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Energy Audit of Educational Institute

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Abstract - *Energy audit is the primary study that identifies energy use among various services and provides opportunities for energy conservation. Energy auditing is an integral part of energy conservation. This paper reviews the initial attempts to understand the energy consumption patterns in a commercial building and to reduce the energy consumption. Payback calculation are done to understand the investment required and hence feasibility is confirmed. This paper also focuses on the CO2 emission generated by the consumed units.*

Key Words: **Audit, Energy saving, Load calculation, CO2 Emission, Payback period.**

1. INTRODUCTION

The energy audit is the process of systematic approach for decision making in the field of energy conservation and energy management. It endeavours to equalize the total energy inputs with their utilization, and serves to identify all the energy streams in the facility. Energy audit is an effective tool in defining and pursuing a comprehensive energy management program within a business. As electrical energy utilization in commercial buildings is increasing rapidly with the increase in utilization of more and bigger capacity electrical equipment. Energy audit is the first step which can be conducted within an organization for the development of electrical energy efficient measures.

The ultimate goal of the energy audit is to emphasize the concept of energy conservation in the campus of an Educational Institute.

The scope of energy audit study includes:

- Identification of energy saving potential based on the energy wastage in different locations.
- Calculations of energy saving potential based on the energy wastage in different locations.
- Recommending low cost measure to enhance the effectiveness of energy use.
- Calculation of payback period for the above recommendations.

2. OBJECTIVE

A detailed energy audit conducted in the Educational Institute mainly aims at the following points:

1) To Assess present pattern of Energy Consumption and Relating Energy input and Production output.
2) To study CO2 Emission.
3) To measure various Electrical parameters.
4) To assess the various equipment/facilities from Energy efficiency aspect and suggesting various measures to reduce electricity consumption and calculating Payback Period for same.

3. METHODOLOGY

As per the energy conservation Act, 2001 [pass by the government of India], Energy audit is defined as "The verification , monitoring and analysis of the use of energy including submission of technical report containing recommendation for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption consist of four phases."

The Methodology of the Audit is Presented in the following chart:

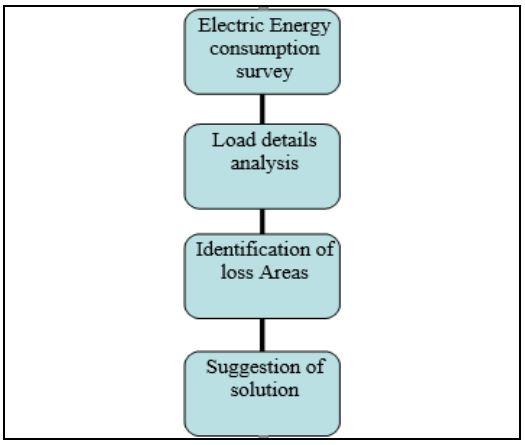

Chart – 1 : Methodolody of Audit

The detail information of above four phases is illustrated/ explained in further Paper:

3.1 Electric Energy Consumption Survey

This energy audit is aimed at obtaining a detailed idea about the various end use energy consumption activities and identification, enumerating and evaluating the possible energy solving opportunities. The target is to achieve savings in electrical consumption.

Electrical Energy consumption

This Educational Institute being an HT consumer takes 11 KV supply from MSEDCL. Energy auditing has been conducted in the Institute in order to estimate the energy consumption of each month and year. For energy auditing it is necessary to analyse consumption of electrical energy. The electricity utility bills for past 11 months (April 2018-February 2019) has been collected for the purpose. This collected data of electricity was taken from the records of institution. Hence the present level of energy consumption of the institution has been analysed, averaged (for 11 months) and found to be:

Table -1 : Present Level of Energy Consumption

No	Parameter/ Value	Energy (KWh)	Power Factor	Maximum Demand (KVA)	CO2 Emission (MT)
1.	Maximum	32264	0.94	206	25.81
2.	Minimum	19396	0.92	142	15.52
3.	Average	27017	0.93	169	21.61

The 1 Unit of Electrical Energy releases 0.8 Kg of CO2 in atmosphere.

Hence, CO2 Emission is Calculated accordingly,

1. For Maximum : 32264*0.8= 25811 Kg = 25.11 MT

2. For Minimum : 19396*0.8=15516 Kg = 15.52 MT

3. For Average : 27017*0.8=21613 Kg = 21.61 MT

Three phase (krykard ALM 36) 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.

