

# ENERGY AUDIT REPORT (2021-22)



OF

**NANDALAL BORGOHAIN CITY COLLEGE, DIBRUGARH**

**Address: Natun Nirmali Gaon,**

**Dibrugarh- 786003**

**Assam**

**Submitted By**

**JKM Consultancy Service, Jorhat**



**Solution For Energy Audit**

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## Preface

Data collection for energy audit of the Nandalal Borgohain City College, Dibrugarh was conceded by team for the period of January 2022 to December 2022.

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.C, electronic instruments, etc. in each room. How much was participation of each component in total electricity consumption.

We really appreciate the effort put by college management for creating awareness of Energy Audit, use renewable energy such as solar energy 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. We really appreciate to develop good quality weather station in house of the college.



**MAIN BUILDING**

## Acknowledgement

We are sincerely thankful to the Nandalal Borgohain City College, Dibrugarh management for giving us the opportunity to conduct energy audit in the college campus.

We are also grateful to Dr. Sanjeevananda Borgohain , principal, Nandalal Borgohain City College, Dibrugarh, Assam whose valuable comment / feedback , during various reviews have helped us to bring the report in the present format.

We express our sincere gratitude to IQAC Coordinator and all other concerned officials for their support and guidance during the conduct of this exercise.

## ENERGY AUDIT CERTIFICATE


This is to certify that an Energy Audit for Nandalal Borgohain City College, Dibrugarh, Assam has been conducted from January-22 to December-22 to assess energy costs, availability and reliability of supply of energy, energy conservations technologies and ways to reduce energy consumption.

  
03/04/2023  
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Chairperson



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## Energy Audit Assesment Team

### (Internal)

- Dr Dulen Saikia, Principal, M.Sc, M.Phil. Ph.d
- Mr Rajib Bordoloi, Associate Prof. M.Sc
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- Above Dr Dulen Saikia: *DS*  
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- Mr. Sabikur Rahman, Assistant Prof.
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## Abbreviations

<b>AHU</b>	<b>Air handling unit</b>
<b>APFC</b>	Automatic Power Factor Controller
<b>DG</b>	Diesel generator
<b>ECP</b>	Energy Conservation Proposal
<b>GCV</b>	Gross Calorific Value
<b>HVAC</b>	Heating, Ventilation and Air Conditioning
<b>HSDG</b>	High speed diesel Generator
<b>PF</b>	Power Factor
<b>SEC</b>	Specific Energy Consumption
<b>TR</b>	Tons of Refrigeration
<b>UOM</b>	Unit of Measurement
<b>APDCL</b>	Assam Power Distribution Company Limited



## Introduction to Energy Audit

- **General:**

Nandalal Borgohain City College, Dibrugarh , Assam 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 equipment. The key to such performance evaluation lies in the sound knowledge of performance of equipment 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.

There are three phases of energy audit

1. Pre audit phase
2. Audit phase
3. Post audit phase

Above phase include following stages

**1. Data collection-** In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation , survey communicating with responsible persons and measurements.



Following steps were taken for data collection:

- a) The team went to each department , centers, library, canteen etc.
- b) Data about the general information was collected by observation and interview.
- c) The power consumption of appliances was recorded by taking an average value in some cases

2. **Data analysis** – Detailed analysis of data collected include: calculation of energy consumption , analysis of latest electricity bill of campus .

