Energy Audit Report

(2019-20)

for

NABIRA MAHAVIDYALAYA, KATOL

Prepared by

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Date: 25/12/2020

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Preface

Data collection for energy audit of the **Nabira Mahavidyalaya, Katol** was conceded by team for the period of 2019-20.

This audit was over sighted to inquire about convenience to progress the energy competence of the campus. Energy audit survey was completed by certified Energy Auditor. All data collected from each classroom, laboratory, every room. The work is completed by considering how many tubes, fan, A.Cs, electronic instruments, etc in each room. How much was participation of each component in total electricity consumption.

We really appreciate the effort put by Nabira Mahavidyalaya's management for creating awareness of Energy Audit, Use of solar sensor lights and their significance use for efficient energy saving and our nature among the all of us. We really appreciate Hon. Management of the college for encouraging us by providing this wonderful opportunity to do the energy audit. Through this, we have been cleared the vision of Institution towards the Green campus and save our green nature.

Main Building

Summary

The objective of the audit was to study the energy consumption pattern of the facility, identify the areas where potential for energy/cost saving exists and prepare proposals for energy/cost saving along with investment and payback periods.

The salient observations and recommendations are given below.

1. Nabira Mahavidyala, Katol uses energy in the following forms:
   a. **From MSEDCL**
   b. **High Speed Diesel Generator (HSDG)**

   Electrical energy is used for various applications, like: Computers, Lighting, Air-Conditioning, Fans Other Laboratory Equipment, Printers, Xerox machines, CCTV, UPS, LCD Projector, Router system, Flood light, Pumping motor etc.
2. The average cost of energy is around **Rs. 53880/Month**(Including diesel cost).
3. The Specific Energy Consumption **(SEC)** is the ratio of energy required per square meter. In this case the SEC is evaluated as electrical units consumed per square meter of area. It is calculated as under for (Electricity): **0.2782kWh/Sq.m**
4. After the measurement and analysis, we propose herewith following Energy Efficiency Improvement measures.

Table: Energy Efficiency Improvement

Sr. No.	Recommendations	Annual Saving Potential (Rs.)	Estimated Investment (Rs.)	Pay Back period (Years)	Remarks (Feasibility)
1	Use of motion/ occupancy sensor in corridors, passage and toilets	16560	10000	0.6	Short Term
2	Replacing Fan with 5 star energy saving Fan or BLDC fan	73092	321000	4.4	Long Term
3	Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights(Library)	11526	58000	5	Long Term
4	Providing Energy Saver Circuit to the Air Conditioners	Saving 10x2329 =23290	Total Cost 4500x10 =45000	1.93	Mid/Short Term
	Total Amount	**Rs. 124468/-**	**Rs. 434000/-**	**3.49 Years**	

Note:
- **Total savings during the energy audit is estimated at Rs. 124468/-**
- **The total energy cost with an overall payback period of 3.49 Years for techno-economic feasibility.**

Abbreviations

AHU	Air handling unit
APFC	Automatic Power Factor Controller
DG	Diesel generator
ECP	Energy Conservation Proposal
GCV	Gross Calorific Value
HVAC	Heating, Ventilation and Air Conditioning
HSDG	High speed diesel Generator
PF	Power Factor
SEC	Specific Energy Consumption
TR	Tons of Refrigeration
UOM	Unit of Measurement
MSEDCL	Maharashtra State Electricity Distribution Company Ltd

Chapter : 1

Introduction to Energy Audit

- **General:**

The Nabira Mahavidyala, Katol entrusted the work of conducting a detailed Energy Audit of campus with the main objectives are as bellows:

- ✓ To study the present pattern of energy consumption
- ✓ To identify potential areas for energy optimization
- ✓ To recommend energy conservation proposals with cost benefit analysis.

- **Scope of Work, Methodology and Approach:**

Scope of work and methodology were as per the proposal .While undertaking data collection, field trials and their analysis, due care was always taken to avoid abnormal situations so as to generate normal/representative pattern of energy consumption at the facility.

