# ENERGY AUDIT IN GOVT. POLYTECHNIC COLLEGE,AJMER CAMPUS

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## ABSTRACT

*An energy audit is a study of a plant or facility to determine how and where energy is used and to identify methods for energy savings. In this paper we are presenting Energy Audit in main Block of Govt. Polytechnic College Ajmer Campus. This energy audit of the GPC AJMER campus academic area, the hostels and was carried out by me of the Department of Electrical Engineering as a part of this paper. This paper is just one step, a mere mile marker towards our destination of achieving energy efficiency and we would like to emphasis that an energy audit is a continuous process. The following paper has been prepared with a view to facilitate our understanding of the energy consumption pattern of the building of GPC, Ajmer. The report focuses on energy efficiency measures. An energy audit is an inspection, survey and analysis of energy flows in building, processor system with the objective of understanding the energy dynamics of the system under study. The energy audit details establishes the needs for plant metering and monitoring enabling the plant manager to institutionalize the practice and hence, save money for the years to come. The steps and sets the preliminary budget for the energy management program. Insupport of the much required energy conservation measures the GPC, ajmer decided to replace old ceiling fans by new energy efficient ceiling fan of 50W and tube-light fittings using 40W with new 28W energy saving tube-light fixtures in entire college campus.*

**Keyword**: - *GPC , Energy, Audit, Tube light, Plant etc .*

## 1. INTRODUCTION

Government Polytechnic College Ajmer or GPC Ajmer is a higher education institute under technical education department Govt. of Rajasthan located in Makhupura, Nasirabad road, Ajmer, Rajasthan. It was established in 1958 with mechanical, electrical and civil engineering faculties and was extended to include electronics engineering. The college teaches diploma courses in mechanical engineering, civil engineering, electrical engineering, printing technology, mechanical automobile engineering, instrumentation engineering, and computer science. GPC AJMER is affiliated to BTER Jodhpur and approved by AICTE. The strength of students is around 1000.

- Civil Engineering
- Computer Sc. Engg.
- Electrical Engineering
- Electronics Engineering
- Mech. Engineering
- Printing Technology
- Instrumentation Engineering
- Mech.(Automobile) Engineering

The energy consumption on campus is mainly in the form of electricity, apart from the use of LPG as cooking fuel in the hostel. The campus had a connected electrical load of 60KW as on MARCH, 2017 and a contract demand of 72 KVA . The electricity bill comprises two parts: one related to the energy consumed (per kWh or per unit energy consumed) and the other is the maximum demand charge (per kVA of maximum demand during the month). There also exists a penalty for low power factor. Furthermore, the energy charge includes a component based on time of use. The Specific Energy Consumption (SEC) is defined as the energy consumption per unit of product output. The specific energy consumption considering students, faculty and staff members were calculated which forms the institute SEC and was taken as reference for comparison. The SEC was calculated to be 3 kWh/person/month (for 2016) for the academic area and Rs. 21 per person per month.This energy audit details has segmented the energy consumption patterns both by departments/ hostels/ offices and by end use activities (lighting, cooling, pumping, washing etc.).

## 2. ENERGY AUDIT FOR BUILDINGS

Energy audit has a vital role in the implementation of energy conservation measures. This enables them to meet the Energy Efficiency Standards. There are several types of energy audits that are commonly performed by energy service engineers with various degrees of complexity. The key aspects of a detailed energy audit procedure and a systematic approach to identify cost efficient energy conservation measures are discussed here.

### 2.1 Need Of Energy Audit

The energy crisis in the present day world has led us to the design of new energy efficient buildings. An energy audit establishes both where and how energy is being used, and the potential for energy savings. It includes a walk-through survey, a review of energy using systems, analysis of energy use and the preparation of an energy budget, and provides a baseline from which energy consumption can be compared over time. An audit can be conducted by an employee of the organization who has appropriate expertise, or by a specialist energy-auditing firm. An energy audit report also includes recommendations for actions, which will result in energy and cost savings. It should also indicate the costs and savings for each recommended action, and a priority order for implementation. As per the Energy Conservation Act, 2001, Energy Audit is defined as the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption.

