CREDA

03rd October, 2018

BUILDING ENERGY AUDIT REPORT

GOVERNMENT COLLEGE

Balrampur, Chhattisgarh

Submitted By

Design2Occupancy Services LLP

A75, Sitapura Industrial Area, Tonk Road,

Jaipur-302022, Rajasthan

www.design2occupancy.com

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1 Acknowledgement

We would like to thank Chhattisgarh State Renewable Energy Development Agency (CREDA) for providing us with work order for Government College, Balrampur Chhattisgarh Ref. No. *CREDA/ECBC/SMD/F-66(1)/12012.*

We would like to express our sincere gratitude to Shri. Alok Katiyar, CEO, Chhattisgarh State Renewable Energy Development Agency (CREDA); Mr. S.M. Deshpande, Chief Engineer, CREDA; Mr Amitabh Sharma, Assistant Engineer, CREDA; Mr. Kushal Tiwari, Project Coordinator, CREDA, for their support in giving us the opportunity to perform the detailed energy audit to identify the potential area of energy savings in the building.

We would also like to thank Sh. SK Kindo, Assistant Engineer, CREDA, Balrampur and other staff members of Government College, who helped us to gather the data and to permit us in accessing the building system.

2 Preface

This report has been prepared for submission to CREDA and provides the details of the energy consumption of the building and the energy conservation measures which if deployed can lead to energy savings. The report contains significant results of the performance audit on levy covers the period 2017-2018. The matters relating to subsequent or earlier periods have also been included, wherever necessary.

The instances mentioned in this report are those which came to notice in the course of test audit conducted during the period 2018-2019. The audit has been conducted in conformity with the Bureau of Energy Efficiency (BEE) energy audit standards and Energy Conservation Building Code (ECBC) 2017 baseline standards.

The works undertaken in the energy audit of premises include:

- Investigating how much connected load is there in facility i.e., electrical appliances installed in facility and other forms of energy sources
- Identifying building envelope i.e., heating factor via windows and ceilings, and their load on equipment or appliances which are subjected, and how much energy they consume
- Identifying cost-effective measures to make energy use more efficient
- Estimating the potential costs and energy savings of implementing efficiency measures
- Checking on how energy use is managed and monitored.

So, the following major use has been examined:

- Air-conditioning and ventilation
- Lighting
- Office equipment
- Building materials, position, insulation
- Energy management practices
- Energy bills and tariffs.

3 Abbreviation

- CREDA - Chhattisgarh State Renewable Energy Development Agency
- ECBC – Energy Conservation Building Code
- CSPDCL – Chhattisgarh State Power Distribution Company Ltd.
- EEM – Energy Efficiency Measures
- EPI – Energy Performance Index
- MRD- Maximum Running Demand
- W - Watt
- kVA – Kilo-Volt-Ampere
- kWh – Kilo-Watt-Hours
- kW – Kilo-Watt
- LED - Light Emitting Diodes
- LPD - Lighting Power Density
- PF – Power Factor
- SRI- Solar Reflectance Index
- SRF- Solar Reflectance Film
- SHGC – Solar Heat Gain Co-efficient
- UPS - Uninterruptible Power Supply
- VLT – Visible Light Transmittance
- EU – Units corresponding to excess supply
- TU – Total units supplied during the month
- CD- Contract demand
- MD – Maximum demand
- CFL - Compact Fluorescent Lamp
- DG – Diesel Generator

4 Tools & Tackles

The following are the tools and tackles used during building energy audit:

S. No.	Instruments Used	Calibration Validity
1	Digital Anemometer	15-12-2018
2	Digital Clamp Meter	19-11-2018
3	Digital Thermometer	27-12-2018
4	Sling Psychrometer	-
5	Sound Level Meter	08-10-2018
6	U-Value Meter	28-12-2018
7	I R Thermometer	28-12-2018
8	Thermal Imaging Camera	-
9	Lux meter	-

5 Building Energy Audit

Based on an inspection of the building (and some measurements), energy auditing includes an evaluation and analysis of the existing situation and the various measures that could be implemented to reduce the energy consumption and improve the indoor environment. The results are presented in an energy audit report describing the findings and related recommended measures with corresponding investments, savings and profit.