- **Approach to Energy Audit:**

We focused our attention on energy management and optimization of energy efficiency of the systems, sub systems and equipments. The key to such performance evaluation lies in the sound knowledge of performance of equipments and system as a whole.

- **Energy Audit:**

The objective of Energy Audit is to balance the total energy inputs with its use and to identify the energy conservation opportunities in the stream. Energy Audit also gives focused attention to energy cost and cost involved in achieving higher performance with technical and financial analysis. The best alternative is selected on financial analysis basis.

Energy Audit Methodology: Energy Audit Study is divided into following steps

1. Historical Data Analysis:

The historical data analysis involves establishment of energy consumption pattern to the established base line data on energy consumption and its variation with change in production volumes.

2. Actual measurement and data analysis:

This step involves actual site measurement and field trials using various portable measurement instruments. It also involves input to output analysis to establish actual operating equipment efficiency and finding out losses in the system.

3. Identification and evaluation of Energy Conservation Opportunities:

This step involves evaluation of energy conservation opportunities identified during the energy audit. It gives potential of energy saving and investment required to implement the proposed modifications with payback period.

Chapter : 2

About Institute (General Details)

Sr. No.	Particulars	Details
1	Name of the Institute	Nabira Mahavidyalaya
2	Address	Katol Dist:- Nagpur 441302
3	Year of Establishment	1961
4	Courses Offered	Bachelor of Arts (B.A.)
		Bachelor of Commerce (B. Com.)
		Bachelor of science (B. Sc.)
		Bachelor of Business administration (BBA)
		M.A., M. Com., M. Sc., MBA
5	Affiliation	R.T.M. Nagpur University, Nagpur

Chapter : 3

Energy Consumption Profile

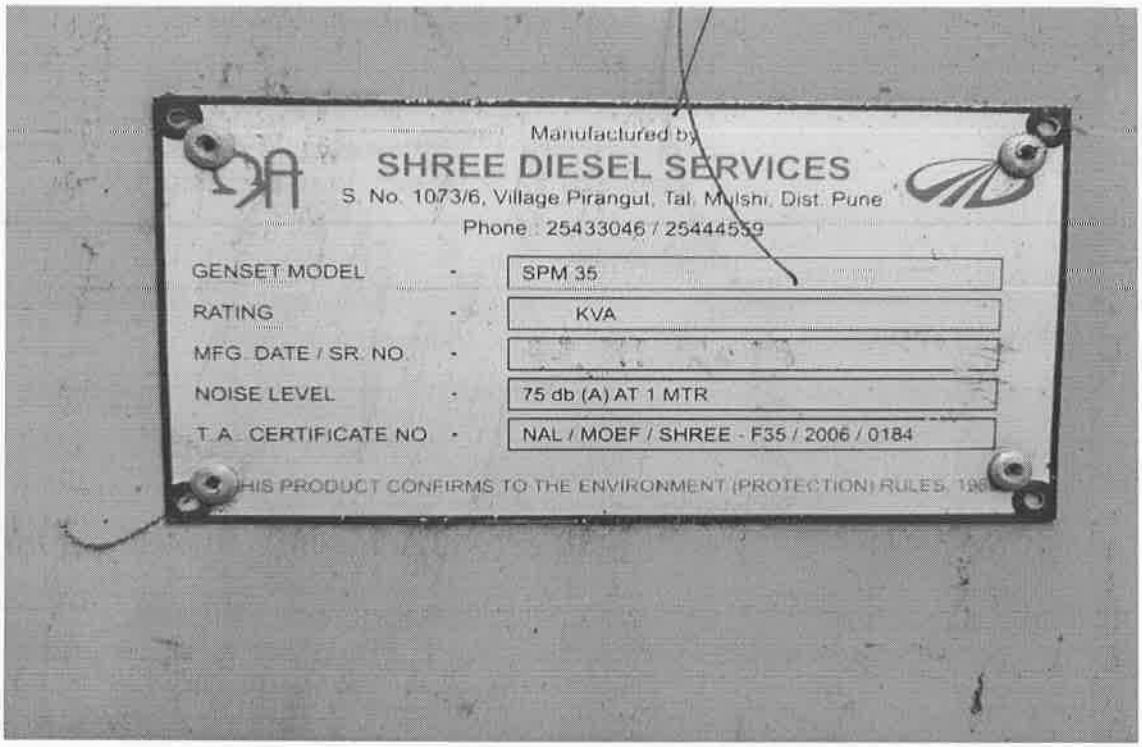
Source of Energy:

