JSS MAHAVIDYAPEETHA JSS SCIENCE AND TECHNOLOGY UNIVERSITY SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING Constituent College of JSS Science and Technology University



- Approved by A.I.C.T.E
- Governed by the Grant-in-Aid Rules of Government of Karnataka
- Identified as lead institution for World Bank Assistance under TEOIP Scheme

ENERGY AUDIT REPORT JSS COLLEGE FOR WOMEN (AUTONOMOUS) SARASWATHIPURAM, MYSURU, KARNATAKA.



SAVE ENERGY SAVE OUR PLANET

ENERGY AUDIT CONDUCTED BY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

&

DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

Sri Jayachamarajendra College of Engineering (SJCE)

Constituent college of JSSSTU

JSS SCIENCE AND TECHNOLOGY UNIVERSITY, MYSORE.

ACKNOWLEDGMENT

We express our sincere gratitude to the Principal of Sri Jayachamarajendra College of Engineering, for having given us an opportunity to conduct Energy Audit at JSS College for women, Mysore.

We express our thanks to the Principal of JSS College for women, Mysore for having authorized the JSS Science and Technological University, Mysore for conducting the Energy Audit at the Academic Campus of the JSS College for women, Mysore.

We hope that JSS Science and Technological University has been able to fulfill the duty entrusted to it in a satisfactory manner.

We look forward to associate with the JSS College for women, Mysore in similar matter in future.

We express sincere thanks and gratitude to the employees of JSS College for women, Mysore for the co-operation and the needful assistance extended to us, during the conduct of Energy Audit.

Our sincere thanks to the following dignitaries, for having given us an opportunity to conduct Energy Audit in JSS College for women, Mysore.

- 1. **Dr. S. B. Kivade**, Principal & Dean (E&T), Sri Jayachamarajendra College of Engineering, Mysore.
- 2. **Dr.M.S.Shashikala**, Professor & Head (E&EE), Sri Jayachamarajendra College of Engineering, Mysore.
- 3. **Dr.V Ramesh**, Professor & Head (I&PE), Sri Jayachamarajendra College of Engineering, Mysore.
- 4. Dr. Suresha K V, Principal, JSS College for women, Mysore.
- 5. Dr. H B Suresh, Dean (Academic), JSS College for women, Mysore.
- 6. Mr. S. Shivashankarappa, Office Superintendent, JSS College for women, Mysore.
- 7. Mr. Guru Swamy, Electrician, JSS College for women, Mysore.

We tried our best to present this energy report as per the requirements of the college.

CONTENTS

Acknowledgement Disclaimer Work Completion Report Energy Audit Team Executive Summary

1. Introduction

- 1.1 Total campus area & college building spread area campus infrastructure
- 1.2 NAAC grading
- 1.3 Campus infrastructure

2. Introduction to energy audit

- 2.1 General
- 2.2 Scope of Work, Methodology and Approach
 - 2.2.1 Approach to Energy Audit
 - 2.2.2 Energy Audit
 - 2.2.3 Energy Audit Methodology
- 2.3 List of Instruments used for Energy Auditing

3. Study of energy consumption profile

3.1 Source of Energy

4. Study of Electrical Systems

- 4.1 Electrical Supply Details
 - 4.1.1 Tariff and electricity charges
- 4.2 Study of Electrical Demand
- 4.3 Electrical Energy Cost Analysis
 - 4.3.1 CESC Consumption
 - 4.3.2 Roof Top 180 kW solar power plants

5. Actual Measurements and its Analysis

5.1 Load Pattern of Different Blocks

6. Diesel Generators

- 7. Air conditioners
 - 7.1 Load of Air Conditioners (AC)
 - 7.2 Observations and suggestions

8. Measurement of Harmonics and load current

- 8.1 Readings recorded by Fluke 434-II power analyzer
- 8.2 Waveforms of Fluke Meter

9. Energy Conservation measures

- 9.1. Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights
- 9.2. Retrofitting of existing inefficient and old Fan Regulators with Electronics Regulators
- 9.3 General Recommendations

Executive Recommendations

References

DISCLAIMER

The primary objective of this Energy Audit is to identify and evaluate opportunities for energy conservation through visits to your facility. Data was gathered during Three day site visit and energy conservation opportunities were identified. When an energy conservation opportunity involving engineering design and capital investment is attractive to the institution and engineering services are not available in-house, it is recommended that a consulting engineering firm be engaged to do the detailed engineering design and cost estimations for implementing the energy conservation opportunity.

