Report on Energy Audit

Conducted

At

The Swami Keshvanand Institute of Technology, M& G

Ramnagariya, Jagatpura, Jaipur-302025

(Rajasthan) India

In Technical Guidance with

PCRA

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PREFACE

Data collection for energy audit of the SKIT campus was carried out during March 2016. This audit was conducted to seek opportunities to improve the energy efficiency of the campus. Reduction of energy consumption while maintaining or improving human comfort, health and safety was of primary concern. Besides simply identifying the energy consumption pattern, this audit seeks to identify the most energy efficient appliances. Moreover, some daily practices relating common appliances have been provided which may help reducing the energy consumption. The report accounts for the energy consumption patterns of the academic area, central facilities and hostels based on actual survey and detailed analysis during the audit. The work encompasses the area wise consumption traced using suitable equipments. The report compiles a list of possible actions to conserve and efficiently access the available scarce resources and their saving potential has been also identified. We look forward to optimum so that the authorities, students and staff would follow the recommendations in the best possible way. The report is based on certain generalizations and approximations wherever necessary. The views expressed may not reflect the general opinion. They merely represent the opinion of the team guided by the opinions of consumers.

ACKNOWLEDGEMENTS

We are thankful to:
Mr. Jaipal Meel, Director, SKIT, Dr. S.K Calla, Director (D &W), SKIT, for giving us this opportunity to contribute in the noble mission of efficient energy management.

We are thankful to Capt. Deepak Gupta, PCRA & Mr Reetesh Kocheta, PCRA for guiding our faculty members and students by conducting seminars and training sessions on energy conservation & the process on how to do energy audit. The training provided to faculty members was really very beneficial in the study of energy consumption patterns and generating this audit report. The scientific and analytical approaches towards new energy solutions, wide knowledge and discerning remarks given by PCRA members really helped us throughout our work.

We are immensely grateful to Mr.Satyan Vijavargiya, Dean (R & D), SKIT Jaipur, for his keenness and undivided attention to this work.

ASHISH SAINI
Convener – Energy Audit

SUMMARY

We have carried out the field work for detailed energy audit, during March 2016. We carried out elaborated measurements as guided by team of PCRA for the various areas like air-conditioning and air-cooling system, lighting, computer equipments, etc. We measured lux level at various locations like office rooms, library, and labs. We analyzed effectiveness of energy consumption, critically in each area.

Energy Audit Team:

1 Mr. Ashish Saini
2 All team members
3 Selected students from the SKIT

Audit Location:

SKIT campus - Ramnagaria, Jagatpura, Jaipur 302025, (Rajasthan), India.

Scope of Work:

The scope of work includes detailed study for energy conservation option of various energy sources like electricity and fuel oil in the building and to recommend action for reducing the same. The broad scope of work will be as per the following:

- **Review of the System**: Review the present electricity consumption, fuel oil estimation of energy consumption in various load centers such as lighting, air conditioning, and other electrical load.
- **Electrical Distribution System**: Review of electrical distribution system like loading, and distributions of electricity in different areas/floors. Exploring the option for energy saving in electrical distribution system.
- **Lighting System**: Review the present lighting system used in the building and condition of lighting. Estimation of lighting load at various locations like major floor, computer lab and library. Detail lux level at different location and its comparison with standard level. Exploring the option for energy saving in lighting system

- **Heating Ventilation and Air Conditioning System (HVAC System):** Review of present HVAC system like central AC, Window AC, Split AC. Find out the total cooling load of building and maximum cooling load of building analysis of HVAC performance like estimation of energy efficiency ratio (EER), specific energy consumption in chiller and AHU exploring the option for energy saving in HVAC system.

- **Diesel Generator (DG) Set**: Review the present DG set operation such as average number of operating hour per day and load on it. Performance assessment of DG set in term of specific oil consumption (kWh/litre). Exploring the option for fuel saving in DG set.

- **Hot Water Generation**: Review the present source of hot water generation such as boiler, thermal fluid heater. Performance assessment of hot water generation system. Exploring the option for energy saving in hot water generation system

- **Other Electrical Load**: Review of other electrical load such as computer and electrical fan etc. Exploring the option for electricity conservation in these section

- **Cost Benefit Analysis**: Cost benefit analysis of retrofitting for getting energy saving in buildings. Cost benefit analysis include simple payback period, internal rate of return (IRR) and Rate of return (ROI).

- **Preparation of Details Energy Audit Report** : Finally, preparation of the detail energy audit report

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1. INTRODUCTION

The Swami Keshvanand Institute of Technology, M & G (SKIT) is a premier institute imparting technical education. It was set-up in 2000. The institute offers six branches at undergraduate level & at post graduate level. It has recognized research centre in electrical engineering leading to PhD degree.

Besides technical education it also offers business administration course. Its pharmacy course is affiliated to Rajasthan University of health science RUHS

1.1 Objective of Energy Audit Exercise

The objective of Energy Audit is to promote the idea of energy conservation in the campus of SKIT Jaipur. The purpose of the energy audit is to identify, quantify, describe and prioritize cost saving measures relating to energy use in hostels, administrative area and academic area etc.

