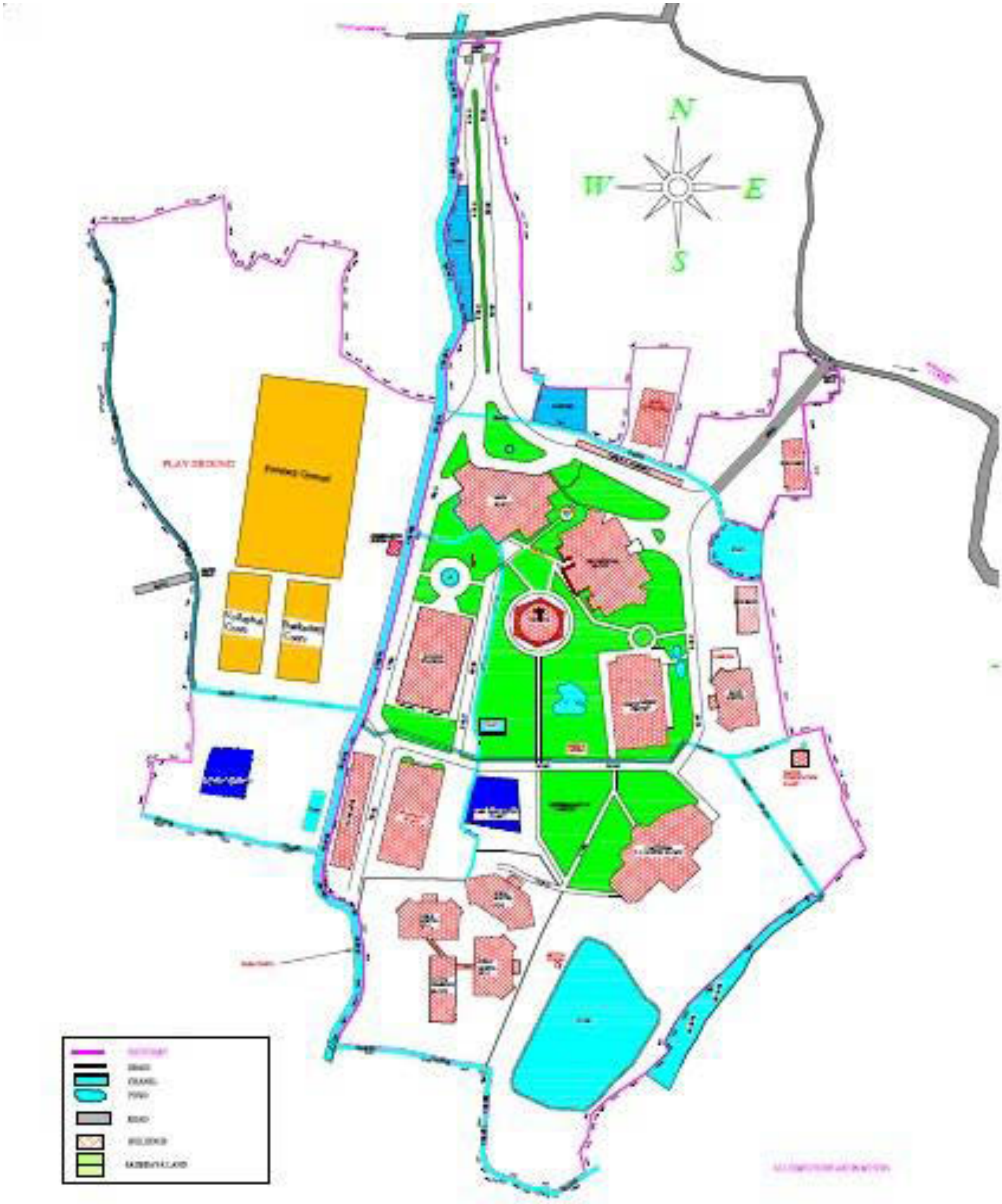
Green Leaf Volunteers

SITE MAP


N
W
E
S
PLAY GROUND
Football Ground
Volleyball Court
Basketball Court
BOUNDARY
DRAIN
CHANNEL
POND
ROAD
BUILDINGS

Preliminary Audit of our College

College campuses are ideal spaces because it is almost probable that some buildings on the campus use energy well above the average. By metering each building and tracking energy use over time, colleges and universities can continuously improve performance. Sahrdaya with its 60,000 sq. meter total built up space and a high Energy Use Intensity (EUI) has the greatest opportunity for savings because even small percentages of improvement can create substantial savings. Comprehensive preliminary energy audit of our built up spaces show that our college campus has an EUI greater than 80, the average limit, the national average being around 100.

This audit

The environmental audit incorporates data comparing recent energy use, utility costs, water, solid waste, natural gas consumption, as well as recycling efforts. By this time our electrical and Electronics Department has taken up this challenge seriously and is fast devising plans, policies and strategies to deliver positive results to the local society also working in sync with the local bodies and community leaders. While determined on energy efficiency in all future constructions, the college has by now switched over significantly to solar energy with its outdoor campus entirely lit up by solar lighting installations and its requirement of hot water partly met by solar heaters.

SOLAR LIGHTING SYSTEM

Energy use in the campus

The institution's energy costs have been rising steadily high. Its present consumption is around 36 to 38 thousand kWh every two months given the fact that most of its rooms, laboratories and facilities remain open only for 8 to 10 hours six days a week. It has a biogas plant which cannot meet all its cooking needs and has to rely on external sources for most of the time. The campus use of solar energy is also nominal and limited to outdoor lighting and water heaters. In the future, the institution will be looking into finding more solar powered projects such as water pumps for the campus and solar recycling compactors. The solar recycling compactors and even solar composting units would be the perfect additions to our campus because its small size avoids large, projects from being erected. These two compact projects would be ideal to use as sustainability teaching tools for educating students, faculty, and the community.

CAMPUS

Biodiesel

Biodiesel can be manufactured from used cooking and vegetable oils. It can serve as an alternate form of fuel that can be used in diesel engines. Biodiesel is gaining more and more popularity in the “Green Revolution” by having environmental and economic benefits such as: cutting down carbon dioxide emissions from vehicles with cleaner burning power and the cost benefit of being cheaper than the diesel fuel used in today’s vehicles.

The first diesel engine was designed and built by Rudolf Diesel in 1897, was in fact originally meant to run on peanut oil. This was successfully the first biodiesel engine ever built. The college can produce the “green” fuel, by building a filtering and purifying system to convert the college’s used cooking oil into effective and useable fuel. We must begin this as a student project, and also as a way to get around by powering personal cars with the fuel the students make.

The oil recovered from the cafeteria should be first added to a large tank and heated up and filtered to remove the water and excess food particles that may still be present. Next, the oil must be heated to about 350° and methanol and sodium hydroxide added to it to alter its chemical structure slightly. After this process, excess methanol can be recovered for later use and a glycerin byproduct can be removed from the crude fuel. Water should then be added to the tank to wash the fuel and dissolve the small particles of unused additives which can be effectively bubbled out using ordinary air leaving only the final product. The glycerin byproduct can be used as an effective compost contributor, or can be made into a truly “green” soap.

The amount of oil used is directly proportionate to the amount of fuel is made. A large part of this operation is relatively cheap to build and maintain. The college can think of funding the biodiesel project. There are few things to keep maintained on this project such as the dry wash filters which are inexpensive along with the screens used to take excess food particles out of the oil. The biodiesel project will indeed make college campuses more environmentally sustainable.