The energy audit in a building is feasibility with detailed equipment study. This helps in identifying energy use among the various services and also in identifying the opportunities for energy conservation. The study shall be revealed to the owner, manager, or management team of the building for the options available for reducing energy waste, the costs involved, and the benefits achievable from implementing those energy-conserving opportunities (ECOs). It is to reduce waste of energy and money to the minimum, permitted by the climate in which the building is located, its functions, occupancy schedules, and other factors. It establishes and maintains an efficient balance between a building's annual functional energy requirements and its annual actual energy consumption.

Energy Audit Process Flow

Executive Summary

6 Executive Summary

Energy audit team has determined energy consumptions of facility in different particulars. Energy audits identify energy consumed by a facility and energy supplied by facility and locates energy conservation measures or projects. The table below depicts the Energy Efficiency Measures (EEMs) concluded after the detailed energy audit. The description given below summarises the EEMs suggested along with their initial investment. The savings in kWh and cost has been analysed and accordingly the payback analysis has been performed.

Investment Category:

S. No.	Category	Range of Investment (INR)
1	Low Investment	Below 1,00,000
2	Medium Investment	1,00,000 < 3,00,000
3	High Investment	Above 3,00,000

Comfort Systems and Controls (HVAC):

S. No.	Description	Investment (INR)	Investment Category	Energy Savings/ year (kWh)	Cost Saving/ year (INR)	Payback Period (Years)
1	**EEM -1 – Replacement of existing Fan with Energy Efficient Fans**	Option – I 1,02,000	Medium Investment	5,622.75	30,925	3.3
		Option – II 2,55,000	Medium Investment	8,835.75	48,596.6	**5.2**
2	**EEM -2 – Replacement of existing Exhaust Fan with Energy Efficient Fans**	24,000	Low Investment	907.2	4,990	**4.8**

Lightings and Controls:

S. No.	Description	Investment (INR)	Investment Category	Energy Savings/ year (kWh)	Cost Saving/ year (INR)	Payback Period (Years)
1	**EEM-3 – Replacement of existing tube light (40W) with LED tubes (24W)**	64,000	Low Investment	2,419.2	13,306	**4.8**

Description of Building

7 About Government College, Balrampur

Government College, Balrampur established in the year 2008. The Building having 2 floors (G+1) i.e., the ground floor and first floor. Government College, Balrampur is established in 12th July 2008 by honourable Dr. Krishan Murti. The facility comprises of office space; class room spaces and lab area.

The District Balrampur - Ramanujganj is located in the northern part of Chhattisgarh state in central India. It was carved out of the erstwhile Surguja district and came into existence on 17th January, 2012. The district shares its boundaries with the states of Uttar Pradesh, Jharkhand, and Madhya Pradesh and is spread out over a total land area of about 60.16 lakh hectares.

Balrampur is a part of the Northern Hills agro - climatic region of Chhattisgarh. The climate of the district is characterized by a hot summer and well distributed rainfall (average 125 cm) during the monsoon season. The district has a total population of 7,30,491 individuals with a sex ratio of 973 females per thousand males. It is a tribal dominated district with almost 63% of the population comprising of Scheduled Tribes while Scheduled Castes comprise of just 4.5% of the total population. PahadiKorwas, Gonds, Khairwars, Kanwars and Pandos are the major tribal groups residing in the district.

Figure - Government College, Balrampur

Figure - Building Inauguration Template

The operating hours of the building is 9:00 AM to 4:00 PM. 7 hours is the average operational hours in a day for Government College.

