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A PATH FOR HORIZING YOUR INNOVATIVE WORK

ENERGY AUDIT OF AN ACADEMIC INSTITUTE

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Abstract: - By nominal GDP India is the world's eleventh largest economy. The eleventh five-year plan of India's Planning Commission set an ambitious target of 9 percent GDP growth for the plan period (2007-2012) [1]. According to the report of the Expert Committee on Integrated Energy Policy, India needs to increase its energy supply by a factor of three to four times and its electricity generation capacity/supply by a factor of five to six of their levels in 2003-04 in order to maintain a sustained growth of 8 percent through 2031-32, India. Total primary energy supply in India is in hydro 1.6%, nuclear 0.6% gas 5.7% solar and wind are 0.2% are shown in figure1.

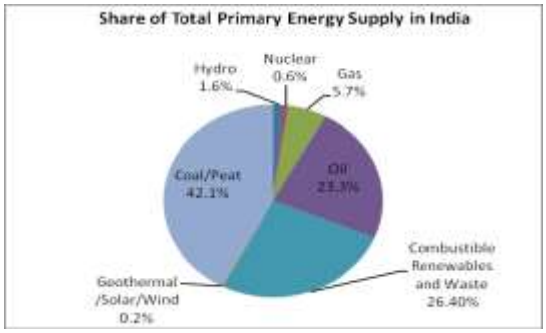

Figure:-1 Total Primary Energy supply in India

At present, India's energy supply is skewed in favor of non-renewable energy sources.

Keywords: Energy Audit, Academic Institute

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INTRODUCTION

The purpose of an energy audit is to analyze the energy flows in a building, and understand its energy dynamics. During the energy audit, I noticed to reduce the amount of energy input into the building without negatively affecting the output(s). Beyond simply identifying the sources of energy use, an energy audit seeks to prioritize the energy uses according to the greatest to least cost effective opportunities for energy savings.

The Energy Audit Process

The process of conducting an energy audit can be very simple. First, I obtain the energy bills for a minimum of 1 year for the building. The current energy data is used to create a baseline and establish what the current energy costs are. Next conducts a room-by-room inspection of the building. During the room-by-room inspection, the auditor examines energy consuming items as well as areas that waste energy. With the new information obtained during the inspection, then calculates the current energy usage and proposed energy savings and document the findings into a summary report.

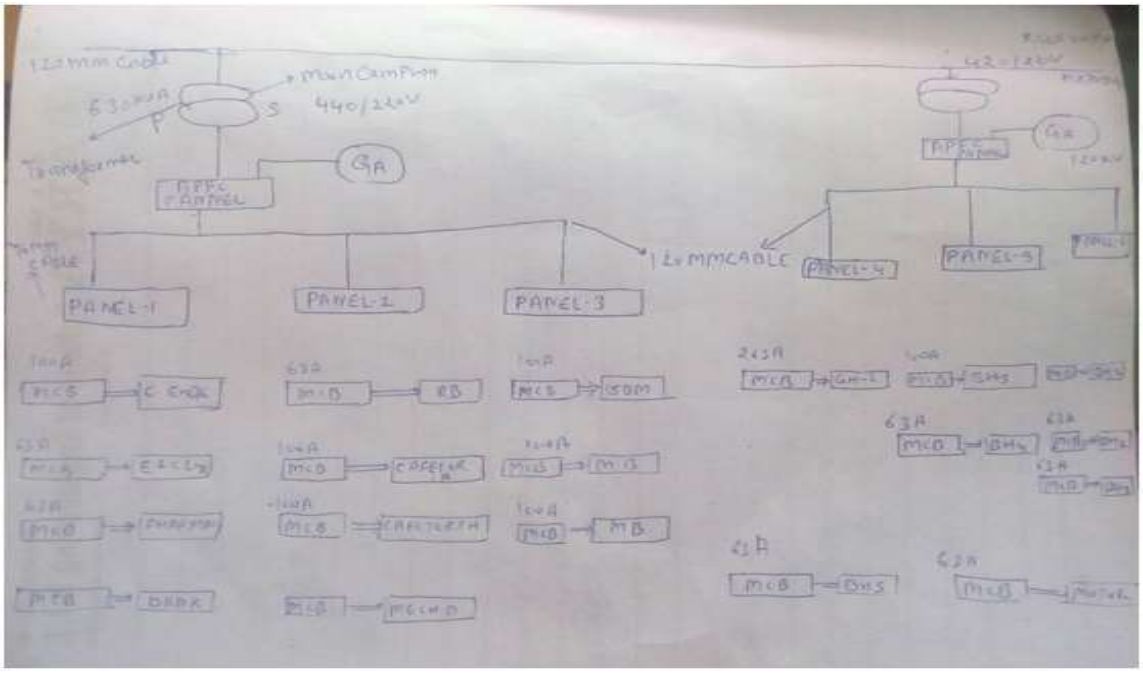

Figure 2: Single line diagram of Gyan Vihar University

OBJECTIVE OF ENERGY AUDIT

Energy today has become a key factor in deciding the product cost at micro level.the requirement of energy is increasing day by day. Directly or indirectly we all are depend on energy so the main objective of energy audit is to save energy. The imperatives of an energy shortage situation calls for energy conservation measure, which essentially mean using less energy for the same level of activity. From Energy Audit We can reduce energy cost. It is instrumental in coping with the situation of variation in energy cost availability.