In addition, since the site visits by our team are brief, they are necessarily limited in scope and a consulting firm could be more thorough. The contents of this report are offered only as guidance. Sri Jayachamarajendra College of Engineering, constituent college of JSS Science and Technology University, Mysuru and all technical sources referenced in this report do not

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(b) Assume any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method or process disclosed in this report. This report does not reflect official views or policies of the previously mentioned institutions. The assumptions and equations used to arrive at the energy consumption and cost savings for the energy conservation opportunities are given in the report. These assumptions made, the assumptions may be adjusted and, using the same equation, new values for the energy and cost savings for each energy conservation opportunity may be determined.

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WORK COMPLETION REPORT

This is to certify that Sri Jayachamarajendra College of Engineering (SJCE) Constituent college of JSS S & TU, Mysore has successfully conducted Energy Audit at JSS College for Women (AUTONOMOUS), Saraswathipuram, Mysore, Karnataka from 29 Nov 2021 to 22 Dec 2021. The work of energy audit was completed on 22 Dec 2021.

Thanking you and assuring you our best service always.

Audit Report BY:

1,-15	Acoustant	G. Day 6 23/12/2
Dr. Mohan N, Co – Assessor 1 Assistant Professor, Dept. of Electrical & Electronics Engineering SJCE, JSSSTU, Mysuru - 570006	Mr. Ravishankar B S, Co – Assessor 2 Assistant Professor, Dept. of Electrical & Electronics Engineering SJCE, JSSSTU, Mysuru - 570006	Dr. Dayakar G. Devaru, Certified Energy Manager Principal Assessor Professor, Dept. of Industrial & Production Engineering SJCE, JSSSTU, Mysuru - 570006

Date: 22/12/21

Place: Mysore



JSS MAHAVIDYAPEETHA JSS SCIENCE AND TECHNOLOGY UNIVERSITY SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING Constituent College of JSS Science and Technology University Approved by A.I.C.T.E



SCIENCE AND TECHNOLOGY UNIVERSITY INIVERSITY Identified as lead institution for World Bank Assistance under TEQIP Scheme

ENERGY AUDIT TEAM

Name	Designation
Dr. Dayakar G. Devaru	Certified Energy Manager & Professor, Dept. of Industrial & Production Engineering SJCE, JSSSTU, Mysuru - 570006
Dr. Mohan N	Assistant Professor, Dept. of Electrical & Electronics Engineering SJCE, JSSSTU, Mysuru -570006
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EXECUTIVE SUMMARY

The objective of the audit was to study the energy consumption pattern of the facility, identify the areas where potential for energy/cost saving exists and prepare proposals for energy/cost saving along with investment and payback periods. The salient observations and recommendations are given below.

1. JSS College for women, Mysore uses energy in the following forms:

A. From Chamundeshwari Electricity supply corporation Limited, Mysore.

B. Electricity SOLAR Grid connected solar plant (180 kW).

C. Diesel Generator (DG)

Electrical energy is used for various applications, like: Computers, Lighting, Air-Conditioning, Fans Other Laboratory Equipment, and Printers, Xerox machines, CCTV, UPS, LCD Projector, Router system, Flood light, Pumping motor etc.

2. The monthly maximum demand (MD) recorded during Mar-2020 to Oct-2021, ranges from 27 kVA to 79 kVA along with rooftop solar PV generation. But, the contract demand is 150 kVA. As per the tariff regulation, the consumer has to pay a minimum fixed charge for 85% of contract demand. That is, for the present load conditions of 27 kVA to 79 kVA, the consumer has to pay fixed charge for128 kVA. Hence, it is recommended to revise the contract demand to 100 kVA, so that the consumer can have a financial saving of Rs. 1, 23,840 per annum by surrendering 50 kVA of demand to Chamundeshwari Electricity supply corporation Limited.

3. After the measurement and analysis, we propose herewith following Energy Conservation Opportunities as shown in Table 1.

The total energy used is **7**, **16**,**705 kWh/yr**. Total energy costs for this period was **₹25**, **99**,**629**. The Energy Conservation Opportunities (ECOs) contained in this Report could save **81**,**197 kWh/yr** which is equivalent to reduction in CO₂ emissions of **77**,**137** Kgs or equal to planting **3**,**673** Trees. The total energy cost savings would amount to approximately **₹7**,**04**,**400/-** or approximately **27.09%** of the annual energy costs for this facility. The total estimated implementation cost is **₹4**,**96**,**280/-** which gives an average simple payback of around **8 months.**

Best Practices found in the institution

- 1. Roof top Solar Photo-voltaic Panel of installed capacity 180 KW
- 2. Roof top solar water heater (flat plate collectors)
- 3. LED Tube lights in offices