7.1 Description of the Building and Introduction

- Client: CREDA
- Facility Name: Government College, Balrampur
- Latitude- 23° 38' 3.94"N
- Longitude - 83° 38' 46.88"E
- Building Operation Since Year- 2008
- Building Operational Hours- 7 Hrs. (09:00 AM to 4:00 PM)
- Climate zone- Composite
- Number of Floors: G+1
- Built-Up Area – 1,418 m^2 Approx.
- Energy Audit Team: Design2Occupancy Services LLP

Figure – Satellite image of College

- Air-Conditioned Area: Less than 5%
- Contract Demand: 10 kW
- Connected Load: 22.09 kW
- Occupancy: 100-200 (Typical)

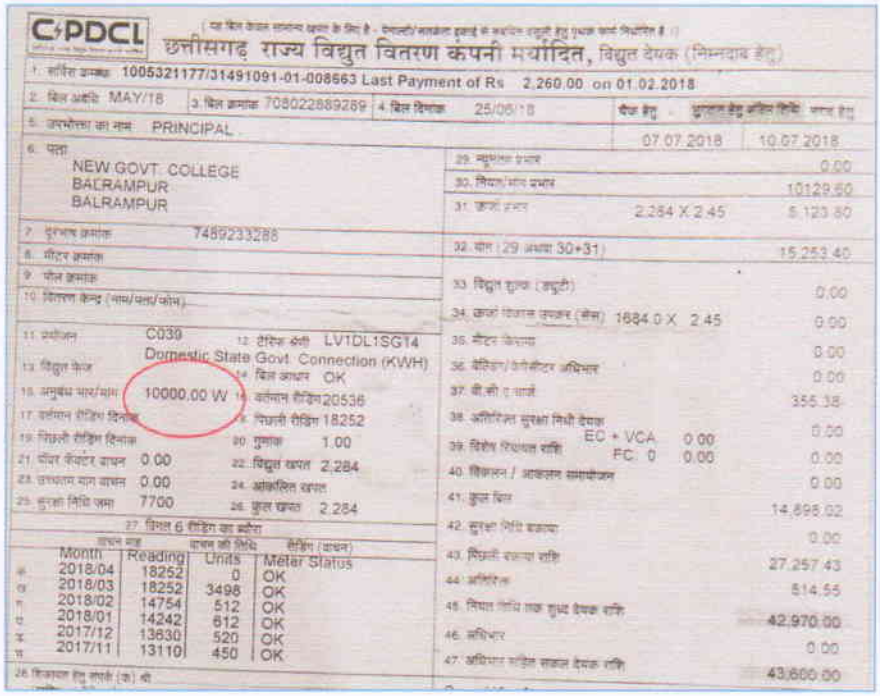
Design2Occupancy team has performed complete energy audit of the building and has reached to the results of the performance of the systems, analysed the energy consumption, traced out the fault in the process/equipment as findings, suggested the energy efficiency measures and respective cost analysis of the energy efficiency measures.

7.2 Analysis of Building Electrical Load and Contract Demand

7.2.1 Contract Demand

A customer's contract demand is the amount of power which a customer agrees to pay to have available at all times. This refers to power which must be made available, as opposed to energy which can actually be utilized; contract demand is measured in kilowatts.

The following image shows the contract demand load of the office building:



CSPDCL छत्तीसगढ़ राज्य विद्युत वितरण कंपनी मर्यादित, विद्युत देयक (निम्नदाब हेतु)

1. सर्विस क्रमांक 1005321177/31491091-01-008663 Last Payment of Rs 2,260.00 on 01.02.2018
2. बिल अवधि MAY/18 3. बिल क्रमांक 708022889289 4. बिल दिनांक 25/06/18
5. उपभोक्ता का नाम PRINCIPAL
6. पता NEW GOVT. COLLEGE BALRAMPUR BALRAMPUR
7. दूरभाष क्रमांक 7489233288
8. मीटर क्रमांक
9. फीस क्रमांक
10. विक्रय केन्द्र (नाम/पता/फोन)
11. प्रयोजन C039 Domestic State Govt. Connection (KWH)
12. टैरिफ श्रेणी LV1DL1SG14
13. विद्युत फेस
14. बिल आधार OK
15. अनुबंध भार/मांग 10000.00 W
16. वर्तमान रीडिंग 20536
17. वर्तमान रीडिंग दिनांक
18. पिछली रीडिंग 18252
19. पिछली रीडिंग दिनांक
20. गुणांक 1.00
21. पीक कैपेसिटर वाचन 0.00
22. विद्युत खपत 2,284
23. उपभोग मात्र वाचन 0.00
24. आकलित खपत
25. सुरक्षा निधि जमा 7700
26. कुल खपत 2,284
27. पिछले 6 रीडिंग का ब्यौरा

