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Energy Conservation through Energy Audit of Engineering Institutions

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Abstract:- **Engineering institutions have mushroomed in India over the years and as of Dec 2016 more than 4500 such institutions which are approved by AICTE exist in India. Engineering Colleges are big consumers of energy be in the form of fuel for transportation, electrical energy for class rooms and labs and LPG for canteen & Mess. Presently the engineering students are unaware of the various forms of primary and secondary energy being consumed in providing technical education and its implications. Educational Institutions are increasing over the years due to rise in population and are involved in imparting knowledge and skills to the youth and thus contribute in nation building. Karwar town is on the north western tip of Karnataka and is adjoining the state of Goa and has two engineering colleges and a host of degree and PU colleges apart from polytechnics.**
Energy auditing involves the study of energy usage in industry, organizations and institutions. As educational institutions are also consuming substantial amount of energy sources such as diesel for transport vehicles and captive DG sets, Electricity for illumination, ventilation and operating of machinery and tools. The study of the manner in which energy is being used; comparison between institutes on per student annual usage shall give fair idea for benchmarking. This study involves procurement of equipment for energy auditing and undertaking energy audits of the engineering college, its two hostels and later on neighboring institutions. By undertaking detailed energy auditing, the various measures which can be adopted for energy conservation can be arrived at so as to have effective demand side management.

Keywords:-- **Energy Audit, Engineering Institutions, Karnataka, Demand Side Management**

I. INTRODUCTION

Energy is a crucial issue now a days and India is a net importer of energy sources spending Rs 8 lakh Crores annually for crude imports to meet the growing aspirations of its citizens. This work involved procuring the equipments for undertaking energy audits of thermal and electrical installations in a self supporting private engineering institution in the state of Karnataka. Short term training programme shall be devised for the mechanical engineering students of higher semesters. The various equipments consuming energy in the institution were studied. By using suitable measuring devices the various parameters of the energy intensive devises were recorded. The energy consumption data of the equipments were compared with the current benchmarks. Based on the analysis of energy consumed the energy requirement per student per annum by the institution shall be arrived at. The similar exercise has been planned to be undertaken duly obtaining consent from nearby institutes. The comparative study shall be undertaken based on specific energy consumption of the two institutes and suitable energy conservation opportunities identified and suggested to the institutions for implementation. This work of energy audit shall be extended to the industries in adjoining areas. . To measure the amount of energy consumption by large machines and equipment by using tong tester and load manager. To measure the illumination levels lux meter was used and thus we can suggest optimum illumination levels for various areas and advise the proper luminaries. To measure the load on the motors of machines and check for the efficiency of induction motors. To check the specific fuel consumption by DG sets and compare with benchmarks to suggest remedial measures to improve energy efficiency

To suggest measures to reduce energy consumption for the institute by conducting detailed energy audits Students of Mechanical engineering shall be trained in energy auditing by conducting short term programmes for skill development and given minor projects Reduce the energy consumption in institutes and industries by undertaking scientific measurements.

Train students and faculty about the various energy intensive equipments in institutes and industry. To train students and faculty in measuring the performance of various energy consuming devices. Energy studies shall be undertaken in technical colleges which includes hostels, DG sets to evaluate their performance. Suggest measures to conserve energy in institutes and industries. Undertake energy auditing in nearby industries. Suggest measures to conserve energy in institutes

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Provide Hands on experience to engineering students on energy auditing. Improved awareness about opportunities to save energy and thus save planet earth for environmental degradation Train adjoining villages on energy conservation underline.

II. ENERGY AUDIT OBJECTIVE

Primary: The First objective is to acquire and analyze data and finding the energy consumption pattern of these facilities. The second objective will be to calculate the wastage pattern based on the results of the first objective. The final objective is to find and implement solutions that are acceptable and feasible Secondary: This would be our first exposure to this field hence experience gain would be vital. This project will precede many follow up projects and hence help graduate engineering students to gain technical and management exposure required for future energy projects It is sure to help create a repertoire of vital contacts hence will develop interaction with alumni, faculty and students.

It would also increase knowledge among students about streams of study other than their own which is in the spirit of the interdisciplinary approach of GSIT Karwar. Energy audit methodology The methodology adopted for this audit was Formation of audit groups for specific areas and end use Visual inspection and data collection Observations on the general condition of the facility and equipment and quantification Identification / verification of energy consumption and other parameters by measurements Detailed calculations, analyses and assumptions Validation Potential energy saving opportunities Implementation As a first step in this regard, 4 teams of total 6 students from the group were formed and each.

Lux meter Reading of Hostels (at GSIT Karwar)
(All readings in lux)
Hostel Study Room - 200
Mess Canteen - 250
Bathroom -100
Sports Room - 120

Clearly the current lighting intensities are very high according to ECBC standards. Hence it is suggested to provide small CFL for corridors and bath rooms and LED tube lights for hostel rooms.
Halogen lamps of 500 W are being used for outdoor illumination which work for almost 13 hours daily.It is suggested

Benchmarking

Energy benchmarking involves the development of quantitative and qualitative indicators through the collection and analysis of energy-related data and energy management practices. Benchmarking in simplistic terms is the process of comparing the performance of a given process with that of the best possible process and to try to improve the standard of the process to improve quality of the system, product, services etc. It allows organizations to develop plans on how to adopt such best practices, usually with the aim of increasing some Aspect of performance. Benchmarking may be a one-off event, but is often treated as a continuous process in which organizations continually seek to challenge their practices. Benchmarking is a method which should be used on a continual basis as best practices are always evolving. Benchmarking of energy consumption is a powerful tool for performance assessment and logical evolution of avenues for improvement. Historical data, well documented, helps to bring out energy consumption and cost trends month-wise / daily. Trend analysis of energy consumption, cost, relevant production features, specific energy consumption, help to understand effects of capacity utilization on energy use efficiency and costs on a broader scale. The basis for benchmarking the energy consumption at GSIT-Karwar Hostels is energy consumed per student. The

