



Orbit Energy & Engineering Services

BEE PAT Energy Auditing, Chartered Engineering, Energy Savings, Technical Consulting

Date: - 17/04/2023

Certificate of Energy Audit

This is to certify that, **Nabira Mahavidyalaya, Katol** situated in Nagpur District has conducted detailed energy audit of their campus and has submitted necessary data and credential for scrutiny. This audit is done for the **session of 2022-23**. The objective and measures carried out by college have been verified based on report submitted and found satisfactory. The effort taken by the facility towards environment and sustainability is highly appreciated and commendable.

Orbit Energy & Engineering Services

For, Orbit Energy and Engineering services


PRASHANT SURESHRAO AKARTE
BEE CERTIFIED ENERGY AUDITOR
Reg. No. EA 17568
Mob-7709978395



Orbit Energy & Engineering Services

BEE PAT Energy Auditing, Chartered Engineering, Energy Savings, Technical Consulting



ENERGY AUDIT REPORT (2022-23) FOR NABIRA MAHAVIDYALAYA, KATOL



Orbit Energy & Engineering Services

Audited by

PRASHANT AKARTE
CERTIFIED ENERGY AUDITOR

PRASHANT SURESHRAO AKARTE
BEE CERTIFIED ENERGY AUDITOR
Reg. No. EA 17568
Mob-7709978395

Date: 17/04/2023



INDEX

| Sr. No. | Particulars | Page No. |
|---------|--------------------------------------|----------|
| | Preface | 3 |
| | Summary | 4 |
| | Abbreviations | 6 |
| 1 | Introduction to energy audit | 7 |
| 2 | About Institute | 8 |
| 3 | Energy Consumption Profile | 9 |
| 4 | Historical Data Analysis | 13 |
| 5 | Actual Measurements and its Analysis | 16 |
| 6 | Electrical System | 18 |
| 7 | Air Conditioners | 20 |
| 8 | Carbon Di-Oxide Emission | 21 |
| 9 | Energy Conservation Proposals | 23 |



Orbit Energy & Engineering Services

BEE PAT Energy Auditing, Chartered Engineering, Energy Savings, Technical Consulting

Preface

Data for energy audit was provided by M/s Nabira Mahavidyalaya, Katol for the period of 2022-2023 in the form of energy bills.

This audit was over sighted to inquire about convenience to progress the energy competence of the campus. 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, solar panels, day light sensors 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.



(PRINCIPAL)



Main Building



Summary

The objective of the audit was to study the energy consumption pattern of the college campus and facilities, 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. 22889/- per 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): 0.1390 kWh/Sq.m

4. Last three years Comparison of SEC and total energy bill per month is as shown below

| Parameters | 2020-21 | 2021-22 | 2022-23 |
|---------------------------------------|---------|---------|---------|
| Power Consumption (Kwh) | 37673 | 28670 | 21872 |
| Billed amount (Rs.) | 366952 | 263102 | 203275 |
| SEC (Electrical)(Kwh/sqft area) | 0.1769 | 0.1346 | 0.1390 |
| Students on roll | 2743 | 2713 | 1313 |
| SEC (Electrical) (Kwh per person) | 133.78 | 96.98 | 154.82 |
| Diesel Consumption (Ltr) | 285 | 148 | 130 |
| Diesel cost (Rs.) | 21375 | 14208 | 12090 |
| AVG total Energy Bill amount (Rs.) | 32361 | 23109 | 22889 |

From the above comparative statement, it can be noted that Power consumption is continuously reducing by the efforts of college management and energy audit initiatives.

5. After the measurement and analysis, we propose herewith following Energy Efficiency Improvement measures.



Orbit Energy & Engineering Services

BEE PAT Energy Auditing, Chartered Engineering, Energy Savings, Technical Consulting

Table: Energy Efficiency Improvement

| Sr. No. | Recommendations | Annual Saving Potential (Rs.) | Estimated Investment (Rs.) | Pay Back period (Years) | Remarks (Feasibility) |
|---------|--|-------------------------------|----------------------------|-------------------------|-----------------------|
| 1 | Smart Power Strip for computers | 25344/- | 82500/- | 3.25 | Long Term |
| 2 | Power factor improvement using APFC | Reduction in bill demand | 20000/- | NA | |
| 3 | Use of master switch outside each room | - | - | - | - |
| | Total Amount | Rs. 25344/- | Rs. 102500/- | 4.0 Years | |

- Note:**
- Total savings during the energy audit is estimated at Rs.25344/-
 - The total energy cost with an overall payback period of 4.0 Years for techno-economic feasibility.



