ENERGY AUDIT REPORT

2022 - 2023

FOR

JSS SCIENCE AND TECHNOLOGY UNIVERSITY
MYSURU, KARNATAKA

PREPARED BY:

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CERTIFICATE

ENERGY AUDIT CERTIFICATE
Academic Year 2022 to 2023

This is to certify that the Mr. JAYESH VIRA, Associated Expert for **M/s. A & N Technologies, QCI-NABET accredited Environmental Consultant** with certificate number **NABET/EIA/2225/IA 0106**, Bengaluru has conducted detailed "Energy Audit" of JSS Science and Technology University, Mysuru, Karnataka, for the years 2022-2023. This Energy audit includes assessment of planning, efforts and actions implemented by the university with energy as well as providing suggestions on strategies for better energy efficiency.

Thanks & Regards
For A & N Technologies

A & N TECHNOLOGIES BENGALURU -560 078

Jayesh Vira
Authorized Auditor
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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. JSSSTU University uses energy in the following forms:

A. From Chamundeshwari Electricity Supply Corporation Limited, Mysuru.

B. From 800 kW Solar Photo voltaic Power Plant

2. After the measurement and analysis, we propose herewith following Energy Conservation Opportunities as shown. Best Practices found in the institution

I. LED Tube lights in university areas

II. Save energy with solar energy

III. Good Maintenance of HVAC

IV. Fiberglass windows

V. LED Street Lights

VI. Solar Power Plant

Total energy costs for this period was ₹11,930,382/-. The Energy Conservation Opportunities (ECOs) contained in this Report could save 3,958,650 KW Hr/year. The total energy cost savings would amount to approximately ₹1,865,212.05/- or approximately 15.6% of the annual energy costs for this facility. The total estimated average simple payback is around 35 months

CHAPTER 1 – INTRODUCTION

1.1 ENERGY AUDIT:

Energy is a primary and most universal measure of all kind of work by human being and nature. It is one of the real contributions to the economic development of any nation. On account of the developing nation, the energy sector shows acceptance up to a significant level to expand energy requirements based on colossal investments to meet them.

The aim of this report is to describe the indispensability of Energy in the present time based on the bulk utilization of different forms of energies to cater the demands. An Energy Audit is an investigation of a plant or office to decide how and where energy is utilized and to distinguish diverse strategies for energy saving Identification of the areas consuming major energy need prior attention to look for energy saving potential. The energy audit is the most effective tool for optimizing the efficiency of the plant without affecting the output of the system. Most of the country in the world is focused on the improving energy efficiency in the various sector.

Energy Audit is the important part of India's effort to improve its energy efficiency, energy quality, and energy intensity. The government of India promoting the energy efficiency in India through Energy Conservation Act 2001. The act instructs the central Government and Bureau of Energy Efficiency to find a way to encourage and advance energy productivity in all area of the economy. Government of India also promoting energy efficiency and awareness at school level by implementing student building capability programme under Energy Conservation awareness scheme for XII five-year plan. A gap analysis of India audit programme compared to the international practice is also addressed and focus on the various government policy, energy audit standard, tool and technique applied to the HVAC system and the Lighting system is discussed in this paper.

The Energy Auditing for a day is the list of the utilization which standardizes the circumstance of the Energy crisis by giving the conservation plans. Educational institutions like any other reputable firms require energy auditing process due to expansion. In such

institutions, the major electrical energy utilizations are normally lighting loads and air conditioning systems.

The electrical energy consumption by lighting loads and air conditioners are approximately 20% and 65% respectively. Refusal to switch of light when not required to be operated in buildings and surroundings has had adverse effects significantly contributing to the wastage in the system, and this can however be corrected by the use of efficiently designed technology for lighting systems which will not only reduce energy losses but also will improve lumen and lifespan of the lighting systems. Also, the use of efficient air conditioners can reduce wastage and improve the overall efficiency in the system.

The management of such institutions spend most of their resources and time in putting up infrastructures such as building of offices, lecture halls, laboratories etc. as well as purchasing equipment, but hardly does management make allocation for stimulant economic measures and financial sources for the investment in energy efficient projects and properly prepare energy efficient project proposals, and this however, has landed some of these educational institutions into a wanton amount of debt to pay for tariff.

The situation brought academic work to a stall whilst security was compromised on campus. The favourable remedial measure to this dilemma, however, is by instituting mandatory periodic energy audits in the various institutions and its likes, in the country which would drastically reduce unnecessary electricity consumption in the National Grid and also significantly downsize energy costs incurred by the institutions over the long term. This has to be accompanied by an inclusive behavioural change of an individuals, information campaign, education and capacity building with the objective to raise the understanding of the significance of energy efficiency and energy management system.

As added benefits, these improvements will bring about mitigation of energy cost which is direct profit, reduction of consumption which leads to direct and indirect reduction of environmental pollution and depleting of the natural resources and narrowing demand supply gap.

