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A Case Study on Energy Conservation & Audit for Household Applications

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ABSTRACT: Power, the word itself says to what extent the world is dependent on it. It may be fortunate or unfortunate, we are totally dependent on the power which is making the usage higher and higher which left us with energy crises and increasing costs of the energy usage. It's time for Energy saving. These days, number of people in favour of the Energy saving has been increasing not to lessen the cost of usage but to let our future generations livewith light and luxury. In this paper we have analyseddifferent methods of energy auditing and we have analysed Energy conservation measures for Homes and Buildings that will save the energy to a little higher extent by using Energy Efficient Devices.

KEYWORDS: Audit, Energy Conservation, Efficiency, Auditing types, Energy Conservation opportunities, ECM'S.

I.INTRODUCTION

Energy crisis is one of the major problems in the existing world.An energy crisis is any great bottleneck in the supply of energy resources to an economy.There has been an enormous increase in the global demand for energy in recent years as a result of industrial development and population growth.Since the early 2000s the demand for energy,especially from liquid fuels, and limits on the rate of fuel production has created such a bottleneck leading to the current energy crisis.This problem will solved through Energy conservation and use of energy efficient equipment.
With the use of energy efficient measures in different sectors of consumption like Lighting, Refrigeration and HVAC helps energy conservation. An energy efficient lighting design with controls reduces the power consumption and will be a major energy saving component along with commercial and residential sectors.A proper light Design will be able to percept the surroundings and can reduce energy consumption. Similarly HVAC,Heating,ventilation and Air conditioning (HVAC) is a significant operating expense in commercial buildings, accounting for 51% of energy use,An HVAC economizer is a dampered vent designed to save energy and give the cooling system a break. Sensors within the economizer compare the outdoor temperature and humidity with that inside the building.If the outside air is cool enough,the damper is opened to bring outside air in, thereby reducing the need for mechanically cooled air. If the outside air is not cool enough, which is indicated by the Economizer's sensors, the damper are closed.

II. ENERGY AUDIT

An energy audit is an inspection, survey and analysis of energy flows for energy conservation in a building, Process or system to reduce the amount of energy input into the system without negatively affecting the output. It shows where the power consumption is more in the given system. It can also be called as controllingof thepower to avoid losses for maximize efficiency.

NEED FOR ENERGY AUDIT:

Energy savings of the order of 5 to 20% are possible by optimizing use of Energy with better housekeeping, low cost retrofitting measures and use of Energy efficient equipment at the time of replacement, renovation or up gradation. Indian industry consumes much more energy per unit production as compared to its counterparts in the developed countries. Energy Audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areaswhere waste can occur and where scope for improvement exists. The Energy Audit would give a

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positive orientation to the energy cost reduction, preventive maintenance and quality control programs which are vital for production and utility activities. Such an audit programme will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc. In general, Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame.The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a "bench- mark" (Reference point) for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization.

III.TYPES OF ENERGY AUDITS

Energy Audit is a schematic approach for decision making in the area of energy management. It is defined as the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving Energy Efficient with cost benefit analysis and an action plan to reduce energy consumption. There are two types of Audits:

A)PRELIMINARY AUDIT:

The preliminary audit alternatively called a simple audit, screening audit or walk-through audit, is the simplest and quickest type of audit. It involves minimal interviews with site operating personnel, a brief review of facility utility bills and other operating data, and a walk-through ofthe facility to become familiar with the building operation and identify glaring areas of energy waste or inefficiency. Typically, only major problem areas will be uncovered during this type of audit. Corrective measures are briefly described, and quick estimates of implementation cost, potential operating cost savings, and simple payback periods are provided. This level of detail, while not sufficient for reaching a final decision on implementing a proposed measures, is adequate to prioritize energy efficiency projects and determine the need for a more detailed audit.

B) DETAILED ENERGY AUDIT:

It is a comprehensive Audit provides a detailed energy project implementation since it evaluates all major energy using systems. It is an accurate method for Energy saving and Audit. In this audit mainly two phases are involved

Phase-I: Pre Audit Phase.

Phase-II: Audit Phase.

Phase-III: Post Audit Phase.

C) STEPS INVOLVES IN ENERGY AUDITING:

1) Interview with key facility person: In this, Meeting is scheduled with auditor and all key auditing personals the meeting is focussed on Audit objectives, scope of work, facility rules and regulations, Roles and Responsibilities of members. In addition to these administrative issues, the discussion during this meeting seeks to establish: operating characteristics of the facility, energy system specifications, operating and maintenance procedures, preliminary areas ofinvestigation, unusual operating constraints, anticipated future plant expansions or changes in product mix, and other concerns related to facility operations.