	Payback in Months	10 Months	9 Months	12 Months	16 Months	1 Month	8 Months
	Implementa tion Cost	2,32,140/-	1, 95,750/-	53,740/ -	4,650/-	10,000/- (Documentat ion)	₹4,96,280/-
ties	Cost Saving Per annum	(76320- 38160)*7.15 =2,72,844/-	(112752-77517) *7.15 =2,51,930.25/-	(10950-3650) *7.15 =52,195/-	(1004.4-502.2) $*7.15$ $=3590.73$	10320*12 =1,23,840/-	₹7,04,400/-
servation Opportunit	Energy consumption per annum after improvement	1060*20*6*25*12 / 1000 =38,160 units	783*55*6*25*12 / 1000 =77,517 units	10*100*10*365 / 1000 =3,650 units	31*9*6*25*12 / 1000 =502.2 units	85*240 / kVA =20,400	1,19,829.2 units
Table 1: Energy Cons	Energy consumption per annum before improvement	1060*40*6*25*12 / 1000 =76,320 units	783*80*6*25*12 / 1000 =1,12,752 units	10*300*10*365 / 1000 =10,950 units	31*18*6*25*12 / 1000 =1,004.4 units	128*240 / kVA =30,720	2,01,026.4 units
	Fittings to be replaced	1060	783	10	31	·	
	Recommendations	Replacing Tube Lights (FTL) with LED Tube Lights	Replacing Fan with 5 star energy saving Fan or BLDC fan	Replacing 300Watt Mercury Vapour Lamp light with smart 100W LED Street Light	Replacing 18 watt CFL with 9 watt LED Bulbs	Surrendering 50 kVA of Demand to CESC Mysore	Total
	Sr. No	1.	5.	ж	4	5.	

CHAPTER 1 INTRODUCTION

JSS Mahavidyapeetha is a socio-cultural institution that has pioneered the concept of education as a tool for social change. While the focus has been on providing opportunities for formal education, there is strong parallel thrust on values, ethics and the meeting of societal obligations. This is an institution that adopts a multipronged approach to ensure a better quality of life.

The present Pontiff H.H Jagadguru Sri Shivarathri Deshikendra Mahaswamiji, the 24thspiritual Head of Suttur Math and President of JSS Mahavidyapeetha has been the torch bearer of its tradition of providing educational excellence.

JSS College for Women (Autonomous) is situated in Mysuru in Karnataka state of India, established in 1954.The College is accredited by NAAC with A+ Grade. JSS College for Women offers 22 courses, 93 Add-on Courses. Focus is given to activities beyond academics at JSS College for Women, which is evident from its infrastructure, extracurricular activities, and National and International collaborations.

1.1 TOTAL CAMPUS AREA & COLLEGE BUILDING SPREAD AREA

The area coverage of the college is as follows:Total land area of campus: 8 acresTotal plinth area of buildings: 4.2 acres

1.2 NAAC GRADING IN ASSESSMENTS NAAC

NAAC accreditation First cycle	: B+
NAAC re-accreditation Second cycle	: A
NAAC re-accreditation Third cycle	: A+
NAAC re-accreditation Fourth cycle	: Under Process

1.3 CAMPUS INFRASTRUCTURE

- Qualified and experienced teaching staff.
- Co-operative non-teaching staff.
- Well-equipped, attractive building with all the facilities.
- Big playground.
- Spacious classrooms.
- Well-equipped computer lab.
- Sports room with sufficient sports equipment.
- Modern, attractive and well-equipped function hall for co-curricular activities.
- Good library.
- Sufficient reading room with Journals, magazines and newspapers.
- Well-equipped science lab.
- Demonstration and seminars are regularly arranged.
- Fellowship and scholarship to economically backward and talented students.
- Spacious & well ventilated Rest Room.
- Well accommodated hostel.
- Canteen Facilities.

Computer Laboratory:

The College has a modern computer science lab, which is useful to the students. The computer lab provides access to high quality, technologically advanced learning environments to the students. It offers state-of-the-art computing resources to help students to realize their personal and career goals. The students are offered short-term courses in computer science subjects to make them career ready. The institution also provides computer training to both the teaching and the non-teaching staff, to keep them informed about the recent advancements. It is open from 8.30 am to 5.30 pm. The department organizes different courses for update computer knowledge of the staff members.

Library:

The College also has well-stocked libraries, which are related to subjects, novels, drama, poetry, dictionaries, encyclopedias, etc.

Reading Room:

There is a separate reading room which subscribes all educational magazines and journals, to help the students prepare for competitive exams.