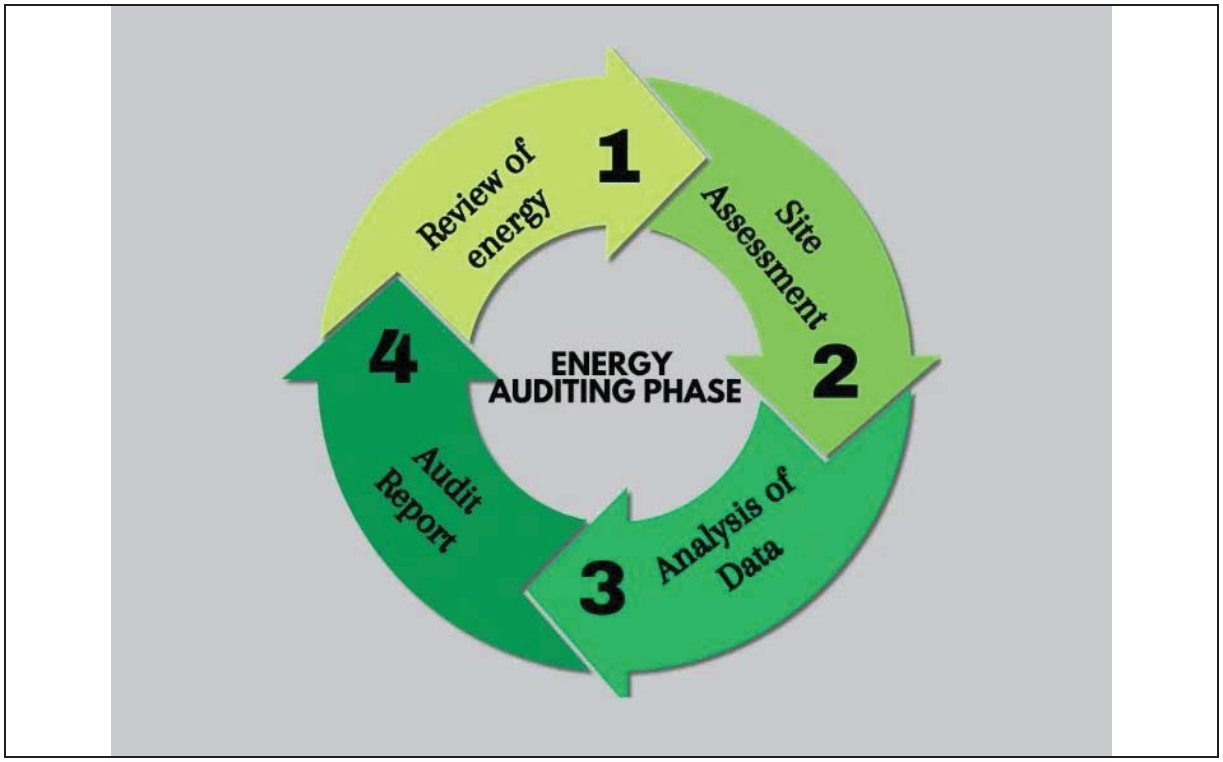

FIGURE 1: ENGERY AUDIT

1.2 SCOPE OF AUDIT

The objectives of conducting energy audit were to identify, prioritize, and recommend a set of cost effective energy conservation schemes in various sections of the plant, which would reduce energy consumption and improve working conditions at workplace. Implementation of the recommended energy conservation measures would lead to reduced energy bills, thereby reducing the energy cost and improving the energy efficiency. The audit follows ASHRAE Level – I Walkthrough. The Scope of the Audit was designed to cover and achieve the following:

- Identify the saving potential by reviewing existing data and infrastructure
- To identify Energy Conservation Measures without investment by optimizing operation and good maintenance practice
- To identify Energy Conservation Measures with minimum investments

CHAPTER 2 JSS SCIENCE AND TECHNOLOGY UNIVERSITY

2.1 ABOUT JSS SCIENCE AND TECHNOLOGY UNIVERSITY:

JSS Science and Technology University, or in its full name Jagadguru Sri Shivarathreeshwara Science and Technology University, is a **private university** located in **Mysuru**, **Karnataka**, **India**. Established in 1963 as Sri Jayachamarajendra College of Engineering (SJCE) has 12 departments in **Engineering** and of Computer Applications department. The SJCE is a constituent college of JSS Science and Technology University from 2016 - 2017 academic years. Few of the programmes are accredited by the **National Board of Accreditation** (NBA). It was founded and managed by the **JSS Mahavidyapeetha**.

2.2 ABOUT JSS MAHAVIDYAPEETHA (JSS MVP):

His holiness Jagadguru Dr. Shivarathri Mahaswamiji established the Jagadguru Sri Shivarathri Mahavidyapeetha in the year 1954. A long and healthy life, education of all and decent standard of leaving the indicators of human development have been the philosophy for JSS MVP. The JSS MVP play a vital role in expanding the scope of its activities to several branches of knowledge, welfare and culture. Its educational effects span crunches for toddlers of working rural womens, school to impart primary and secondary education, colleges, polytechnics, engineering and technical, medicine etc., The education institutions located in several areas serve a board septum of society from remote tribal villages to metropolitan cities such as Bengaluru, Nodia, New Delhi, Ooty and Coimbatore besides their presenting USA and Dubai.

The present pontiff, the 24th Peethadhipathi of Jagadguru Sri Veerasimhasana Mahasamsthana Math, Sri Suttur Kshetra, and the President of JSS Mahavidyapeetha, assumed responsibilities in the year 1986.

His Holiness Jagadguru Sri Shivarathri Deshikendra Mahaswamiji is the Chancellor of JSS Academy of Higher Education and Research, Mysuru, a health science-based Deemed University, and JSS Science and Technology University, Mysuru, a private technological university.