Water

The College gets its water from its own one-acre-pond and the monsoon rains. It has adequate s storage facilities and water filtration plants. A stream runs across the entire breadth of the campus but during summer it grows slim and lean. The College has rainwater harvesting system and a wastewater recycling plant. Altogether these arrangements can well take care of the needs of the college. In order to conserve water, however, the College should monitor water consumption with meters in every building and install more efficient showerheads and toilets. This can considerably reduce water usage and help conserve water, the most precious of nature's gifts.

POND

Sewage:

The college maintains a (description 0f the plant) wastewater treatment plant with …….. gallons per day (mgal/day) passing through it. The cost of this project and the savings it brings are yet to be calculated. The water treatment plant will have to be upgraded in its efficiency in future to meet the growing demands of campus life.

WASTE WATER TREATMENT PLANT

Dining Services:

The motivation for analyzing the food sector of the College in this audit is to determine where our food comes from, how much is local, and how much is organic. Buying local strengthens the local economy and protects the environment by cutting down travel time. We have to think globally, but act locally n this regard. Most of the college's food comes from the local markets. Efforts however need to be made to grow food in college's own sustainable farms in the near future. In that case tilling the soil must be avoided in order to eliminate the use of a tractor and to thereby decrease the amount of top soil runoff. This will in turn reduces the amount of fertilizers needed. The college should also think of opening up on the campus an organic snack stall to promote home-grown organic farm produce.

CANTEEN

The sustainability efforts also reached our dining locations. We will no longer wrap the takeout food in aluminum foil. Instead, food is placed in paper bags for takeout. Management is currently working on replacing polystyrene cups with cups made from more sustainable materials Some of the containers for the Grab-n-Go lunch option are now made with compostable materials. Catering is the final aspect of dining services that is striving to be environmentally sustainable. Efforts are being made to replace plastic ware with chinaware and suspend the use of black plastic utensils. Catering services is also working to find ways to recycle its food waste. There have been considerations to buy recyclable utensils and/or "spudware," utensils made from potatoes!

Food Waste

All wastes are disposed of.

Tray-less Dining Halls

The purpose of a tray-less dining hall is to

1) reduce the amount of food waste produced
2) decrease the amount of water going into and out of the canteen
3) reduce the amount of electricity used in running the dishwashers and

4) decrease the amount of dish washing chemicals purchased and wasted.

As a result of this initiative, dining services can reduce the amount of food waste and the water usage by about one-third per semester. But tray-less dining can be brought into effect only gradually. To begin with drop the use of trays any one day of the week. Then an additional tray-less day can be added each week until trays were no longer available.

Most appliances currently in use are at least 30 years old, but are being replaced by more energy efficient appliances as they wear out. Users are urged to turn off appliances when they have
fFinished using them. Dining services made the switch to electric gas oven in the summer of 2009. Many light fixtures have begun using Compact Fluorescent Light (CFL) bulbs with special care being taken to not use CFL bulbs on lights that warm food. However, dining services switched to high heat heating lights for those lights that heat food. Management also tracks the costs of equipment repairs in comparison to the original cost of the equipment to determine whether or not it would be more cost effective to replace that piece of equipment with a more environmentally-friendly model.

Other Initiatives

Cardboard products are recycled, and efforts are being made to find available space to recycle more plastics. During the next academic year we intend to replace individual ketchup bottles on each table with a condiment station with fast food-style pump dispensers. Bleached napkins will also be replaced with napkins made from post-consumer recyclable materials. In addition, we are looking into more ways to recycle the large volume of cans and plastic bottles generated every week by the college.

Solid Waste:

All solid waste generated in the college is collected and transported to far off destinations for recycling. A co-generation plant is also planned in order to generate electricity and as they are recycled.

Recycling:

Each building on the campus is equipped with recycling bins on each floor. Glass, plastic, and aluminum recycling is standard with paper recycling in every public computer lab and professor's office. Recycling is more extensive in dormitory buildings with one room per building housing glass, plastic, aluminum, newspaper, white paper, magazine, and cardboard recycling as well as general trash waste cans. It is our hope in the future to install permanent glass, aluminum, and plastic .

Recycle Mania

Besides EARTHWEEK, the environmentally conscious contest Green Leaf is already hosting every year, it will also announce a state-wide recycling competition, *Recycle-Mania,* from the next academic year to promote waste reduction vewing with concern the minimum waste of about 3 kilograms each user of the campus generate every week. Earth Week is basically celebrating Earth Day. They have many fun events and speakers. The ultimate purpose of Earth Week is to raise awareness that we can make subtle changes in our day-to-day life that will have an effect on the environment for the better. Earth Week is our own event, whereas RecycleMania is planned as a state-wide competition between colleges to evaluate who recycles the most and the best. This gives the students a cause to rally around in a competitive manner to create the best result.

Campus Involvement:

For change to occur, it is crucial that the students, faculty and administration welcome it. Sahradya has an environment that invites opportunities to better its community through campus organizations. Green Leaf is a group of students who strive to create an environmentally friendly campus. Their purpose is to create awareness and eventually act on that awareness.

Green Leaf also works with other campus organizations on campus like the NSS. . In working together, they hope to achieve a greener campus. Together they stress the importance of small changes in our everyday life that can collectively improve our carbon footprint. For example, they encourage students to fully shut down their computers at night rather than using sleep mode and to unplug all chargers when not in use. On a small campus such as ours, these minute changes can have a large impact on our energy use as a whole.

Green Leaf consists of students and faculty members dedicated to developing, implementing, and promoting environmental sustainability. The increased faculty involvement helps to bring influential environmental speakers to the college for talks and guidance. Topics of the next year will include the biodiesel production project, local food revolution, and a history of our agriculture and water quality data continuously updated and revised and made available to the public. We also intend to clean up the campus stream.

Purchasing:

A future audit will explore the purchases for academics and Buildings & Grounds to see how much thought was given into buying recycled or sustainable equipment and supplies.

CAMPUS

E-Waste:

E-waste can be described as consumer and business electronic equipment that is near or at the end of its useful life. E-waste makes up about 5% of all municipal solid waste worldwide but is much more hazardous than other waste because electronics contain cadmium, lead, mercury, and poly -cholorinated biphenyls (PCBs) that can damage human health and the environment. The older computers are removed and experience “tumble down” or reuse in professor’s offices or labs. The computers that are out of commission are used for parts and then finally the ones left over are put up for sale to the campus employees. The computers that are not purchased are sent out for Parts where they strip the computer for parts, then sell them or recycle what they cannot sell. Upon removing all hazardous materials and scrap metal from the electronics, they send them for recycling.
Another innovative idea that IT services is making is investing in virtual machines. This means means that we will have fewer computers in the IT department and use a larger computer to increase utilization, consolidation, and efficiency while simultaneously decreasing heat, cooling, and electricity costs.

Other sustainable measures that IT services encourage are having student lab monitors shut down all computers every night and having faculty members do the same. In another initiative to control waste, is to introduce a print control with 600 pages, with minimal charges and a penalty charged on those who cross that balance. Without a penalty for over-printing the paper waste in every lab could be astronomical. IT also recycles their toner cartridges after every use and recycles their cardboard boxes.

Campus Grounds:

The college's Buildings and Grounds (B&G) staff are influential in trying to make the campus a more environmentally-friendly institution. A large generator of waste is the ground keeping that needs to be dealt with daily. One of our future projects is the evaluation of composting grass clippings and leaf litter in conjunction with a local farmer.