Classrooms:

The classrooms are well-furnished and spacious enough to accommodate more than ahundred students.

Sports Room:

The College also has adequate sports materials to encourage the student's in sports activities.

Indoor:

Indoor games: Chess, Table tennis, etc.

Outdoor:

Outdoor games: Volley ball, Ball badminton, Shuttle cock, Throw ball, etc.

Playground:

The College has a vast playground

Cultural Activities:

Students are encouraged to take part in various cultural activities. They participate at the college-level, taluk-level, district-level and state-level sports and cultural competitions. Many students have exhibited excellent performance and have won many prizes.

National Service Scheme:

To have community-oriented service, the college has dynamic and dedicated NSS Unit. NSS helps students to get involved in social activities and infuses confidence and self- reliance among the students. The main aim of NSS is to involve students in nation building activities. NSS develops leadership qualities and enhances patriotism among students.

Co-Curricular Activities:

To strengthen the current academic and research tempo, supportive activities such as Seminars, Symposia, Workshops, Conferences and field visits are arranged throughout the year. Other activities such as Drama, Mono acting, Music, Quiz, Essay competition etc., are also conducted.

CHAPTER 2 INTRODUCTION TO ENERGY AUDIT

1.1 General

The JSS College for Women (Autonomous) entrusted the work of conducting a Detailed Energy Audit of campus at Mysore with the main objectives as below:

- To study the present pattern of energy consumption
- To identify potential areas for energy optimization
- To recommend energy conservation proposals with cost benefit analysis.

1.2 Scope of Work, Methodology and Approach

Scope of work and methodology were as per the proposal .While undertaking data collection, field trials and their analysis, due care was always taken to avoid abnormal situations so as to generate normal/representative pattern of energy consumption at the facility.

1.2.1 Approach to Energy Audit

We focused our attention on energy management and optimization of energy efficiency of the systems, sub systems and equipments. The key to such performance evaluation lies in the sound knowledge of performance of equipments and system as a whole.

1.2.2 Energy Audit

The objective of Energy Audit is to balance the total energy inputs with its use and to identify the energy conservation opportunities in the stream.

Energy Audit also gives focused attention to energy cost and cost involved in achieving higher performance with technical and financial analysis. The best alternative is selected on financial analysis basis.

1.2.3 Energy Audit Methodology

Energy Audit Study is divided into following four steps

• Historical Data Analysis

The historical data analysis involves establishment of energy consumption pattern to establish base line data on energy consumption and its variation with change in production volumes.

• Actual measurement and data analysis

This step involves actual site measurement and field trials using various portable measurement instruments. It also involves input to output analysis to establish actual operating equipment efficiency and finding out losses in the system.

• Identification and evaluation of Energy Conservation Opportunities

This step involves evaluation of energy conservation opportunities identified during the energy audit. It gives potential of energy saving and investment required to implement the proposed modifications with payback period. All recommendations for reducing losses in the system are backed with its cost benefit analysis.

1.2.4 List of Instruments used for Energy Auditing

• FLUKE 434-II POWER ANALYZER



• Clamp Meter



CHAPTER 3 STUDY OF ENERGY CONSUMPTION PROFILE

3.1 Source of Energy:

JSS College for Women (Autonomous) uses Energy in following forms:

1. Electricity from CESC

JSS College for Women (Autonomous) receives Electricity from Chamundeshwari Electricity Supply Corporation Limited, Mysore.



Fig Shows Incoming Supply from Chamundeshwari Electricity Supply Corporation Limited, Mysore.

2. Electricity SOLAR Grid connected solar plant (180 kw)

JSS College for Women (Autonomous) installed 180kw rooftop solar power which is used to feed the Campus load and export the remaining energy to Chamundeshwari Electricity Supply Corporation Limited, Mysore.



Fig Shows Solar Panels installed at campus.

JSS College for Women, Saraswathipuram, Mysore.

3. Diesel Generator

Diesel is used as a fuel for Diesel Generator which is run whenever power supply from Chamundeshwari Electricity Supply Corporation Limited, Mysore is not available.



Fig Shows Cummins Diesel Generator installed at campus.

CHAPTER 4 Study of Electrical Systems

4.1 Electrical Supply Details

The electrical supply to JSS College for Women's (Autonomous) campus comes from **Chamundeshwari Electricity Supply Corp Ltd (CESCOM)**, **Mysore** supply at **11 kV**, which is stepped down to **415 V** by a transformer of **250KVA**.

