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ENERGY AUDIT A SOLUTION TO ENERGY CRISIS

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ABSTRACT

Energy has been a way of life in modern days. We are so much dependent on it, hardly can we imagine any activity without power. It may be fortunate or unfortunate, we are totally dependent on power which is making its usage higher and higher which left us with energy crises and increasing costs of the energy usage. It is time to save energy not to lessen the cost but to save for our future generation to live in luxury. In this paper I have analysed ***Energy Management*** *and estimating energy usage and wastage by* ***Energy Audit*** *and how to conserve it.*

I. PREFACE

India's Energy scenario: Before we go to details of energy management and auditing it is important to look into the Energy Scenerio of our country.

By 0 0 ou t y's E e gy e ui e e t ould e a ou d ,00,000MW from an existing 1,85,000MW. Our per capita energy consumption is 4816KWH or 305 kilogram oil equivalent, which is very low compared to world standard. It is around 4050 in Japan, 7850 in USA, 1200 in China. But per capita consumption is growing annually 9 to 10%. At present **I dia's** 85% electric power generated comes from coal, oil, natural gas. We have a coal reserve around 150billion tonnes which may last for 100years. The oil reserve in India is low around 0.3% of total world oil reserve and it may last for 20 to 25 years. India has abundant nuclear fuel reserve equivalent to 6 to 7 times of coal reserve, but viability of nuclear plant is very difficult. Though India have abundant source of coal it is constrained to regional locations, have high ash content, so affecting the efficiency of thermal power plants. Due to high emission from power plant environmental impact is also very high. So far our energy requirement is largely depends on importing oil, gas and coal. At present we import around 80% of oil, 30% of gas, 200million ton of coal annually. This increases our import bill. Also setting up a power plant is not easy and is constrained by land, environmental and rehabilitation issues. On the supply side the mis-match between demand and supply is so large that India can ill-afford to choose one option in preference to other. For several years, in fact may be for next few decades, India would need to exploit all possible options to create reasonably large capacity base on energy side. It need to expand manifold the coal production, extract through all possible means, the oil and gas reserves, where ever possible, resort to import coal will need to continue substantially on oil import.

To reduce the demand supply there is a substantial scope in demand side management. Moreover It has been established that 20% energy produced is wasted because of inefficient use. The Government of India enacted a legislation called Energy Conservation Act in the year 2001. The Bureau of Energy Efficiency (BEE) has been put in place in pursuance to implementation of this law.

To solve this enormous problem of energy crisis the **Energy Management** and **Energy Audit** plays a crucial role.

Consequent to The Honourable Prime Minister 's announcement that all Govt. Organisations should bring down their energy consumption by 30 % and private organisations by 20 %, over a period of next 5 years, by conducting comprehensive energy audit studies, The Bureau of Energy Efficiency (BEE), Ministry of Power, Govt. of India, New Delhi has identified about 10 Govt. buildings.

II. WHAT IS ENERGY MANAGEMENT

Energy management is the strategy of optimising energy requirement, following well defined systems and procedures. In our context when it comes to energy saving energy management is to monitoring, controlling and conserving energy. The aim is to reduce energy cost and wastage without affecting production and quality and also to reduce environmental effects.

III. OBJECTIVES OF ENERGY MANAGEMENT

This can be clarified by asking following questions
How much energy is consumed?
How is the energy consumed?
Where is the energy consumed?
When is the energy consumed?
What is the quality of the energy consumed?
In order to address this queries energy audits are conducted. Let us understand audits.

IV. DEFINITION

As per Indian Energy Conservation Act 2001: Energy audit is defined as:
The e ifi atio , o ito i g a d a alysis of use of e e gy i ludi g su issio of te h i al report containing recommendations for improving energy efficiency with cost benefit analysis and action plan to **edu e e e gy o su ptio .**

V. AIM OF ENERGY AUDIT

The energy audit is one of the preliminary activities to be performed in achieving an effective energy management program designed to improve the energy efficiency and reduce the energy operating costs of a facility.
An energy audit consists of a detailed examination of how a facility uses energy, what the facility pays for that energy, and finally, a recommended program for changes in operating practices or energy consuming equipment that will cost effectively save on energy bills.
So energy audit is called energy survey or energy analysis. It should not be confused with financial audit.

VI. TYPES OF ENERGY AUDIT

Types of energy audit depends on:

- Function and type of Industry

- Depth to which final audit is needed
- Potential and magnitude of cost reduction is desired

Considering above factors audit is done in following steps:

i. Preliminary audit

ii. Detailed audit

VII. STEPS OF ENERGY AUDIT

Preliminary audit involves following steps:

- Estimate annual energy consumption of the organisation.
- Estimate the scope of saving in terms of units and monetary.
- Find the areas where it is easiest to do or find low cost or immediate improvement areas.
- Identify areas where more detailed study are needed and scope of improvement is large.

Preliminary audit uses existing or easily available data

7.1 Steps for Detailed Audit

Detailed audit involves most accurate estimate of energy saving and cost. This is based on considering equipments consuming high energy, operating conditions and calculations.