Green Houses: However, Sahrdaya needs to improve upon its ways of effectively and efficiently using and maintaining energy in constructing and renovating buildings using Green House Techniques. Green designs are building plans that have environmental, economic, and social elements that benefit all building stakeholders, including owners, occupants, and the general public. With simple building techniques they can reduce operating costs, enhance building marketability, increase worker productivity, and reduce harmful greenhouse gas emissions.

Greenhouse Gas:

In the future, College's greenhouse gas emissions should be calculated using the Clean Air-Cool Planet: Campus Carbon Calculator. This calculator is the most thorough way to assess a campus's emission output because it analyzes six greenhouse gases specified by the Kyoto Protocol (CO2, CH4, N2O, HFC, PFC, and SF6). The extensive spreadsheet allows projects emissions for the years 1990-2060 when completed in its entirety. When Lycoming College can gather all the information necessary for this endeavor, an accurate and almost literal carbon footprint will be achieved.

Environmental Sustainability Curriculum (Add a campus photo anywhere in this page)

We have even a curriculum to suggest promoting the conservation and awareness of the environment as shown below:

Fundamentals of Geology
Plant Science
Sustainable Business Management
Ecology
Aquatic Biology
Tropical Marine Biology
Plant Animal Interactions
Invertebrate Zoology
Vertebrate Biology
Environmental Practicum

Environmental Sustainability

The study of environmental sustainability examines the balance between our society's ability to meet current needs while minimizing our environmental impact for future generations. At our institution, students have the unique opportunity to work with experienced faculty and professionals to develop and apply solutions. To compliment their classroom experience, they can do even an internship in the field of environmental sustainability.

Future Endeavors Include (But Are Not Limited To):

a) Wide use of motion sensors in buildings so when rooms or hallways are vacant the lights shut off on their own.
b) Making sure all computers in public computer labs are turned completely off during unoccupied hours.
c) Providing permanent and clearly-labeled recycling stations in every building.
d) Replacement of current light fixtures with compact fluorescent (CFL) light bulbs.
e) Use storage tanks in the plumbing systems so recycled water can be used to flush toilets.

CAMPUS PLANT LIFE AND LAND UTILIZATION

The entire greenery of the campus can be divided into landscaped terraces of vast meadows, extensive flower gardens and orchards of fruit bearing trees. Bamboo lends the natural glow of yellow to the campus. The campus has the gift of a stream running across the entire breadth of the area. Ponds (2), one of an acre in area, also form part of the water bodies in the campus. The herbal garden is a Sahrdaya speciality:

Terraced Turf in Square feet:

A) Buffalo Grass	:	65,471
B) Mexican Grass	:	10,82,691
Total		11,48,162

Kerala Flora in numbers

Chempakam	:	45
Ilanji	:	36
Red Palm	:	108
Chethi	:	74
Junipress	:	10
Jasmin	:	165
Royal Palm	:	50
Bottle Brush	:	36
DVDV	:	26
Aanappana	:	02
Kanikonna	:	08

Trees:

Mango Trees	:	56
Coconut Trees	:	758
Jackfruit trees	:	05
Jaathi	:	123
Manimaruthu	:	21
Postal Palm	:	15
Mahagani	:	1360
Teak	:	77
Bamboo bunches	:	53

Herbal Garden (three acres) Inventory:

We maintain 225 varieties of medicinal plants in the garden. They are listed below with their botanical name and family name:

SL NO:	BOTANICAL NAME	FAMILY NAME
1	Clematis aphylla	Ranunculaceae
2	Nigella caryophyllata	Ranunculaceae
3	Michelia champaca	Magnoliaceae
4	Polyalthia longifolia	Anonaceae
5	Polyalthia pendula	Anonaceae
6	Cananga odorata	Anonaceae
7	Nymphaea stellata	Nymphaceae
8	Nelumvo nuciser	Nymphaceae
9	Sida rhombifolia	Malvaceae
10	Hibiscus rosa-sinensis	Malvaceae
11	Hibiscus varigata	Malvaceae
12	Hibiscus mutavilis	Malvaceae
13	Helicteris isora	Sterculiaceae
14	Kleinhovia hospita	Sterculiaceae
15	Thespesia pupulnea	Malvaceae
16	Ferula assafoetida	Apiaciae
17	Oxalis corniculata	Oxalidaceae
18	Balsam impatiens	Balsaminae
19	Murraya exotica	Rutaceae
20	Murraya koenigii	Rutaceae
21	Aegle marmelos	Rutaceae
22	Feronia platyclada	Rutaceae
23	Azabirdchta nindica	Meliaceae
24	Suietenia mahogoni	Meliaceae
25	Xylocarpus moluccelsis	Meliaceae
26	Mangifira indica	Anacardiaceae
27	Anacaridium occidentale	Anacardiaceae
28	Artocarpus integrifolius	Moraceae
29	Evodia roxvurghiana	Rutaceae
30	Xanthoxylum rhetsa	Rutaceae
31	Bauhinia purpurea	Leguminosae

32	Bauhinia biloba	Leguminosae
33	Bauhinia acuminata	Leguminosae
34	Pongamia glabra	Leguminosae
35	Clitoria ternatea	Leguminosae
36	Arachis subterranea	Leguminosae
37	Cassia tora	Leguminosae
38	Cassia fistula	Leguminosae
39	Saraca indica	Leguminosae
40	Caesalpinia sappan	Leguminosae
41	Caesalpinia pulcherima	Leguminosae
42	Caesalpinia coriaria	Leguminosae
43	Delonix regia	Leguminosae
44	Engerolobium saman	Leguminosae
45	Peltophorum ferrungium	Leguminosae
46	Xylia xylocarpa	Leguminosae
47	Mimosa pudica	Leguminosae
48	Mimosa incina	Leguminosae
49	Acacia incina	Leguminosae
50	Dalbergia melenoxylon	Leguminosae
51	Indigofera tinctoria	Leguminosae
52	Albizzia lebbeck	Leguminosae
53	Pterocarpus santalinus	Leguminosae
54	Santalum album	Santalaceae
55	Rosa indica	Rosaceae
56	Terminalia catappa	Combretaceae
57	Terminalia chebula	Combretaceae
58	Calycopteris floribunda	Combretaceae
59	Eucalyptus lanceolatus	Myrtaceae
60	Callistemon lanceolatus	Myrtaceae
61	Psidium guajava	Myrtaceae
62	Syzygium cumini	Myrtaceae
63	Pimenta officinalis	Myrtaceae
64	Anthocephalus cadamba	Rubiaceae
65	Ixora cornea	Rubiaceae
66	Ixora minima	Rubiaceae
67	Pentas cornea	Rubiaceae
68	Mussaenda indica	Rubiaceae
69	Mussaenda philipiensis	Rubiaceae

70	Tagetus erectus	Compositae
71	Chrysanthemum indicum	Compositae
72	Cosmos bipinntes	Compositae
73	Cosmos sulphureus	Compositae
74	Artemisia cina	Compositae
75	Bellis perennis	Compositae
76	Vernonia cineria	Compositae
77	Zinnia elegans	Compositae
78	Emelia sonchifolia	Compositae
79	Lagerstromea flos reginae	Myrtaceae
80	Lawsonia alba	Myrtaceae
81	Lawsonia inermis	Myrtaceae
82	Punica granatum	Punicaceae
83	Mimusops elengi	Sapotaceae
84	Achras sapota	Sapotaceae
85	Lucuma nervosa	Sapotaceae
86	Vallaris solanacea	Apocynaceae
87	Allamanda catrtica	Apocynaceae
88	Allamanda grndiflora	Apocynaceae
89	Plumeria rubra	Apocynaceae
90	Plumeria alba	Apocynaceae
91	Alstonia dichotama	Apocynaceae
92	Wrightia tinctoria	Apocynaceae
93	Holarrr hena antidysentrica	Apocynaceae
94	Nerium odorum	Apocynaceae
95	Couroupita guainensis	Myrtaceae
96	Rauwolfia serpentima	Apocynaceae
97	Cryptostegia volubilis	Asclepia daceae
98	Alstonia scholaris	Apocynaceae
99	Carissa opaca	Apocynaceae
100	Wattakakka volubilis	Asclepia daceae
101	Calotropis gigantia	Asclepia daceae
102	Gymnema sylvestris	Asclepia daceae
103	Ichnocarus frutescens	Apocynaceae
104	Hemidesmus indica	Asclepia daceae
105	Quamolit pinnata	Convolvulaceae
106	Ipomea batatas	Convolvulaceae
107	Cuscuta reflexa	Convolvulaceae

