A Step towards Revolutionary Sustainable Change in Infrastructure of Silver Oak Group of Institutes for Conservative, Energy Efficient and Economical Network Model

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Abstract : India's economy has been one of the fastest growing economies in the world with two digit figures in the last decade and third largest producer of Electrical energy in the world. Despite such achievements the gap between demand and supply of electrical energy is increasing every year and power sector is highly capital – intensive. Consequently, the rate of electric consumption has also been increasing very fast. Energy saving is a social responsibility of every individual. In order to reduce energy consumption for sustainable and energy-efficient network, continuous energy audit and process tracking of machines are essential. In associations like Engineering Colleges, the best working consumption is often observed to be electrical energy. In many appraisals of the reason-ability of the cost or potential cost investment funds in the above segment, would constantly show up as a best need, and in this way energy Audit. In the course of the process the electricity bill of the institution was analyzed in detail and it was found that the maximum demand which occurs at some point of the month was contributing a considerable amount to the monthly electricity bill. This was taken as an area of improvement and research was done on it. The motivation behind our venture - 'Energy Audit and Management of Silver Oak Group of Institutes - Ahmedabad' is to arrange, evaluate, portray and organize cost sparing measures identifying with energy use in the scholastic range of 7 large buildings. The report compiles a list of possible actions like reduction of maximum demand through smart load shedding procedures; installation of state of art equipment's to conserve the energy. This undertaking is only one stage, a simple mile marker towards our goal of making our grounds 'SOGI' as a standout among the most energy productive grounds in Gujarat.

Index Terms **- Energy Conservation, Energy Management, Energy Audit, Tariff Plan**.

I. INTRODUCTION

Energy is one of the major inputs for the economic development of any country. Power capacity has risen at the rate of 5.87% per annum over the last 25 years. In 2011-12, India was the fourth largest consumer in the world of Crude Oil and Natural Gas, after the United States, China, and Russia. The total installed capacity for electricity generation in the country has increased from 16,271 MW as on 31.03.1971 to 2,36,387 MW as on 31.03.2012, registering a compound annual growth rate (CAGR) of 6.58% [1]. So some steps are required to conserve the energy globally using systematic approach. However a more comprehensive method in checking energy usage and wastage is the "Energy Audit". Energy audits do not provide the final answer to the problem. This identifies where the potential for improvement lies, and therefore, where energy management efforts must be directed. An energy audit is first step towards understanding how energy is being used in a given facility. Energy Audit is considered as one of the comprehensive methods in checking the energy usage and wastage in buildings. The process of energy audit includes historical energy data collection, formulation of energy audit programmed to the actual implementation. There is now a universal recognition of the fact that new technologies and much greater use of some that already exist provide the most hopeful prospects for the future. The energy process is an organized approach to identify energy waste in a facility, determining how this waste can be eliminated at a reasonable cost with a suitable time frame. Energy audit is widely used and many have different meaning depending on energy service companies. Energy auditing of a building can range from a short a walkthrough of the facility to a detailed analysis. However, there is an occasion where coexisting of the saving of energy and the comfort of the life become difficult when promoting energy saving. In the present study, the Silver Oak College of Engineering and Technology was established in 2009 as the Self finance Engineering College in the Ahmedabad. In the year 2014 one new college of Aditya Silver Oak Institute of Technology was establish under Silver Oak Group of Institutes located in Ahmedabad, India is selected for the research objective, and we intended on the energy saving of the Institute facilities. Regarding to the energy saving of the SOGI, energy was made and some directions leading to the energy saving as much as possible are proposed in this paper.

1.1 Objective of Energy Audit Exercise

The objective of Energy Audit is to promote the idea of Energy Conservation in the Campus of SOGI. The purpose of the energy audit is to identify, quantify, describe and prioritize cost saving measures relating to energy use in the SOCET, ASOIT and Institute Central Facilities.
The work eligible for Energy Audit Study should be directed towards:

1. Identification of areas of energy wastage and estimation of energy saving potential in the SOCET, ASOIT and Institute Central Facilities.
2. Suggesting cost-effective measures to improve the efficiency of energy use.
3. Estimation of implementation costs and payback periods for each recommended action.
4. Documenting results & vital information generated through these activities.