The work eligible for Energy Audit study is directed towards: Identification of energy consumption area and estimation of energy saving potential in campus. The objectives are:

- Suggesting cost-effective measures to improve the efficiency of energy use.
- Estimation of implementation costs and payback periods for each recommended action.
- Documenting results and vital information generated through these activities.
- Identification of possible usages of co-generation, renewable sources of energy (say solar energy) and recommendations for implementation, wherever possible, with cost benefit analysis.

1.2 Analysis of Area of Use

Identifying the places where energy is used is vital and hence the audit should focus on and raise awareness of energy use and cost. The results of the analysis can be used in the review of management structures and procedures for controlling energy use.

Important points to consider when collecting load data are:

- Usage: The usage of the equipments in terms of hours per day and days per year can be collected from key persons in hostels, departments etc. It is important to ensure the accuracy of this data because the potential for energy savings lies with wise allocation of the equipments operating hours.

- Actual power consumed: Actual power consumption is measured by watt-meter or power analyzer.
- Supplementary Information: Some other supplementary information is also collected such as state of insulation in case of ACs or availability of natural light etc.

1.3 Identification of Target Areas

Opportunities for energy savings can range from the simplest, such as lighting retrofits, to the most complex such as the installation of a co-generation plant. After the preliminary identification of opportunities, more time should be spent on those which have shorter payback periods.

1.4 Cost Benefit Analysis

The identified energy conservation opportunities should be analyzed in terms of the costs of implementing the project versus the benefits that can be gained. Say for example, if we wish to install a heat plate exchanger to recover waste heat, we must calculate the total cost of installation and compare that with the savings derived from recovering waste heat.

1.5 Action Plan to Set Implementation Priority

After passing the cost benefit analysis, an action plan should be developed to ensure that the opportunities identified are implemented. The action plan should include all the major steps for implementing the opportunity as well as making the people responsible. Furthermore, there should be a plan for monitoring the results.

1.6 Benefits of Energy Audit

An energy audit is a detailed assessment of where and how energy is used within your business. Energy audit helps us to discover appropriate usage of electricity and in case of any faults the corresponding measures can be taken up. The benefits of energy audit:

1. Lowering energy Bills
2. Reducing connected Load
3. Increasing the comfort Level
4. Protect the environment

2. EXISTING ELECTRICAL LOAD PATTERN

Electric load pattern gives us the information about the distribution of load. Electric load data are collected by equipment, application as well as location wise.

2.1 Overall Campus Building Details

There is one vikram sarabhai block, one m. visvesvaraya block, one vishvakarma block, and one dhanwantri block in the campus. Besides them one nirwana boy's hostel one nooran girl's hostel and supporting infrastructure like library, computer labs & temple exist in SKIT Jaipur campus.

Presently institute has 400 kW solar roof top generations. In addition to that capacity of DG set for power back up is 320 KVA/256 kW. Total connected equipment load of the institute 811.748 kW.

2.2 Location Wise Load Pattern

Table: 2.2.1 Dhanwantri Block

S.N	Equipment	Type	Quantity	Load (kW)
1	Ceiling fan	80 W	205	16.4
2	Wall fan	50 W	6	0.3
3	Lighting	T-12 (40 W)	380	15.2
4	Corridor light	T-12 (40 W)	59	2.36
5	Air conditioner	Without star (1200 W)	17	20.4
6	Cooler	Ordinary water pump	2	0.6
7	Ducting	1 HP	3	2.238
8	Monitor	CRT (80 W)	105	8.4
9	Printer	Standby load=30 W Running load=300 W	15	0.45
Total connected load (kW)				**66.348**

Table: 2.2.2 Vikram Sarabhai Block

S.N	Equipment	Type	Quantity	Load (kW)
1	Ceiling fan	80 W	420	33.6
2	Exhaust fan	50 W	8	0.4
3	Lighting	T-12 (40 W)	229	9.16
4	Corridor light	T-12 (40 W)	29	1.16
5	CFL	20 W	167	3.34
6	Air conditioner	Without star (1200 W)	61	73.2
7	Monitor	CRT (80 W)	706	56.48
8	Printer	Standby load=30 W Running load=300 W	30	0.9
Total connected load (kW)				**178.24**

Table: 2.2.3 M. Visvesvaraya Block

S.N	Equipment	Type	Quantity	Load (kW)
1	Ceiling fan	80 W	661	52.88
2	Lighting	T-12 (40 W)	466	18.64
3	Corridor light	T-12 (40 W)	106	4.24
4	Air conditioner	Without star (1200 W)	5	6
5	Cooler	300 W	5	3
6	Lift		2	12.6
7	Monitor	CRT (80 W)	317	25.36
8	Printer	Standby load=30 W Running load=300 W	14	0.42
Total connected load (kW)				**123.34**