2) Facility Tour:

After the initial meeting, a tour of the facility is arranged to observe the various operations first hand, focusing on the major energy consuming systems identified during the interview, including the architectural, lighting and power, mechanical, and process energy systems.

3) Document Review:

During the initial visit and subsequent kick-off meeting, available facility documentation are reviewed with facility representatives. This documentation should include all available architectural and engineering plans, facility operation and maintenance procedures and logs, and utility billsfor the previous three years. It should be noted that the available plans should represent "as-built" rather than "design" conditions. Otherwise, there may be some minor discrepancies between the systems evaluated as part of the audit and those actually installed at the facility.

4) Facility Inspection:

After a thorough review of the construction and operating documentation, the major energy consuming

Processes in the facility are further investigated. Where appropriate, field measurements are collected to substantiate operating parameters.

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5)Staff Interviews:
Subsequent to the facility inspection, the audit team meetsagain with the facility staff to review preliminary findings and the recommendations being considered. Given that the objective of the audit is to identify projects that have high value to the customer, management input at this junction helps establish the priorities that form the foundation of the energy audit. In addition, interviews were scheduled with key representatives designatedby the facility as having information relevant to the energy audit. These representatives may include majorenergy consuming system service and maintenance contractors and utility representatives.
6) Utility Analysis:
The utility analysis is a detailed review of energy bills from the previous 12 to 36 months. This should include all purchased energy, including electricity, natural gas, and fuel oil, liquefied petroleum gas (LPG) and purchased steam, as well as any energy generated on site.
7) Identify/Evaluate Feasible ECMs:
Typically, an energy audit will uncover both major facility modifications requiring detailed economic analysis and minor operation modifications offering simple and/or quick paybacks. A list of major ECMs is developed for each of the major energy consuming systems (i.e., envelope, HVAC, lighting, power, and process). Based upon a final review of all information and data gathered about the facility, and based on the reactions obtained from the facility personnel at the conclusion of the field survey review, a finalized list of ECMs (energy conservation measures) is developed and reviewed with the facility manager.
8) EconomicAnalysis:
Data collected during the audit is processed and analysed back in our offices. We build models and simulations with software to reproduce our field observations and develop a baseline against which to measure the energy savings potential of ECMs identified. We then calculate the implementation cost, energy savings and simple payback for each of the ECMs being investigated.
9) Prepare a Report Summarizing Audit Findings:
The results of our findings and recommendations are summarized in a final report. The report includes a description of the facilities and their operation, a discussion of all major energy consuming systems, a description of all recommended ECMs with their specific energy impact, implementation costs, benefits and Payback. The report incorporates a summary of all the activities and effort performed throughout the project with specific conclusions and recommendations.
10) Review Recommendations with Facility Management
A formal presentation of the final recommendations is presented to facility management to supply them withsufficient data on benefits and costs to make a decision on which ECMs to be implemented.

IV.ENERGY

Energy is the ability to perform a specific task. There are different forms of energy such as Electrical, Mechanical etc. Electricity is produced through different forms such as Thermal, wind, hydro etc. But the non-renewable resources(Coal,Water and Petroleum products) are being depleted.Energy is more than numbers on a utility bill; it is the foundation of everything we do. All of us use energy every day—for transportation, cooking, heating and cooling rooms, lighting, manufacturing, water-use, and entertainment. We rely on energy to make our lives comfortable, productive, and enjoyable. Sustaining this quality of life requires that we use our energy resources wisely. So we must change to energy efficient technology or Renewable technology power generation. So, it is preferred to use energy efficient technology because the amount of power generated through renewable sources is limited. Moreover If we think of using renewable (Solar,Wind or any other),we should first accept that we are using these sources to produce power.The appliances that we will connect to these sources will be electrical appliances that will consume power.As Renewable energy sources are not cheap,we have to understand that a bigger system will be expensive.To reduce the cost the best approach is to reduce the electricity requirement of the systems connected to it and using energy efficient appliances .Energy efficient technology will be a best solution to reduce the gap between the Energy consumption to Energy production. The careful management of resources includes reducing total energy use and using energy more efficiently. The choices we make about how we use energy turning machines off when not in use or choosing to buy energy efficient appliances will have increasing impacts on the quality of our environment and lives. There are many things we can do to use less energy and use it more wisely. These things involve energy conservation and energy efficiency.