II. ENERGY AUDIT METHODOLOGY

The methodology adopted for this 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 - Detailed analysis of data collected was done using Microsoft Excel and Elektra. The database generated using by Microsoft Excel and Elektra 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.

The purpose of the Silver Oak Group of Institutes Audit Survey is to determine the general condition of the institution with respect to energy performance and the institutional potential willingness to improve the institute's energy performance. This energy audit is aimed at obtaining a detailed idea about the various end use energy consumption activities and identifying, enumerating and evaluating the possible energy savings opportunities. The target is to achieve savings in the electrical energy consumption to the extent of 20%.

2.1 Analysis of Connected Load

With the use of the software Elektra and Excel, we have analyzed the power consumption by equipment, application as well as location. Here is the summary of the analysis presented in form of charts for better understanding.

2.1.1 Building wise Connected Load

There are 9 blocks with 2 engineering colleges including academic departments, Temple, Gaushala, and supporting infrastructures like library, computer center, incubation center, staff quarter etc. The analysis implies that Main Building has more connected load than any other building. Chart shown above represents percentage of connected load with respect to total connected load in the campus. A point to note in the above chart is the higher percentage of connected load in Main Building as compared to other buildings. This describes how air conditioners and computers affect the consumption distribution. Workshop has lower consumption in spite of having lathe machines and furnaces, as maximum eight lathe machines are operated at a time, also the operating hours of these machines are very less.

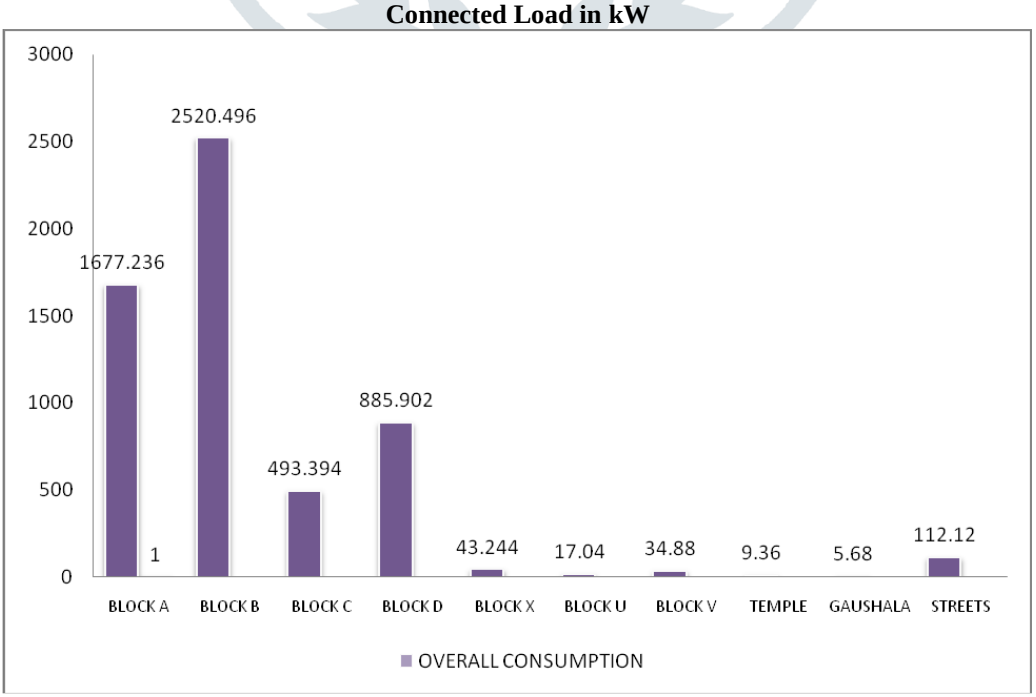

Fig. Error! No sequence specified.. Total Block wise connected load in Silver Oak Group of Institutes (kW)

From the above graph, we can find that lighting system, ventilation system and computers affect the factor of power consumption most. Main building and extension blocks are engineering building having number of laboratories and computer centers, which consumes more power. Computers in all the buildings consume less power with compare to traditional computers as all the monitors are LCD/LED. Hence, power consumption can only be reduced by reducing operating hours and proper usage.