Table: 2.2.4 Vishvakarma Block

S.N	Equipment	Type	Quantity	Load (kW)
1	Ceiling fan	80 W	293	23.44
2	Lighting	T-12 (40 W)	243	9.72
3	Corridor light	T-12 (40W)	15	0.6
4	Air conditioner	Without star (1200 W)	10	12
5	Monitor	CRT (80 W)	82	6.56
6	Printer	Standby load=30 W Running load=300 W	58	1.74
Total connected load (kW)				**54.06**

Table: 2.2.5 Nooran Girls Hostel

S.N	Equipment	Type	Quantity	Load (kW)
1	Ceiling fan	80 W	158	12.64
2	Lighting	T-12 (40 W)	190	7.6
3	Corridor light	T-12 (40 W)	25	1
4	Geyser	2 kW	23	46
5	Ducting	8 HP	11	65.64
Total connected load (kW)				**132.88**

Table: 2.2.6 Nirwana Boys Hostel

S.N	Equipment	Type	Quantity	Load (kW)
1	Ceiling fan	80 W	460	36.8
2	Lighting	T-12 (40 W)	460	18.4
3	Corridor light	T-12 (40 W)	60	2.4
4	Geyser	2 kW	12	24
5	Ducting	8 HP	23	137.26
Total connected load (kW)				**218.86**

Table: 2.2.7 Mess/Food Court

S.N	Equipment	Type	Quantity	Load (kW)
1	Ceiling fan	80 W	67	5.36
2	Lighting	T-12	30	1.2
3	CFL			2
4	Refrigerator & freeze			10
Total connected load (kW)				**18.56**

2.3 Summary of Location Wise Load

The table shows the summary of load of SKIT campus. It shows that highest load is of vikram sarabhai block while the least load is of pump load.

Table 2.3 Summary of Location wise Load

S.N	Area	Present Load (kW)
1	Dhanwantri block	66.348
2	Vikram Sarabhai block	178.24
3	M. Visvesvaraya block	123.34
4	Vishvakarma block	54.06
5	Nooran Girls hostel	132.88
6	Nirwana Boys hostel	218.86
7	Mess/Food court	18.56
8	Street light	12
9	Pump load	7.46
Total connected load (kW)		**811.748**

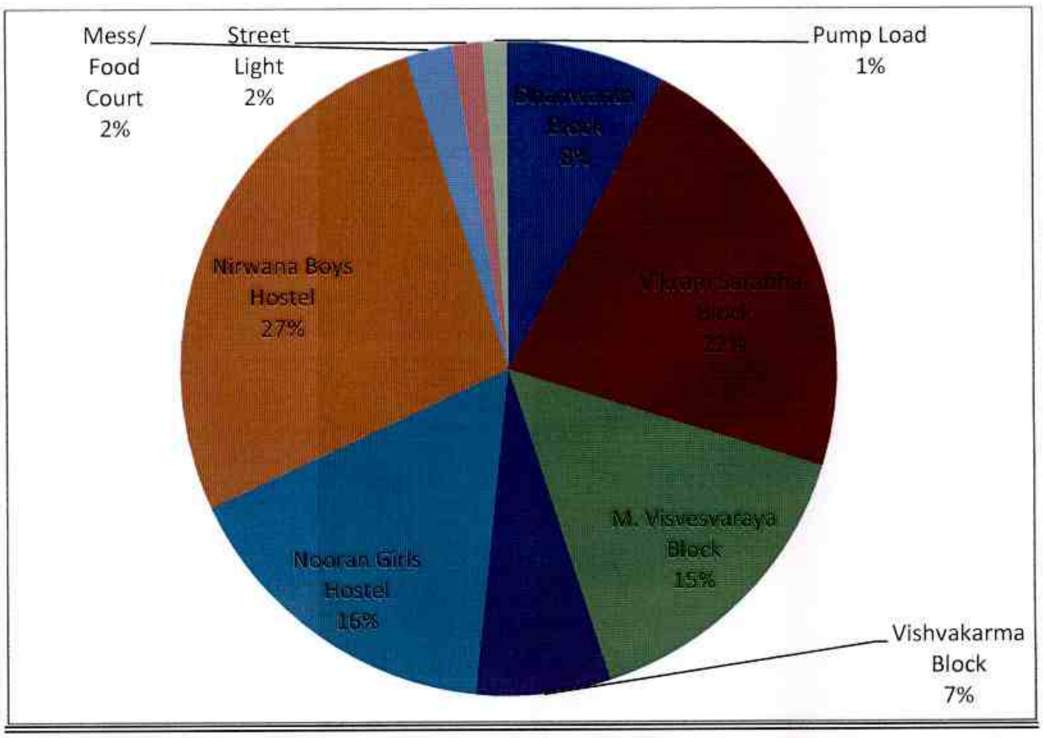


Figure 2.3 Percentage representation of SKIT load

The load of Nirwana boys hostel is 27%, which is highest among all shares. Pumping load takes the least load i.e 1%. The major concern is boy's hostel and girl's hostel which takes 27% & 16% respectively. These load of hostels run throughout the year from the evening to night.