108	Evolvulus alsinoides	Convolvulaceae
109	Solanum nigrum	Solanaceae
110	Scoparia dulcis	Scrophulariaceae
111	Oroxylon indicium	Bignoniaceae
112	Bignonia radicans	Bignoniaceae
113	Tecoma stans	Bignoniaceae
114	Thunbergia grandiceae	Acanthaceae
115	Vateria indica	Dipterocarpaceae
116	Jasminum officinale	Oleaceae
117	Jasminum malabaricum	Oleaceae
118	Vitex negundo	Verbenanceae
119	Lantana camara	Verbenanceae
120	Tectona grandis	Verbenanceae
121	Duranta plumeri	Verbenanceae
122	Phyllostachys leuteus	Acanthaceae
123	Leucas aspera	Lamiaceae
124	Elephantopsis	Compositae
125	Oscimum basalicum	Lamiaceae
126	Oscimum santum	Lamiaceae
127	Anisomeles malabaricum	Lamiaceae
128	Justica betonica	Acanthaceae
129	Cyanthula prostrata	Amaranthaceae
130	Premna latifola	Verbinaceae
131	Aerva lanata	Amaranthaceae
132	Cleosia cristania	Amaranthaceae
133	Loranthus indicus	Loranthaceae
134	Euphorbia splendens	Euphorbiaceae
135	Ricinus communis	Euphorbiaceae
136	Euphorbia hirta	Euphorbiaceae
137	Phyllanthus amarus	Euphorbiaceae
138	Cronton sparciflorus	Euphorbiaceae
139	Codiaeum varigum	Euphorbiaceae
140	Emblica officinalis	Euphorbiaceae
141	Ficus religiosa	Moraceae
142	Ficus benghalensis	Moraceae
143	Ficus benjamina	Moraceae
144	Ficus gibbosa	Moraceae
145	Ficus glomerata	Moraceae

146	Elettaria cardamomum	Zingeberaceae
147	Heliconia indica	Musaceae
148	Costus speciosum	Zingeberaceae
149	Canna indica	Cannaceae
150	Agave americana	Liliaceae
151	Asparagus racemous	Liliaceae
152	Allium bulbiliferum	Liliaceae
153	Vanda roxburghi	Orchedaceae
154	Sanseveria roxburghi	Liliaceae
155	Dracena ungustifolia	Liliaceae
156	Corypha umbrellaculifera	Palmae
157	Caryota urens	Palmae
158	Cocos nucifera	Palmae
159	Elaeis guinensis	Palmae
160	Livinstonia sinensis	Palmae
161	Mentha piperata	Lamiaceae
162	Bougainvillea racemosa	Nyctaginae
163	Roystonia regia	Palmae
164	Roystonia cylindrica	Palmae
165	Pandanus veitchii	Pandanaceae
166	Monstera deliciosa	Araceae
167	Alocasia offcinalis	Araceae
168	Kyllinga tricepes	Cyperaceae
169	Cynondon dactylon	Poaceae
170	Cymbopogon citratus	Poaceae
171	Casuarina equsitefolia	Caurinaceae
172	Oredoxa regia	Palmae
173	Panicum antidotale	Poaceae
174	Panicum miliare	Poaceae
175	Bambusa polymorpha	Poaceae
176	Bambusa arundinacea	Poaceae
177	Bambusa vulgaris	Poaceae
178	Bixa orelena	Bixaceae
179	Vitis qudrangularis	Vitaceae
180	Garcinia cambogie	Guttiferae
181	Garcinia morella	Guttiferae
182	Centella asiatica	Apiaceae
183	Aristolochia indica	Aristolochiaceae

184	Muchlenbeckia platyclada	Cactaceae
185	Hydrilla verticillata	Hydrochartaceae
186	Ochlandra travanchoria	Poaceae
187	Passiflora edulis	Passifloraceae
188	Moringa Umbellata	Moringaceae
189	Myristica fragrans	Myristicaceae
190	Mickania Scandens	Compositae
191	Desmodium trifolium	Leguminosae
192	Sesbania grandiflora	Leguminosae
193	Aracha ceylona	Palmae
194	Terminalia tomentosa	Combretaseae
195	Arundo donax	Poaceae
196	Eupatorium trplinervum	Compositae
197	Thespesia lampas	Malavaceae
198	Oscium kilimandoscharicum	Lamiaceae
199	Lagestromia lanceolata	Lythraceae
200	Agrostis stolonifera	Oxalidaceae
201	Biophytum sensitivum	Oxalidaceae
202	Macaranga peltata	Euphorbiaceae
203	Milium compressum	Poaceae
204	Terma orientalis	Ulmaceae
205	Crateva Nurvala	Capparidaceae
206	Hydenocarpus pentandra	Hydenocarpaceae
207	Piper longum	Piperaceae
208	Crinum Latifolium	Amaryllidaceaea
209	Disopyros ebenum	Ebenum
210	Eclipta Alba	Composite
211	Cardiospermum halicacabum	Sapindaceae
212	Boerhana Diffusa	Nyctaginae
213	Humboldtia vauliana	Leguminosae
214	Moringa Umbellata	Rubiaceae
215	Plumbago auriculata	Plumbaginaceae
216	Plumbago indica	Plumbaginaceae
217	Plumbago zeylancia	Plumbaginaceae
218	Lophopetalum wrightianum	Celasteraceae
219	Pothos arvensis	Araceae
220	Terminalia belarica	Combretaceae
221	Strychnos nuxvomica	Loganiaceae

222	Oldenlandia corymbosa	Rubiaceae
223	Cyclea peltata	Menispermaceae
224	Lagerstromia speciosa	Lythraceae
225	Veriveria zizanioides	Poaceae

Rare Plants

THE PARADISE TREE (LAKSHMI TARU)

Botanical name: **Simarouba glauca** *DC.*
Family: **Simaroubaceae**

Simarouba glauca is a species of flowering tree that is native to Florida in the United States, southern Florida, South America, and the Lesser Antilles. Common names include Paradise Tree, Aceituno, and Bitterwood. Its seeds produce an edible oil. The tree is well suited for warm, humid, tropical regions. Its cultivation depends on rainfall distribution, water holding capacity of the soil and sub-soil moisture. It is suited for temperature range of 10 to 50 °C . It can grow at elevations from sea level to 1,000 m (3,300 ft). It grows 40 to 50 ft (12 to 15 m) tall and has a span of 25 to 30 ft (7.6 to 9.1 m). It bears yellow flowers and oval elongated purple colored fleshy fruits.

Distribution

It is an exotic species introduced from El-Salvador of Central America. It is a versatile multipurpose tree, which can grow well even in the degraded soils. This tree is regarded as highly suitable for growing on both arable and non-arable wastelands.