Month	Reading	Units	Meter Status
2018/04	18252	0	OK
2018/03	18252	3498	OK
2018/02	14754	512	OK
2018/01	14242	612	OK
2017/12	13630	520	OK
2017/11	13110	450	OK

	07.07.2018	10.07.2018
29.		0.00
30.		10129.60
31.	2,284 X 2.45	5,123.80
32. योग (29 अथवा 30+31)		15,253.40
33. विद्युत शुल्क (छत्तीसगढ़)		0.00
34.	1684.0 X 2.45	0.00
35.		0.00
36.		0.00
37.		356.38
38.		0.00
39.	EC + VCA 0.00 FC 0 0.00	0.00
40.		0.00
41. कुल बिल		14,696.02
42.		0.00
43.		27,257.43
44.		514.55
45.		42,970.00
46.		0.00
47.		43,600.00

Figure - Contract Demand

As it can be observed that the contract demand load of the building is 10 kW.

7.2.2 Connected Load

It is defined as the sum of ratings of all electrical equipments that are connected at the supply point regardless of their status of operation. It depends on the installed equipment without measuring or testing their actual demand. Government College, Balrampur has different types of load in the building. Office building loads are majorly divided in different category:

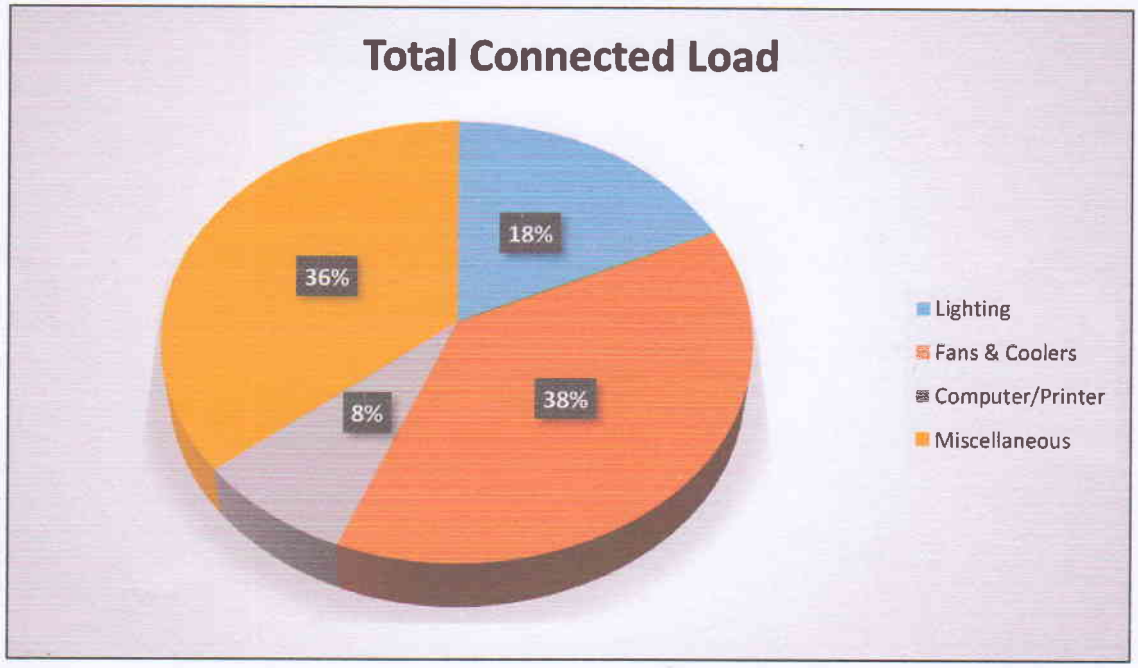
1. Lighting Load
2. Cooling load
3. Evaporative Coolers & Fans Load
4. Equipment's Load (Computer, Printer, Water purifier, etc.)
5. Laboratory Apparatus Load

Lighting load of the building is 4.1 kW which contributes 18% of the total connected load of the building. Evaporative coolers, ceiling fans & exhaust fans contribute 8.3 kW, which is 38% of the total connected load. Various

computer/printers are installed in facility contributing 8% of total connected load i.e., 1.8 kW. The building total connected load is around 22.09 kW. Following table gives a detail regarding various loads in the building along with their power consumption in kW.

