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An Electrical Energy Audit at Siddharth Institute

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Abstract: -- Energy plays a central role in all organisations, especially those are energy intensive. Energy audit was conducted at the Siddharth Institute of Science & Technology (SISTK), Puttur, to estimate the energy consumed in a daily and on annual basis. Energy auditing consists of several tasks which can be carried out depending on the type of audit & function of audited activity. It started with review of historical data of energy consumption, those data is important in order to understand the patterns of energy used. The next step is to setup an energy audit program. This program should start with survey of the site to gather the information of electrical equipments presently used. The energy audit discussed in this paper will only focused on Siddharth Institute of Science & Technology. It is carried out with an aim and analysis for identifying possible energy saving measures of this institute.

***Keywords: energy audit, data collection, campus, information gathering*.**

I. INTRODUCTION

An energy audit is an inspection, survey and analysis of energy flow for energy conservation to reduce the amount of energy input into the system without negatively affecting the output. Energy auditing is testing and analysis of how the enterprises use energy. According to national energy conservation, laws, rules and regulations for energy, consumption investigation and energy audit management. An energy audit consist of a detailed examination of how the facility uses energy, what the facility pays for that energy, a finally a recommended program for changes in operating practices. Purpose of energy audit is to recommend steps to be taken by management for improving the energy efficiency, Reduce energy cost and saving the money on the energy bills. As per Energy Conservation Act 2001, Energy Audit is defined as "The Verification, monitoring and analysis of energy including submission of a technical report containing recommendations for improving energy efficiency with cost benefit analysis and in action plan to reduce energy consumption.

II. METHODS OF ENERGY AUDITING:

1) Preliminary energy audit
2) Detailed energy audit
3) General energy audit

1. Preliminary energy audit:

This Preliminary Energy Audit is also known as Simple Audit (or) walk-through audit is the simplest and quickest auditing type. The preliminary energy audit is least expensive as it involves a visual inspection of each of the associated system. The preliminary energy audit provides an initial estimate of potential savings and also serves as a basis for determining, if a more comprehensive audit will be needed.

2. Detailed energy audit:

Detailed Energy Audit is also called as comprehensive audit. It expands a general energy audit and it covers estimation of production input for different process, collection of past data on production levels and specified energy consumption. The detailed energy audit will include an economic analysis of the proposed technological improvements and operational characteristics and on site measurements and testing.

3. General energy audit:

The General Energy Audit also known as mini-audit or site energy audit for which utility bills are collected for a period of 12 to 36 months to allow the auditor to evaluate the facility energy. This type of audit will be able to identify all energy conservation measures appropriate for the facility, given its operating parameters.

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III. LIST OF ELECTRICAL EQUIPMENTS CONSUMING ENERGY (SISTK):

Total number of blocks =2

Table 1SISTK Details

Total number of rooms	68
Total number of class rooms	28
Total number of staff rooms	17
Total number of rest rooms	12
Total number of labs	7
Total number of drawing rooms	2
Special rooms	2

Total Siddharth Institute of Science & Technology, Puttur is having A and B Blocks. Following electrical load consumable equipments are available there.

Table 2 SISTK Electrical load equipments

Load	Total number of equipments
Fan	305
Tube light	156
Printer	4
Xerox	1
Spilt AC	3
CRT System	136
CFL	18

The room wise electrical energy consumable equipments details are discussed in below.

A. Total energy consumption details of Class rooms:

All the class rooms were not using the more tube lights as we are having excellent lighting and ventilation.

As per the time table of the college, 7 hours per day (9 am to 4 pm) is allotted for the theory classrooms & 25 days per month. So the total number of hours of usage per month is 25*7= 175 hours.

Table 3 SISTK Electrical load consumption details of Class rooms

Load	Rating of Equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Tube light	40	45	1800	315
Ceiling fan	70	156	10920	1911
Total Energy consumption per month =2226kWh				

B. Total energy consumption details of Staff rooms:

As per the time table of the college, 7 hours per day (9 am to 4 pm) is allotted for the staff rooms & 25 days per month. So the total number of hours to usage per month is 25*7=175 hours per month. But systems and printers are running nearly 4 hrs per day 25*4=100hours.