4.1.1 Tariff and electricity charges

The electric supply at JSS College for Women (Autonomous) campus is charged under HT2C of the Chamundeshwari Electricity Supply Corp Ltd (CESCOM) the tariff structure of **HT2C** general is given in table 5.

Note: HT-2 (c) Applicable to Government Hospitals, Hospitals run by Charitable Institutions, ESI hospitals, Universities and Educational Institutions belonging to Government and Local bodies, Aided Educational Institutions and Hostels of all Educational Institutions.

Demand charges Rs.240/kVA of billing demand/ month*		
Energy charges		
For the first one Lakh units	715 paise per unit	
For the balance units	755 paise per unit	

*Indicates Present Tariff structure Chamundeshwari Electricity Supply Corp Limited, Mysore.

4.2 Study of Electrical Demand

Table Shows Maximum Demand & Contract Demand of Campus

SL. NO	MONTH	MAXIMUM DEMAND(KVA)	CONTRACT DEMAND(KVA)	AMOUNT FOR ACTUAL MD(Rs)	AMOUNT FOR 85% CD (Rs)	DIFFERENC E (Rs.)
1	MAR-20	92	150	22080	26880	4800
2	APR-	32	150	7680	26880	
	20*					19200
3	MAY-20	38	150	9120	26880	17760
4	JUL-20	27	150	6480	26880	20400
5	AUG-20	38	150	9120	26880	17760
6	NOV-20	36	150	8640	28160	19520
7	DEC-20	38	150	9120	28160	19040
8	JAN-21	49	150	11760	28160	16400
9	FEB-21	79	150	18960	28160	9200
10	MAY-21	24	150	5760	28160	22400
11	JUN-21	30	150	7200	30720	23520
12	JUL-21	39	150	9360	30720	21360
13	AUG-21	51	150	12240	30720	18480
14	SEP-21	58	150	13920	30720	16800
15	OCT-21	59	150	14160	30720	16560
Т	OTAL	46	150	1,65,600/-	4,28,800/-	2,63,200/**

JSS College for Women, Saraswathipuram, Mysore.

*After installation of roof top solar

**Excess Demand paid without consuming full contract demand

4.3 Electrical Energy Cost Analysis

4.3.1 CESC Consumption

The monthly energy consumption in kWh from CESC*, Mysore for the past 15 months is shown in below table.

SL.NO	MONTH	Consumption CESC (kWh)	Power Factor	Total Bill Paid to CESC** (Rs)
1	MAR-20	2,97,090.1	0.97	2,47,272
2	APR-20*	12,020.5	0.94	1,03,301
3	MAY-20	8,476.9	1	64,061
4	JUN-20	5,778.5	1	10,641
4	JUL-20	5,032.8	0.93	6,706
5	AUG-20	5,617.5	0.97	9,344
6	NOV-20	5,832.9	0.96	12,517
7	DEC-20	10,305.6	0.99	27,303
8	JAN-21	7,385.5	0.99	85,383
9	FEB-21	12,205	0.97	1,22,660
10	MAY-21	4,355.2	1	18,947
11	JUN-21	4,335	1	-14,179
12	JUL-21	6,045	1	6,126
13	AUG-21	12,592.5	0.99	74,244
14	SEP-21	11,355	0.99	66,326
15	OCT-21	12,862.5	1	60,335
ТО	ΓAL	4,21,290.5		9,00,987

* Indicates these data's extracted from the CESC Monthly Consumption bill

** Indicates Total Bill Paid to CESC Mysore after obtaining solar rebate at the rate of 3.07 Rs for 1 kWh energy.



JSS College for Women, Saraswathipuram, Mysore.

4.3.2 Roof Top 180 kW Solar Power Plant.

The monthly Bill paid to Sangam rooftop solar private limited, Mumbai for installed **180Kw Roof Top solar Power Plant** at JSS College for Women for the past **13 months** is shown in below table.

SL.NO	MONTH	Generated unit	Rate per unit	Total Bill Paid to Seller Company* (Rs)
1	JUN-20	18,112	5.75	1,04,144
2	JUL-20	20,264	5.75	1,16,518
3	AUG-20	16,240	5.75	93,380
4	SEP-20	16,600	5.75	95,450
4	OCT-20	22,520	5.75	129,490
5	NOV-20	18,480	5.75	1,06,260
6	DEC-20	15,952	5.75	91,724
7	JAN-21	17,646	5.75	1,01,476
8	FEB-21	20,128	5.75	1,15,736
9	MAR-21	21,864	5.75	1,25,718
10	APR-JUN-21	57104	5.75	3,28,348
11	JUL-21	16,584	5.75	95,358
12	AUG-21	16,824	5.75	96,738
13	SEP-21	17,096	5.75	98,302
ТО	TAL	2,95,414		16,98,642/-

* Indicates Payments made to Sangam rooftop solar private Limited, Maharashtra from JSS College of women, Mysore.