3. **Recommendation** - On the basis of results of data analysis and observations , some steps For reducing power and water consumption were recommended. Proper treatments for waste were also suggested. Used of fossil fuels has to be reduced for the sake of community health The above target areas particular to the college was evaluated through questionnaire circulated among the students for data collection. Five categories of questionnaires' were distributed. The format of this are given below :

### **Pre audit phase**

#### **Survey form for data collection :**

1. List ways that you use energy in your college .( Electricity , Electric stove , Kettle, Microwave , LPG , Petrol , Diesel and others ).
2. Electricity bill amount for the last five year
3. Amount paid for LPG cylinders for last one year
4. Weight of firewood used per month and amount of money spent ? Also mention the amount spend for petrol/diesel/others for generators?
5. Are there any energy saving methods employed in your college? If yes ,please specify . If no ,suggest some.
6. How much money does your college spend on energy such as electricity , gas , etc. In a month .(Record monthly for the year 2016).
7. How many CFL bulbs has your college installed ? Mention use (Hours used/ Daily for how many days in a month)
8. Energy used by each bulb per month? (For example- 60 watt bulb x 4 hour x No of bulbs= kwh).
9. How many LED bulbs are used in your college ? Mention the use (Hours used / day for how many days in a month)

10. Energy used by each bulb per month?( kwh) .
11. How many incandescent(tungsten)bulbs have your college installed? 12.Mentions used (Hours used/day for how many days in a month)
13. Energy used by each bulb per month?(kwh).
14. How many fans are installed in your college ? Mention use(Hours used /day for how many days in a month)
15. Energy used by each fan per month ? (kwh)
16. How many air conditioners are installed in your college? Mention use(Hours used /day for how many days in a month)
17. Energy used by each air conditioners per month?(kwh)
18. How many electrical equipment including weighing balance are installed in your college ?
19. Mention the use (Hours used /day for how many days in a month)
20. Energy used by electrical equipments per month?(kwh)
21. How many computers are there in your college? Mention the use (Hours used /day for how many days in a month)
22. Energy used by each computer per month?(kwh)
23. How many photocopiers are installed by your college ?Mention use(Hours used /day for how many days in a month)
24. How many cooling apparatus per month are installed in your college ? Mention use(Hours used /day for how many days in a month)
25. Energy used by cooling apparatus per month?(kwh) Mention use(Hours used /day for how many days in a month)
26. Energy used by each photocopier per month?(kwh) Mention use(Hours used /day for how many days in a month)how many inverters your college installed ? Mention use(Hours used /day for how many days in a month)
27. Energy used by each inverter per month?(kwh)
28. How many electrical equipment are used in different labs of your college? Mention use(Hours used /day for how many days in a month)
29. Energy used by each equipment per month?(kwh)

30. How many heaters are used in the canteen of your college? Mention use (Hours used /day for how many days in a month)
31. Energy used by each heater per month (kwh)
32. Number of street lights in your college?
33. Energy used by each street light per month?(kwh)
34. Any other item that uses energy(Please write the energy used per month) Mention use(Hours used/day for how many days in a month)
35. Are any alternative energy sources /Known conventional energy sources employed / installed in your college?(Photovoltaic cell for solar energy, windmill ,energy efficient stoves etc., )Specify.
36. Do you run “switch off” drills at college?
37. Are your computers and other equipment put on power saving mode?
38. Does your machinery(TV, AC, Computer , weighing balance , printers, etc.)run on standby mode most of the time? If yes , how many hours?
39. What are the energy conservation methods adopted by your college?
40. How many boards displayed for saving energy awareness?
41. How much ash is collected after burning firewood per day in the canteen?
42. Write a note on the methods/ practice / adaptation by which you can reduce the energy used in college campus in future.

## **2. Audit Phase**

In Nandalal Borgohain City College, Dibrugarh , Assam, energy auditing was done with the help of team teaching staff and students. The energy audit began with the teams walking through all the different facilities at the college, determining the different types of appliances and utilities (lights, taps, toilets, fridges, etc.) as well as measuring usage per item (watts indicated on appliances) and identifying the relevant consumption patterns (such as how often an appliance is used) and their impacts. The staff and learners were interviewed to get details of usage, frequency or general characteristics of certain appliances.

## **Data collection**

Data collection was done in the sector such as sources of energy and energy consumption pattern, college records and documents were verified several times to clarify the data received through survey and discussions. Although whole process was completed from 2021 march to February , 2022 , previous energy patterns were also observed.