7.2 Detailed Audit Has Three Phases

Phase I: Pre audit phase

Phase II: Audit phase

Phase III: Post audit phase

All above steps may be summarised in a tabular form:

	Plan of action	Purpose/ result
Step - I	1. Plan and organise 2. Informal meeting with Energy manager/ production manager	➢ Resource planning/ establish an audit team. ➢ Macro data collection. ➢ Familiarisation of process activities. ➢ First hand observation.
Step - II	1. Conduct meeting/ awareness program among staffs	➢ Building cooperation ➢ Orientation and awareness creation.
Step - III	1. Primary data gathering, process flow diagram and energy utility diagram	➢ Historic data analysis, Base line data collection ➢ Prepare annual energy bill and consumption pattern.
Step - IV	1. Conduct survey and monitoring	➢ Measurement of Power consumption of Drives, HVAC and lighting system etc accurately by power measuring instruments.

Step - V	1. Analysis of Energy use	➢ Energy lost and waste analysis
Step - VI	1. Identification and development of energy conservation opportunities	➢ Conceive develop and refine ideas ➢ Review previous methods ➢ Use brainstorming, value analysis ➢ Contact vendors for new and efficient technology
Step - VII	1. Cost benefit analysis	➢ Assess technical feasibility and economic viability ➢ Prioritise low, medium and long term measures
Step - VIII	1. Preparation of report	➢ Presentation of report to top management
Step - IX	1. Implementation and follow up	➢ Action plan and schedule for implementation ➢ Follow up and periodic review

7.3 Areas of Energy Audit

Different areas in a industry such as machine, equipment or in building may be targeted for energy audit. They may be:

I. Electricity
II. Steam
III. Compressors
IV. AC systems
V. Heating system
VI. Ventilation
VII. Transformer
VIII. Indoor and outdoor lighting

VIII. TECHNICAL AND ECONOMIC FEASIBILITY FACTORS

Any energy saving projects should be thoroughly studied and analysed for technically and economic feasibility. It should not disturb the production process. The payback period is calculated as

Payback Period = Total Investment/ Cost of Energy saved in a year.

8.1 Energy Saving Potential A Sample Survey

Sl. No.	SECTOR	CONSUMPTION IN BILLION UNITS	SAVING POTENTIAL IN BILLION UNITS	% SAVING
1	INDUSTRY	265.38	18.57	7
2	DOMESTIC	121	24	20
3	AGRICULTURE	92	27	30
4	COMMERCIAL BUILDING	9.92	1.98	20
5	MUNICIPALITIES	12.45	2.8	23
	TOTAL	501	75	15

IX. SIMPLE MEASURES TO CONSERVE ENERGY

- Maximum use of sunlight
- Use transparent roofing sheet wherever possible
- Use high efficient lights such as CFL instead of filament and LEDs in place of CFLs.
- Replace conventional ballast with electronic ballast
- Use higher energy rated appliances
- Insulate the room properly while using AC.
- Use occupancy sensors

9.1 Energy Performance of A Facility

It can be measured by following formulae

Energy performance factor = $\frac{\text{Reference year equivalent} - \text{Current year energy}}{\text{Reference year equivalent}}$

Where as:

Reference year equivalent is the energy used in the reference year (may be in the year of pre audit) to produce same output in the current year. This gives a measure of **i p o e e t of fa ility's e e gy p og ess.**

9.2 Benchmarking

Benchmarking is comparing own performance with other similar organisation which has set a higher standard. Benchmarking may be done with our own past performance. It helps in:

- Identification of best practices
- Basis for monitoring and target setting
- Scope of margin available in Energy consumption and cost reduction.

9.3 Sample Audit Report

Here audit report of a typical college building is displayed, energy saving with adapting new technology, payaback period of the capital invested is analysed.

CONVENTIONAL FITTINGS				REPLACEMENT			SAVINGS IN ENERGY			Payback	Column1
Type	No of fittings	Rating in Watt	Yearly consumption in KWH	Type	Rating in Watt	Yearly consumption in KWH	Energy saved in KWH	Cost of One unit of Electricity in Rs	Monetary Savings in Rupees	Avg cost of replacement	Payback period in years
Tube	100	40	6400	CFL	25	4000	2400	3.5	8400	50	0.60
CFL	200	25	8000	LED	15	4800	3200	3.5	11200	100	1.79
Fans	50	100	8000	Energy efficient fans	60	4800	3200	3.5	11200	1500	6.70
Ballast	100	56	8960	Electronic ballast	44	7040	1920	3.5	6720	150	2.23
Resistance regulator	50	24	1920	Electronic regulator	16	1280	640	3.5	2240	150	3.35
No occupancy timer	50		0	Occupancy timer		0	1000	3.5	3500	500	7.14
Coolers	60	120	11520	Energy efficient fans	70	6720	4800	3.5	16800	2000	7.14
HVAC 3 Star	30	2200	105600	5 star	1000	48000	57600	3.5	201600	40000	5.95

X. CONCLUSION

Energy conservation is need of the hour. To optimise use of energy accounting is very much important. In the coming years India will see a manifold of demand in energy due to population growth, increase in living standard of the people. Our resources are limited, our capacity to utilise the existing resources is also limited. One of the approachable and immediate solution to energy crisis is proper monitoring and accounting and to implement it.

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