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V.ENERGY EFFICIENCY& CONSERVATION

Energy Conservation:
Energy conservation refers to reducing energy through using less of an energy service. Energy conservation differs from efficient energy use, which refers to using less energy for a constant service.
For example, driving less is an example of energy conservation. Driving the same amount with a higher mileage vehicle is an example of energy efficiency. Energy conservation and efficiency are both energy reduction techniques.
Energy efficiency, sometimes called efficient energy use, is using less energy to provide the same level of performance, comfort, and convenience.
For example,

- ✓ Insulating a home allows a building to use less heating and cooling energy to achieve and maintain a comfortable temperature.
- ✓ Installing a fluorescent bulbs or natural skylights reduces the amount of energy required to attain the same level of illumination compared with using traditional incandescent light bulbs.
- ✓ Compact fluorescent lights use one-third the energy of incandescent lights and may last 6 to 10 times longer.

There are many motivations to improve energy efficiency. Reducing energy use reduces energy costs and may result in a financial cost saving to consumers if the energy savings offset any additional costs of implementing an energy efficient technology. Reducing energy use is also seen as a solution to the problem of reducing carbon dioxide emissions .Energy efficiency and renewable energy are said to be the twin pillars of sustainable energy policy and are high priorities in the sustainable hierarchy Modern appliances, such as, freezers, ovens, stoves, dishwashers, and clothes washers and dryers, use significantly less energy than older appliances. Current energy efficient refrigerators, for example, use 40 per cent less energy than conventional models

VI. RECOMMENDATIONS FOR LOW POWER CONSUMPTION IN HOMES AND BUILDINGS

A) LIGHTING: Take advantage of sunlight and leave lights off during the day.Use compact fluorescent light bulbs in place of conventional incandescent light bulbs. CFL uses approximately one- fourth the wattage of an incandescent bulb producing a similar level of illumination, and they last 8,000 to 10,000 hours. Install motion-detection switches or timers for outdoor lighting rather than leaving lights on all night. Replace incandescent night lights with LED or electro luminescent lights. Change conventional ballast with electronic ballast.Many automatic devices can help in saving energy used in lighting. Consider employing infraredsensors, motion sensors, automatic timers, dimmers and solar cells wherever applicable, to switch On/off lighting circuits.

B)FANS: As in case of lights, switch offthe fans when not in use. If you are buying a new fan, buy energy efficient fans. Wherever your fan usage is more than 12 hours, replace them by energy efficient fans, you will get your money back in 2 years and after that it will be all bonus for you.

C)TV: Most of the time, we keep the TV and associated electronic items (Set-up box, Speakers, etc.) on even when not in use. You may think that this does not consume a lot of electricity, but it does. Make it a habit to switch off the TV when you are not watching it.

D)REFRIGERATORS: Keep the refrigerator away from the wall by about half feet. Refrigerators throw out heat and this heat needs to escape. If we do not let the heat go away, its efficiency reduces. Also, do not keep your fridge stuffed with lot of food items. In winters, you can keep the fridge in min cool mode. If some container has very less food, try to finish it, as the fridge will waste more energy in keeping the container itself cool.

E)AC's: If you have one or more ACs at home, this is the item you should focus on the most to save electricity. Ensure that your doors and windows are properly closed when you use the ACs. Replace the old Air Conditioner with Energy Efficient Equipment .Switching on the fan while using the ACs helps you in keeping the AC at a higher temperature Old ACs use lot of electricity so better to replace it with new equipment.

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F) REDUCE ELECTRICITY USUAGE:

1.Turn off all electric appliances (lights, computers, televisions) when they are not in use. Computer printers and photocopiers are typically.
2.Watch TV with the light off
3. Change out a CRT TV with an LCD model of equivalent size.
4. Reduce miscellaneous electric use from power adapters and electronics in standby mode by plugging them into a power strip that can be switched off.
6. Set your computer to automatically shut off the monitor and switch to standby mode (if available) after a certain number of minutes of disuse. Choose a flat panel display instead of a conventional CRT. Adjust your display's brightness to the surrounding light conditions (less brightness is needed in dark rooms).
7. Purchase a laptop and use it as a replacement for your desktop computer. Most laptops are optimized for energy efficiency and don't need an uninterruptible power supply, since the battery can be used during thunderstorms.
8. Use products with the Energy Star logo (or similar). In particular, recycling and replacing old refrigerators with an Energy Star-approved one can save a few hundred kilowatt-hours a year. Replacing old refrigeration and air conditioning units (even if they are still functional) with more efficient ones is often an economically and ecologically sound decision.
9. Consider installing and using a clothes line for drying clothes. Each load not dried in an electric dryer saves 3 to 5 kilowatt hours.
10. Unplug appliances that will not be used for an extended period of time; many devices, especially consumer electronics, use a small amount of electricity even when they are switched off, due to indicator lights or listening for remote-control signals. Direct current converters, which are typically used to connect small consumer electronics devices to household power, lose a significant amount of energy as heat, even when the device is not plugged into the converter.
11. Refrigerator is probably among the biggest energy users in the home. Take special care to operate it efficiently:
12. Clean the condenser coils on your refrigerator to keep them operating efficiently.
13. Reduce the number of trips you make to the refrigerator/freezer and do not leave the door open unnecessarily.
14. Small refrigerators are often less efficient than larger models because they usually have less insulation or a less-efficient compressor.

VII. ANALYSIS OF THE POWER CONSUMPTION IN HOME

As in Homes & Buildings the main power consuming areasare:-

1. Lighting.
2. Cooling.
3. Heating.
4. Entertainment.
5. Other Appliances.

Lighting includes of Bulbs,Tubes,Fixtures,Indoor, and Outdoor Applications.
Cooling includes of Ceiling Fans,Air Conditioners, and Refrigerators etc...
Heating comprises of Electric Iron,Geysers,Ovens,and Stoves etc...
Entertainment comprises of Radio, Television, and Desktops, Laptops etc...
Other appliances include Mixers,Grinders,Pump motors,Washing Machines etc...
Calculation for total wattage consumption for existing devices:
1Unit =1 kWh=1000 W-h
1)Total number of T12Tube lights with 55w is:4no*55w*4hours daily consumption=512watts per day=0.512kWh.
2)Total number of Ceiling fans with 80w rating is 4 with 12 hours dailyusage is =80w*4no*12hrsusage=3840 watts per day=3.84kWh daily Consumption.
3) Refrigerator (Single door) with 230 litres capacity=800w*24 hours=19200 watts per day=19.2 kWh per day.
4)Air conditioner 1.5 Ton=2400watt*5hrs=12000 watts per day=12 kWh perday.
5)Heating:Electric Iron=1100watts*1hrs daily=1100 watts per day=1.1 kWh per day.
6)Entertainment: Television=188w*14 hours daily=2632 watts=2.632 kWh per day.
7)Desktop computer=250w*5hours=1250watts per day=1.25 kWh perday.
8)Other Appliances:Mixer=200*2hrs=400 watts=0.4 kWh perday.
9)Washing Machine=1500w*2hrs=3000watts =3.0 kWh perday.

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10)Water Pump 1 HP=750*1hrs=750watts=0.75 kWh perday.
Total power consumed by these regular Appliances is=44684 watts=44.684 kWh per day.

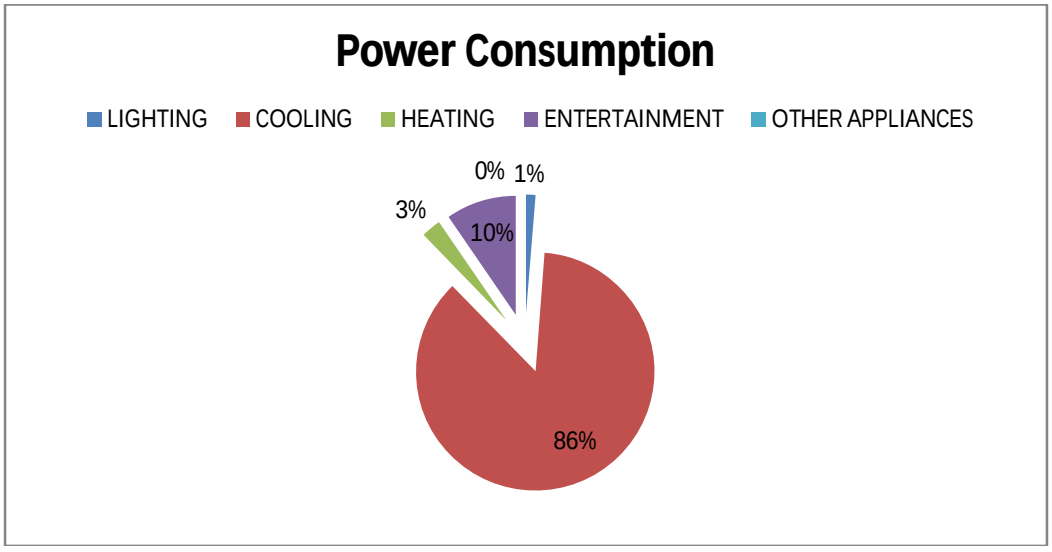

Fig 1: Energy Consumption by different Appliances in House.