Equipment wise Connected Load

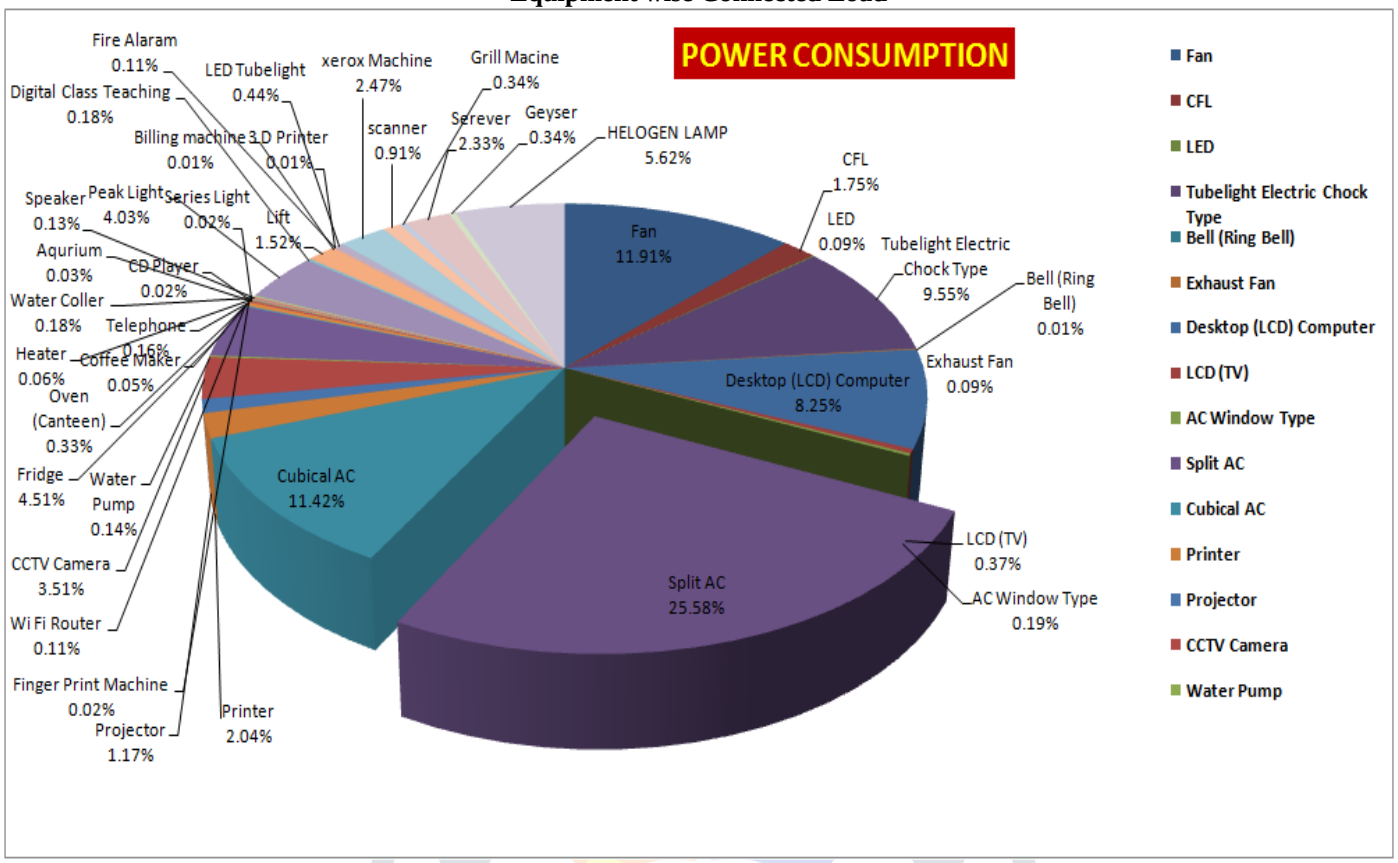

Fig. 2. Total Equipment wise connected load in Silver Oak Group of Institutes (KW)

The above graph represents that Lab machines and ACs play an important role in calculation of connected load, whereas ventilation system consisting of ceiling fan, wall fans and exhaust fan consumes less power with compare to other equipment.

III. ANALYSIS OF ELECTRICITY BILLS

For energy auditing of SOGI it is necessary to analysis of consumption of electrical energy previous years. The electricity bills data of SOGI is collected of last year. The collected data is visualized through graph then only wastage of energy consumption can be easily identified for making recommendations to high authority. This collected data of electricity bills of SOGI is taken from records.

Per Month Active Power Usage:

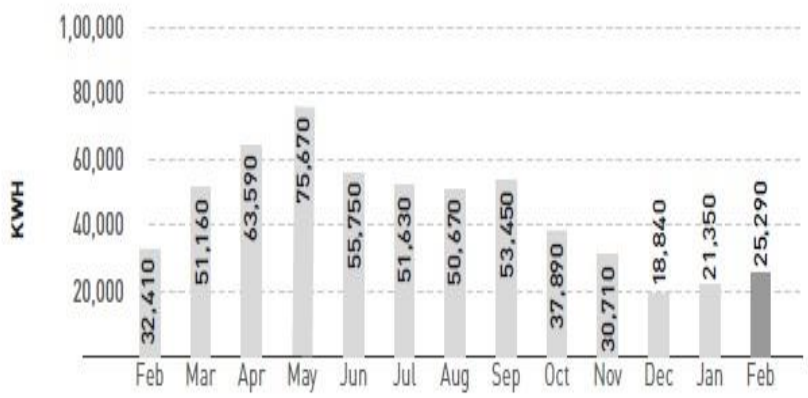

Fig. 3. Month Wise Active Power Usage of SOGI

As stated above, in the month April-2017 and May 2017, active power used was above 60000 KWH, which is higher than any other months.

3.1 Tariff Structure

Table 3.1: Tariff Structure of Electricity Bill for SOGI

FIXED CHARGED (Per Month)	**HTMD 1**	**HTMD 2***
For Billing Demand	**₹/kW**	**₹/kW**