CHAPTER 5

Actual Measurements and its Analysis

Sr.	Name of	Power	Quantity	Power	Usage	Power
No.	Appliance	Rating	- •	Consumption	per	Consumption/day
		(Watt)		(Watt)	Day	(Watt)
					Hr.	, , , , , , , , , , , , , , , , , , ,
A	В	С	D	E=C*D	F	G=E*F
1.	Fluorescent	40	1060	42,400	6	2,54,400
	Lamp(FTL)					
2.	Fan	80	783	62,640	6	3,75,840
3.	PC	60	131	7,860	6	47,160
4.	Metal Halide	250	12	3,000	2	6,000
	(Indoor Stadium)					
5.	LED 16 W	16	399	6,384	6	38,304
	LED 9 W	9	144	1,296	6	7,776
	LED 35W	35	4	140	10	1,400
6.	CFL 18W	18	31	558	6	3,348
7.	Xerox machine	750	8	6,000	2	12,000
8.	Printer	Standby	39	19,500	2	39,000
		mode: 30-				
		50w/				
		printing				
		mode:300-				
		500w				
9.	AC(Logicool-	2300	3	6,900	2	13,800
	1.16kg)					
10.	CCTV	10	43	430	24	10,320
		1KVA	9	9,000	6	54,000
		1.5KVA	1	1,500	6	9,000
		2KVA	5	10,000	6	60,000
11	LIDS	2.5KVA	1	2,500	6	15,000
11.	015	3KVA	1	3,000	6	18,000
		5KVA	1	5,000	6	35,000
		7.5KVA	2	15,000	6	90,000
		9KVA	1	9,000	6	54,000
12.	Water Cooler	60w	11	660	1	660
13.	RO System	2hp	1	1,471	1	1,471
14.	LCD Projector	282	24	6,762	2	13,524
15.	Charging socket	23	780	17,940	-	AS PER USE
16.	P.A.System	250	10	2,500	1	2,500
17.	Exhaust fan	60	34	2,040	6	12,240
18.	Electric bell	25	6	150	1	150
19.	Refrigerator	2kwhr/day	11	2,200	24	52,800
20.	Washing Machine- 10Kg	1500	3	4,500	12	54,000
21.	Mercury Vapour lamp(OUTSKIRT)	300	10	3,000	8	24,000

5.1 Load Pattern of College Campus (Full)

JSS College for Women, Saraswathipuram, Mysore.

22.	Bhojana shala Machines	9.5hp	1	6,987.25	3	20,961.75		
23.	DG Gen set	25KVA	1	AS PER USE		AS PER USE		
24.	Grid connected	180Kw	1	1,80,000	12	1.80,000		
	solar plant			, ,		, ,		
25.	Lab(Chemistry	12.654KW	1	12,654	3	37,962		
	Organic							
	Chemistry,							
	,Chemical Lab,							
	Micro Biology,							
	Nuclear Lab,							
	Inorganic Lab)							
26.	Fax Machine	30	2	60	2	120		
27.	Scanner	460	2	920	3	2,760		
28.	AH Point	-	152	AS PER USE		AS PER USE		
29.	LAN Main Points	40-50w	18	900	24	21,600		
		6500	1 (Main	6,500	12	78,000		
30	Lift		Building)					
50.		3000	1 (Kitchen)	3,000	3	9,000		
		80	4(LED)	320	6			
		120		120	8	960		
31	TV		1(Cathode					
			Ray Tube					
			(CRT)					
			televisions)					
32.	Water Purifier	2000		4,000	1	4,000		
			2					
33.	Pest Killer	60		120	10	1,200		
			2					
34.	Sump Motor	1HP		735.5	8	5,884		
			1		-			
35.	Submersible Motor	5HP	2	3,677.5	8	29,420		
26		(0)	3	400	2	1.440		
36.	Incandescent Lamp	60	o	480	3	1,440		
27	Ecous Light	1000	0	22.000	2	66.000		
57.	(Auditorium)	1000	22	22,000	3	00,000		
20	(Auditorium)	1000		1 000	2	2 000		
30.	Sustem(Control	1000	1	1,000	З	3,000		
	Boom)		1					
* TL:-	Koom)	tion considers	d annrovimatal	y Actual load car	aumetion	might be different		
	ding to optical use of a	tion considered	u approximatel	y. Actual load con	sumption	might be different		
accord	according to actual use of power for particular time period.							