2.4 Equipment Wise Load Pattern

Equipment wise load analysis has been performed in order to identify the equipments, with same application area, which consume more power as compared to others. During equipment wise analysis of the overall campus, the equipments with load less than 1% of the total load of the campus were ignored so as to make the analysis results simple and easy to comprehend. Following table summarizes the result of equipment wise analysis of load of SKIT campus.

Table 2.4 Equipment Wise Load Pattern

S.N	Equipment	Type	Quantity	Load (kW)
1	Ceiling fan	80 W	2264	181.12
2	Wall fan	50 W	6	0.3
3	Lighting	T-12 (40 W)	1998	79.92
4	Corridor light	T-12 (40 W)	294	11.76
5	CFL			5.34
6	Air conditioner	Without star AC	93	111.6
7	Cooler	Ordinary water pump	7	3.6
8	Geyser	2 kW	35	70
9	Refrigerator & Freeze			10
10	Street light			12
11	Lift		2	12.6
12	Ducting		37	205.138
13	Pump			7.46
14	Monitor	(80 W)	1210	96.8
15	Printer	Standby load=30 W Running load=300 W	117	3.51
Total connected load				**811.14 kW**

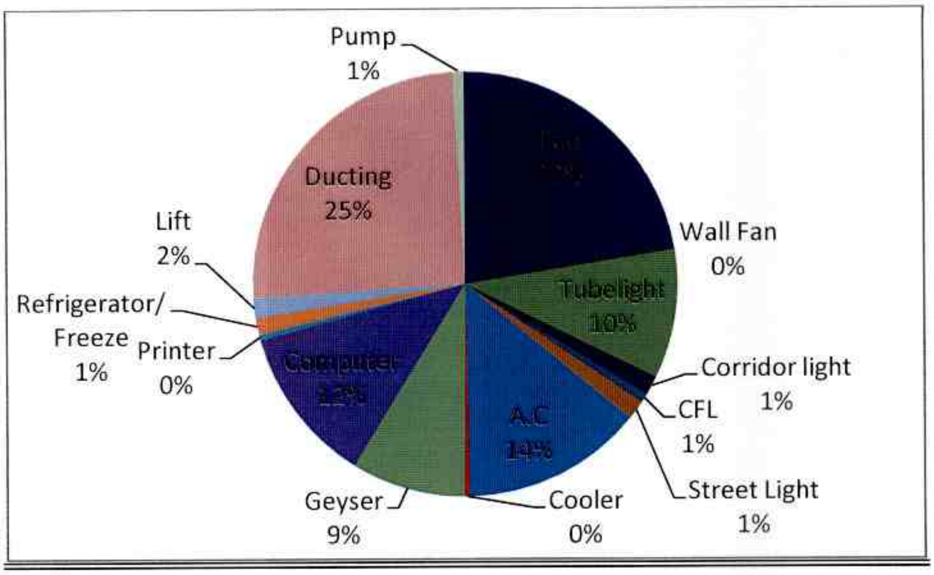


Figure: 2.4 Load sharing by different equipments

According to the above fig, the maximum power is consumed by ducting (25%), followed by fan (22%). In the comfort application geyser consumed only 9%.

Tube light takes (10%), it consists of study area & office rooms. The other lighting load is 3%.

2.5 Electricity Units Analysis

2.5.1 Consumption of Electricity Units from Grid

Table 2.5.1 Monthly Electricity Units

	Units		
	Year 2014	Year 2015	Year 2016
January		63480	126000
February		62480	49000
March		60080	46000
April		75220	58000
May		119890	244000
June		152710	
July	49608	119570	
August	52948	108360	
September	56808	158000	
October	55392	169070	
November	83500	76470/141316	
December	72620	125354	

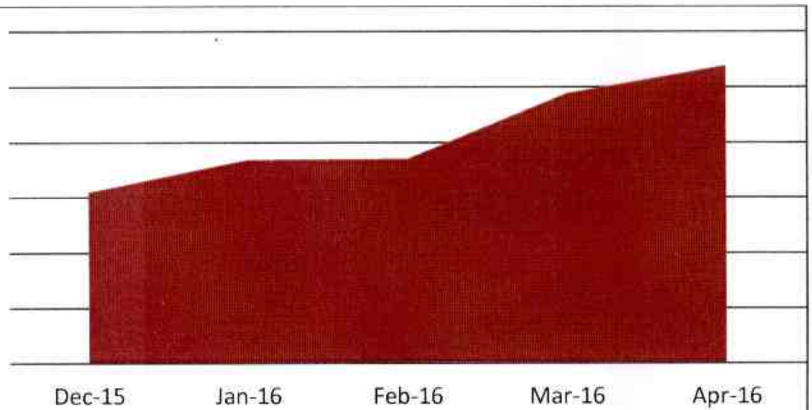
As seen in the table the consumption of the electricity is increasing every year. The consumption of units is more in summer due to the use of AC and ducting. The units shown in the year 2016 is less because of the generation by roof top solar plant. These are not the final units, as export units to state electricity board (RSEB) have not been reimbursed.