Table 4 SISTK Electrical load consumption details of room

Load	Rating of equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Tube light	40	32	1280	224
Ceiling fan	70	29	2030	356
Systems	350	8	2800	280
Printers	250	2	500	50
Total Energy consumption per month =910 kWh				

C. Total energy consumption details of Rest rooms:

As per the time table of the college, 7 hours per day (9 am to 4 pm) is allotted for the rest rooms & 25 days per month. So the total number of hours to usage per month is 25*7=175 hours.

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Table 5 SISTK Electrical load consumption of rest rooms

Load	Rating of equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Tube light	40	12	480	84
Total Energy consumption per month = 84 kWh				

D. Total energy consumption details of Lab rooms:

As per the time table of the college, 6 hours per day and 2 shifts, each shift is 3hrs is allocated for this lab rooms & 25 days per month. So the total number of hours to usage per month is 25*3= 150 hours.

Table 6 SISTK Electrical load consumption details of labs

Load	Rating of Equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Tube light	40	43	1720	258
Ceiling fan	70	60	4200	630
Total Energy consumption per month =888kWh				

E. Total energy consumption details of Drawing rooms:

As per the time table of the college, 6 hours per day and 2 shifts, each shift is 3hrs is allocated for this drawing rooms & 25 days per month. So the total number of hours to usage per month is 150hours.

Table 7 SISTK Electrical load consumption details of drawing room

Load	Rating of Equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Tube light	40	12	480	72
Ceiling fan	70	16	1120	168
Total Energy consumption per month =240kWh				

*F. **Total energy consumption details of Library**:*

As per the time table of the college, 7 hours per day (9 am to 4 pm) is allotted for this library & 25 days per month. So the total number of hours to usage per month is 175 hours. Xerox machine are using rarely 50 hours.

Table 8 SISTK Electrical load consumption details of library

Load	Rating of Equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Tube light	40	6	240	42
Ceiling fan	70	36	2520	441
CFL lights	11	11	374	66
Systems	2	2	500	88
Xerox	1	1	250	13
Total Energy consumption per month =650kWh				

G. Total energy consumption details of Principal & examination room:

As per time table of the college, 7 hours per day (9 am to 4 pm) is allotted for this principle & examination rooms & 25 days per month. So the total number of hours to usage per month is 25*7=175 hours, computers and printer are 100 hours per month.

Table 9 SISTK Electrical load consumption details of

Load	Rating of equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Tube light	40	6	240	42
Ceiling fan	70	8	560	98
Systems	350	4	1400	140
Printer	250	2	500	50
Ac	1500	1	1500	263
Xerox	250	3	750	75
Total Energy consumption per month = 84 kWh				

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H. Total energy consumption details of CSE Laboratory:

In those labs tube lights and ceiling fans consumptions are included in lab room details as per routine of the college 6 hours per day 2 shifts each shift 3 hrs is allotted for this laboratory & 25 days per month. . So the total number of hours to usage per month is 150 hours.

Table 10 SISTK Electrical load consumption details of CSE laboratory

Load	Rating of equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Systems	250	90	22500	3375
Total Energy consumption per month = 3375 kWh				

I. Total energy consumption details of EEE Laboratory:

In those labs tube lights and ceiling fans consumptions are included in lab room details as per time table of the college, 6 hours per day 2 shifts each shift 3 hrs is allotted for this laboratory & 25 days per month. . So the total number of hours to usage per month is 25*6=150 hours.

Table 11 SISTK Electrical load consumption details of EEE laboratory

Load	Rating of Equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Lab setup	150	8	1200	180
Total Energy consumption per month =180kWh				

J. Total energy consumption details of ECE Laboratory:

In those labs tube lights and ceiling fans consumptions are included in lab room details as per time table of the college, 6 hours per day 2 shifts each shift 3 hrs is allotted for this theory classroom & 25 days per month. So the total number of hours to usage per month is 25*6=150 hours.

Table 12 SISTK Electrical load consumption details of ECE laboratory

Load	Rating of Equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Lab setup	100	10	1000	150
Total Energy consumption per month =150kWh				

K. Total energy consumption details of Mechanical Laboratory:

In those labs tube lights and ceiling fans consumptions are included in lab room details as per time table of the college, 6 hours per day 2 shifts each shift 3 hrs is allotted for this laboratory & 25 days per month. . So the total number of hours to usage per month is 25*6= 150 hours.