• Up to& Including Contract Demand		
[1] Up to 1000kW	260.00	225.00
[2] 1000kW and above	335.00	225.00
• In excess of the contract Demand	385.00	285.00
ENERGY CHARGES (per month)	**HTMD 1**	**HTMD 2***
	₹/unit	₹/unit
For first 400 unit consumed per kW of Billing Demand	4.45	4.00
For remaining units consumed	4.35	4.00
TOU CHARGES (for units consumed in peak hours)	HTMD 1	HTMD 2*
For Billing Demand	₹/unit	₹/unit
Up to 300kW	.80	0.60
Above 300kW	1.00	.60

3.2 Billing Demand

Billing demand will be taken under
1. Maximum demand recorded during the month OR
2. 85% of the contract demand OR
3. 100 kW, whichever is high

IV. MEASUREMENTS AND CALCULATION

4.1 Calculation for energy conservation in computers

Mostly per day operating hours of computers in campus is 7 hours. LCD consumes 60 W and monitors consume 66W.The power consumption by the computer under different modes of operation. If we will consider that all these system will operate for 7 hour then energy consumption. If we will consider that all these system will operate for 7 hour then energy consumption. We can reduce operating to 5 hours by putting the entire computer to sleep mode for2 hours. Then yearly energy conservation can be achieved near about 37.5 KWH.