Environmental requirement

Climate and Temperature

It grows well up to 1000m MSL. The temperature of the species is 10-50°C with an annual rainfall of 500-2200 mm.

Soil

In all types of well-drained soil with pH 5.5-8.0. However, a minimum of 1.0 m deep soil is preferred for its growth. Soils of shallow depth with canker underneath are relatively unfavourable for its growth.

Phenology

The tree starts flowering and fruiting at about three years of age. Flowering is annual beginning in December and continuing up to February. The tree starts bearing when they are 4-6 years old and reach stability in production of another 4-5 years. The droplets (blackish purple in pink genotypes and brownish yellow in green genotypes) are ready for harvest by March/April. Season and duration of reproductive phenoperiods vary according to location and climate. Individual fruits have a development and ripening period of 1-2 months. Fruit is ellipsoid drupe, 2 - 2.5 cm long, with thin hard cuticle and juicy fruit pulp.

Silviculture

Simarouba glauca DC. (Family. Simaroubaceae), commonly known as aceituno, *Simarouba* or tree of heaven, is a medium sized evergreen tree (height 7-15 m) with tap root system and cylindrical stem. It is an exotic species introduced from El-Salvador of Central America. It is a versatile multipurpose tree, which can grow well even in the degraded soils. This tree is regarded as highly suitable for growing on both arable and non-arable wastelands. It needs no special care and requires minimum protection as it is generally not browsed by cattle, goats and sheep (Syamsundar Joshi *etal*, 1996).

Climate and Soil

It grows well up to 1000m MSL in all types of well-drained soil with pH 5.5-8.0. However, a minimum of 1.0 m deep soil is preferred for its growth. The temperature of the species is 17-35°C with an annual rainfall of 500-2200 mm. Soils of shallow depth with canker underneath are relatively unfavourable for its growth.

Flowering and Fruiting

The tree starts flowering and fruiting at about three years of age. Flowering is annual beginning in December and continuing up to February. The tree starts bearing when they are 4-6 years old and reach stability in production of another 4-5 years. The droplets (blackish purple in pink genotypes and brownish yellow in green genotypes) are ready for harvest by March/April. Season and duration of reproductive phenoperiods vary according to location and climate. Individual fruits have a development and ripening period of 1-2 months. Fruit is ellipsoid drupe, 2 - 2.5 cm long, with thin hard cuticle and juicy fruit pulp.

Utilization

All the parts of Simaruba are useful in one-way or the other. The seeds are considered economically important as they contain 50-65 per cent edible oil, which can be used in the manufacture of vanaspathi. From 1950 onwards, in El-Salvador and other Central American countries the oil is marketed for edible purposes under the trade name Manteea Vegetal 'Nieve" and the demand for the product has steadily increased. As industrial oil, it is well suited for the manufacture of quality soaps, lubricants, paints, polishes, pharmaceuticals, etc. (Syamsundar Joshi and Shantha Hiremath, 2000). The pressed cake resulting from the milling operation contains a very high percentage of protein (64%) and can be used as a cattle feed after the extraction of toxic elements. The pressed cake is also being utilized as organic fertilizers. The shells (endocarp) can be used in the cardboard industry. Pulp (about 20 kg/tree/year) constituting about 60 per cent of the fresh fruit by weight contains about 11% sugars and It can be used for juice making or in the fermentation industry. Leaf litter is a good feed for earthworms and it makes good manure. The leaf and the bark contain the chemical viz. quassin, a resinous matter which is helpful in curing amoebiasis, diarrhoea and malaria.

Natural Regeneration

This species regenerate naturally through self-sown seeds disseminated through the excretes of birds and monkeys which feed on these fruits. However, the natural regeneration in the stand population of Simaruba has been found to be very poor.

Artificial Regeneration, Seed Maturity and Seed Collection

The physiological maturity of seeds with maximum germination capacity and longevity is attained 11-13 weeks after flowering when the Simaruba fruits attained peak weight, when embryo is fully developed and enclosed in a hard fibrous endocarp and some of the fruits started falling on the ground. A study at Forest College and Research Institute reported that seed reaches physiological maturity at 13 weeks after flowering, when the fruits are turned into purple colour. The optimum periods of collection is when the colour of the fruits turns from greenish yellow to blackish purple. The fruits are best to collect from the tree since fallen fruits often attacked by soil borne fungus. The fungus is carried along with pulpy fruit in deterioration of seeds. The fruits attacked by the fungus few hours after their fall, as they are pulpy and rich in carbohydrates. The easiest way of collection is to spread a tarpaulin under the trees and collect the fruits after they have been manually stripped of the branches or shed by shaking or beating the branches.

Seed Extraction

For maximum seed quality, grade the fruits to separate undeveloped, immature, damaged and decayed fruits and also grade for colour groups viz., fully green, greenish yellow and dark purple. Discard green fruits, which account for poor quality.After collection, the fruits are transported to the place of processing in gunny bags. Plastic bags or plastic containers should not be used for collection and transportation of fruits. The fruit pulp must be removed immediately after collection, either by hand or in a depulper. Depulping is done by macerating the fruits by hand in a bucket. The skin of the fruit floats on the water when water is poured in the bucket. The seeds with some pulp still adhered to it are transferred to bamboo basket. They are then thoroughly washed under running water. Macerate and wash only small lots of seeds, instead of filling the bucket to the brim avoid stagnation of water for long hours.

Seed Drying

Immediately after extraction seeds must be dried in shade for few hours followed by sun drying to reduce the moisture content. The surface moisture of the seeds should be removed immediately after depulping and washing by drying them. If the rooms are humid and closed, then use fan, air blower etc. The seeds should always be spread in a single layer and should not be heaped for uniform drying. The initial moisture level of the seed is 12-15 per cent.

Storage and Viability

Seed is orthodox and if stored at low temperature, it will retain high viability for several years. If the seed is stored in paper/cloth bags at room temperature, 9-12 months storage can be expected without loss in viability. Germination of fresh seed is 70-80 per cent. The seed coated with pulp in a thin skinny epicarp needs to be separated, sun dried and stored till crushed for oil extraction. Any delay in separating the seed and drying, will effects the quality of oil content. The seeds are decorticated before extracting the oil.

Pretreatment

Pre-treatment is generally not necessary, since it does not have any dormancy. However, soaking in water for 12 hours may enhance the germination of seeds.

Seed Grading

After drying and cleaning, seed lots should be further conditioned to upgrade the seed quality. This step usually comprises of removal of empty, immature, broken or insects damaged seeds. Separation of full and empty seeds due to specific gravity differences can be accomplished by liquid flotation techniques.

Nursery Technology

i)Sowing in Polybags

Under test condition, seeds are germinated in sand at fluctuating 35-40°C and 12 hours light and other dark condition. In the nursery, seeds are sown in a bed or directly in containers. Freshly collected seed could be sown directly in the container. It normally germinate on the soil surface, since, the seed germination is epigeous. For raising container seedlings, fill the polybags (15 x 25 cm size) with the nursery mixture (soil:sand:FYM in the ratio 3:1:1) sow the seed in the bags@ 1 seed/bag. The seed start germinating on the 15th day after sowing and takes 25 days to complete germination. The germination rate of Simaruba varies between 60 to 80 per cent depends on the locality factors. Hence, to ensure higher viability of the seeds, sowing the seeds within six months of collection is highly recommended. Presoaking the seed for 24 hours in cold water and removal of endocarp will also increase its germination capacity.

ii) Sowing in Mother Bed

A raised nursery bed has to be prepared at a size of 10 m x1 m. The seeds are generally sown in lines. Usually the lines are made at 10 -15 cm apart and the seeds are sown in 3 - 5 cm apart. The depth of the sowing should be 2 - 4 times the diameter of seeds, and ensure *that the* seeds are just covered with soil.