## **Site Tour**

Site inspection was done along with students and staff.

## **Review of Documents and Records**

Documents such as electricity bill registers of electricity fuel consumption were collected .

## **Energy Consumption Profile**

### **A.Source of Energy:**

a.Electricity from Assam Power Distribution Company Limited

b.High Speed Diesel Generator (HSDG):

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

There is one number of DG set which is dedicated to supply power to entire campus.

The salient technical specifications are as follows:

Company	JOYSHREE POWEROL
Model no	15 KVA 1 PH 3255 GM –C2
Machine no	JP- 15 – K- 3464
KVA	15 KVA
KW	12
Voltage	415v
Current	87amp
Power factor	0.8

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

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

**Table No 4.1 Variation in Units Consumption & Power Factor (PF)****I. Nandalal Borgohain City College, Meter no AP10006349**

<b>SI. NO.</b>	<b>Month</b>	<b>No. of unit( KWh)</b>	<b>Amount</b>	<b>Power factor</b>
1	JANUARY	1101	8035	0.93
2	FEBRUARY	1007	15267	0.93
3	MARCH	1123	8154	0.94
4	APRIL	-----	-----	-----
5	MAY	1981	13904	0.97
6	JUNE	2102	14677	0.97
7	JULY	2309	16135	0.98
8	AUGUST	2175	16018	0.98
9	SEPTEMBER	2502	17993	0.98
10	OCTOBER	1750	12728	0.97
11	NOVEMBER	1383	12974	0.97
12	DECEMBER	1092	9324	0.94
13				
<b>Total unit (Average)</b>		<b>1684</b>	<b>13200.81</b>	<b>0.96</b>

**Conclusion: Variation of PF**

The Power Factor 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.

Whenever the average power factor over a billing cycle or a month, whichever is lower, of a higher tension consumer is below 90%, Penal charges shall be levied to the consumer at the rate of 2 % (two %) of the amount of monthly energy bill (excluding of Demand Charges, FOCA, Electricity Duty and Regulatory Liability Charge etc.)

For power factor of 0.99, the effective incentive will amount to 5% (five percent) reduction in the energy bill and for unity power factor; the effective incentive will amount to 7% (seven percent) reduction in the energy bill.

General Observations based on Electricity Bill:

1. The average electricity cost is Rs. 6.15 considering the last twelve months.
2. Average monthly Power Factor is maintained near P.F. 0.96
3. Load Factor need to be improved to maximum value.
4. Average Power factor is affected during January to December 2022 is 0.96 and need to improve power factor up to 0.99