### 2.2 Types Of Energy Audits

- Walk-Through Audit
- Utility Cost Analysis
- Standard Energy Audit
- Detailed Energy Audit

## 3. GENERAL PROCEDURE FOR A DETAILED ENERGY AUDIT

To perform an energy audit, several tasks are typically carried out depending on the type of the audit and the size and function of the building. Some of the tasks may have to be repeated, reduced in scope, or even eliminated based on the findings of other tasks. Therefore, the execution of an energy audit is often not a linear process and is rather iterative. The main purpose of this step is to evaluate the characteristics of the energy systems and the patterns of energy use for the building. The building characteristics can be collected from the architectural/ mechanical/electrical drawings and/or from discussions with building operators. The energy use patterns can be obtained from a compilation of utility bills over several years. Analysis of the historical variation of the utility bills allows the energy auditor to determine any seasonal and weather effects on the building energy usage.

## 4. VERIFICATION METHODS OF ENERGY SAVINGS

Energy conservation retrofits are deemed cost-effective based on predictions of the amount of energy and money a retrofit will save. However, several studies have found that large discrepancies exist between actual and predicted energy savings. Due to the significant increase in the activities of energy service companies (ESCOs), the need became evident for standardized methods for measurement and verification of energy savings. This interest has led to the development of the North American Energy Measurement and Verification Protocol published in 1996 and later expanded and revised under the International Performance Measurement and Verification Protocol. In principle, the measurement of the retrofit energy savings can be obtained by simply comparing the energy use during pre- and post-retrofit periods. Unfortunately, the change in energy use between the pre- and post-retrofit periods is not only due to the retrofit itself but also to other factors such as changes in weather conditions, levels of occupancy, and HVAC operating procedures. It is important to account for all these changes to accurately determine the retrofit energy savings. Several methods have been proposed to measure and verify savings of implemented energy conservation measures in commercial and industrial buildings.

## 5. ENERGY AUDIT METHODOLOGY

The methodology adopted for this audit was

- Audit for specific areas.
- 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

The various measuring instruments like Power demand analyzers and Lux meters to assist in the auditing activity. Also, cooperation of the Electrical Maintenance and Estate Section was sought to collect past data and for taking measurements.

## 6. MEASUREMENTS PERFORMED

### 6.1 **Lighting And Fan Loads**

The energy consumption of FTLs (Fluorescent Tube Lights) which are commonly used in the campus is shown below. The energy consumption of the FTLs used in hostels is found to be high compared to 28W T5 FTL.

**Table - 1:** Measurements for lighting

| **FTL with Electronic Ballast** | | | |
|---|---|---|---|
| V(volts) | I(Amp) | P(W) | P.F. |
| 223 | 0.53 | 42. | 0.58 |

| **FTL with Electro-Magnetic choke** | | | |
|---|---|---|---|
| V(volts) | I(Amp) | P(W) | P.F. |
| 228 | 0.53 | 46 | 0.38 |

Few of the lux measurements taken in the campus are as shown below.

| **Room No** | **#52-FTL** | **#48-FTL** |
|---|---|---|
| Day without Fl. Lamp | 84 | 32 |
| Day with Fl. Lamp | 174 | 133 |
| Night | **74** | **93** |
| Study Table | **72** | 32 |

The lux levels are found to be far less than the standard values in rooms.

**Fans**

From the power consumption of ceiling fans with resistance and electromagnetic regulators, it was seen that the latter consumes less power at lower speeds of the fan.

**Table - 2:** Sample measurements on fans.

Sample Reading

| Ceiling Fan | | **Resistance regulator** | | |
|---|---|---|---|---|
| Fan Tab | V(volts) | I(Amp) | P(W) | P.F. |
| 1 | 223 | 0.42 | 42 | 0.448 |

Sample Reading

| Ceiling Fan | | **Electronic Regulator** | | |
|---|---|---|---|---|
| Fan Tab | V(volts) | I(Amp) | P(W) | P.F. |
| 1 | 233.7 | 0.26 | 13 | 0.214 |

**6.2 Computers & Printers**

The power consumption by the computer and printer under different modes of operation are shown below.