Pricking out

When the seedlings are 7-10 cm tall with taproot about 15 cm long (40-50 days after sowing) they are ready for transplant. Pricking out of seedlings is generally done into polythene bags. The polybag size is generally 10-22 cm or 15-22 cm (200 gauge thickness). The soil mix used to fill the bags consists of garden soil, sand and compost in the ratio 1:1:1. The mixture is thoroughly pulverized and sieved. The bags are watered twice in a day. *Since, the taproots grow faster* than the shoot, *frequent shifting of seedling* should be done to prevent the roots from striking the ground. Six months old seedlings are ready for out planting. Application of biofertilizers may enhance the quality of seedlings and reduce the nursery period.

Weeding

Regular and efficient weddings are essential for the success of production good planting stock. Weeding should almost be a continuous process, keeping the plants free from weed competition. Combining weeding operation along with shifting will economize the cost of seedling production.

Stump Preparation

Studies at Forest College and Research Institute have shown that stumps prepared from 10-12*months old plants with 2.5 cm of shoot and 20 cm of root have given good establishment. Such type of stump planting is advocated forvnoist locality.

Planting

Six months old seedlings are suitable for planting in the main field. The field preparation should be done during June-July with the help of southwest monsoon. Seedlings are planted at a espacement of 6 x 6 m (277 trees/ha) in pits of 45 x 45 x 45 cm size half filled with top soil and 2.0 kg compost + 20 g phosphorus + 20 g nitrogen. The plans grow well with protective watering. Pitting may be done during September and planting should be taken up with the onset of northeast monsoon i.e. during October. Every year ploughing and crescent basins formation have to be taken up prior to the onset of the monsoon to harvest rain water and in turn to induce flowering and fruiting. Timely weeding in the first two years helps the better establishment of saplings.

Vegetation Propagation

Softwood cleft grafting and air layering gives 80 per cent success, which helps in growing male and female trees in the desired ratio (1:6).

Silviculture! Characters

Simarouba glauca is a light demander and capable of withstanding the drought condition.

It is however, very frost tender especially in the seedling and sapling stages. It is a medium coppicer and fire tender. It can with stands pollarding.

Pests and Diseases

There are no serious diseases of Simaruba plants. In nursery, the seedlings are affected by damping-off and wilt disases, which are generally controlled by proper drainage and application of fungicides.

Yield

Even though bearing commences in the 3^ or 4th year, the tree gives the economic yield of 20 kg/tree from lO"1 year onwards.

Utilization

All the parts of Simaruba are useful in one-way or the other. The seeds are considered economically important as they contain 50-65 per cent edible oil, which can be used in the manufacture of vanaspathi. As industrial oil, it is well suited for the manufacture of quality soaps, lubricants, paints, polishes, pharmaceuticals, etc. (Syamsundar Joshi and Shantha Hiremath, 2000). The pressed cake resulting from the milling operation contains a very high percentage of protein (64%) and can be used as a cattle feed after the extraction of toxic elements.

The pressed cake is also being utilized as organic fertilizers. The shells (endocarp) can be used in the cardboard industry. Pulp (about 20 kg/tree/year) constituting about 60 per cent of the fresh fruit by weight contains about 11% sugars and It can be used for juice making or in the fermentation industry. Leaf litter is a good feed for earthworms and it makes good manure. The leaf and the bark contain the chemical viz. quassin, a resinous matter which is helpful in curing amoebiasis, diarrhoea and malaria.

Noni Plant

Other common name(s): noni fruit, noni juice, Indian mulberry, morinda, hog apple, meng koedoe, mora de la India, ruibarbo caribe, wild pine
Scientific/medical name(s): *Morinda citrifolia*

Description

The noni or morinda plant is a tropical evergreen tree that grows to about 10 feet tall in Tahiti and other Pacific Islands, as well as in parts of Asia, Australia, South America and the Caribbean. The tree can grow

as tall as 10 feet and bears a fruit about the size of a potato which starts out green and ripens into yellow or white. The juice, fruit, bark, and leaves are used in herbal remedies and Polynesian folk medicine.

Overview

There is no reliable clinical evidence that noni juice is effective in preventing or treating cancer or any other disease in humans. Although animal and laboratory studies have shown some positive effects, human studies are just beginning. Research is under way to isolate various compounds in the noni plant so that further testing can be done to learn whether they may be useful in humans.

How is it promoted for use?

Proponents claim the noni fruit and its juice can be used to treat cancer, diabetes, heart disease, cholesterol problems, high blood pressure, HIV, rheumatism, psoriasis, allergies, infection, and inflammation. Some believe that the fruit can relieve sinus infections, menstrual cramps, arthritis, ulcers, sprains, injuries, depression, senility, poor digestion, atherosclerosis, addiction, colds, flu, and headaches. It is further claimed that the juice can heal scratches on the cornea of the eye.

In India, proponents use noni as a remedy for asthma and dysentery, and folk healers in the Pacific islands use it for many types of illness. In the United States, some noni juice distributors promote it as a general tonic, stress reliever, facial and body cleanser, and dietary and nutritional supplement.

What does it involve?

Parts of the noni plant are used as a juice, a tonic, a poultice, and brewed (infused) like tea. The juice, which has an unpleasant taste and odor, is used on the scalp as a treatment for head lice. Some proponents also advise drinking the juice, mixed with other juices and flavorings to mask its unpleasant taste. The leaves and bark are sometimes made into a liquid tonic for urinary complaints and muscle or joint pain. The unripe noni fruit is mashed together with salt and applied on cuts and broken bones. Ripe fruit is used as a poultice for facial blemishes or as a remedy for skin sores, boils, or infections. Tea-like infusions made from leaves of the plant are used as remedies for tuberculosis, arthritis, rheumatism, and as anti-aging treatments.

In the United States, noni products are sold in various forms including juice, extract, powder, capsules (dietary supplements), facial cleansers, bath gels, and soaps. Noni distributors and Internet sites selling the juice or supplements often recommend that they be taken on an empty stomach.

What is the history behind it?

The noni fruit has been popular for centuries among Polynesians, who introduced the noni plant to Hawaii. During World War II, soldiers stationed in the South Pacific ate the fruit for added sustenance. Over the past few years, products from the noni plant have become available in health food stores and online in the United States.

In 1998, a company that manufactures noni juice and other noni products for distribution was charged with making unfounded claims by the Attorneys General of Arizona, California, New Jersey, and Texas. The company claimed that the juice could treat, cure, or prevent many diseases including cancer, HIV, diabetes, rheumatism, high blood pressure, cholesterol problems, psoriasis, allergies, heart rhythm abnormality, chronic inflammation, and joint pain.

The company was ordered to stop advertising these health claims until it could provide scientific evidence of its claims and receive approval from the U.S. Food and Drug Administration (FDA). That same year, juice marketed under the name of "Noni" was banned in Finland until claims of the juice's ability to prevent, treat, or cure illness were removed from advertising brochures.

Between 2002 and late 2014, the FDA’s website shows that it has warned several companies to stop making claims that noni could cure, treat, or prevent disease, since proof of such abilities had still not been submitted to the FDA. However, these claims are still widely made on websites and elsewhere.

What is the evidence?

A number of animal and laboratory experiments have been done on different compounds taken from the noni plant. A group of Hawaiian researchers caused tumors to grow in mice and then injected specially prepared noni juice into their abdomens. Mice who received the treatment survived twice as long as the untreated mice. Other scientists studying freeze-dried extract from the roots of the plant found that the substance appeared to prevent pain and induce sleep in mice.