### Actual Measurements and its Analysis

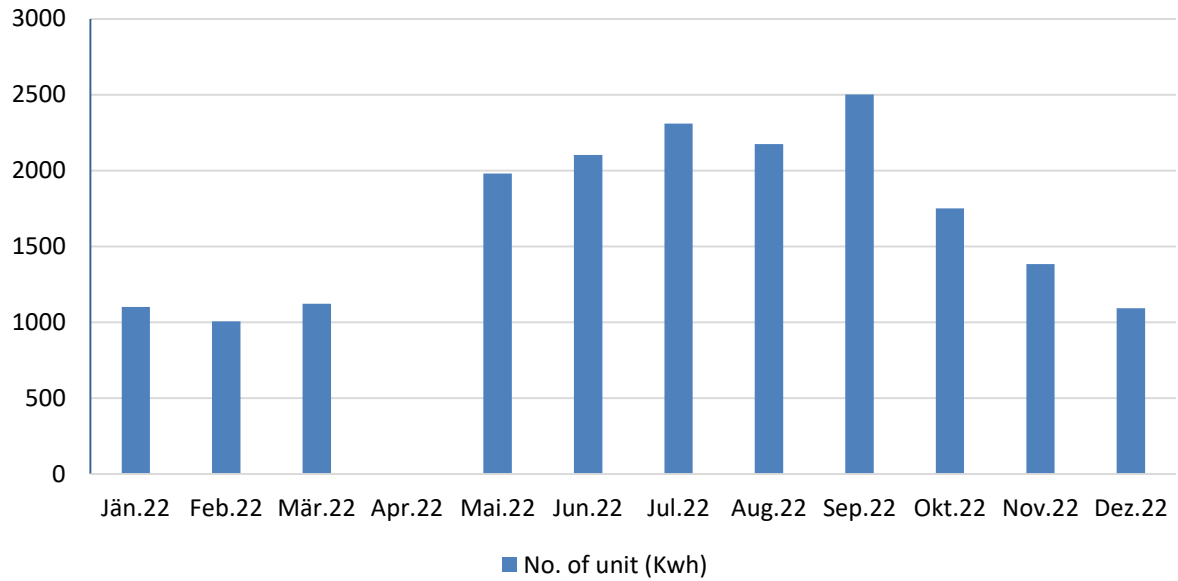
SI. NO.	ITEMS	Power rating (watt)	Quantity	Power consumption (watt per hr)
1	Bulb (CFL)	20	167	3340
2	Bulb (LED)	10	171	1710
3	Ceiling Fan	70	183	12810
4	Wall fan	70	14	980
5	Computer	100	16	1600
6	Printer	100	04	400
7	Projector	100	02	200
8	Refrigerator	100	02	200
9	Exhaust Fan	70	01	70
10	Inverter	1000	02	2000
11	Air Conditioner	2000	03	6000
12	Water Purifier	60	03	180
13	Water Pump	1500	03	4500
14	XEROX Machine	1000	02	2000
15	LED TV	50	02	100
16	C.C.T.V	40	32	1280
	<b>Total</b>			<b>37,370</b>



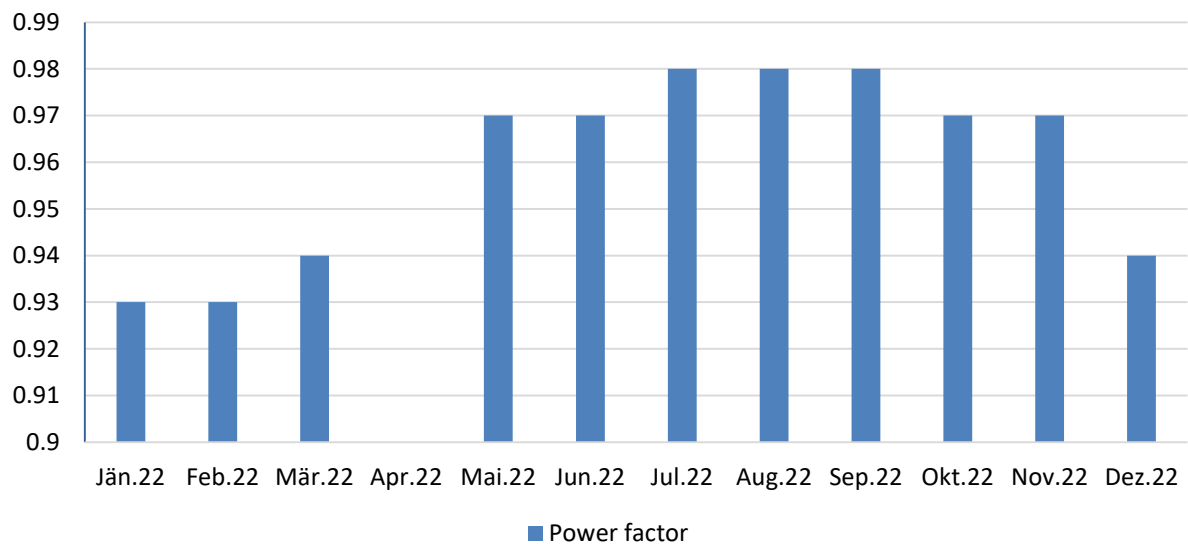
**Remarks:**

- It has been observed that in old and new building majority of electrical power consumption is through light load such as fan, FTL and power load such as refrigerator, ups, 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.