2.5.2 Generation by Roof Top Solar Plant

As seen in the given table the units generated by solar plant are less in winter as compared to summer. It is due to the fact the duration of sun time has been increased in summer. The maximum units generated in summer in a day are 2287 which are highest till yet.

Table 2.5.2 Units Generated by Solar Plant

Months	Units
December	31041
January	36902
February	37094
March	48851
April	53878



	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16
■					
■ Units	31041	36902	37094	48851	53878

Fig.2.5.2 variation in solar generation in a time interval

3 ENERGY AUDIT METHODOLOGY

The methodology adopted for this energy audit was a three step process comprising of:

- Data collection: In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, interviewing key persons, and measurements.
- Data analysis: Collected data were analyzed using MS Excel. The database generated by MS Excel was used for producing graphical representations.
- Recommendation: On the basis of results of data analysis and observations, some steps for reducing power consumption, without affecting the comfort and satisfaction, were recommended along with their cost analysis.

3.1 Data Collection

For suggesting any corrective measures to reduce power consumption, it is first necessary to know the power consumption pattern in detail. For this, the exhaustive data collection exercise has been performed at all the departments, academic area, hostels, and other supporting entities such as library, computer labs etc. Following steps have been taken for data collection:

- ❖ The team visited to academic area, administrative area, labs, hostels etc.
- ❖ Information about the general electrical appliances is collected by observation and interviewing.
- ❖ The power consumption of appliances is measured using power analyzer in some cases (such as monitors) while in other cases, rated power was used like CFL, AC, Fan etc.
- ❖ The details of usage of the appliances were collected by interviewing key persons e.g. warden care taker (in case of hostels), personnel of institute maintenance and project department etc.
- ❖ Intensity of light was measured using lux meter at administrative area, academic area, hostels, corridors etc.
- ❖ In case of air conditioning, insulation is checked by visual inspection.
- ❖ Approximations and generalizations were done at places with lack of information available

3.2 Data Analysis

In data analysis, the data collected is processed to draw significant conclusions to pinpoint loopholes and identify the areas to focus upon. Analysis of the power consumption data is used to obtain the power consumption pattern and to get the information about the areas where electric power is wasted.

3.3 Recommendation

Energy as well as cost benefits analysis of different appliances are performed and recommendations are made based on the capital cost recovery time (simple payback period). Following steps are involved in this process:

The capital cost involved in replacement of an appliance and/or retrofit is estimated.

- Energy saving by the recommendation is calculated in terms of price of energy per year.
- These two costs were compared to calculate the capital cost recovery time.
- If capital cost recovery time is less than the product life, the recommendation can be implemented.

Some other recommendations are also made which are based on lighting intensity, AC insulation etc.

4 RECOMMENDATIONS

Based on the analysis of the power consumption data, certain steps have been recommended for improving energy efficiency of the campus. Complete cost benefit analysis of implementation of recommended measures has been performed wherever necessary. Also, a number of general measures for energy efficiency have been listed. Some important recommendations for better energy efficiency are described below:

4.1 Lighting

For lighting there is an option available

- ➢ LED lighting system

LED Lighting is 4 to 5 times costly then T-5/T12 FTL, but this is compensated by saving in units and by saving in fix charge by reduction of load

4.1.1 Replacing T-12 Tube Lights with Energy Efficient LED Tube Lights (15W)

Dominant light source at most places in the campus is T-12 (36 watts) FTLs with electronic Ballast which consumes 40 W. As per our data collection, the campus has in total 1998 T-12 FTLs. If this T-12 electronic Ballast [Choke] is replaced by LED tube light, 25W power can be saved per FTL.

4.1.1.1 Cost Benefit Analysis of Replacing T-12 FTL with Energy Efficient LED Tube Lights (15 W)

- Total No. of T-12 tube lights in campus = 1998
- Average power of T-12 electronic ballast [choke] FTL = 40W
- Average power LED light (15 W) = 15W
- Power saved per FTL = (40-15) W =25W
- Total power saving = 1998*25W = 49950 W = 49.95 kW
- Working hours 6 hrs, then total units = 299 units/day
- Units saved in one year = 299*30*12= 107640
- Savings in Rs per year = 107640*6.74 = Rs 725493
- Average cost of replacing each FTL = Rs 1500
- Total cost of replacing all FTLs = 1998*1500 = 2997000
- Capital cost recovery time = 2997000/725493 = 4.13

Hence, the capital cost recovery time for replacing all T-12 FTLs of the campus is around 4.13 years.

4.1.2 Replacement of T-12 (36W) Tube Light with Energy Efficient LED Light (8 W) in Hostel Corridor

Presently lightening system in the hostels corridor provide more lux level than required so these lightening source can be replaced by the less power consuming (8 W) LED Lighting. A saving of 32 W per tube light can be achieved in the hostel corridors.