Total Connected Load Breakup			
S. No	**Systems/Area**	**Load in (kW)**	**Load Percentage (%)**
1	Lighting	4.1	18%
2	Fans & Cooler	8.3	38%
3	Computer/Printer	1.8	8%
4	Miscellaneous	7.9	36%
Total load of the building(kW)		**22.09 kW**	

Table: Breakup of Connected Load Summary



Pie-Chart Showing Break-up of Connected Load

Contract Demand according to Utility Bills (kW)	**Calculated Connected load (kW)**
10	**22.09**

Table – Contract Demand vs. Connected load

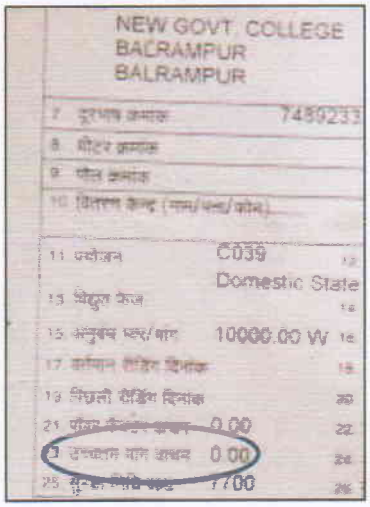
7.2.3 Contract Demand v/s Connected Load v/s Maximum Running Demand

Maximum Running Demand refers to the maximum amount of electrical energy that is being consumed at a given time by facility. The facility provided two bill to the auditors due to which the team wasn't able to analyse the maximum running demand load. Also, the auditors observed that from 2 months available bills, the maximum running demand in the bill provided is 0. Whereas, the facility is paying a constant amount i.e. 75% of the sanctioned contract demand as minimum payment. Also, it has been assumed by the auditor that the electricity meter may have been faulty as the MRD is not reaching to expected measures.

The energy meter plays an important role in ensuring that the facility receives accurate bills. If the energy meter is faulty, the facility could end up being overcharged for their energy, due to incorrect calculations. There are a number of different faults meter can have, including:

- The meter has stopped reading consumption, so it stays the same even when energy is being used.
- The meter display has disappeared or there is a message reading 'error' or 'battery.'

Therefore, as per observation the electric meter of Government College, Balrampur is not working accurately as, the maximum running demand of facility is showing zero value which is not practically possible and is not reaching near to the expected readings.



7.2.4 Electrical Quantities Fluctuation

Electrical parameters were measured from Clamp meter and Panel.

Electrical Parameters Fluctuation								
Feeder No	**Voltage Measurement (V)**			Rated Voltage (V)	**Current Measurement (A)**			Average Current (A)
	R-Y	Y-B	B-R		R	Y	B	
Panel - 1	411	418	414	415	9.6	12.6	10.4	10.86
Feeder No	**% Voltage Fluctuation**				**% Current Fluctuation**			
	R-Y	Y-B	B-R		R-Y	Y-B	B-R	
Panel - 1	-0.9%	+0.7%	-0.2%		-12%	16%	-4%	