Nabira Mahavidyalaya, uses Energy in following forms:

a. **Electricity from MSEDCL :**
Nabira Mahavidyalaya receives Electricity from KATOL Circle.

b. **High Speed Diesel Generator (HSDG) :**

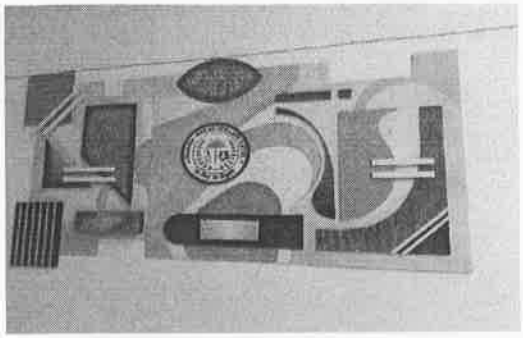
HSD is used as a fuel for Diesel Generator which is run whenever power supply from MSEDCL is not available.



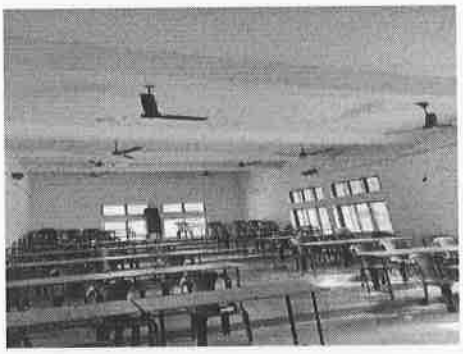
SDS make Diesel Generator (35KVA RATING)

Following are the major consumers of electricity in the facility:

- Computers
- Lighting
- Air-Conditioning
- Fans
- Other Lab Equipment
- Printers
- Xerox machines
- CCTV
- UPS
- LCD Projector
- Router system
- Flood light
- Pumping motor

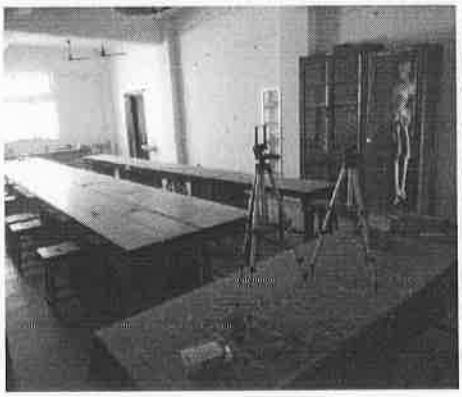


SR COLLAGE



CLASS ROOM

LIBRARY



LABORATORIES

Specific Energy Consumption (SEC):

Specific Energy Consumption (SEC) is defined as energy usage per Square meter of area. it is calculated as total electrical kWh/total area of the campus. By calculating SEC, we can crudely target the factors of energy efficiency or inefficiency

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Chapter : 4

Historical Data Analysis

4.1: Study of Variation of Monthly Units consumption & Power Factor:

In this Chapter, we study the details of the 12 month Electricity Bills.