4.1.2.1 Cost Analysis of Replacing T-12 (36W) Tube Lights with Energy Efficient LED Light (8 W)

- Total No. of T-12 in the hostel corridors = 85
- Average power of T-12 (36W) = 40W
- Average power of LED Light (8W) = 8W
- Power saved per tube light = (40-8) W = 32W
- Total power saving = 32*85 = 2.720 = 2.72 kW
- Working hours is 12 hrs, then total units saved = 2.72*12 = 32 unit/day
- Units saving in one year = 32*30*12 = 11520
- Savings in Rs per year = 11520*6.74 = 77644
- Average cost of replacement of T-12 tube light = Rs. 500
- Total cost of replacing all T-12 (36W) = Rs. 500*85 = 42500
- Capital cost recovery time = (42500)/ (77644) = 0.54 yr

Hence, the capital cost recovery time for replacing all T-12 with energy efficient LED tube light (8 W) is around 0.54 years.

4.1.3 Replacement of Sodium Lamp and Bulb with LED Lighting

There is appx 100 sodium bulb in street light in the campus. This method of lighting is very inefficient as compared to LED street lighting.

4.1.3.1 Cost Benefit Analysis of Replacing Sodium Lamp with LED Lighting

- Total no. of sodium lamps in campus = 100
- Average power of sodium lamps = 150 W
- Average power of LED lighting = 40 W
- Power saved per sodium lamp = (150-40) W = 110 W
- Total power saving = 110*100 = 11000= 11 kW
- Working units in 10 hrs, then total units saved = 110 per day
- Units saved in a year = 110*30*12 = 39600
- Saving in Rs per year = 39600*6.74 = 266904
- Total cost of replacing all sodium lamp = 100*3000 = Rs 300000

- Capital cost recovery time = (300000/266904) = 1.12 year

Hence, the capital cost recovery time for replacing all sodium lamps of the campus is around 1.12 years

4.2 Fans

4.2.1 Replacing Existing Ceiling Fans by Energy Efficient BLDC Fans

Most of the buildings in SKIT Jaipur campus are 10 years old and so are the fans. Most of the fans here are not energy efficient fans. According to the data collected, there are a total of 2264 regular fans. A saving of 45W per fan can be obtained by replacing these fans by energy efficient fans.

4.2.1.1 Cost Benefit Analysis of Replacing Existing Fans by Energy Efficient BLDC Fans

- Total No. of existing fans in campus = 2264
- Average power saved per fan = 45W
- Total power saving = 2264*45W = 101880 W = 101.88 kW
- Working hours = 8 hrs, then total units saved in a day = 815
- Total Rs saving in a year = 6.74* 815*250 =1373275
- Average cost of replacing per fan = Rs. 3000
- Total cost of replacing all fans = 2264*3000 = Rs 6792000
- Capital cost recovery time = (6792000)/ (1373275) = 4.94 yr

Hence, the capital cost recovery time for replacing all existing fans of the campus is around 4.94 years.

4.3 Computer Equipments

4.3.1 Replacement of the CRT Monitors with LED Monitors

There are 1210 computers with CRT monitor. On an average, CRT monitors consume 90 W while LED monitors consume only 10 W. There is saving of 80W per monitor. LED monitors costs Rs 4700 per monitor. Scrape cost of old CRT monitors is assumed Rs 700 per piece.

4.3.1.1 Cost Benefit Analysis of Replacement of CRT Monitors with LED Monitors

- Total No. of computers with CRT monitors in campus = 1210
- Power saved per monitor = 80W
- Total power saving = 1210*80 W = 96800 W = 96.8 kW
- Working hours = 5 hrs, units saved in a day = 484 kWh
- Units saved in per year = Rs. 484*300 = 145200
- Saving in Rs per year = 145200*6.74 = 978648
- Average cost of replacing each monitor = Rs. 4000
- Total cost of replacing all monitors = 1210*4000 = Rs. 4840000
- Capital cost recovery time = (4840000)/ (978648) = 4.94 yr

Hence, the capital cost recovery time for replacing CRT monitors by LED monitors is 4.94 years. Since the product life is much more than that, the move is economically beneficial.

4.4. Air Conditioner

4.4.1 Replacement of Existing ACs with Energy Efficient Five Star Rated ACs

Most of the ACs in the buildings are existing with zero star rating. These are not energy efficient as COP of these is less than two while the COP of five stars AC is 3.4. As the energy consumption of AC is very large as compared to any other electrical device used in the campus so the efficiency and proper functioning is very important for the energy saving. According to the data collected there are 89 ACs in the campus. A saving of 0.75kW/ton can be obtained by replacing existing non rated ACs with five stars ACs. We can replace 89 zero star ACs with five stars ACs on the basis of financial analysis.