CHAPTER 6 Diesel Generators

6.1 Diesel Generator system.

One 100 kVA Diesel Generator set is installed, for giving supply to the whole campus of JSS College for Women including Hostel Blocks.



Fig Shows Cummins Diesel Generator installed at campus

6.2 Energy Saving Measures for DG Sets

- Ensure steady load conditions on the DG set, and provide cold, dust free air at intake (use of air washers for large sets, in case of dry, hot weather, can be considered
- Improve air filtration.
- Ensure fuel oil storage, handling and preparation as per manufacturers' guidelines/oil company data.
- Consider fuel oil additives in case they benefit fuel oil properties for DG set usage.
- Calibrate fuel injection pumps frequently.
- Ensure compliance with maintenance checklist.
- Ensure steady load conditions, avoiding fluctuations, imbalance in phases, harmonic loads.
- In case of a base load operation, consider waste heat recovery system adoption for steam generation or refrigeration chiller unit incorporation. Even the Jacket Cooling Water is amenable for heat recovery, vapour absorption system adoption.

- In terms of fuel cost economy, consider partial use of biomass gas for generation. Ensure tar removal from the gas for improving availability of the engine in the long run. (Biogas may be generated from the degradable waste generated at the college campus Bhojana shala
- Carryout regular field trials to monitor DG set performance, and maintenance planning as per requirements.

CHAPTER 7 AIR CONDITIONERS

In the facility for air conditioning there is no centralized system with AHU (air handling unit), but mostly spilt air conditioners are installed.

7.1 Load of AIR CONDITIONERS (AC) was as follows:

Name	Rated Power (W)	Qty	Voltage in Volts	Current in Amp (Each)
Air Conditioner- 1.16Kg-1 Star (LogiCool)	2300 Watt	3	230V	10.2 A



Fig Shows Air conditioner installed at campus

7.2 Observations and suggestions

- Retrofitting old & inefficient split type1 star AC with 5 star AC
- Normal air conditioning temperature should be kept as high as possible (I.e.24 d.cel.). By thumb rule, increase in 3 degrees in indoor air temperatures can save 1% of electricity.
- The ventilation in area can be provided with installation of natural ventilation. Natural ventilation will also minimize the requirement of exhaust fans.

CHAPTER 8

Measurement of Harmonics and load current

Parameters	R-Phase	Y-Phase	B-Phase	Neutral
Voltage in Volts	252.2	249.2	254.8	3.1
Voltage Phase Shift	0	-240	-120	NA
(Degree)				
Current in Amps	155	157	158	0
Current phase	-106	-335	-216	NA
shift(Degree)				
Voltage Harmonics	2.1%F			
(%)				
Current Harmonics	14.1%F			
(%)				
Frequency (HZ)	50HZ			
Power Factor	0.99			

8.1 Readings recorded by Fluke 434-II power analyzer

8.2 Waveforms of Fluke 434-II power analyzer



Fig Shows Current & Voltage Phasor of Campus

Harmonics	iD 2.1%f		Harmonics	in 14.2% fit k 3.6	
Рині ∢∳····108%	Ŏ _ 0:00:05	5- 00 9	Рині 4)- 108%	© 0:00:00	1> ⊡9
¢···· 50% <mark>·</mark> · ·····			¢····· 50%·· · · · · ·	nar sladningar sladningar sladning	e sonne sonne
THDDC 1 3 10/12/21 12:20:08	5 7 9 11 5 440U 50Hz 30 WYE	13 15 17 EN50160	THDDC 1 3 10/12/21 12:20:13	,	13 15 17 E EN50160
	ALL METER O	ITS STUP START		ALL METER EVE	START

Fig Shows Current & Voltage Harmonics of Campus



Fig Shows Current & Voltage Sinusoidal Waveform of Campus

Observation:

All the parameters are within the tolerance band and hence it found all the norms are satisfactory.

CHAPTER 9

Energy Conservation measures

Detailed calculations of some of the important Energy Conservation measures are given here.