Table No 4.1 Variation in Units Consumption & Power Factor (PF)

Sr. No.	Month	Consumption (kWh)	Power Factor (Only Jr.Collage)
1.	Apr-19	4955	0.665
2.	May-19	6508	0.666
3.	Jun-19	5676	0.610
4.	Jul-19	5689	0.660
5.	Aug-19	6670	0.713
6.	Sep-19	6564	0.777
7.	Oct-19	6028	0.625
8.	Nov-19	4381	0.664
9.	Dec-19	3347	0.661
10.	Jan-20	2848	0.672
11.	Feb-20	3262	0.713
12.	Mar-20	3218	0.650
	Total Units	**59146**	**Average = 0.673**

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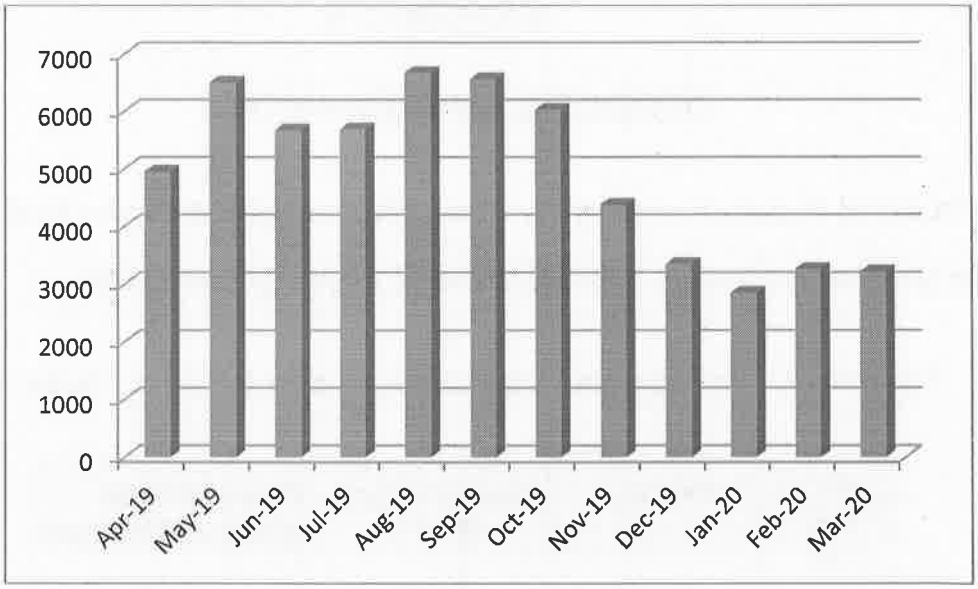
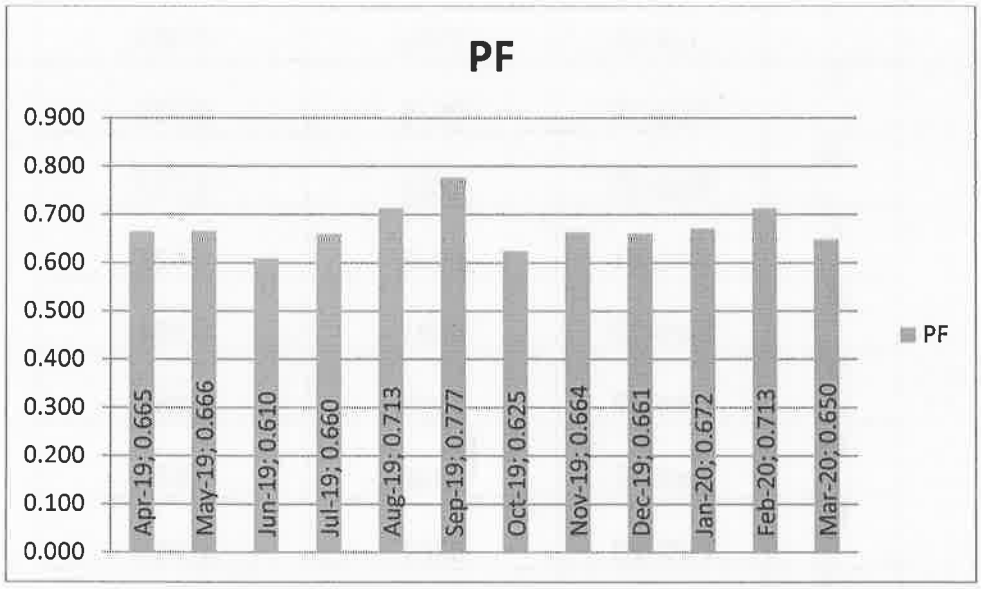