His foresight and an inclusive and global vision have made it possible for JSSMVP to extend its activities beyond Karnataka and the nation. Propelled by spiritual guidance, inspiration and the leadership of HH Jagadguru Sri Shivarathri Deshikendra Mahaswamiji, JSSMVP is home to more than 300 Institutions, two universities, 100,000 students and over 20,000 employees. The Mahavidyapeetha can easily be described as one of the region's largest education providers and employers.

The earnest efforts of His Holiness to address the challenges of society in areas such as literacy, health care, employment generation and societal work have been lauded and recognized by one and all. His vision and inspirational guidance have prepared JSS institutions to match 21st-century expectations and needs.

Sri Jayachamarajendara College of Engineering which was founded by Jagadguru Dr. Sri Shivarathri Rajendra Mahaswamigalavaru the 23rd pontiff of Suttur math was officially inaugurated in 1963 by T. M. A. Pai, who was the Chairman of the Manipal Academy of Higher Education. Courses in Civil, Electrical and Mechanical Engineering branches were started first. The first batch of engineering graduates completed their course in the 1968 the Electronics and Communication Engineering branch was established in the year 1968. The Computer Science and Engineering branches was started in the year 1992, Polymer Science and Technology in the year 2000, Information Science and Engineering was started. Acknowledging state of Art infrastructural facilities, faculty and expertise, the Visveswaraya Technological University (VTU) confirmed the "Autonomous Status" from the year 2007 - 08. At present the college is constituent college of JSS Science and Technology University.

Established in the year 2016, Jagadguru Sri Shivarathreeshwara Science and Technology University (JSSSTU) aim to create future i.e., global university with a learning centric eco system and focus on science and technology. The university committed to high quality education opportunities for youth and transform not only its neighbourhood but offer courses to equip aspiring the youth to meet Global meet of industry in every sector

2.3 VISION, MISSION AND MOTTO:

JSS Science and Technology University is strategically planned and established with a sole aim to "**Serve the Mankind through Education**" with following **Vision, Mission and Moto**

VISION:

- Advancing the University as a leader in education, research and technology on the international arena.
- To provide the students a universal platform to launch their careers, vesting the industry and research community with skilled and professional workforce.
- Accomplishing the University as an epicentre for innovation, centre of excellence for research with state of the art lab facilities.
- Fostering an erudite, professional forum for researchers and industrialist to coexist and to work cohesively for the growth and development of science and technology for betterment of society.

MISSION:

- Education, research and social outreach are the core doctrines of the University that are responsible for accomplishment of in-depth knowledge base, professional skill and innovative technologies required to improve the socio economic conditions of the country.
- Our mission is to develop JSS S&T University as a global destination for cohesive learning of engineering, science and management which are strongly supported with interdisciplinary research and academia.
- JSS S&T University is committed to provide world class amenities, infrastructural and technical support to the students, staff, researchers and industrial partners to promote and protect innovations and technologies through patents and to enrich entrepreneurial endeavours.
- JSS S&T University core mission is to create knowledge led economy through appropriate technologies, and to resolve societal problems by educational empowerment and ethics for better living.

True to JSS legacy and dedication to the service of mankind the JSS Science and Technology University adopted '**Science and Technology for Better Living'.** The moto of the university is shown in figure 2.

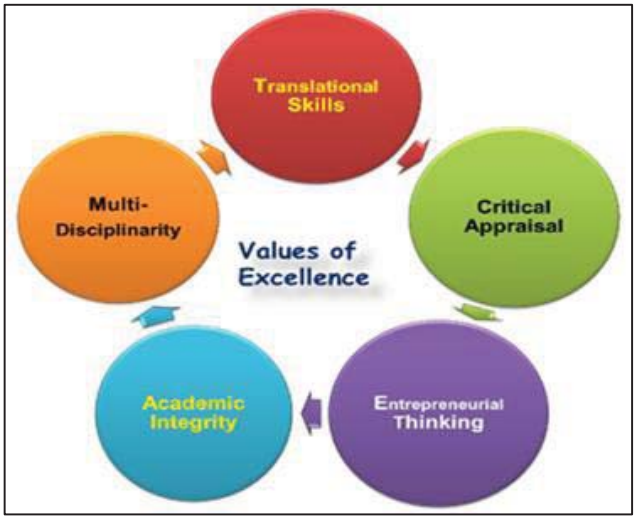

FIGURE 2: MOTO OF JSS STU

Karnataka's share in National GDP is around 6%. The character of the state economy has drastically changed from primarily agrarian in 1956 towards industrial and service economy in 2010. Government of Karnataka (GOK) Vision is to develop a vibrant knowledge society and achieve a sustainable and orderly process of industrialization by enhancing

human capabilities. In accordance with Government of Karnataka (GOK) Vision JSS Mahavidyapeetha has established JSS Science and Technology University at Mysuru.

JSS Science and Technology University is one of the recent additions to the institutions administered by JSS Mahavidyapeetha, and is the second University being established besides a Medical University at Mysuru. India's higher education system is on the verge of major reforms and JSS Science and Technology University has been established envisioning to create a bright future and a desired learner centric eco-system and transform into a futuristic global University. The availability of skilled human resources and trained technical manpower in engineering and technology is a major reason for growing investments in the state. In this context, higher education system has a key role and more particularly JSSSTU with an objective of transforming the students at all levels of higher education including research and innovation with measures to improve quality of workforce.