4.2 Choosing a ceiling mount fan – size

The size of ceiling mount fan can choose will depend on room size, and for very large rooms, on the number of fans you decide to install. Under 36" Fans with a blade diameter under 3 feet are intended for compact rooms –less than 80 square feet or 7 square meter ,for instance an 8*10 or 9*9 rooms. 36 to 42" Fans with a blade diameter under 3 to 3.5 feet are suitable up to 150 square feet or 14 square meters-a 10*15 or 12*12 foot room. 42 to 48 Good for rooms of 150-225 square feet or 14-21 square meters. Formula used to install two consecutive fans Min. Clearance = 2 (Dia of the circle traced by fan blade)

4.3 Calculations for installing install occupancy sensors

In areas such as Classrooms, compressed air room, rest room, office rooms, conference room, etc. Sometimes lights are kept on when they are not occupied, resulting in wasted energy consumption. Since the best way to save energy on lighting is to switch off when it is not needed, installing occupancy sensors will help to improve the situation so that lighting is on only when and where needed.

V. PROPOSED RECOMMENDATIONS FOR ENERGY CONSERVATION

The general recommendations are presented here. The savings due to their implementation could not be easily quantified, but their importance cannot be understated. Implementing all these measures, a total saving of 20-25% can be achieved without compromising much on the existing facilities and comforts.

5.1 Reduce lighting

There are a couple of ways to do this is to take advantage of natural daylight. Turning lights off or dimming them during the day allows for lower energy costs and a more comfortable environment. Need more light on a work surface use task lights?

5.2 Use timers and sensors

The installation of occupancy sensors, timers, or photocells will ensure that interior and exterior lights are turned off at the appropriate time. These inexpensive devices can reduce lighting costs by up to 40 per cent by turning off lights in unoccupied areas. In closets and restroom install motion sensors or timers so that the lights are off when no one is using the room.

5.3 Use of motion sensor

Motion Sensor Senses If there are People in that area or not, Accordingly it keep the vital systems Running as desired e.g.(lights, TV's, Air conditioning .etc.). However if motion Sensor Do not detect movement for quite long time according to the area usage class, then it shall start to power down and reduce energy wastage. This is the main concept behind it. Actually there are two types of motion sensors, one is occupancy type and one is normal type. Each one of those types is also work in different topology, wither standalone type, or part of a system.

5.4 Motion sensor light switch

Fit a motion sensor light switch to automatically switch off lights when a room is empty. The Motion Sensor Light Switch pictured above is a new product which will only turn lights on in a room when it is occupied. By automatically turning off the lights when no-one is in the room, the manufacturers claim that an average of 128 hours of unnecessary lighting will be avoided reducing electricity consumption for the lighting by 10%.

5.5 Better Practices for AC

The institute has in total 262 window type ACs and 126 split type ACs which make a very large part of total energy consumption of the campus. But, at many places it was found that AC is not used with best recommended practices. Even simple things, such as insulation, are not taken care of. Window panes were found broken at many places. Also, at certain places ACs were found to be used without keeping curtains. These poor practices account for increase in AC load and thus consumption.

VI. CONCLUSIONION

In order to save energy in the campus, it is necessary to categorize, quantify, describe and prioritize cost saving measures relating to energy use in the academic area, laboratories, library, and Faculty house. With the help of the calculation, data of connected load, single line diagrams, electrical power can be distributed as per the requirement and power consumption can be reduced. By analysing lighting load and replacing it as per the standards, illumination system can be made more effective. The other recommendations to save and use energy properly are: capacitor bank can be installed in order to overcome/reduce reactive power, operating panel can be set up at distribution side and bus-bar interchange mechanism can be formed to ensure power continuity. The electricity bills can be reduced by changing tariff plan of connection. Hence, as per todays' need, educational buildings, engineering laboratories, R&D labs as well as local electrical power utility can be made energy efficient.

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