Table 13 SISTK Electrical load consumption details of MECHANICAL laboratory

Load	Rating of Equipment (W)	Number of equipment	Load connected (W)	Energy consumption (kWh)
Lab setup			4000	600
Total Energy consumption per month =600kWh				

L. Total energy consumption details of CIVIL Laboratory:

In civil engineering there are no electrical consumable equipments in those labs tube lights and ceiling fans consumption are included in lab room details.

IV.ELECTRICITY BILLS DATA COLLECTION:

For energy auditing at Siddharth Institute of Science & Technology, Puttur it is necessary to analyse the consumption of electrical energy of previous year. The electricity bill data of Siddharth Institute of Science & Technology was collected from Mar 2015 to Feb 2016. The collected data is visualized through graph, and then only

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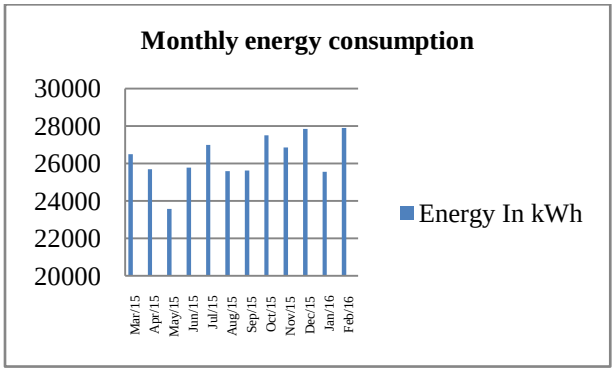
wastage of energy consumption can be easily identified for making recommendations to superiors. The collected data of energy bill at Siddharth Institute Science & Technology, Puttur is taken from record of accounts department.



V. ASSUMPTIONS

On an Average we are consuming energy for

1. Tube light which is working for 7hrs per day.
2. Ceiling fan which is working for 7hrs per day.
3. 1kWh=7.25/- paisa as per electricity bills.

VI. ENERGY SAVING CALCULATIONS:

Energy saving by replacing T12 tube light to T5 tube light

T12 Tube Lights

Total no of T12 lights = 156
Total power consumption=156 ×40 = 6,240W = 6.24 KW/day
Total energy consumption / day = Power consumption × Operating hrs =6.24kw×7hrs = 43.68kWh
Energy cost/ day (1kwh =Rs 7.25/-)= 7.25×43.68 = Rs 317/-
Total annual energy cost = Energy cost /day × No of working days =317×255 = Rs 80,835/-

T5 Tube Lights

Total no of T5 lights = 156
Total power consumption= 156 ×28 =4,368 W = 4.368KW
Total energy consumption / day = Power consumption × Operating hrs=4.368kw×7hrs = 30.576kWh
Energy cost/ day (1kwh = 7.25/-) =7.25×30.576 = Rs 222/-
Total annual energy cost = Energy cost /day × No of working days = 222×255 = Rs 56,610/-
Annual cost saving = 80,835-56,610
= Rs 24,225 /-
Cost of T5 tube light =130
Total cost of replacement = 130×156 = Rs 20,280/-
Payback period = Total investing/Annual saving =20,280/24,255= 8 months.

Energy saving by replacing normal ceiling fan to energy efficient ceiling fan

Normal Ceiling Fan

Total no of fans = 305
Total power consumption = 305 ×70 = 21,350W = 21.35 KW
Total energy consumption / day = Power consumption × Operating hrs=21.35kw×7hrs = 149.5 kWh
Energy cost/ day (1kwh = 7.25/-) = 7.25×149.45 = Rs 1,084/-
Total annual energy cost = Energy cost /day × No of working days = 1,084×255 = Rs 2, 76,420/-

Energy Efficient Fan

Total no of efficient fan = 305
Total power consumption = 305×60 = 18,300W = 18.3KW
Total energy consumption / day = Power consumption × Operating hrs = 18.3kw×7hrs = 128.1kWh
Energy cost/ day (1kwh = 7.25/-) = 7.25×128.1= Rs 929/-
Total annual energy cost = Energy cost /day × No of working = 929×255 = Rs 2, 36,895/-
Annual cost saving = 2, 76,420 – 2, 36,895= Rs 39,525/-
Cost of energy efficient fan =1,500
Total cost of replacement = 305×1,500= Rs 4, 57,500/-
Payback period= Total investing/Annual saving
=4, 57,500/39,525=11 years 5 months.