Another team of investigators reported that damnacanthal, a compound removed from the foliage of the noni plant, may inhibit a chemical process that turns normal cells into cancer cells. However, since extracted chemicals or substances differ from the whole raw plant, a study of an extract might not produce the same result as a study using the whole plant. In addition, while animal and laboratory studies may show a certain substance holds promise as a helpful treatment, further studies are necessary to learn whether the results apply to humans. Researchers are working to isolate and purify any compounds in the juice that might be active in humans so that further testing can be done.

A 2008 study conducted at the University of Hawaii looked at people with cancer to find out if there were dose limits to noni extract. They found that people asked to take more than 6 capsules 4 times a day (more than 12 grams of noni each day) were very likely to drop out of the study because of the challenge of taking so many pills. The patients taking 3 or 4 capsules 4 times a day (6 to 8 grams per day) reported better quality of life than those getting higher or lower doses. This study did not have a control group, so it’s uncertain whether the noni was responsible for the improvement.

A study published in 2012 looked at smokers with abnormal lipid profiles (cholesterol, triglycerides, etc.), which are typically linked to higher risk of heart attacks. Patients who took noni juice every day had improvements in these lipid tests after 30 days. The subjects were not followed to find out if they would actually have fewer heart problems. This study didn’t look at cancer risk.

Noni fruit juice and supplements may act as antioxidants in the body; the fruit pulp contains various amounts of vitamin C and A, as well as trace minerals.

More research is needed before it can be determined what role, if any, noni plant compounds may play in the treatment of cancer or other health conditions.

Are there any possible problems or complications?

This product is sold as a dietary supplement in the United States. Unlike companies that produce drugs (which must be tested before being sold), the companies that make supplements are not required to prove to the Food and Drug Administration that their supplements are safe or effective, as long as they don't claim the supplements can prevent, treat, or cure any specific disease.

Some such products may not contain the amount of the herb or substance that is on the label, and some may include other substances (contaminants). In a 2013 study, a test of 44 samples found that fewer than half the herbal supplements tested contained any of the herb that was listed on the label. More than half the samples contained ingredients that were not on the label. This suggests that the 2007 FDA rules to assure the proper listing of supplement ingredients are not always followed. Even when they are, the rules do not address the safety of the ingredients or their effects on health.

Most such supplements have not been tested to find out if they interact with medicines, foods, or other herbs and supplements, or if they even contain the ingredients on their labels. Although some reports of interactions and harmful effects may be published, full studies of interactions and effects are not often available. Because of these limitations, any information on ill effects and interactions below should be considered incomplete.

A few supplement makers pay the US Pharmacopeia to test and verify that their products contain the ingredients listed on their labels. These supplements all have the USP Dietary Supplement Verified mark on their labels.

The safety and long-term effects of noni juice and other noni products are not well known. A few cases of liver problems have been reported in people taking noni in European countries. One of these patients had previous liver damage and required a liver transplant, but the others recovered when noni was stopped.

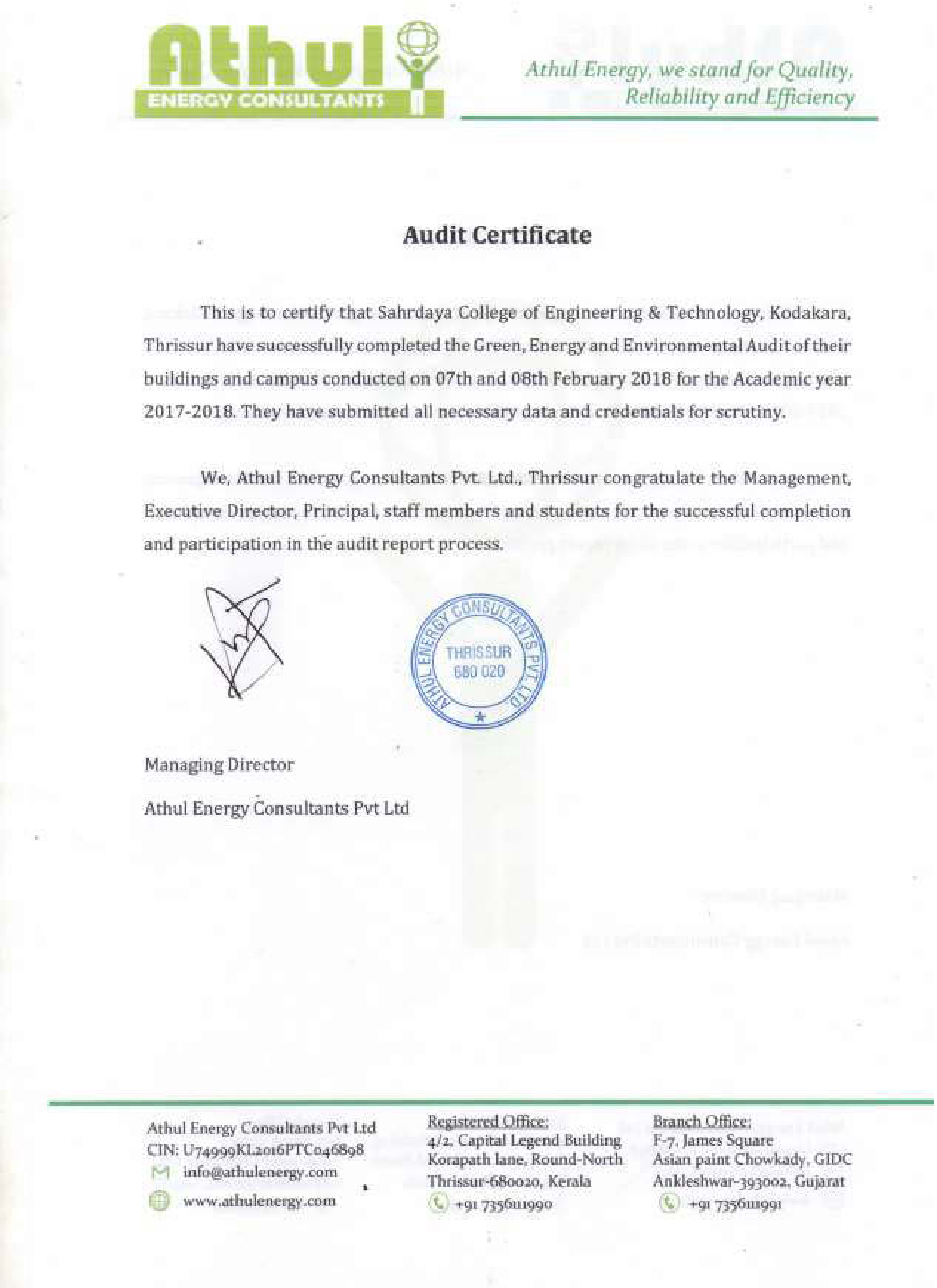
The juice has a significant amount of potassium, equivalent to a similar amount of tomato juice or orange juice, and may pose problems for people with kidney disease and others who must restrict their potassium intake. It is also high in sugar, which must be considered for people with diabetes and others who are restricting their calorie intake. It may also cause the urine to turn a pink or reddish color. Noni juice and supplements have not been studied in pregnant or breastfeeding women.

Noni juice has some risk of interacting with medicines, including a number of chemotherapy drugs, that use the same processing pathways in the body. This can cause certain drugs to build up in the body to levels that might cause problems, and lower the blood levels of others so that they become less effective. In at least one study, it also appears to reduce the anti-cancer activity of certain cancer treatments.