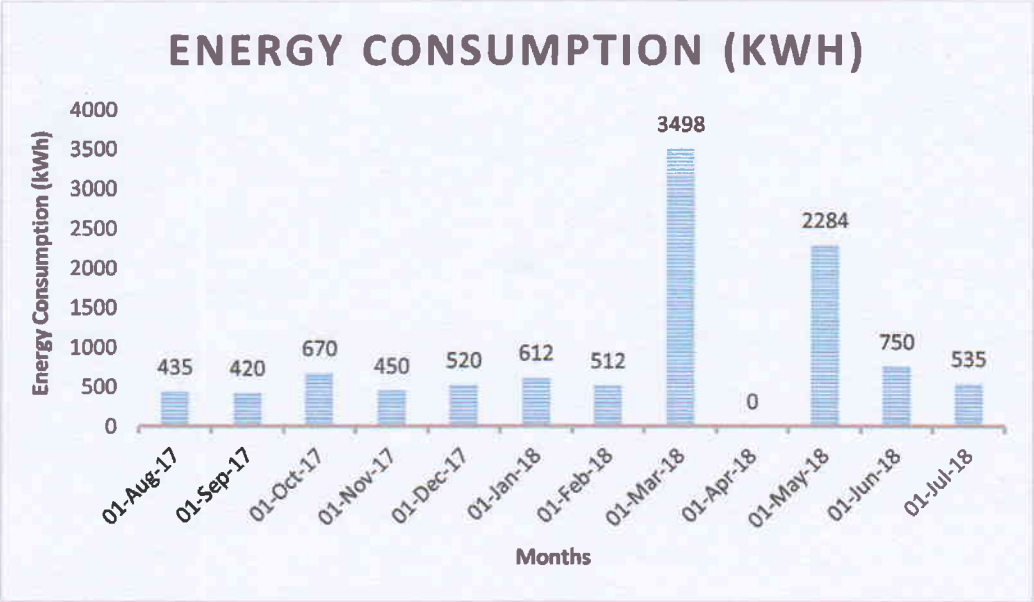
It can be observed from the above table that the electrical parameters (i.e. Current (A) and Voltage (V)) are fluctuating from the rated parameters and the fluctuation is not in the permissible range. Thus, it is suggested to the facility team to install a phase-balancing device at panel to sort-out such issues.

7.2.5 Energy Consumption Scenario

The below table reflects the electricity consumption (kWh) from Aug'17 to July'18:

S. No.	Month	Energy Consumption (kWh)	Power Factor
1	01-Aug-17	435	0.0
2	01-Sep-17	420	0.0
3	01-Oct-17	670	0.0
4	01-Nov-17	450	0.0
5	01-Dec-17	520	0.0
6	01-Jan-18	612	0.0
7	01-Feb-18	512	0.0
8	01-Mar-18	3498	0.0
9	01-Apr-18	0	0.0
10	01-May-18	2284	0.0
11	01-June-18	750	0.0
12	01-July-18	535	0.0
Total Energy Consumption		10,686	0.0

Table - Energy Consumption (Aug 2017 – July 2018)



Monthly Electricity Consumption – kWh

Observations:

It has been observed from available utility bills and Power Factor data table that electricity bills continuously showing power factor of facility is zero. It has been suggested that facility should install automatic power factor controller to maintain 0.97 minimum power factor which is also ECBC mandatory requirement. It has been also suggested that facility should calibrate or repair the energy meter installed in facility as it may be error in readings taken by energy meter.

7.2.6 Electricity Rate Analysis:

Electricity rate analysis shows the variation in electricity unit rate of previous few months. It provides the total amount of the electricity bill (Rs.) to be paid for total units consumed (in kWh) of one month. The following table shows the calculation of average utility unit rate:

S. No.	Month	Total Utility Bill (Rs.)	Energy Consumption (kWh)	Rate/Unit (Rs/kWh)
1	01-Feb-17	2,327.6	512	4.5
2	01-May-17	14,898.0	2284	6.5
Total Average of Electricity Rate (Rs.)				**5.5**

Table – Average Energy Tariff

Note: Energy charges rate per unit depends upon the total utility bill amount for every month.

$$\text{Energy charges rate per unit} = \frac{Total\ Utility\ Bill\ (Including\ all\ other\ charges)}{Energy\ Consumption\ (kWh)}$$

7.2.7 Tariff Details of Chhattisgarh State Power Distribution Company Limited

7.2.7.1 Billing Demand

The billing demand for the month shall be maximum demand (in kVA) of the consumer recorded during the billing month or 75% of the contract demands whichever is higher except the consumers who have reduced their contract demand to zero. The billing demand shall be rounded off to the next whole number.