4.4.1.1 Cost Benefit Analysis of Replacement of Existing ACs with Five Stars ACs

- Total No. of ACs to be replaced in campus = 89
- Total power saved in = 89*0.75= 66.75 kW
- Operating hours 6 hrs in a day, units saving = 400
- Rs saving in year (for 200 days) = 6.74*400*200(days) = 539200

- Total cost of replacing all ACs with five star ACs = Rs. 30000*89 = 2670000
- Capital cost recovery time = (2670000)/ (539200) = 4.95 yr

Hence, the capital cost recovery time for replacing zero stars ACs of the campus is around 4.95 years.

Proper Insulation of Room

Good quality insulation must be maintained in the air conditioned rooms by keeping all doors and windows closed properly so as to prevent cool air go out and hot air come in.

Proper Insulation of Refrigerant Pipe Line

During audit mostly Refrigerant pipe line of outdoor units found without insulation. This increases the temperature of refrigerant entering into the evaporator and thus reduces the refrigerant effect. For getting same refrigerant effect (cooling) more energy is consumed.

Curtains

Always keep curtains on windows to prevent direct sunlight inside the room to avoid heating of cooled air. This reduces load of AC significantly.

Maintenance

Proper maintenance and cleaning of ACs is required at regular intervals to make it work at highest efficiency. Any dirt in filter will reduce efficiency of ACs very significantly. (During Audit it has been seen that many ACs filters were not clean)

4.5 Other Recommendations

This section includes some other useful recommendations for energy saving.

4.5.1 Use of Master Switch Outside Each Room

Installation of a master switch outside a room can make it easy for a person to switch off all the appliances of a room in case someone forgets to switch off while leaving the room. This can help improving energy efficiency.

4.5.2 Use of Reflectors in Tube Lights

Use reflector in tube lights to improve the lux levels. This is clear from photo that mostly light is falling on ceiling where it is not required. By using reflector this light can reflect towards floor (where its required).

4.5.3 Cleaning of Tube Lights

Cleaning of tube lights increases its lux level

4.5.4 Use of Pressure Cooker in Mess Kitchen

Daily more than thousand people's food is cooked in mess. Rice and pulses is routine item of menu. Presently pressure cookers are not used in Mess kitchen. If pressure cookers are used in mess for cooking rice, pulses and boiling other eatable item then up to to 20% LPG gas can be saved.

4.5.5 Bio Gas Plant

Mess produces more than 100 kg kitchen waste per day and it is dumped outside. This waste may be a good source of bio gas plant.

4.5.6 Energy Saving Measures for DG Sets

Energy Saving Measures:

- Ensure steady load conditions on the DG set, and provide cold, dust free air at intake (use of air washers for large sets).
- Improve air filtration.
- Ensure fuel oil storage, handling and preparation as per manufacturer's guide lines/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.
- Carryout regular field trials to monitor DG set performance, and maintenance planning as per requirements.
- Use of Waste heat recovery unit for exhaust gases.

List of selected students involved in energy audit

Department of Information Technology

S.NO	Name	Roll No
1	Abhishek Jain	13ESKIT004
2	aishwarya Rathore	13ESKIT006
3	Akshika Jain	13ESKIT007
4	Aman Goyal	13ESKIT009
5	Bhavna Rathi	13ESKIT019
6	Bhawana Agarwal	13ESKIT020
7	Chirag Gangwal	13ESKIT023
8	Harsh Bansal	13ESKIT027
9	Ishnai Pandya	13ESKIT028
10	Jai Surana	13ESKIT031
11	Kirti Dodeja	13ESKIT032
12	Mehul Kumar	13ESKIT037
13	Mohak Gaur	13ESKIT039
14	Monika Prasad	13ESKIT042
15	Nitesh Moorjani	13ESKIT052

Department of Electronic Engineering

NAME	ROLL NUMBER	CLASS
Aman Agarwal	13ESKEC012	EC-A 1st Shift
Harshit Indoria	13ESKEC035	EC-A 1st Shift
Harshit Soni	13ESKEC036	EC-A 1st Shift
Raina Sood	13ESKEC063	EC-B 1st Shift
Rajat Sharma	13ESKEC065	EC-B 1st Shift
Shailendra Sharma	13ESKEC071	EC-B 1st Shift
Shresth Sharma	13ESKEC075	EC-B 1st Shift
Shreya Bhatia	13ESKEC076	EC-B 1st Shift
Urvi Sharma	13ESKEC086	EC-B 1st Shift
Anshul Vanawat	13ESKEC713	EC 2nd Shift
Harshita	13ESKEC722	EC 2nd Shift
Kalpesh Jain	13ESKEC725	EC 2nd Shift
Khushal Sharma	13ESKEC727	EC 2nd Shift
Natwar Singh	13ESKEC740	EC 2nd Shift
Shree Soni	13ESKEC749	EC 2nd Shift
Abhijeet Singh	13ESKCS004	CS 1st Shift
Arpit Singh	13ESKCS022	CS 1st Shift