At present, the university runs 14 under graduate programs out of which 13 in Bachelor of Engineering (BE) and BCA. The university offering a MCA program; 14 M.Sc., Programs; 4 MBA programs and 16 MTech., programs. Today more than thirty thousand students are studying in the university and they are guided by well qualified & experienced faculty members who work to integrate the mission of the university by their teaching and training methods.

The university has progressed in improving the quality of the students by Improving collaboration with the industry, quantitative increase and qualitative improvement in research by faculty and researches individually, jointly and collaboratively. Figure 3 Shows the location of the university in JSS Technical Institution campus.

FIGURE 3: LAYOUT PLAN OF JSS SCIENCE AND TECHNOLOGY UNIVERSITY CAMPUS

Features of the university are as follows:

- Campus spread over 78 acres of land.
- More than 45506 sq.mtrs of built up area.
- Well Established Laboratories
- Library and Information centres
- Fully internet networked campus.

- Equipped with 1Gbps wi-fi enabled connectivity with 10 Gig backbone network
- Excellent Training and Placement Department.
- Separate Boys and Girls Hostels inside the Campus.
- Indoor and outdoor sports facilities
- Lush Green Garden with native species

The university has provide the following essential services for the benefit of students in the campus,

- Bank - 2 Nos.
- Shopping Centre – Stationary shop, Medical Shop, Cafeteria, Milk Parlour, Canteen, Haircutting Saloon and Cloth Shop.
- Health Centre
- Yoga Centre
- Meditation Centre and Prayer Hall
- Hostels

2.4 STAFF AND STUDENTS DETAILS.

The well experienced faculty and staff has been appointed in JSS STU for offering courses for UG, PG and Research programs. The following table 1 shows the number of staff (technical and non-technical) and student's strength of the university.

TABLE 1: DETAILS OF EMPLOYEES AND STUDENTS STRENGTH

Sl No	Year	Teaching Staff		Non-Teaching Staff		Students		Total
		Male	Female	Male	Female	Male	Female	
1.	2022-23	140	117	175	77	3208	1957	**5674**

2.5 ACADEMY COMMITTEES:

The following Committees have been constituted to oversee achieving excellence in Academics in JSS STU and also to provide an excellent and study environment conducive to Pedagogical innovation and Academic Excellence.

1. Anti-Ragging Cell
2. Grievance Redressal Committee:
3. Mechanism for Students Grievances Redressal:
4. Internal Complaints Committee (ICC)
5. Student Counselling Cell
6. JSS STU Review Committee Purchase Committee
7. Training and placement Cell
8. Transport Committee
9. Internal Quality Assurance Cell (IQAC)
10. Right to Information (RTI)
11. Hostel Management committee
12. Library Committee

CHAPTER 3 METHODOLOGY

The university is conducting Energy audit the audit on a yearly basis from 2019 onwards. The following methodology was adopted for auditing Energy.

- Pre audit meeting
- Preparation of questionnaires for audit
- Circulation of questionnaires to the concerned in the university
- Verification of information provided in questionnaires
- Intermediated audit meeting with stakeholders
- Walk through audit for verification and capturing geotag photographic evidences
- Data Analysis
- Post audit meeting with stake holders
- Report preparation and submission

3.1 DATA COLLECTION:

Complete data collection is carried out during the preliminary data collection phase where in various tools such as preparing a questionnaire, bodily inspection of campus, observations and reviews of the records, interviews with key persons, etc. was done in order to obtain qualitative information, focus groups was formed as an essential part of the data collection process. The questionnaire (Annexure) prepared to conduct the audit in the campus is in accordance with the guidelines, rules, acts and formats, Central Pollution Control Board and other statutory organizations. The data covers the target areas to summarize the present status of energy management in the university campus.

3.2 SURVEY BY QUESTIONNAIRE

Baseline data for the audit report preparation was collected by questionnaire survey method. Most of the guidelines and formats in the questionnaires are based on broad aspects required for audit. Therefore, using these guidelines and formats, combinations, modifications and restructuring was done and sets of questionnaires were prepared as energy. All the questionnaires comprises of group of modules. The first module is related to

the general information of the concerned department or section which broadly includes name of the department or section, month and year, total number of students and employees, average working days and office timings etc. The next module is related to the present consumption of resources energy. One separate module is based on the questions related to the losses.