7.2.7.2 Power factor Incentive/Surcharge

Power factor Incentive/Surcharge for all HV category consumers shall be billed on the following terms:

a) If the average monthly power factor of the consumer increases above 95%, he shall be paid an incentive at the following rate

For each one percent increase by which his - average monthly power factor is above 95%, up to unity power factor	One percent (1%) of the total amount of bill under the head 'energy charge'

b) If the average monthly power factor of the consumer falls below 90%, he shall pay a surcharge in addition to his normal tariff, at the following rate:

For each one percent increase by which	One percent (1%) of the total amount of

his - average monthly power factor is below 90% up to 85%	bill under the head 'energy charge'

c) If the average monthly power factor of the consumer falls below 85%, he shall pay a surcharge in addition to his normal tariff the following rate:

For each one percent increase by which his - average monthly power factor is below 85%	Two percent (2%) of the total amount of bill under the head 'energy charge'

d) If the average monthly power factor of the consumer falls below 70%, then the CSPDCL shall have the right to disconnect consumer's installation after serving a notice of 15 days. Supply may be restored only after steps are taken to improve the power factor to satisfaction of CSPDCL. This is, however without prejudice to the levy of surcharge for low power factor in the event of supply not being disconnected.

e) For this purpose, the "average monthly power factor" is defined as the ratio of total "Kilo Watt Hours" to the total 'Kilo Volt Ampere hours' recorded during the month. This ratio will be rounded off to two figured after decimal, 5 or above in the third place after decimal being rounded off to the next higher figure in the second place after decimal.

f) Notwithstanding the above, if average monthly power factor of a new consumer is found to be less than 90% at any time during the first 6 months from the date of connection, and if he maintains the average monthly power factor continuously in subsequent three months at not less than 90%, then the surcharge billed on account of low power factor during the said period, shall be withdrawn and credited in next month's bill.

7.2.7.3 Delayed Payment surcharge

If the bill is not paid by the consumer within the time period described (due date) for payment of the bill, a surcharge @1.5% per month or part thereof, on the total outstanding amount of the bill (including arrears, if any but excluding amount of

surcharge), shall be payable in addition, from the due date of payment as mentioned in the bill.

7.2.7.4 Advanced payment Rebate

A rebate @0.5% per month will be payable on net amount of advance at the end of the billing cycle of that particular month, subject to the net amount of advance is not less than □20,000/- and shall be adjustable in next month's bill.

7.2.7.5 Additional Charge for exceeding Contract Demand

The consumers should restrict their maximum demand to the extent of contract demand. In case the maximum demand during any month exceeds the contract demand, the foregoing tariffs shall apply only to the extent of the contract demand and corresponding units of energy. The demand excess of contract demand and corresponding units of energy shall be treated as excess supply. The excess supply so availed, if any, in any month shall be charged at one and half times of the normal tariff applicable to the consumer (demand and energy charges) for the excess demand is found beyond 20% of the contract demand and at the rate two times of normal tariff if the excess demand is found beyond 20% of contract demand.

For the purpose of billing of excess supply, the billing demand and the units of energy shall be determined as under: -

a) **Billing Demand/ Contract Demand:** The demand in excess of the contract demand in any month shall be the billing demand/ contract demand of the excess supply
b) **Units Energy:** The units of energy corresponding to kVA's of the portion of demand in excess of the contract demand shall be:

   EU = TU (1-CD/MD)

   Where:

   EU – denotes units corresponding to excess supply;

   TU – denotes total units supplied during the month;

CD- denotes contract demand; and

MD – denotes maximum demand.

The excess supply availed in any month shall be charged along with the monthly bill and shall be payable by the consumer.

The billing of excess supply at one and half times/two times of the normal tariff applicable to consumer is without prejudice to the CSPDCL's right to discontinue the supply in accordance with the provisions contained in the Chhattisgarh State Electricity Supply Code.

c) No rebates/incentives are payable on such excess supply.

7.3 Energy Performance Index

Energy Performance Index (EPI) is the total energy consumed in a building over a year divided by total built-up area (kWh/m^2/year) and is considered as the simplest and most relevant indicator to analyse the energy efficiency of a building.

The total energy consumed (kWh) by the facility includes the electricity consumption from the grid supply, renewable energy consumption and electricity produced or purchased from any other sources. The total built-up area doesn't include the parking area.