Talk with your doctor, nurse, or pharmacist about using noni with the medicines you are taking. Relying on this type of treatment alone and avoiding or delaying conventional medical care for cancer may have serious health consequences.

2. CERTIFICATION FROM AUDITING AGENCY

7.1.6 CERTIFICATION OF AUDITING AUTHORITY – 2018



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ENERGY CONSULTANTS

Athul Energy, we stand for Quality,
Reliability and Efficiency

Audit Certificate

This is to certify that Sahrdaya College of Engineering & Technology, Kodakara, Thrissur have successfully completed the Green, Energy and Environmental Audit of their buildings and campus conducted on 07th and 08th February 2018 for the Academic year 2017-2018. They have submitted all necessary data and credentials for scrutiny.

We, Athul Energy Consultants Pvt. Ltd., Thrissur congratulate the Management, Executive Director, Principal, staff members and students for the successful completion and participation in the audit report process.

ATHUL ENERGY CONSULTANTS PVT LTD
THRISSUR
680 020

Managing Director

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CERTIFICATION BY AUDITING AUTHORITY 2020

Athul
ENERGY CONSULTANTS

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Reliability and Efficiency

20-01-2020

Audit Certificate

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THRISSUR
680 020

Managing Director

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2. AWARDS AND RECOGNITIONS

7.1.6 AWARDS AND RECOGNITIONS

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION

CLEAN CAMPUS AWARD - 2017

This is to certify that SAHRDAYA COLLEGE OF ENGINEERING & TECHNOLOGY, THRISSUR participated in "AICTE-Clean Campus Award 2017" held on 2nd October, 2017 at College of Engineering, Pune (CoEP), Maharashtra.

Prof. Anil D. Sahasrabudhe
Chairman

AICTE -Clean Campus Award- 2017

UNIVERSITY OF CALICUT

SWACHH CAMPUS AWARD 2015

Presented to
Sahrdaya College of Engineering & Technology, Thrissur
having been adjudged as the cleanest campus
among the affiliated colleges under
the University of Calicut.

Calicut University P.O.
Date: 07-08-2015

Vice Chancellor

SWACHH CAMPUS AWARD 2015
SAHRDAYA COLLEGE OF
ENGINEERING &TECHNOLOGY

University of Calicut – Swacch Campus Award - 2015

SOUTH INDIAN Bank
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Congratulates

SAHRDAYA COLLEGE OF ENGINEERING & TECHNONOLY

for achieving

'Swatchh Campus Award 2015'

of Calicut University

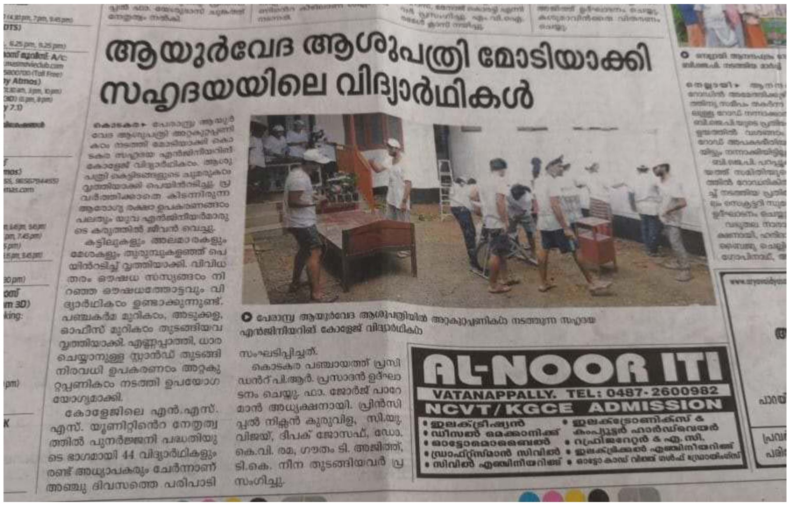
South Indian Bank – Recognition for Swacch Campus Award 2015

3. BEYOND CAMPUS ENVIRONMENTAL PROMOTION ACTIVITIES

7.1.6 BEYOND CAMPUS PROMOTIONAL ACTIVITIES

Cleaning Activities initiated by NSS

Planting Trees as part of Environment Day



ആയുർവേദ ആശുപത്രി മോടിയാക്കി സഹൃദയയിലെ വിദ്യാർഥികൾ

കൊടകര ▸ പേരാമ്പ്ര ആയുർവേദ ആശുപത്രി അറ്റകുറ്റപ്പണികൾ നടത്തി മോടിയാക്കി കൊടകര സഹൃദയ എൻജിനീയറിങ് കോളജ് വിദ്യാർഥികൾ. ആശുപത്രി കെട്ടിടങ്ങളുടെ ചുമരുകൾ വൃത്തിയാക്കി പെയിന്റടിച്ചു. പ്രവർത്തിക്കാതെ കിടന്നിരുന്ന ആരോഗ്യ രക്ഷാ ഉപകരണങ്ങളും പലതും യുവ എൻജിനീയർമാരുടെ കരുത്തിൽ ജീവൻ വെച്ചു.

കട്ടിലുകളും അലമാരകളും മേശകളും തുരുമ്പുകളഞ്ഞ് പെയിന്റടിച്ച് വൃത്തിയാക്കി. വിവിധ തരം ഔഷധ സസ്യങ്ങളാം നിറഞ്ഞ ഔഷധത്തോട്ടവും വിദ്യാർഥികൾ ഉണ്ടാക്കുന്നുണ്ട്. പഞ്ചകർമ മുറികൾ, അടുക്കള, ഓഫീസ് മുറികൾ തുടങ്ങിയവ വൃത്തിയാക്കി. എണ്ണപ്പാത്തി, ധാര ചെയ്യാനുള്ള സ്റ്റാൻഡ് തുടങ്ങി നിരവധി ഉപകരണങ്ങൾ അറ്റകുറ്റപ്പണികൾ നടത്തി ഉപയോഗയോഗ്യമാക്കി.

കോളേജിലെ എൻ.എസ്.എസ്. യൂണിറ്റിന്റെ നേതൃത്വത്തിൽ പുനർജ്ജനി പദ്ധതിയുടെ ഭാഗമായി 44 വിദ്യാർഥികളും രണ്ട് അധ്യാപകരും ചേർന്നാണ് അഞ്ചു ദിവസത്തെ പരിപാടി സംഘടിപ്പിച്ചത്.

കൊടകര പഞ്ചായത്ത് പ്രസിഡൻറ് പി.ആർ. പ്രസാദൻ ഉദ്ഘാടനം ചെയ്തു. ഫാ. ജോർജ് പാറേമാൻ അധ്യക്ഷനായി. പ്രിൻസിപ്പൽ നിക്സൻ കുരുവിള, സി.യു. വിജയ്, ദീപക് ജോസഫ്, ഡോ. കെ.വി. രമ, ഗൗതം ടി. അജിത്ത്, ടി.കെ. നീന തുടങ്ങിയവർ പ്രസംഗിച്ചു.

പേരാമ്പ്ര ആയുർവേദ ആശുപത്രിയിൽ അറ്റകുറ്റപ്പണികൾ നടത്തുന്ന സഹൃദയ എൻജിനീയറിങ് കോളജ് വിദ്യാർഥികൾ

News on Perambra Ayurvedic Hospital Cleaning

Organic Farming Practice Initiated by Students

Workshop on - LED Bulb Making

Cleaning Activities by NSS

Cleaning Activities by NSS