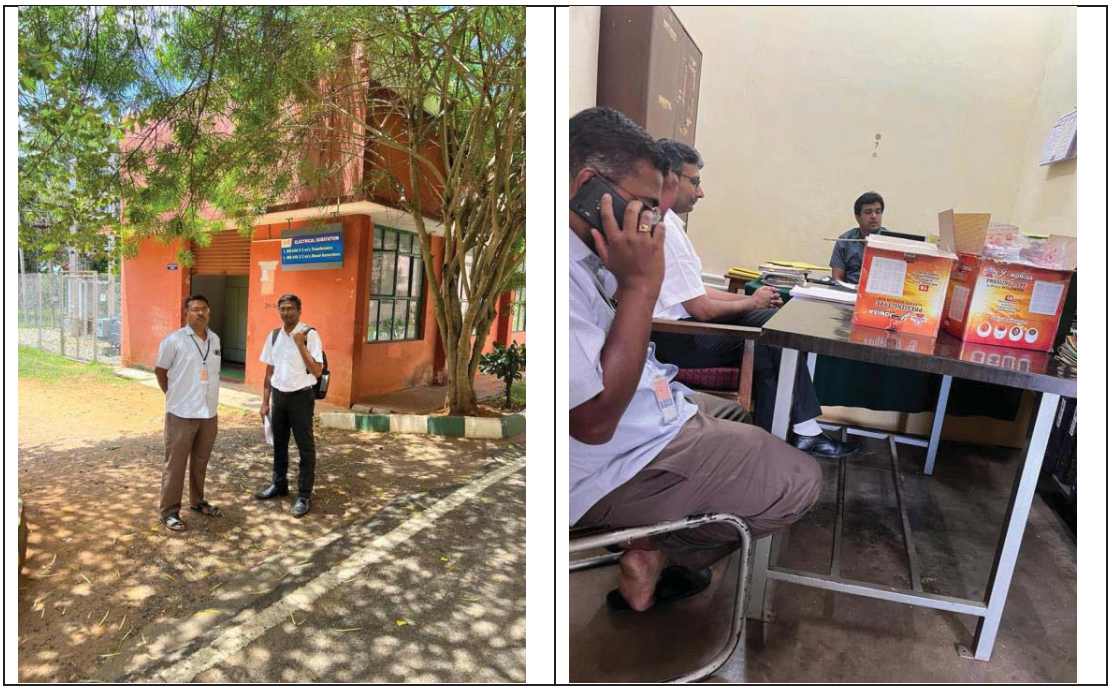

FIGURE 4: ONSITE SITE VISIT

3.3 ONSITE VISIT AND OBSERVATIONS:

The data related to the audit was collected by visiting each and every facility of college campus. The questionnaires were filled up according to the present situation. Photographic documentation was also done during the visit to the campus. Figure 4 shows the photography taken during the pre-audit meeting and during onsite data collection.

3.4 DATA ANALYSIS

The data required for the analysis is taken from the data provided in the questionnaire such as calculation of energy consumption, analysis of latest electricity bill of the campus, measuring water consumption, carbon foot printing, etc. The data from questionnaire and survey forms is tabulated for the convenience of data availability;

Recommendations and Environmental Management Plan is built according to the analysis done in this step.

3.5 RECOMMENDATION AND REPORTING

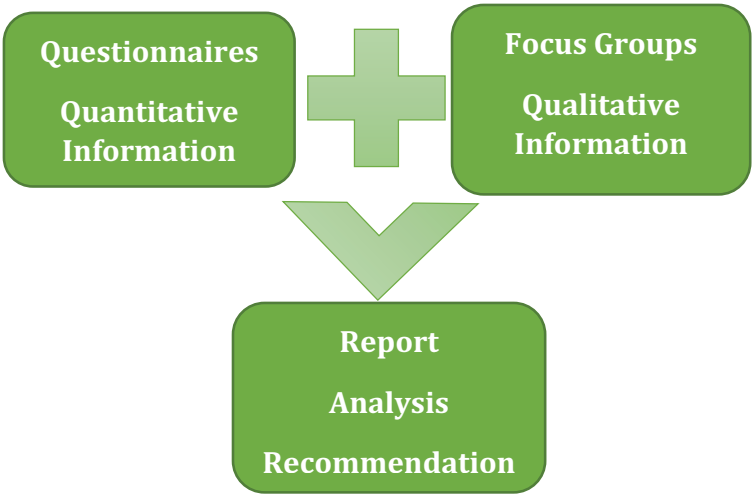

FIGURE 5: ENERGY AUDIT METHODOLOGY

Some recommendations have been drawn up in the target areas based on a data analysis step. It is suggested that specific measures are to be taken to reduce energy consumption.. The suggestions relating to the reduction of their carbon footprint shall also be considered by the university. Figure 4 shows the energy audit methodology adopted.

3.6 LIST OF STAFF INVOLVED IN GREEN AUDITING

Sl No.	Audit Team	Designation
1.	Dr. Dayakar G Devaru	Professor – Industrial and Production Engineering Dept.
2.	Dr. Mohan	Professor Electrical and Electronics Engineering Dept.

CHAPTER 4 ENERGY CONSUMPTION

Energy sources utilized by all the departments, support services of JSS STU include electricity and liquid petroleum. Major use of the energy is at office, canteen, hostel and laboratories, for lighting, transportation, cooking and workshop instruments. Electricity is supplied to the college campus by Chamundeshwari Electricity supply corporation Limited.

4.1 ENERGY CONSUMPTION

Electricity is utilized at all the department, office, laboratories, support services includes Gymkhana, Library, Quarters, guest house, campus. Canteens, hostel etc., The University is technical institute several type of equipment's are used in the laboratory and some of them are run every day for 24 hrs.

The calculations are based on the data provided by the college and actual observations taken at the site. The collected data shows all departments in the college and the support service have maximum number of major energy consuming equipment's and energy consumption is 12,66,760 KWh/ Annum. The annual electricity consumption and the bill are shown below.