**Table - 3: Measured power consumption for computers and printers in different operating modes**

| **S No** | **Equipment** | **Mode of Operation** | **Power (W)** | **Power factor** |
|---|---|---|---|---|
| **1** | Monitor | **On** | 28 | 0.586 |
| **2** | CPU | **On** | 54.0 | 0.630 |
| **3** | Monitor & CPU | **On** | 108 | 0.640 |
| **4** | Laser Printer | **On** | 5 | 0.380 |

## 7. ENERGY EFFICIENT LIGHTING

Electric lighting is a major energy consumer. Enormous energy savings are possible using energy efficient equipment, effective controls, and careful design. Using less electric lighting reduces heat gain, thus saving air-conditioning energy and improving thermal comfort. Electric lighting design also strongly affects visual performance and visual comfort by aiming to maintain adequate and appropriate illumination while controlling reflection and glare.Lighting is not just a high priority when considering hotel design; it is also a high- return, low-risk investment. By installing new lighting technologies, hotels can reduce the amount of electricity consumed and energy costs associated with lighting.There are several types of energy efficient lighting and affordable lighting technology. The following are a few examples of energy-saving opportunities with efficient lighting.

- Installation of occupancy/motion sensors to turn lights on and off where appropriate.
- Use an automated device, such as a key tag system, to regulate the electric power in a room.
- Installation of compact fluorescent lamps (cfls) in place of incandescent lamps.
- Installation of energy-efficient fluorescent lamps in place of "conventional" fluorescent lamps.

## 8. ENERGY EFFICIENT FAN ENERGY EFFICIENT FAN

I-fans use EC-technology. EC-technology combines the advantages of AC and DC motors. Easily connected to the net, the motor and all the electronic components including the net filters are contained in a single metal housing. This eliminates the need for shielded cables and makes using extremely long cables possible. In addition, the motor is supplied with a connection box, and includes 2.5 m of cable enabling quick installation, without opening the motor. The fan is easy to control using a 0-10V-signal and via I/O-Net communication from a Fancom controller. The most important advantage offered by EC technology is its energy efficiency. The efficient motors produce less heat, so therefore lose less energy. Using the I-fan in Fancom ventilation systems can give you the benefit of energy savings of 75%. Even compared to the currently used energy efficient systems with frequency control, energy savings of up to 20% are feasible. The extra investment can be earned back within the space of just one to two years.

### 8.1 Reliable

I-fans are highly resistant to the aggressive substances found in the air in livestock buildings. They have IP66 classification, which means that according to the official standards they are "dust tight" (highest classification) and "protected against heavy seas or water projected in powerful jets". IP66 classification safeguards a long and malfunction free operating life. Extra safety features ensure reliable air replenishment in the house. The automatic failsafe keeps the fan running at the lowest value if the signal from the climate computer fails. At restart there are two options - a capacity of 50% or 100%. If overload or overheating threatens to occur the fan corrects its RPM, but always continues to run. This means that your animals have enough fresh air under all circumstances. The fan can also be operated manually.

### 8.2 Intelligent

Internal electronics regulate the RPM of the fan, so an external triac or frequency controller is no longer required. The motor continually checks the RPM and corrects it automatically. The result is an extremely constant air flow without any negative wind influences.

## 9. RESULT ANALYSIS

We are living in a developing country our need of energy increases day by day but resources of Energy Limited in our country. They are reducing day by day there for the gap between demand and supply increase regularly. The cost of energy also increases regularly. To reduce cost of energy conservation is necessary most power in our country consumed by industries however industries are not paying attention to save energy. They are paying attention only on their production. There is a lot of waste energy in industry but the management ignore. So it is very important that the industry people should be educated regarding conservation of energy energy audit is an important process for that purpose. Industries should offer regular energy audit to reduce energy and other wastage.

### 9.1 Recommendation

The Following Measures are suggested to save the energy Consumption in GPCA Campus.

| S.NO | Implementation Measures |
|---|---|
| **1** | Install APFC for p.f. improvement in Labs. |

| | |
|---|---|
| **2** | Replace Electromagnetic ballast by Electronic ballast in TL |
| **3** | Replacing Electromagnetic FTLs by T5 in Departments |
| **4** | Replacing common area lighting in departments with T5 TL /CFL |
| **5** | Replace rheostatic speed regulators with electronic speed regulators for fan |
| **6** | Replacing TLs used in student rooms with 28W ballast FTLs. |
| **7** | Ordinary fans(70w) are replaced by energy efficient fan(50w) |
| **8** | Replacing faulty non-return valves of pumps |
| **9** | Installing 200 Aircon savers for 1.5 Ton ACs with a higher duty cycle (> 8 hrs./day) |