Month wise Unit Consumption



Month wise Power Factor variation

Conclusion : Variation of PF (Poor power factor – need to improve)

The Power Factor need to improve to reduce the utility power bill. Most utility bills are influenced by KVAR usage. A good Power Factor provides a better voltage, reducing the pressure on electrical distribution network, reducing cable heating, cable over loading and cable losses. Reducing over loadings of control gears and switch-gears etc.....

4.2 Study of Month wise Electricity Bill Variation:

Table No 4.2 Variation in Electricity Bill

Sr. No.	Month	Electricity Bill Amount (Rs.)
1	Apr-19	53350
2	May-19	71490
3	Jun-19	59320
4	Jul-19	63050
5	Aug-19	61470
6	Sep-19	66110
7	Oct-19	61090
8	Nov-19	47690
9	Dec-19	37210
10	Jan-20	31370
11	Feb-20	36440
12	Mar-20	36590
	Total Annual Bill =	**Rs.625180**
	Average Monthly Bill =	**Rs. 52098**

Conclusion: Monthly Electricity Bill Variation has been identified.

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Chapter : 5

Actual Measurements and its Analysis

Sr. No.	Name of Appliance	Power Rating (Watt)	Quantity	Power Consumption (Watt)	Usage per Day Hr.(Avg)	Power Consumption /day (Whr)
A	B	C	D	E = C X D	F	G = E X F
1	Air Cooler	250	17	4250	2	8500
2	Water cooler	2.5Kwh per day	5	12500	8	12500
3	Water purifier	1Kwh per day	4	4000	8	4000
4	Led Tube Light	20	564	11280	5	56400
5	Ceiling Fan	80	534	42720	2	85880
6	Fridge (150 lit)	2Kwh per day	10	20000	6	20000
7	Fridge (310 lit)	3Kwh per day	1	3000	6	3000
8	Deep fridge	4Kwh per day	2	8000	6	8000
9	AC	1500	10	15000	4	60000
10	Central AC	12000	1	12000	8	96000
11	Computer	60	132	7920	4	31680
12	Printer	Standby mode: 30- 50w/ printing mode:300- 500w	32	10000	2	20000
13	Xerox	650	5	3250	2	6500
14	Water pump (1 phase)	1HP	2	1492	2	2984
	Water pump (3 phase)	3 HP	1	2238	2	4476
	Water pump (3 phase)	5 HP	1	3730	2	7460
15	Focus Light	100	1	100	12	1200
16	Ex. Fan	200	16	32000	2	64000
17	Diesel Generator	35KVA	1	As per use		285 Ltr per year

**** This is total load consumption considered approximately. Actual load consumption might be different according to actual use of power for particular time period.***

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Remarks:

- It has been observed that in old and new building majority of electrical power consumption is through light load such as fan, LED light and power load such as refrigerator, Air conditioners etc. **unnecessary use of electrical equipment must be avoided.**
- As per individual dept. level load consumption, we understand the scope for improvement of energy saving. Hence our electricity bill will be reduced by proper load management techniques along with optimum utilization of resources.

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Chapter: 6

Study of Electrical Systems

6.1: Electrical Supply Details:

The electrical supply to Nabira Mahavidyala, Katol comes from MSEDCL supply at 415V three phase level.