4.2 POWER CONSUMPTION AS PER ELECTRICITY BILL-2022

TABLE 2: ANNUAL ELECTRICITY CONSUMPTION AND BILL DETAILS

SL NO.	MONTH	KWH	KW	PF	KW CHARGES	KWH CHARGES	TOTAL CHARGES
1	MAR 23	110200	553	0.936	143780	995714	1139494
2	FEB 23	122500	553	0.941	143780	914825	1058605
3	JAN 23	117680	553	0.933	143780	992874	1136654
4	DEC 22	116200	553	0.899	143780	970278	1114058
			553				

5	NOV 22	99376		0.937	143780	834628	978408
6	OCT 22	88784	553	0.928	143780	780314	924094
7	SEPT 22	101536	553	0.953	143780	819964	963744
8	AUG 22	140244	553	0.927	143780	1148109	1291889
9	JULY 22	129876	553	0.927	143780	1062801	1206581
10	JUNE 22	125392	553	0.911	143780	1006791	1150571
11	MAY 22	114972	553	0.905	143780	822504	966284
Total		**1,266,760**				**10,348,802**	**11,930,382**

4.1 LPG CONSUMPTION

Maximum LPG is used in Support services i.e., Hostels, Canteen and laboratories. LPG is used as a fuel for cooking purpose in canteen. The total LPG consumption per day is 114 Kg.

FIGURE 6: PHOTOGRAPHS OF THE LPG ROOM

4.1 ALTERNATIVE ENERGY INITIATIVE

The campus has installed solar panels for alternative energy initiative. The 616.5 kW rooftop solar power which is used to feed the Campus load and export the remaining energy to Chamundeshwari Electricity Supply Corporation Limited, Mysuru. In the last 12 months (April 2022 to March 2023) the college has exported 36,288 kWh out of 5,77,166 kWh of power generated from solar grid.

Percentage of Annual Power requirements met Renewable Energy Sources (Current year data):

$$\text{Percentage of Annual Power requirements met Renewable Energy Sources} = \frac{\text{Annual Power requirements met Renewable Energy Sources}}{\text{Annual Power requirements}}$$

=45% of Annual Power requirements met Renewable Energy Sources

FIGURE 7: PHOTOGRAPHS OF THE SOLAR PANEL

POSSIBLE RECOMMENDATIONS

- Fluorescent to LED
- Resistance type fan regulator to electric type fan regulator
- Replacement of old fans with new Brushless DC (BLDC) fans
- Old 2-star AC to new 5-star AC
- Power factor correction to convert one 50 kVAR to 5 kVAR
- Timer control for exterior lighting
- Contract demand reduction

- Installing insulation sheet (aluminium bubble sheet) for Mechanical workshop
- Solar generation verification/ maintaining 1 KW power stated
- Verify whether energy generated by solar as expected or not.
- Power quality analyser: Power quality issues can affect the operation of critical loads and can have the negative impact on operation. This power quality analyser can monitor the cost of energy wasted due to poor power quality. The wider range of measurement function and measurement method in this analyser is the ideal tool and for the calculation of errors.

CHAPTER 5 ENERGY CONSERVATION MEASURES

The following energy conservation measures can be adopted at JSS University Mysuru.

5.1 Replace Fluorescent Tube Lights (FTL) with LED Tube Lights

The 40 W FTL*s* can be replaced with the LED tube lights 20 W. These changes can be made at the places where the usage is higher. Usually minimum of 1years warranty is given and approximate burning hours is 40,000. (15 years considering 6 hours per day running).

Following calculations are done for 6 hours working:

TABLE 3: TUBELIGHT BILL

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 365 = 2,190 h/year.
Tube Light Yearly savings	2,190 x 20 W = 43.8kWh/year/Tube Light
Average Cost of electricity	Rs.10.00/ kWh.
Saving	43.8 kWh x 10.00 = Rs. 438 / year / Tube light
Approximate investment on single LED Tube lights	Rs. 219. (Panasonic LED20W Batten, 1 pc).
Number of Tube Lights to be replaced	1600
Electrical Energy Saved	43.8 x 1600 = 70,080kWh / yr
Total Yearly Saving	1,600 x 438 =Rs. 7,00,800/-year
Total Investment	1,600 x Rs.219 = Rs. 3,50,400/-
Payback (3,50,400/438000*12)	9.6 months

FIGURE 8: FLUORESCENT BULB

FIGURE 9: LED TUBE LIGHT

5.2 Retrofit existing inefficient and old Fan Regulators with Electronics Regulators to Save Energy

The difference between the electronic and ordinary electrical regulator is that in electronic regulator power losses are less because as we decrease the speed the electronic regulator gives the power needed for that particular speed but in case of ordinary rheostat

type regulator, the power wastage is same for every speed and no power is saved. In electronic regulator, triac is employed for speed control by varying the firing angle speed and it is controlled but in rheostatic control resistance is decreased by steps to achieve speed control.

Following calculations are done for 6 hours working:

Power consumption by 60 W with conventional

TABLE 4: TOTAL COST SAVING BILL FOR FAN

regulator from full speed to minimum speed	70 W/ fan
Equivalent Energy Efficient Regulator	55 W/ Fan
Savings in power	15 W/ Fan
Operating hours	6 h/day x 365 = 2,190 h/year
Fan Energy Yearly savings	2,190 x 15 = 32.85kWh/year/Fan
Average Cost of electricity	Rs.10.00/ kWh
Saving	32.85 kWh x 10.00= Rs. 328.5 / year / Fan
Approximate investment on single Electronics Regulators	Rs.250 (Approximate)
Number of Fan Regulators to be replaced	513
Electrical Energy Saved	32.85 x 513 = 16852.05 kWh / yr.
Total Yearly Saving	513 x 328.5 = Rs. 168520.5 /year
Total Investment	513 x Rs. 250 = Rs. 128250/-
Payback	(128250/328500) = 0.39 Year

FIGURE 10: FAN REGULATOR

5.3 Retrofit existing inefficient old Fans with BLDC fans to Save Energy

The difference between the old fans and the BLDC fans is the power consumption as the new BLDC fans consumes less than 50% as compared to conventional ones.