Orbit Energy & Engineering Services



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 |

Orbit Energy & Engineering Services



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 |
| 6 | Nos of Students on roll during 2022-23 | 1313 |



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 Generators which are being run whenever power supply from MSEDCL is not available.



Diesel Generator (35KVA RATING)



Orbit Energy & Engineering Services

BEE PAT Energy Auditing, Chartered Engineering, Energy Savings, Technical Consulting

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
- Floodlight
- Pumping motor



SCIENCE BUILDING



CLASS ROOM



LIBRARY





Orbit Energy & Engineering Services

BEE PAT Energy Auditing, Chartered Engineering, Energy Savings, Technical Consulting



LABORATORY



COLLEGE MAIN ENTRANCE



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.



Orbit Energy & Engineering Services



CHAPTER :4

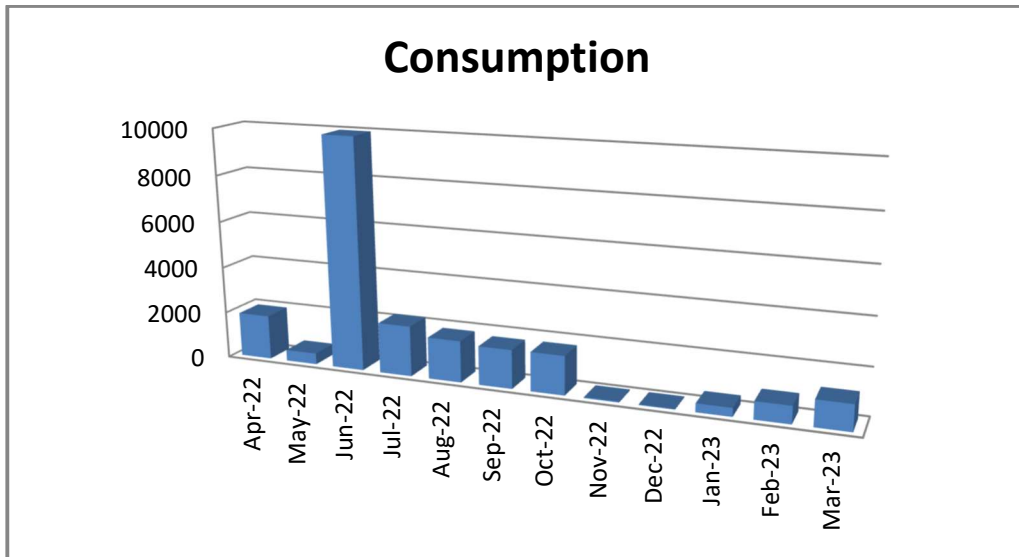
Historical Data Analysis

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

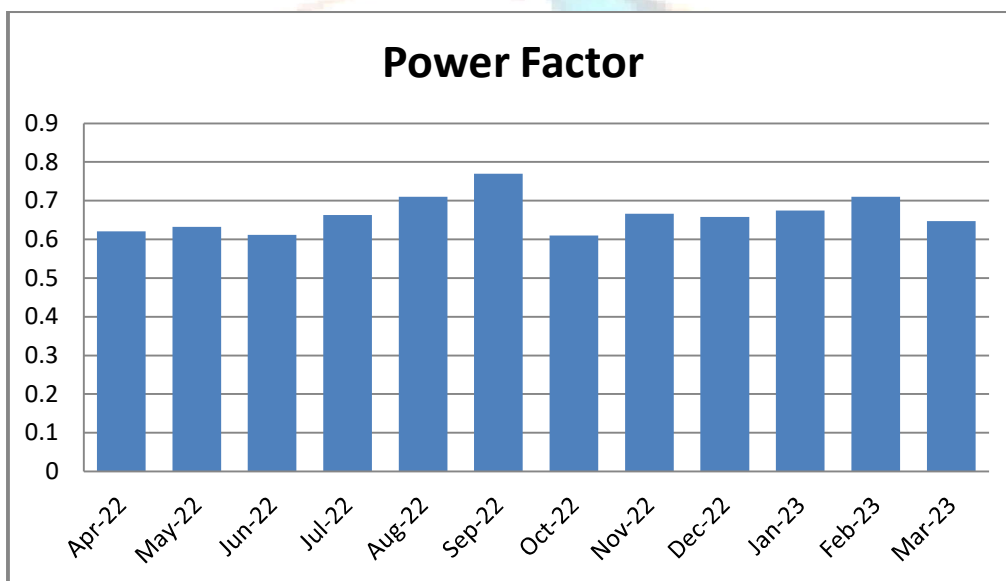
In this Chapter, we study the details of the 12 month Electricity Bills.