6.1.2 Study of Electrical Demand:

There are seven meters installed in the premises. The details of meters are as under

Table No 6.1: Meter Details:

Sr. No.	Area	Meter No	Tariff plan	Sanctioned Demand
1	Jr Collage	426010001134	73 LT-XB1	3KW
2	Sr. Collage	426010000171	73 LT-XB1	1KW
3	Class room	426010002203	73 LT-XB1	1KW
4	Library	426010057792	73 LT-XB1	0.4KW
5	Jimkhana	426010002921	73 LT-XB1	0.1KW
6	Computer Lab	426010108541	73 LT-XB1	9.4KW
7	MBA	426010105461	52 LT II Comm 1ph <20kw	6.6KW

Performance in power factor is not appreciable as the PF is maintained average 0.673 in annual power consumption.

So there is scope for improvement of power factor. Power factor is affected during April to March 2020. If we more focus on average power factor of 0.95, we will get the reduction in energy consumption..

Hence we have to more focus on **power factor correction/improvement using capacitor bank Or APFC panel.**

Lighting System

Observations and suggestions:

- It is found that FTL, CFLs is installed in the facility.
- It is recommended that some tube lights in this area can be switched off when sufficient daylight is available.
- Presently there are no reflectors installed for tube lights.
- Every light or electric gadget left on when not needed is wasting energy and money and is causing pollution that is totally unnecessary.
-

Don't forget to power down these things when not in use:

- Lights
- Heaters and fans (or air-conditioning)
- Printers and scanners
- Battery and phone chargers
- Computers
- Gaming consoles
- TVs, DVD players
- Stereos

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Chapter : 7

Study of Air Conditioners

In the facility for air conditioning there is no centralized system with AHU (air handling unit), but mostly spilt air conditioners are installed.

Load of ACs was as follows:

Item	Rated Power (kW)	Qty	Voltage
Split ACs	1.5	10	230
Duct Acs	12	1	410

Observations and suggestions:

1. Normal air conditioning temperature should be kept as high as possible (I.e.24 deg.C). By thumb rule, increase in 3 degrees in indoor air temperatures can save 1% of electricity.
2. The ventilation in area can be provided with installation of natural ventilation. Natural ventilation will also minimize the requirement of exhaust fans.

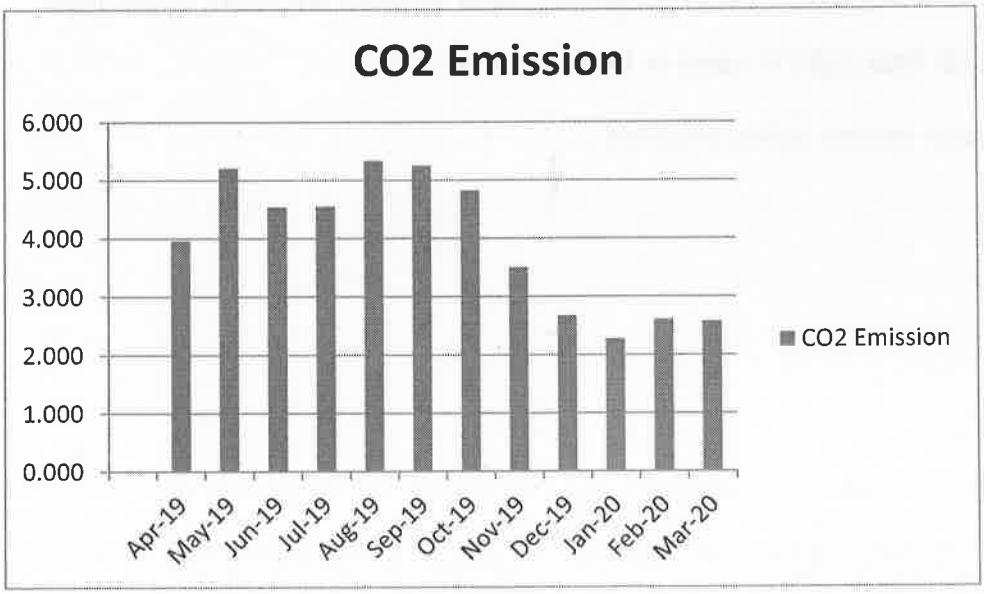
Chapter : 8

Carbon Di-Oxide Emission

In this Chapter we compute the CO_2 emissions. For consumption of 1 Unit (1 kWh) of Electricity, the CO_2 emitted is 0.8 Kg. OR the Emission is 0.8 Kg/kWh. In the following Table we present the total units consumed and CO_2 emitted as under:

Table 8.1: CO_2 Emission:

Sr. No.	Month	kWh	CO_2 Emitted in MT
1	Apr-19	4955	3.964
2	May-19	6508	5.206
3	Jun-19	5676	4.541
4	Jul-19	5689	4.551
5	Aug-19	6670	5.336
6	Sep-19	6564	5.251
7	Oct-19	6028	4.822
8	Nov-19	4381	3.505
9	Dec-19	3347	2.678
10	Jan-20	2848	2.278
11	Feb-20	3262	2.610
12	Mar-20	3218	2.574
	Total	**59146**	**Avg. Emission =3.943**



Carbon Di-Oxide Emission

Merits/Existing Features for Energy Savings.

1. Staff vigilance.
2. Computers are connected in LAN.
3. Printers are shared in LAN.
4. Screen savers facility implemented for every computer.
5. AC's used are of three STARS.
6. Refrigerators are of three STARS.
7. Incandescent Bulbs are nowhere used.
8. They are replaced by LED tube.
9. Maximum use of natural light.
10. Cross Ventilation is provided in laboratory & class rooms, which reduced number of fans.
11. Most of the practical's are scheduled in noon time where Billing Rate in normal.
12. Walls are painted with off white colour to have sufficient brightness.
13. LED flash light is used in Seminar hall.
14. Solar sensor lights installed

Chapter: 9

Energy Conservation Proposals

9.1 Providing Energy Saver Circuit to the Air Conditioners:

The **energy saver circuits for the air conditioners, intelligently reduces the operating hours** of the compressors either by timing or temperature difference logic without affecting the human comfort. This can save around 15% to 30% of the electricity depending on the weather conditions and temperature settings.

There are total 10 split type air conditioners. It is Recommended that the old air conditioners are being replaced with new energy efficient BEE STAR labeled (3 Star and above) air conditioners in a phased manner.

- Considering the average compressor ON Time = 5 h/day
- Power consumption by 1.5 TR compressor = 1.5 kW
- Average daily consumption = 1.5 x 5 = 7.5
- kWh/day/ air conditioner Yearly operating days = 300 days/year/ air conditioner
- Yearly electricity consumption = 2250 kWh/year/ air conditioner
- Considering a saving of 15%, total annual savings = 15% x 2250

  = 337.5 kWh/year/ air conditioner
- Cost of electricity = Rs. 6.90 /kWh
- Yearly savings = 6.90 x 337.5 = Rs. 2329/year/ air conditioner
- Total number of Air Conditioners = 10

Summary :

- ✓ **Total yearly Saving = 10 x 2329/year = Rs. 23290/year**
- ✓ **Total Cost of each energy saver circuit = Rs. 4500 x 10 = Rs. 45000/-**

9.2 Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights(Library)

The 36 W FTLs can be replaced with the LED tube lights 16 W. These changes can be made at the places where the life is higher. Usually minimum of 3 years warranty is given and approximate burning hours is 40 000. (15 years considering 8 hours per day running)

Following calculations are done for 8 hours working:

- Power consumption by 36 W FTL with conventional choke = 40 W/ Tube Light
- Equivalent LED tube light = 16 W/ Tube Light
- Savings in power = 24 W/ Tube Light
- Operating hours = 8 h/day x 300 = 2400 h/year
- Tube Light Yearly savings = 2400 x 24 W = 57.6 kWh/year/Tube Light
- Average Cost of electricity = Rs.6.90/ kWh
- Saving = 57.6 kWh x 6.90 = Rs.397.44 / year/ Tube light
- Approximate investment on single LED Tube lights = Rs. 200
- Number of Tube Lights to be replaced = 29