By using Energy Efficient Equipment
1.In Lighting, if we replace regular lighting with T5 or Fluorescent lamps then,
21w*4no*4hrs=336w net savings=512-336=176 watts.
2. In Ceiling Fans if we replace with Energy Efficient Fans then,
80w*4no*12hrs=3840 watts ,48w*4no*12hrs=2304 watts,Net savings=1536 watts
3. In Refrigerators if we reduce the number of openings of fridge door and using Energy Efficient (5 star rating)then,
,800w*24hrs=19200watts, 650w*24hrs=15600 watts per day, Net savings=3600 watts
4. AC require 2400 w but 5 star require only 1600w*5hrs=8000watts Net savings =800watts.
5. In Television if we use energy efficient Plasma TV then ratings is 128w*14 hours=1792watts per day, Net savings=840watts.
6. If we replace desktop with laptop then 65w*5hours=325watts Net Savings=925 watts.
7. If we use controllers and sensors in water pump there will be 500 watts savings, Net Savings=250 watts
8. Energy efficient Washing machine=800*2=1600watts per day

Total watts conserved by replacing Energy efficient Equipment are: 30457watts
i.e., 14227 units saved per day if we replace with Energy Efficient Equipment.
With normal appliances the units consumed is: 44.684 units per day
But replacing normal appliances with Energy Efficient Appliances the units consumed is 30.457units only.
There is nearly 14 units savings per day i.e., 14units*30days=420 units saved per month=420*12 months=5040 units saved per year.

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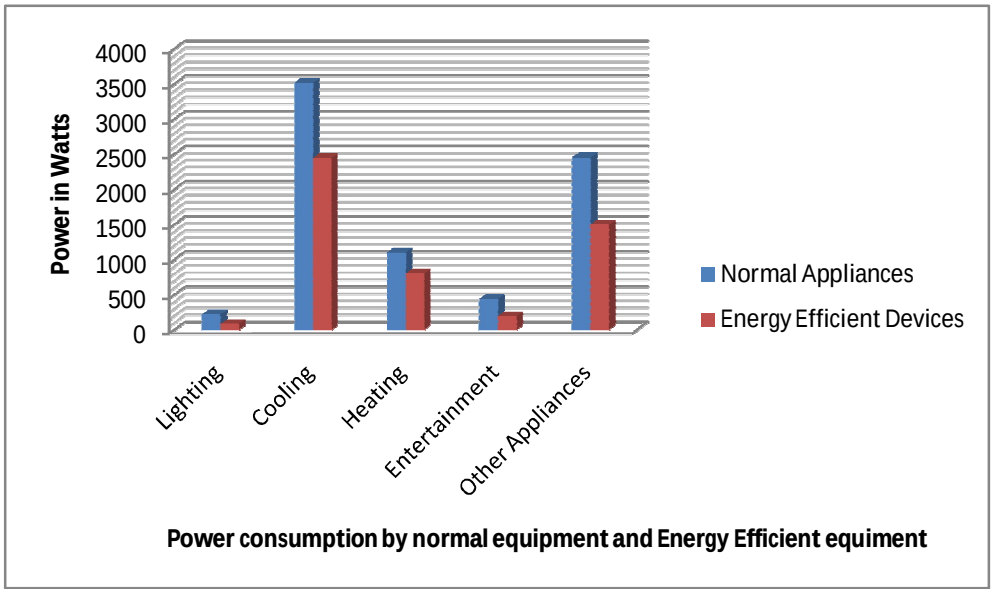

Fig 2: Energy Consumption By normal and Energy Efficient Equipment

VIII.CONCLUSION

Energy Audit deals with verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving Energy Efficient with cost benefit analysis and an action plan to reduce energy consumption. Energy Saving is a Social Responsibility for every individual. In this paper we have analysed the amount of wattage consumed by different devices and suggested necessary replacements and showed the net savings. By this analysis, if we implement Energy Efficient Equipment we can conserve a lot of 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.

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