Table No 4.1 Variation in Units Consumption

| Sr. No. | Month | Consumption (kWh) |
|---------|--------------------|-------------------|
| 1. | Apr-22 | 1909 |
| 2. | May-22 | 475 |
| 3. | Jun-22 | 9934 |
| 4. | Jul-22 | 2159 |
| 5. | Aug-22 | 1776 |
| 6. | Sep-22 | 1653 |
| 7. | Oct-22 | 1665 |
| 8. | Nov-22 | 46 |
| 9. | Dec-22 | 34 |
| 10. | Jan-23 | 368 |
| 11. | Feb-23 | 746 |
| 12. | Mar-23 | 1107 |
| | Total Units | 21872 |



Month wise Unit Consumption



Month wise Power Factor variation

Conclusion : Power consumption of complex has reduced by around 0.95% due to energy saving initiatives, implementation of energy audit recommendations and awareness. But power factor need to improve further.

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.....



Orbit Energy & Engineering Services

BEE PAT Energy Auditing, Chartered Engineering, Energy Savings, Technical Consulting

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-22 | 16058 |
| 2 | May-22 | 4808 |
| 3 | Jun-22 | 85217 |
| 4 | Jul-22 | 19500 |
| 5 | Aug-22 | 17180 |
| 6 | Sep-22 | 17094 |
| 7 | Oct-22 | 15368 |
| 8 | Nov-22 | 2428 |
| 9 | Dec-22 | 3188 |
| 10 | Jan-23 | 4416 |
| 11 | Feb-23 | 7611 |
| 12 | Mar-23 | 10408 |
| | Total Annual Bill = | 203275 |
| | Average Monthly Bill = | 10799 |

Conclusion: Monthly Electricity Bill Variation has been identified.



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 | 2 | As per use | | 148 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.*



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.



Orbit Energy & Engineering Services



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 | MBA | 426010105461 | 73 LT-VII | 10 KW |
| 2 | Chemistry Lab (Sr. Collage) | 426010000171 | 73 LT-VII | 10 KW |
| 3 | Gas Plant (Jr. College) | 426010004419 | 73 LT-VII | 0.40 KW |

Performance in power factor is not appreciable as the PF is maintained average 0.665 in annual power consumption.

So there is scope for improvement of power factor. Power factor is affected during April-2022 to March 2023. 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.
- Led lights with reflectors should be used for proper illumination and reduction in power consumption.