| Name of Block | Fan | Tubelight | PC | kw | Power Saving by replacing with energy efficient appliances(kw) | Working Hrs | Energy Consumption In kwh | Energy saving in kwh |
|---|---|---|---|---|---|---|---|---|
| Printing, Civil, Mechanical Workshop | 0 | 12 | | 0.480 | 0.144 | 10 | 4.800 | 1.440 |
| | 103 | 152 | 4 | 13.290 | 3.884 | 6 | 79.740 | 23.304 |
| | 21 | 58 | 2 | 3.790 | 1.116 | 4 | 15.160 | 4.464 |
| | 0 | 2 | | 0.080 | 0.024 | 1 | 0.080 | 0.024 |
| Main Block | 0 | 12 | | 0.480 | 0.144 | 10 | 4.800 | 1.440 |
| | 0 | 12 | | 0.480 | 0.144 | 8 | 3.840 | 1.152 |
| | 94 | 156 | 30 | 12.820 | 3.752 | 6 | 76.920 | 22.512 |
| | 20 | 30 | | 2.600 | 0.760 | 4 | 10.400 | 3.040 |
| | 2 | 3 | | 0.260 | 0.076 | 2 | 0.520 | 0.152 |
| | 4 | 5 | | 0.480 | 0.140 | 1 | 0.480 | 0.140 |
| Admin Block,EL,IE, Library, Girls Hostel | 16 | 44 | | 2.880 | 0.848 | 10 | 28.800 | 8.480 |
| | 2 | 12 | | 0.620 | 0.184 | 8 | 4.960 | 1.472 |
| | 59 | 244 | 9 | 13.890 | 4.108 | 6 | 83.340 | 24.648 |
| | 49 | 107 | 15 | 7.710 | 2.264 | 4 | 30.840 | 9.056 |
| | 19 | 39 | 1 | 2.890 | 0.848 | 2 | 5.780 | 1.696 |
| | 4 | 11 | | 0.720 | 0.212 | 1 | 0.720 | 0.212 |
| Total | 393 | 899 | 61 | 63.47 | 18.648 | | 351.18 | 103.232 |

**9.2 Calculation Of Pay Back Period**

Grant Total of Saving=total saving of as per table
=103.232 kwh
Energy Saved per day=103.232 kwh
Energy Saved per day in Rs.= 103.232 *7=Rs.722.624
Energy Saved per year in Rs.= 722.624*240=Rs. 173429.76
1. Replacing 40w TL by T-5 , 28W,

Total cost in Rs.= No. of installation as per table *cost of new T.L. set
= 894*350= Rs. 312900 ----------A

2. Replacing of ceiling fan 70w by ceiling fan 50w,

Total cost in Rs= No. of installation as per table *cost of new fan
=391*1155=Rs. 451605 ----------B

Grant Total COST in Rs.= Total (A+B)
=312900+451605
= Rs. 7645055

Pay Back Period=Grant Total Cost In Rs./Energy Saved Per Year
=RS. 764505/RS.173429.76
= 4.4 year

## 10. CONCLUSIONS

The main aim of this paper was that the institute could utilize maximum energy at low cost. This can be achieved by taking up three objectives. The first was to perform an energy audit on the institute to assess its current level of efficiency. The second objective was to apply energy convert conservation measures to the week areas of the institute. Lastly, the audit created a series of recommendation dealing changes that the institute can take up to become more efficient to become more energy efficient. These objectives proved to be more Complex than initially anticipated, with unforeseen complications arising, but we are able to achieve the desired results. The walk through audit of the institute provided copious amount of data but that in itself was not enough to research any changes. We needed to obtain some more detailed information such as the history of utility uses for the institute, appliance details and performance of each appliance for this we have conducted a detailed energy audit it took about 3 months. The payback period of energy audit program for GPC, Ajmer will be 4.5 years implementation of ECOs is being carried out and will be completed latest by 2017. The implementation of energy saving measures suggested in this report is solely depended upon the decision of the management of the college. Several ECOs that are cost effective or not often implemented due to lack of internal funding such as a replacement of old appliances by energy efficient appliances. If we replace the energy saving appliance like tube- lights, LED bulb and ceiling fan in house hold and other industries, where the continuous power consumed. The cost will be regained in 2-3 years.

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