Table1: ECBC Code 2006

Type of Interior Or Activity	Minimum Illuminance required (In Lux)
General	200
Reading Room	200
Reading tables	200
Bathrooms	50
Computer Workspace	300
Interior Parking Area	20
Music Rooms	200
Sports halls	200
Corridors, passageways &Stairs	50
Canteens ,Cafeterias ,Dining Rooms and Mess Rooms	150
Food Preparation and Cooking	300

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III. INSTALLATION OF SOLAR WATER HEATERS

We calculate the parameters that will be associated with this recommendation. Analysis for the Solar water heating systems for hostels of GSIT Karwar. Sample calculation for Hostel block. Considering Residents 110 Assuming an average requirement of 25 L of hot water per day Thus daily amount of hot water used= 110x25 = 2750 L An average flat plate collector area of 2 m^2 gives 125L of hot water per day. [1]

Thus total collector area required = 2750/125x2 = 11 m2 Assuming cost of installation to be around 15,000 Rs/m2 total capital cost comes out to be = 165000 Rs Total immersion coil usage in the hostel for approximately 110 hrs on a typical cool day for 1 kW for half an hour = 110x0.5= 55 kWh/day 55 x 25 = 1375 kWh/month

Immersion heaters are typically operational in IIT Karwar for about 120 days from November to February. Thus total energy consumption = 120x55 = 6600 kWh
Total expense with geysers = 6660x6 Rs/kWh = 39600 Rs.
Thus simple payback period = 165000 / 39600 = 4.16 years.

Clearly this is a comfortable payback period and it is advisable to have solar water heaters installed in this facility. The same calculation is done for all the hostel of GSIT

Table 2 Installation Of Biogas Plant At Hostel

Hostel	Connected Load in kW	LPG usage in kg/day	Food Wastage kg/day
Boys	7500	7	15
Girls	1500		

Typical waste food density is 890 kg/m^3[2]
Total volume of waste food per day is about 15 l.
Taking example of a commercially available bio gas unit Sintex floating type biogas plant FTGB- 50-01 of 0.5 m3/day capacity. [4]
Food waste generated (kg per day) =10
Installation cost (Rs) = 18,000
O & M (Rs) = Rs 1,000 p.a.
Methane generation = 4000 j/kg
Manure generated (kg per day) = 1 kg
Assumptions calorific value of biogas = 21MJ/m3
Calorific value of lpg = 46.1 mj/ kg
Energy output of biogas plant per day = 40 MJ
this implies that lpg saved = 1 kg/day
Total working days = 300 days
Approximately total annual savings = 300x1x60 = Rs 18000
Payback period = 1 year
Hence it is strongly recommended to install a biogas plant to utilize the food waste judiciously.

IV. CONTRACT DEMAND:

A study was undertaken to assess the contract demand vis a vis the maximum demand of the institution. The connected load was about 150 kVA and the maximum demand as cited in the energy bill by electricity supply company was recorded as follows. Considering the maximum demand recorded for over a year, it was decided to go in for reduction of contract demand from 150 kVA to 60 kVA. According there was a saving in the fixed payment charges from 113 kVA to 45 kVA = 68 kVA. Each kVA costs Rs 170 hence the saving achieved on monthly basis works out to Rs 11, 560.

Table 3 Recoded MD at GSIT, Karwar from August 2015 to Dec 2016

Month	Contract Demand kVA	75% of CD (kVA)	Recorded Demand (kVA)	Billing Demand (kVA)
Aug15	150	113	25	113
Sep 15	150	113	24	113
Oct 15	150	113	27	113
Nov 15	150	113	27	113
Dec15	150	113	24	113
Jan 16	150	113	25	113
Feb 16	150	113	25	113
Mar 16	150	113	27	113
Apr 16	150	113	29	113
May 16	150	113	27	113
June 16	60	45	27	45
July 16	60	45	18	45
Aug 16	60	45	22	45
Sept 16	60	45	32	45
Oct 16	60	45	27	45
Nov 16	60	45	26	45
Dec 16	60	45	28	45

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Centrifugal pump for pumping water
Two pumps each of 3 hp motor are used for pumping water from well to ground level tank and from tank to over head tanks of college and hostel.
The electrical measurements of the pump reveals the following
3 hp pump
Power (Hostel Pump) 440 V x 3.6,3.7,3.8 Amps
Power (College Pump) 440 V x 3.8, 3.9, 4.1 Amps (Rewound Motor)

It is observed that the rewound motor is consuming 10% extra power when compared to the unwound motor. Hence it is proposed to go in for economical evaluation to study if replacement is economically viable.

V. CONCLUSION

The study indicates that the awareness about energy conservation in engineering students is low. There is opportunity for conservation in educational institutions and scientific approach towards energy management needs to be undertaken by the concerned stakeholders. This measure shall help in conserving energy, reduce the expenditure towards energy costs and contribute to environment saving measures. Exterior illumination the 500 W halogen lamps have been replaced by 250 W Metal halide lamps which give better illumination. These measures have ensured energy conservation in this institution.

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