Following calculations are done for 6 hours working:

Power consumption by 60 W with conventional

TABLE 5: TOTAL COST SAVING BILL FOR FAN

regulator from full speed to minimum speed	70 W/ fan
Equivalent Energy Efficient Regulator	35 W/ Fan
Savings in power	35 W/ Fan
Operating hours	6 h/day x 365 = 2,190 h/year
Fan Energy Yearly savings	2,190 x 15 = 76.65 kWh/year/Fan
Average Cost of electricity	Rs.10.00/ kWh
Saving	76.65 kWh x 10.00= Rs. 766.5 / year / Fan
Approximate investment	Rs.2450 (Approximate)
Number of Fans to be replaced	513
Electrical Energy Saved	76.65 x 513 = 39321.45 kWh / yr.
Total Yearly Saving	513 x 766.5 = Rs. 393214.5 /year
Total Investment	513 x Rs. 2450 = Rs. 1256850/-
Payback	= 2.66 Year

5.4 Increase the efficiency of Power generation from Solar PV by regular maintenance

As per the reference7 the reduction in solar efficiency due to dust accumulation on PV panel without any maintenance is approximately 40%. Since the maintenance is irregular, the reduction in the existing power generation of the solar panels in JSSSTU is around 7%. By cleaning the panels, its efficiency can be improved by a considerable amount. As per the Ministry of New and Renewable Energy Website, 1 kW of Solar PV Panel should produce 1,500 kWh of electricity per year in the region of Mysuru .

FIGURE 11: SOLAR PANELS

5.5 Replace the existing old Air Conditioners with 5 Star Air Conditioners with inverter technology

The main difference between an inverter and non-inverter AC lies in their compressor speed. An inverter AC has a variable speed compressor, while a non-inverter AC has a fixed speed compressor. Variable speed compressors are more energy efficient than their fixed counterparts and make less noise as well.

An inverter air conditioner is a type of air conditioning unit that can adjust the compressor's motor speed to regulate the temperature. The use of an inverter switch allows for greater flexibility in terms of power usage. Inverter ACs are more energy efficient than no inverters because they can change their power consumption depending on how hot it is outside, or if you have multiple people in your home at any given time.

Another difference worth mentioning is that the refrigerant used in non-inverter AC emits harmful emission which adversely impacts the environment. Modern inverter ACs use efficient refrigerants such as R32 which provides better cooling capacity and also emits less harmful emissions to the environment.

5.6 Inverter ACs save up to 30% of electricity compared to non-inverters.

Non-inverter air conditioners use the on/off method, where the compressor is switched on and off at regular intervals to maintain the desired temperature. This uses more energy than inverters and can result in more wear and tear on your system. Compressors that are no inverters do not run at full speed all the time, making them less efficient than their inverter counterparts.

As said before, an inverter AC uses variable speed compressors, which have a wider range of speeds compared to on/off compressors used by non-inverters. This allows it to operate in more modes that take advantage of different conditions and load requirements, thereby improving its efficiency throughout a wide range of operating conditions.

Oytput wattage for 1.5 ton AC (Watts)	Star Rating (Split AC) Stars	Min EER needed W/W	Input Wattage (Watts)
5275	*	2.7	1954
5275	**	2.9	1819
5275	***	3.1	1702
5275	****	3.3	1598
5275	*****	3.5	1507

FIGURE 12: INPUT AND OUTPUT WATTAGE OF AIR CONDITIONERS BASED ON STAR RATING

TABLE 6: TOTAL COST SAVINGS BILL FOR AC.

Existing Energy Consumption per Year	255.2 x 6 hours/day x 365 days/yr = 558888 kWh
Proposed Energy Consumption per Year	174 x 6 hours/day x 365 days/yr = 381060 kWh
Total Energy Savings	= 558888 - 381060 = 177828 kWh
Total Cost Savings	= 177828 x ₹10 /kWh = ₹1778280
Air Conditioner cost	₹3480000
Pay Back Period	= ₹3480,000 /₹1778280x 12 months/yr = 23.4 months

FIGURE 13: STAR AC IN ERGONOMICS LAB

FIGURE 14: OLDEST AC IN JSSSTU

FIGURE 15: 5 STAR AC IN CAD LAB

5.7 Executive Recommendation

- Energy auditing inside the premises 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 i.e. solar, wind, Biogas energy. Hospital Facility should take initiative to arrange seminars, lectures, paper presentation competition etc., for general awareness.

5.8 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, library 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 after10 minutes/30 minutes.
- Lights in toilet area may be kept OFF during daytime.
- Use Automatic Power Factor Correction (APFC) Panel for PF improvement.
- 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.

5.9 Install Occupancy Sensors in Designated Areas

5.9.1 Recommended Action

Install occupancy sensors with ultrasonic motion sensing in the designated areas to reduce the electrical usage for lighting during unoccupied periods. These areas were either unoccupied or had little employee movement at the time of assessment.