Advantages of Analyzer:

- It will record output in analog as well digital format.
- It will measure all electrical parameters at a time.
- This Analyzer measures the quantities like V_{rms}, A_{rms}, V_{fund}, A_{fund}, VA_{fund}, V_{peak}, A_{peak}, Frequency, KW, KVA, KVAR, KWh, Power factor.

Features of Analyzer:

- Have a battery backup.
- Measurements are recorded automatically.
- Storage facility is available.
- Long term analysis is possible.
- Data can be viewed in graphs.

With the help of this meter we have calibrated the MSEDCL meter which is installed in the Institute premises.

It is a 24- hour analysis as shown in table:

Table – 2: Calibration of MSEDCL Meter

Date	Time	Parameter	Reference Meter (KRYKARD ALM 32)	Meter under Test (MSEDCL Meter)
18/9/2019	12:20 PM	Initial kWh Reading	0.00	251889
19/9/2019	12:19 PM	Final kWh Reading	701.03	252241
Difference			701.03	352
Multiplying Factor			1.00	2.00
Corrected difference			701.03	704
% Error			0.424%	

After taking measurements, we have done the analysis and calculated the error which is 0.424%.

- Standard: The percentage error should be less than or equal to ± 5%.
- Observation: In this case it is 0.424%, which is within acceptable limits.

Hence MSEDCL meter is callibrated.

3.2 Load detail analysis

The different loads available in the institute are:

- Fan
- T-8 FTL
- 20W LED
- PC
- Projector
- PRINTER
- AC
- Others

The load utilization survey of institute is represented using pie chart as follows:

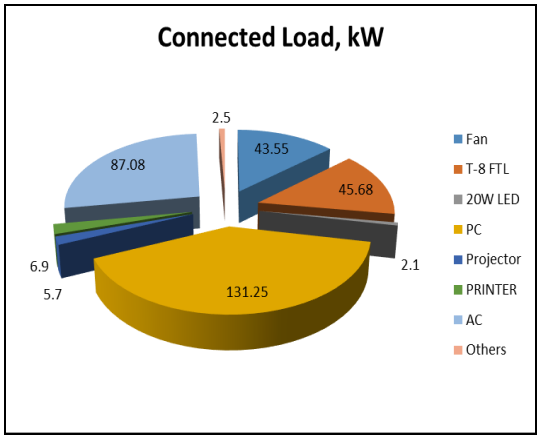

Chart - 2: Total Connected Load

The details of the connected load are:

TABLE - 3: Details of Connected Load

No	Equipment	Qty	Load, W/Unit	Load, kW
1	Fan	670	65	43.55
2	T-8 FTL	1142	40	45.68
3	20W LED	105	20	2.1
4	PC	875	150	131.25
5	Projector	38	150	5.7
6	PRINTER	46	150	6.9
7	AC	43	2025	87.08
8	Others	25	100	2.5
9	**Total**			**325**

3.3 Identification of loss areas

After investigating the audit site properly, we observed that where the energy losses are more and the areas are:

- Lighting loads/area
- Rotating systems

Hence, the Suggestions given in this area to reduce the Losses are:

1. Replacement of 1142 Nos T-8 Fittings by 20 W LED Fittings.
2. Replacement of 630 Nos conventional Fans by Energy Efficient Fans.
3. Replacement of Conventional Ballast with Electronic Ballast.

3.4. Calculation of Payback Period

The Payback Period Calculation for above suggestions is as shown in the following table:

TABLE – 4: Payback Period Calculation

Recommendation	Potential annual savings	Investment required (Rs)	Simple payback period
Replacement of 1142 Nos T-8 fittings by 20 W LED fittings	954712	399700	10 Months
Replacement of 630 Nos conventional fans by energy efficient fans	582230	804000	32 Months
Replacing conventional ballast with electronic ballast	276384	285500	24 Months

4. 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. By this analysis, if we implement Energy Efficient Equipment, we can conserve power being wastage with current devices without disturbing the output and we can use it for some other devices. By using Energy Efficient Devices, we can save and reduce shortage of Power and can reduce power inflation.

5. REFERENCES

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