### Month wise power consumption



### Month wise power factor



## **Lighting System**

### **Observations and suggestions:**

- It is found that FTL, Bulbs, CFLs is installed in the facility.
- It is recommended that some tube lights in this area 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.
- Stand-by power can use up to 8% of a household's total electricity.

For most homes a 10% reduction in electricity consumption can save \$200 a more a year off our electricity bill and nearly  $\frac{3}{4}$  of a tone of CO<sub>2</sub> pollution. A 20% reduction on average consumption will save over \$400 and over 1.5 tons of CO<sub>2</sub>.

### **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
- Kitchen gadgets such as blenders, kettles, toasters etc.

## 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.

**a. Load of ACs was as follows:**

Item	Rated Power (kW)	Qty	Voltage	Current Amp	Actual Power (kW)
ACs	2	3	240	8.3	1.9

### Observations and suggestions:

1. Normal air conditioning temperature should be kept as high as possible (i.e., 24 d.cel.). 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.

## Carbon Di-Oxide Emission

In this Chapter we compute the CO<sub>2</sub> emissions. For consumption of 1 Unit (1 kWh) of Electricity, the CO<sub>2</sub> 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<sub>2</sub> emitted as under:

**Table: CO<sub>2</sub> Emission:**

Sl. NO.	Month	No. of unit( KWh)	CO2 Emitted in MT
1	JANUARY	1101	0.88
2	FEBRUARY	1007	0.8
3	MARCH	1123	0.89
4	APRIL	-----	-----
5	MAY	1981	1.58
6	JUNE	2102	1.68
7	JULY	2309	1.85
8	AUGUST	2175	1.74
9	SEPTEMBER	2502	2
10	OCTOBER	1750	1.4
11	NOVEMBER	1383	1.16
12	DECEMBER	1092	0.87
<b>Total unit (Average)</b>		<b>1684</b>	<b>1.35</b>

### **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. Refrigerator's are of three STARS.
7. Incandescent Bulbs are nowhere used.
8. They are replaced by CFL tubes with electronic choke.
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 when Billing Rate is normal.
12. Walls are painted with off white colour to have sufficient brightness.
13. LED flash light is used in Seminar hall.

## **Energy Conservation Proposals :**

### **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.

### **Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights :**

The 167 FTLs can be replaced with the LED tube lights 10 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 20 w FTL = 20 W/ CFL
- Equivalent LED tube light = 10 W/ LED
- Savings in power = 10 W/ LED
- Operating hours = 8 h/day x 300 = 2400 h/year
- LED Light Yearly savings = 2400 x 10 W = 24 kWh/year/LED
- Average Cost of electricity = Rs.6.15/ kWh
- Saving = 24 kWh x 6.15 = Rs.147.6 / year/ LED
- Approximate investment on single LED Tube lights = Rs. 100
- Number of CFL Lights to be replaced = 167

**Summary:**

Total Yearly Saving =  $167 \times 147.6 = \text{Rs. } 24649.2 \text{ /year}$

Total Investment =  $167 \times \text{Rs. } 100 = \text{Rs. } 16700/-$

## **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 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 daytime
- Use AUTOMATIC POWER FACTOR CORRECTION (APFC) Panel FOR PF improvement.
- Need to focus on existing solar plant which is generating power below the rated power
- 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.
- Need to use power saver circuits for AC.

### **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.

### **2.3 Post audit phase**

#### **Follow up and action plans**

Energy audits form a part of an on-going process. Innovative energy saving initiatives has to be designed and implemented every year to make the college environmentally sustainable. Follow of programs of energy auditing recommendations should be done meticulously before the next audit.

**Photograph:**