5.9.2 General Information

The areas in were identified as areas where occupancy sensors could be used. By wiring occupancy sensors into these areas, the lighting usage could be reduced during unoccupied periods. Energy savings will result from reduced electrical usage for lighting. The annual operating hours for lights in the plant area are 2,000 hrs/yr.

TABLE 7: LIST OF LAMPS AND LOCATIONS REQUIRED TO INSTALL OCCUPANCY SENSORS

Location	Type of Lamps	Ballast type*	No. of Fixture	No. of bulb/ fixture	Wattage per bulb (W)	Total Wattage (W)	Time Occupied † (%)	Hours of Operation (hr/yr)
Class room	T5	E	4	4	28	448	60%	2190
Washroom	T5	E	2	2	28	112	40%	2190
Total	**-**		**6**		**-**	**560**	**-**	**-**

* E – Electronic

† Estimated Occupancy Percentage

Anticipated Savings

Energy Savings, ES = 3360 kWh/year
Energy Cost Savings, ECS = ES x (unit cost of electricity) = 33,600/year /year
Annual CO_2 Savings = 15,342.46 lbs (Note: 1kWh = 2.19 CO_2)

5.9.3 Implementation Cost & Simple Pay Back

The occupancy sensors recommended would work in conjunction with the existing switches. Several types of controls are available, including motion sensors. An ultrasonic motion-sensing controller, which produces a low intensity, inaudible sound and detects changes in the sound waves caused by any type of motion, is recommended for the designated areas. A single occupancy sensor is rated for lights up to 1200W at 120V. The cost of each occupancy sensor is $80 and estimated time to install each sensor is 1 hour. Hence 10 sensors will be required for plant areas.

Capital cost for the occupancy sensors, CC, is

Capital Cost (CC) = No. of sensors x Cost per sensor
= 700 * 300
= 2,10,000

It is estimated that the time required to install each occupancy sensor is 1 hour. Hence the total labour cost, LC, would be:

Labour Cost (LC) = 10 * 500 per day
= 5000 per day

If the labours work or 5 days then : 5000*5=25000

Hence, the total implementation cost (IC) is estimated as:

Implementation Cost (IC) = CC + LC
= 210000 + 25000
= 235000

Payback period = Implementation Cost / Energy Cost savings (rupees/Year) x 12 months
= (235000/33,600) x 12
= months
≅ 21 months

The total cost savings of $275/year will pay for the implementation cost of $475 in 21 months.

What is a PIR motion sensor?

PIR (passive infrared) sensors utilize the detection of infrared that is radiated from all objects that emit heat. This type of emission is not visible to the human eye, but sensors that operate using infrared wavelengths can detect such activity.

FIGURE 16: MOTION SENSOR

FIGURE 17: MOTION SENSOR IN WASHROOMS

CHAPTER 6 CONCLUSION

Energy is one of the major inputs for the economic development of any country. In this paper we have suggested necessary replacements and showed the net savings after analysing the amount of wattage consumed by different devices. Considering the fact that the organization is a well-established, long time run establishment with good reputation, there is significant scope for conserving energy and make the campus as self-sustained in it. Energy audit is an effective tool in identifying problems associated with energy management program. A careful audit in any organization will lead to manage energy system in organization at minimum energy cost. In development process to cope with increasing energy demands, In this paper we have considered the academic sector for evaluation of energy audit and energy conservation of. Key issues pertaining to the implementation of Energy Conservation proposal and methodology have been discussed in detail. Based on the exhaustive literature survey were presented for energy conservation and energy audit in keeping mind the present Energy scenario and future condition.

CHAPTER 7 FUTURE RECOMMENDATION

The major appliances in our college are air conditioners, choke bulbs, fans, computers and they account for a big chunk of the college monthly utility bill. And if the air conditioner or computer is more than a decade old, a lot more is spend on energy than you need to. Today's major appliances don't hog energy the way older models do because they must meet minimum federal energy efficiency standards. These standards have been tightened over the years, so any new appliance you buy today has to use less energy than the model you're replacing. For instance, if you buy one of today's most energy-efficient air conditioner, it will use less than half the energy of a model that is 12 years older.

- Compact fluorescent bulbs (CFL): CFL use 75% less energy than Normal bulbs. CFL are four times more energy efficient than Normal bulbs. CFL can last up to ten times longer than a normal bulb.
- Fit external lights with a motion sensor.
- Replace air conditioner filters every month.
- Turn off central air conditioning 30 minutes before leaving your home.
- Consider using ceiling or portable fans to circulate and cool the air.
- A ceiling fan in operation throughout night will gobble up 22 units in a month.
- The ordinary regulator would take 20 watts extra at low speed.
- The energy loss can be compensated by using electronic regulator.

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Sr. Director, NABET
Date: February 8, 2023

Signature Not Verified

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National Productivity Council

(National Certifying Agency)

PROVISIONAL CERTIFICATE

This is to certify that Mr. / Ms. Jayesh Talakshi Vira

son / daughter of Mr. Talakshi

has passed the National Certification Examination for Energy Auditors held in October - 2011, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

He / She is qualified as ***Certified Energy Manager*** *as well as* ***Certified Energy Auditor.***

He / She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.

This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

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Place : Chennai, India

Date : 1st February, 2012

Controller of Examination