9.1. Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights

The **40 Watt** FTLs can be replaced with the LED tube lights of **20 Watt**. These changes can be made at the places where the usage is higher. Usually minimum of 3 years warranty is given and approximate burning hours is 40,000. (15 years considering 8 hours per day running)

Following calculations are done for 6 hours working:

•Power consumption by 36 W FTL with conventional choke = 40 W/ Tube Light

•Equivalent LED tube light = 20 W/ Tube Light

•Savings in power = 20 W/ Tube Light

•Operating hours = 6 h/day x 300 days/year = 1800 h/year

•Tube Light Yearly savings = 1800 x 20 W = 36 kWh/year/Tube Light

•Average Cost of electricity = Rs.7.15/ kWh

•Saving = 36 kWh x 7.15 = Rs.257.4 / year/Tube light

• Approximate investment on single LED Tube lights = Rs. 219 (Panasonic LED 20W Batten, 1 pc)

•Number of Tube Lights to be replaced = 1060

Summary:

Total Yearly Saving =1060 x 257.4 = **Rs. 2, 72,844/year**

Total Investment =1060 x Rs. 219 = **Rs. 2, 32,140**

Payback:

(2, 32,140/2, 72,844)=**0.851** Year = around 10 months.

9.2. Retrofitting of existing inefficient and old Fan Regulators with Electronics Regulators

Following calculations are done for 6 hours working:

•Power consumption by 80 W with conventional regulator from full speed to minimum speed = 80 W/ fan

•Equivalent Energy Efficient Regulator = 55 W/ Fan

•Savings in power =25 W/ Fan

•Operating hours = 6 h/day x 300 = 1,800 h/year

•Fan Energy Yearly savings = 1,800 x 25 = 45 kWh/year/Fan

•Average Cost of electricity = Rs.7.15/kWh

•Saving = 45 kWh x 7.15 = Rs.321.75 / year / Fan

• Approximate investment on single Electronics Regulators = Rs. 250 (Approximate)

•Number of Fan Regulators to be replaced = 783

Summary:

Total Yearly Saving =783 x 321.75 = **Rs. 251,930.25/year**

Total Investment = 783 x Rs. 250 = **Rs. 1, 95,750/-**

Payback:

(1, 95,750/251,930.25) = **0.777** Year = around 9 months.

SI.	Energy Conservation	Energy Cost	Implementation	Payback in
No.	Opportunity	Savings	Cost	Months
1	Replacing Tube Lights (FTL) with LED Tube Lights	2,72,844/-	2,32,140/-	10 Months
2	Replacing Fan with 5 star energy saving Fan or BLDC fan	2,51,930.25/-	1, 95,750/-	9 Months
3	Replacing 300w Mercury Vapor Lamp light with smart 100W LED Street Light	52,195/-	53,740/-	12 Months
4	Replacing 18 watt CFL with 9 watt LED Bulbs	3590.73/-	4,650/-	16 Months
5	Surrendering 50 kVA of Demand to CESC ,Mysore	1,23,840/-	10,000/- (Documentation)	1 Month
	Total	₹7,04,400/-	₹4,96,280/-	8 Months

Similarly for other recommendations the implementation cost and payback periods are as shown in the following table.

9.3 General Recommendations

- All Class Rooms and labs to have Display Messages regarding optimum use of electrical appliances in the room like lights, fans, computers and projectors. Save electricity. Display the stickers of save electricity, save nature everywhere in the campus. So that all stakeholders encouraged to save the electricity.
- Use motion sensor in corridors, passage and toilets.
- Most of the time, all the tube lights in a class room are kept ON, even though, there is sufficient light level near the window opening. In such cases, the light row near the window may be kept OFF.
- All projectors to be kept OFF or in idle mode if there will be no presentation slides.
- All computers to have power saving settings to turn off monitors and hard discs, say after 10 minutes / 30 minutes.
- The comfort / Default air conditioning temperature to be set between 24°C to26°C.
- Lights in toilet area may be kept OFF during daytime
- Use Automatic Power Factor Correction (APFC) Panel for PF improvement.
- Need to use power saver circuits for AC.
- Need to replace FTL by smart LED Tube
- Need to replace ordinary bulb by LED bulb.
- Need to replace ordinary CRT monitor by LED.
- Need to replace ordinary refrigerator by BEE power saver refrigerator if possible.

Executive Recommendations

- There has to be Institute level student community that keeps track of the energy consumption Parameters of the various departments, class rooms, halls, areas, meters, etc
- Energy auditing inside the campus has to be done on a regular basis and report should be made public to generate awareness.

• Need to create energy efficiency/ renewable energy awareness among the college campus i.e. solar, wind, Biogas energy. College should take initiative to arrange seminars, lectures, paper presentation competition among students and staff for general awareness.

References

1. Central Electricity Authority (CEA) Regulations & Supply Code 2014

2. Institute of Electrical and Electronics Engineers (IEEE) standards.

3. Bureau of Energy Efficiency (BEE) guide lines and Energy Management Centre web site.

4. Tariff- structure 2020-21, Chamundeshwari Electricity Supply Corporation Limited, Mysore.