Energy saving by replacing CRT computer monitor to LCD computer monitor

CRT Monitors

Total no of CRT computers = 136
Total power consumption = 136×350 =47,600W = 47.6 KW
Total energy consumption / day = Power consumption × Operating hrs= 47.6kw×4hrs =190.4 kWh
Energy cost/ day (1kwh = 7.25/-) = 7.25×190.4 = Rs 1,381/-
Total annual energy cost = Energy cost /day × No of working days = 1381×255 = Rs 3, 52,155/-

LCD Monitors

Total no of LCD computers = 136
Total power consumption = 136×250 = 34,000W =34 KW
Total energy consumption / day = Power consumption × Operating hrs= 34kw×4hrs =136kWh
Energy cost/ day (1kwh = 7.25/-) = 7.25×136 = Rs 986/-

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Total annual energy cost = Energy cost /day × No of working days = 986×255 = Rs 2, 51,430/-
Annual cost saving = 3, 52,155 – 2, 51,430= Rs 1, 00,725/-
Cost of LCD monitor = 6,000
Total cost of replacement = 6,000×136= Rs 8, 16,000/-
Payback period = Total investing/Annual saving 3
=8, 16,000/1, 00,725=8 years 1 month

VII. RECOMMENDATIONS:

- T5 tube light is considered to be higher efficiency performance and consuming up to 28W. T5 tube light having longer life once installed, replacement tube (only tube) cost much less.
- LCD monitors typically requires about 30% of the power required for a CRT monitors with the same screen area.
- Windows AC consumes larger power consumption as compared to spilt AC
- Energy savings is achieved by follow-up of our recommendations.

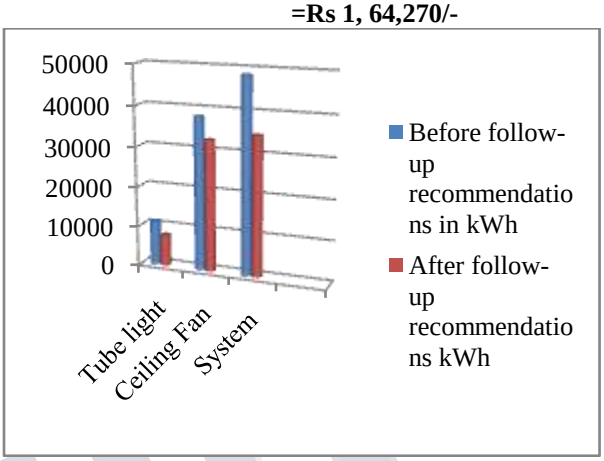
VIII. RESULTS & DISCUSSION:

The Proposed energy analysis gives strong warning to the consumer not only in terms of the energy bills also the energy crisis in the near future to all sectors of people and in this analysis, the recommendations reduces around 20-25% of the energy and 20-30% of cost reduction. The details of saving after implementing the recommendations (follow-up) are the tube light 30%, ceiling fan 14%, system 28%. Therefore the 24% of overall energy would be saved in the entire college campus.

Table 14 Comparison of before & after recommendations

Load	Before follow-up Recommendations		After follow-up Recommendations	
	Annual Energy consumed in KWH	Annual cost in RUPEES	Annual Energy consumed in KWH	Annual cost in RUPEES
Tube light	11139	80758	7797	56529
Ceiling Fan	38110	276298	32666	236829
System	48552	352002	34680	251430
Total	97801	709058	75143	544788

Total annual savings = 7, 09,058 - 5, 44,788
=Rs 1, 64,270/-



IX. CONCLUSION:

The analysis and calculations of electrical energy conservation of Siddharth Institute of Science & Technology, Puttur are carried out by follow-up the recommendations and saved 20% of annual electrical cost and 15 to 25 % electrical energy consumption.

Total annual savings = Rs 1, 64,270/- (approximately) Later we will introduce automatic sensor for switching on/off for lighting and fan load control.

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