METHODOLOGY ADOPTED & DATA COLLECTION

An academic institution has been selected for energy analysis. It contract demand of the institute is 250KVA. The institute has installed a roof top solar Pu plant of 120kWp, which is grid interactive through net metering. Institute last two year bills are shown in table.1:

Table 1: Electrical Bill Analysis for the Year 2016

Particular	Monthly(2016)											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	DEC
Contract Demand KVA	250	250	250	250	250	250	250	250	250	250	250	250
Max Demand KVA	169.8	123.9	108	104	146.1	166.3	154.5	309.6	193.4	192	198.3	
Bill Demand KVA	187.5	187.5	187.5	187.5	187.5	187.5	187.5	187.5	187.5	187.5	187.5	187.5
PF	0.96	0-933	0.943	0.943	0.961	0.95	0.94	0.867	0.897	0.913	0.881	0.835

Units (KWH)	28545	17709	20361	22899	33420	32427	28848	28224	28800	25200	20100	10500
PF Incentive/ Surcharge	-3827	-	-	-	-2738.77	-483.16	-	6938.97	-	-	3189	-
Total Bill (Rs)	260162	181957	197699	218257	300738	294577	317411	268328	255563	244578	196163	143083

Table 2: Solar Data Analysis of Year 2016

Solar Data Analysis 2016						
	JULY	AUG	SEP	OCT	NOV	DEC
Rate/Unit	7.45	7.45	7.45	8.35	8.35	8.35
UNITS IN KWH	9168	12080	16680	14960	13680	12880

Average Electricity Generation per kWh/day

$$= \frac{9168+ 12080+16880+14960+13680+12880}{183*120}$$

=79648/21960

=3.62kWh/DAY

Data collection of the connected load:

The electrical equipment data of all academic buildings are tabulated in tables 7-14. The average working hour for tube light & fan are taken 4 hour for 302 days & for ACs 8 hour for 183 days

	No. of AC	Rating(Ton)	Working Hour
Reception	5	2.5	8
LT-1	6	1.5	8
Office	3	2	8
Office-1	2	1.5	8
Office-2	3	1.5	8
Office-3	1	1.5	8
Office-4	1	2	8
Office-5	2	1.5	8
Office-6	1	1.5	8
Office-7	1	1.5	8
Office-8	1	1.5	8
Office-9	2	1.5	8
Office-10	1	1.5	8
Office-11	1	1.5	8
Office-12	1	1.5	8
Office-13	1	1.5	8
Office-14	1	1.5	8
Office-15	1	1.5	8
Office-16	1	1.5	8
Office-17	1	1.5	8
Office-18	2	1.5	8
Office-19	5	2.5	8
Office-20	**No. of AC**	**Rating(Ton)**	**Working Hour**
Office-21	1	1.5	8
Office-22	4	1.5	8
Office-23	5	2.5	8
Office-24	1	2	8
Office-25	8	4.5	8
Office-26	4	1.5	8
Office-27	2	1.5	8
Office-28	1	2	8
Office-29	1	1.5	8
Total	70	54.5	
Total Energy(kWh)/ Year	79		

Table 3: Electrical Load of ACs Analysis

Institute Summary of Electrical appliances

Table 4: No of Electrical appliances Analysis

Appliances	Total Number
Fan	1074
Tube light	773
Computer	483
Water Cooler	4
Projector	22
Water Pump	5

DISTRIBUTION NETWORKS:

We have three sources of electricity in the university. These details have been given below:

Transformer:

A **transformer** is a static electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. A varying current in one coil of the transformer produces a varying magnetic field, which in turn induces a varying electromotive force (EMF) or "voltage" in a second coil. Transformers are used to increase or decrease the alternating voltages in electric power applications

Fig 3: Transformer of 630KV

Transformer Temp. Difference is Shown in Table 5:

Table 5: Transformer temp. Difference

Make	Capacity	Average Load In KVA		Temp Of Oil	
	In KVA			In(Degree C)	
		Summer	Winter	Warm Winter	Winter
				Min	Min
				Max	Max
	630	200-250	150-175	50-55	20-25

Diesel Generator:

A **diesel generator** is the combination of a diesel engine with an electric generator to generate electrical energy.Diesel generating sets are used in places without connection to a power grid, or as emergency power-supply if the grid fails, as well as for more complex applications such as peak-lopping, grid support and export to the power grid. In our university there is a 250 KVA diesel generator in the

Institute. Its data analysis has been given below:

Figure 4: Diesel-Generator

Table 6: Temp Differences in a Generator

LOAD voltage	diesel consumption	Oil temp
100-150KVA	20-25 LITER	43 DEGREE
150-200KVA	25-30 LITER	43DEGREE
200-250KVA	30-35 LITER	43DEGREE

Temp can vary 40 degree to 60 degree

Solar:

Solar energy is the light and heat energy produced by the sun. The solar energy that reaches the earth can be used to produce electricity through the use of solar panels. Solar energy is a renewable energy resource whose use does not affect its future supply. University use solar power as a backup its data has been given below:

Figure 5: Solar installation

Solar data of the institute for 2017:

Data which has been taken from Solar has been shown in the Table: 21

Table 7: Solar data of Year 2017

Solar Plant Data Analysis	January	February	March	April	May	June	July	August	September	October	November
Units In Kwh	12280	14400	19880	17920	15480	15400	7560	10120	4760	14160	13120

Capacity Utilization Factor: CUF Monthly is shown in Table:

Table 8 : CUF Analysis of Solar

MONTH	UNIT in KWH	PLANT CAPACITY(KWp)	CUF(%)
JAN	12280	120	13
FEB	14400	120	16
MAR	19880	120	20
APR	17920	120	20
MAY	15480	120	17
JUN	7560	75	14
JULY	10120	100	13
AUG	4760	75	8
SEP	14160	120	15
OCT	13120	120	14

Energy Performance Index Table:

Table 9: Energy Performance Index Table

Energy Performance Table			
Month	Energy Units used KWh	Area(m2)	EPI based on month)
July	38016	67169	6.8
October	40160	67169	7.2

Energy performance index has been calculated for the months of July and October. Energy Performance Index in kWh/sqm/year considered for rating the building with star label under the major climate zone are tabulated in table 10

Table 10: Climate Zone: Composite

Climate zone : Composite		
Air Conditioned area> 50% of building area	**Air conditioned area<50% of building area**	**Star Label**
EPI(KWh/sq m year)	EPI(kWh/sq m/ year)	
190-165	80-70	*
165-140	70-60	**
140-115	60-50	***
115-90	50-40	****
Below 90	below 40	*****

ENERGY CONSERVATION MEASURES &RECOMMENDATIONS

Energy saving for air conditioners:

Table11: Floor/Capacity

Total Floor Area(Sq Ft)	Basic Cooling Capacity (BTU/H)
100-150	5000
150-250	6000
250-300	6500
300-350	7250
350-400	8000

400-450	8750
450-500	9650
500-550	10500
550-700	12500

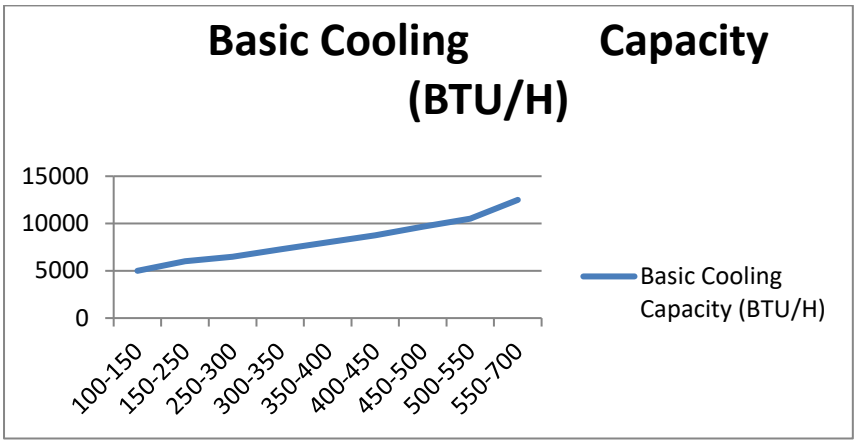

Fig 6: Area vs Cooling Capacity

Source: www.nrcan.gc.ca/.../roomaircond/

The set point of AC depends upon the return air temperature (temperature of room air).The temperature of inlet air of AC is constant whether it is running on 16degC or 24degC.People who don't know run their AC on 16degC by thinking that it will cool their room faster which is not true.

It will take same amount of time to cool the room up to comfortable temperature. If you set your set point at 16degC then the compressor will not shut off because room air temperature can never reach 16–17 degC. So if compressor is running constantly that means more energy consumption.

General terms for Energy Saving:

Electricity:

1. Schedule your operations to maintain a high load factor.
2. Minimize maximum demand by tripping loads through a demand controller
3. Use standby electric generation equipment for on-peak high load periods.

4. Correct power factor to at least 0.99 under rated load condition.

5. Shut off unnecessary Printer, computers, and copiers at night

➢ **Fans:**

1. Clean screens, filters, and fan blades regularly.

2. Use aerofoil-shaped fan blades.

3. Minimize fan speed.

4. Use low-slip or flat belts.

5. Check belt tension regularly.

Lighting

1. Change Tube light and CFL with the LED BULB so we can save more power and money.

2. Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.

3. Consider day lighting, skylights, etc.

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