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

Orbit Energy & Engineering Services



CHAPTER :7

Study of Air Conditioners

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

Orbit Energy & Engineering Services



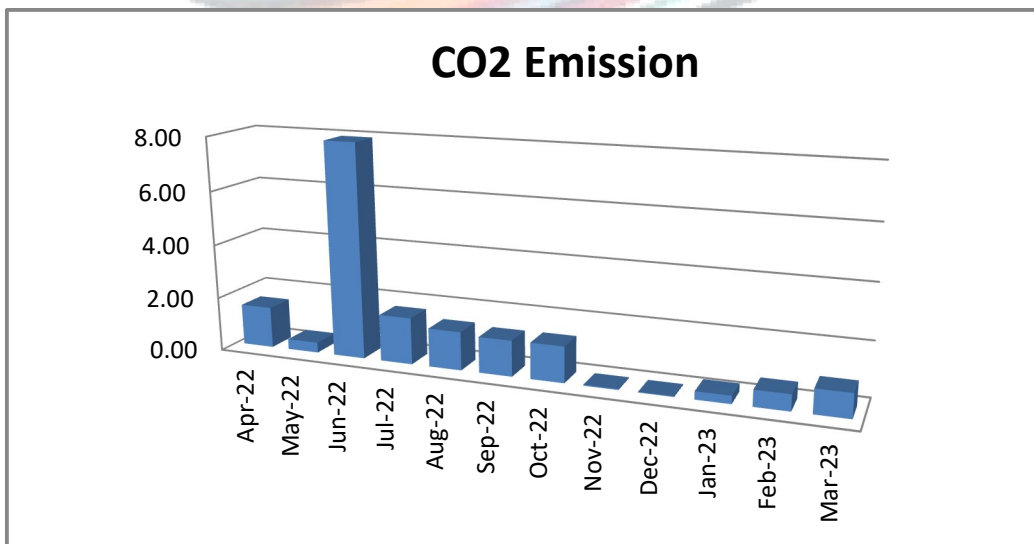
CHAPTER :8

Carbon Di-Oxide Emission

In this Chapter we compute the CO₂ emissions. For consumption of 1 Unit (1 kWh) of Electricity, the CO₂ emitted is 0.8 Kg. OR the Emission is 0.8 Kg/kWh. In the following Table we present the total units consumed and CO₂ emitted as under:

Table 8.1: CO₂ Emission

| Sr. No. | Month | kWh | CO ₂ Emitted in MT |
|---------|--------------|---------------|-------------------------------|
| 1 | Apr-22 | 1909 | 1.53 |
| 2 | May-22 | 475 | 0.38 |
| 3 | Jun-22 | 9934 | 7.95 |
| 4 | Jul-22 | 2159 | 1.73 |
| 5 | Aug-22 | 1776 | 1.42 |
| 6 | Sep-22 | 1653 | 1.32 |
| 7 | Oct-22 | 1665 | 1.33 |
| 8 | Nov-22 | 46 | 0.04 |
| 9 | Dec-22 | 34 | 0.03 |
| 10 | Jan-23 | 368 | 0.29 |
| 11 | Feb-23 | 746 | 0.60 |
| 12 | Mar-23 | 1107 | 0.89 |
| | Total | 203275 | Avg. Emission =1.46 |



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.
15. Management has installed solar panels in the month of July 2022 for reduction in internal power consumption



CHAPTER :9

Energy Conservation Proposals

9.1 Power factor improvement by using APFC panel:

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.

Total power consumption of college during 2022-23 was 21872 Kwh and average power factor of 0.665. To improve the power factor to unity, it is required to install automatic power factor correction capacitors at incoming.

$$\text{KW load} = 21872 / (30 \times 24) = 30.37 \text{ KW}$$

$$\text{Total reactive power (KVAh)} = 21872 / 0.665 = 32890$$

$$\text{Reactive power for unity PF (KVAh)} = 21872 / 1 = 21872$$

$$\text{Additional KVA} = 32890 - 21872 = 11018 \text{ KVAh}$$

$$\text{KVAr required to improve the power factor to unity} = 30.27 \times 1.108 \text{ (multiplying factor)} \\ = 33.53 \text{ KVAr}$$

Summary :

- ✓ No direct monetary benefit to institute due to tariff plan, but will be beneficial in terms of switchgear life, improved conductor current carrying capacity and many more.
- ✓ Total Cost of installation= Rs.20000/-

9.2 Smart Power Strip for Computers

A smart power strip (also called a smart power bar) looks similar to a traditional power bar, however circuitry is designed to monitor and control power to each electrical outlet in the strip to improve energy efficiency and prevent household electronics from wasting power.

Following calculations are done for 8 hours working:

- Total number of PCs in campus that can use Smart Power Strip= 132
- Rating of each PC= 60 W
- Annual hours of usage = $4 \times 200 = 800$
- Total Power Consumption= 31680 KWH
- Saving by using a Smart power strip= 10% of total
- Power Saved= 3168



- Savings in rupees = $3168 \times 8 = 25344$
- Cost of a smart power strip = 2500
- Hence, total number of smart power strips needed = $132 / 4 = 33$
- Total Cost = $2500 \times 33 = 82500$ rupees
- Payback period = $82500 / 25344 = 3.25$ years

9.3 Use of Master Switch outside each room

Installation of a Master Switch outside a room can make it easy for a person to switch off all the appliances of a room in case someone forgets to switch off while leaving the room. This can help improving energy efficiency.



Orbit Energy & Engineering Services



9.4 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 after 10 minutes/30 minutes.
- The comfort/Default air conditioning temperature to be set between 24°C to 26°C.
- Lights in toilet area may be kept OFF during day time
- Use AUTOMATIC POWER FACTOR CORRECTION (APFC) Panel FOR PF improvement
- 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.

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.

PRASHANT SURESHRAO AKARTE
BEE CERTIFIED ENERGY AUDITOR
Reg. No. EA 17568
Mob-7709978395