Department of Mechanical Enginnering

S.No.	Name of Student	Roll No.
1	Hitesh Sharma	13ESKME036
2	Ayush Mathur	13ESKME016
3	Anshul Bhardwaj	13ESKME010
4	Mohit Jain	13ESKME060
5	Prateek Agarwal	13ESKME739
6	Dileep Kumawat	13ESKME715
7	Geetendu Sharma	13ESKME716
8	Shubham Jain	13ESKME754
9	Himanshu Khandelwal	13ESKME721
10	Shubham Kothari	13ESKME755
11	Rajat Jangir	13ESKME744
12	Justin Varghise	13ESKME723
13	Anurag	13ESKME011
14	Arjit Jain	13ESKME012
15	Akshaya Garg	13ESKME004

Swami Keshvanand Institute of Pharmacy, Jaipur

S. No.	Name of Student	Class
1.	Arjita Jha (Miss)	B. Pharm -III
2.	Sakshi Khandelwal (Miss)	B. Pharm –III
3.	Meraj Ali Ansari	B. Pharm –III
4.	Shiv Kumar Saini	B. Pharm –III
5.	Imadur Rahman	B. Pharm –II
6.	Mohd.Arif	B. Pharm –II
7.	Mohd.Salman	B. Pharm –I
8.	Vishnu Chaudhary	B. Pharm -I
9.	Chatrapal Singh	B. Pharm -I
10.	Mukesh Mandal	B. Pharm -I

Department of Civil Engineering

Sr. No	Name	Class
1	Jitendra Kumar Gurjar	6th Sem -A
2	Shubham Sharma	6th Sem -A
3	Md. Irfan	6th Sem -A
4	Deendayal Saini	6th Sem -A
5	Anshuman Singh Rathore	6th Sem -A
6	Aman Purohit	6th Sem -A
7	Bramha Singh Mali	6th Sem -A
8	Kumar Mayank	6th Sem -A
9	Jitendra Singh Rathore	6th Sem -A
10	Arvind	6th Sem -A
11	Divyanshu Varshney	6th Sem -A
12	Kartik Gupta	6th Sem -A
13	Akshay Kumar	6th Sem -A
14	Lokesh Nagar	6th Sem -A
15	Deepak Pareek	6th Sem -A
16	Sumit Mittal	6th Sem -B
17	Vikas Prajapat	6th Sem -B
18	Tarun Kasliwal	6th Sem -B
19	Sunita Meena	6th Sem -B
20	Swati Achra	6th Sem -B
21	Shivani Goyal	6th Sem -B
22	Vishakha Bhandari	6th Sem -B
23	Punit Sharma	6th Sem -B
24	Uday Bhanu Singh Khichi	6th Sem -B
25	Kishore Suwalka	6th Sem -B
26	Anoop Singh Bhati	6th Sem -B
27	Sumit	6th Sem -B
28	Shashank Agarwal	6th Sem -B
29	Saurabh Sain	6th Sem -B
30	Ramdhan Choudhary	6th Sem -B

Department of Computer Science		
S.NO	Name	Roll NO
1	Abhijeet singh Rathore	13ESKCS004
2	Anirudh Pareek	13ESKCS012
3	Arpit Singh Sikarwar	13ESKCS022
4	Garima Kaur	13ESKCS036
5	Kaushal Kumar	13ESKCS048
6	Shubham Jain	13ESKCS091
7	Shubham Sharma	13ESKCS095
8	Shubham Singh Tanwar	13ESKCS096
9	Vaishali singh Daiya	13ESKCS111
10	Sumit Arora	13ESKCS853
11	Goral Arora	13ESKCS715
12	Mohammed Akram	13ESKCS721
13	Palash Bhatnagar	13ESKCS729
14	Riya Soni	13ESKCS746
15	Yashmayee Jain	13ESKCS763

Department of Electrical Engineering

S.NO	Students	Class
1	Teena	VI sem II
2	Heena agrawal	VI sem II
3	Dhruvesh Singh Shekawat	VI sem II
4	Kuldeep	VI sem II
5	Girish	VI sem II
6	Amit	VI sem II
7	Anil	VI sem II
8	Ayushi	VI sem--A
9	Ashal gautam	VI sem--A
10	Anjali Mahla	VI sem--A
11	Amar Kumar	VI sem--A
12	Chirag Soni	VI sem--A
13	Bharat	VI sem--A
14	Himanshu	VI sem--A
15	Kamaljeet	VI sem--A
16	Garvit	VI sem--A
17	Devesh	VI sem--A
18	Shilpi	VI sem--B
19	Surbhi	VI sem--B
20	Rajsee	VI sem--B
21	Rashmi	VI sem--B
22	santosh	VI sem--B
23	lekha	VI sem--B
24	neha	VI sem--B
25	vivek sharma	VI sem--B
26	parth	VI sem--B
27	udit	VI sem--B
28	narendra	VI sem--B
29	sumit	VI sem--B
30	sumit talwani	VI sem--B
31	titiksh	VI sem--B