Summary:

- ✓ **Total Yearly Saving =29 x 391.16 = Rs. 11525.76/year**
- ✓ **Total Investment = 29 x Rs. 200 = Rs. 58000**

9.3 Replacing Fan with 5 star energy saving Fan or BLDC fan

BLDC fans are brushless DC fan used as energy saving ceiling fans. Power consumption can be reduced by 65% of power consumed by normal fan.

Following calculations are done for 6 hours working:

- Power consumption by normal ceiling fan = 80 watt
- Power consumption of BLDC fan of equivalent output = 25watt
- Savings in power = 65 W/ fan
- Operating hours = 6 h/day x 300 = 1800 h/year
- Fan Yearly savings = 1800 x 55 W = 99 kWh/year/fan
- Average Cost of electricity = Rs.6.90/ kWh
- Saving = 99 kWh x 6.90 = Rs.683.1 / year/ fan
- Approximate investment on single fan = Rs. 3000
- Number of fans to be installed=534 nos
- 20% replacement every year=107 nos
  - ✓ **Cost per year= Rs.321000/year**
  - ✓ **Saving per year=Rs.73092/year**

9.4 Use of motion/ occupancy sensor in corridors, passage and toilets

Motion sensor or occupancy sensors activate while any motion takes place in the sensor activation range. So lights, fans or any other electrical appliances will be ON only during occupancy.

Following calculations are done for 8 hours working:

- Avg. power consumption of appliances to be controlled by a sensor= 200W
- Operating hours = 8 h/day x 300 = 2400 h/year
- Power saved hours (25%) = 600 h/year
- Yearly savings due to one sensor= 600 x 200 W = 120 kWh/year
- Average Cost of electricity = Rs.6.90/ kWh
- Saving = 120 kWh x 6.90 = Rs.828 / year
- Approximate investment on single sensor = Rs. 500
- Total requirement of sensors = 20 nos
  - ✓ **Total investment= Rs.10000/-**
  - ✓ **Saving per year=Rs.16560**

9.5 General Recommendations

- All Class Rooms and labs to have **Display Messages** regarding optimum use of electrical appliances in the room like, lights, fans, computers and projectors. "Save electricity". **Display the stickers of save electricity, save nature** everywhere in the campus. So that all stakeholders encouraged to save the electricity.
- Most of the time, all the tube lights in a class room and staff rooms are kept ON, even though; there is sufficient light level near the window opening. In such cases, the light row near the window may be kept OFF.
- All projectors to be kept OFF or in idle mode if there will be no presentation slides.
- All computers to have power saving settings to turn off monitors and hard discs, say after10 minutes/30 minutes.
- The comfort/Default air conditioning temperature to be set between 24°C to26°C.
- Lights in toilet area may be kept OFF during daytime
- Use AUTOMATIC POWER FACTOR CORRECTION (APFC) Panel FOR PF improvement.

- Need to use power saver circuits for AC.
- Need to replace FTL by smart LED Tube
- Need to replace ordinary bulb by LED bulb.
- Need to replace ordinary CRT monitor by LED.
- Need to replace ordinary refrigerator by BEE power saver refrigerator if possible.
- Out of total electricity bill paid, 53 percentage are actual energy utilized charges and remaining expense belongs to additional taxes on energy consumption

Executive Recommendations:

1. **There has to be Institute level student community that keeps track of the energy consumption Parameters of the various departments, class rooms, halls, areas, meters, etc**
2. **Energy auditing inside the campus has to be done on a regular basis and report should be made public to generate awareness.**
3. **Need to Create energy efficiency/ renewable energy awareness among the college campus i.e. solar, wind, Biogas energy. College should take initiative to arrange seminars, lectures, paper presentation competition among students and staff for general awareness**

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