As per the **Bureau of Energy Efficiency (BEE[1])** star label program for buildings, below are the star rating criteria for an office building (with less than 50% Air-conditioned area)

Climate Zone – Composite

[1] Scheme for BEE Star rating for Office Building 2009 - Published by BEE, Govt. of India

Energy Performance Index (August-17 to July-18)	
Total Consumption Unit in a year (kWh)	10,686
Total consumption via Solar plant in a Year (kWh)	7,395
Total Consumption via DG in a year (kWh)	2,000
Total Consumption by facility in a year (kWh)	20,081
Total Built up area (m^2)	1,418
EPI (kWh/m^2/Year)	14.2

Table- EPI Calculation (August 2017-July 2018) for Govt. College, Balrampur

EPI (kWh/sqm/year)	Star Label
80-70	1 Star
70-60	2 Star
60-50	3 Star
50-40	4 Star
Below 40	5 Star

Table -BEE Star rating criteria

The calculated Energy Performance Index (EPI) for Government College, Balrampur is 14.2kWh/m^2/year from Aug 2017 – July 2018.

Thus, Government College, Balrampur building currently falls in the **BEE 5-star** category for commercial office buildings for composite climate zone in India.

Suggestion:

As per above calculation, the calculated Energy Performance Index (EPI) for the Government College, Balrampur facility is 14.2kWh/m2/Year. As per provided BEE Star rating criteria, falls in the category of BEE 5-Star rated building. So, we can target our facility for BEE-Star rated Building.

The Application fee to be paid to BEE is 1 lakh INR.

Building Envelope

8 Building Envelope

The concept of a building envelope relates to design and construction of the exterior of the house. A good building envelope involves using exterior wall materials and designs that are climate-appropriate, structurally sound and aesthetically pleasing. These three elements are the key factors in constructing your building envelope. The building envelope of a house consists of its roof, sub floor, exterior doors, and windows and of course the exterior walls.

Building Envelope for facility consists of follows:

Wall

The wall construction of the building consists of a brick layer and cement plaster. Cement Plaster is applied on inside and outside of the brick wall. The brick is of around 225 mm thick. The U-value of the wall comes out to be as 2.3 W/m²K after the measurement performed by the U-Value meter.

Element	U Value Measured	ECBC 2017 U-Value
Wall u-value	2.3 W/m²K	0.63 W/m²K

Figure – Shows Wall of Facility

Roof

The building roof construction is made of 6 inch concrete slab. A roof is part of a building envelop. All roofs are not covered by solar photovoltaic, or any other renewable energy system, or utilities and services that render it unsuitable for the purpose and shall be either cool roofs or vegetated roof. The U-value of the roof is 2.8 W/m²K performed by the U-Value meter.

Element	U Value Measured	ECBC 2017 U-Value
Roof U Value	2.8 W/m²K	0.33 W/m²K

Figure - Roof of facility

Window Area

Window area or window-to-wall ratio (WWR) is an important variable affecting energy performance in a building. Window area will have impacts on the building's heating, cooling, and lighting, as well as relating it to the natural environment in terms of access to daylight, ventilation and views. The window-to-wall ratio is the measure of the percentage area determined by dividing the building's total glazed/window area by its exterior envelope wall area but as per elevation of facility it has been found that all windows fitted in building envelope is made up of wooden frame. So, Windows aren't applicable for solar heat control films on their external or internal surface.

Figure - Window of facility

The WWR is under the limit of ECBC 2017, which prescribes the maximum limit of 40%.

Building Envelope Sealing:

a. Some joints around fenestration, skylights, and door frames have leakages which are required to be sealed. However, most of the joints have no leakage observed visually.
b. Leakages should be visually inspected by facility team on periodic basis.
c. No leakages or openings were found between walls and foundations, or between walls and roof, or wall panels which may result in cooling losses.
d. Openings at penetrations of utility services through roofs, walls, and floors were found sealed with door closers.
e. Site-built fenestration and doors were found sealed.

Comfort Systems & Controls

9 Comfort Systems and Controls

The systems which provide thermal comfort to the humans are the comfort system, which may be Air-conditioners and/or circulation fans. There are some parameters, which provide thermal comfort. Temperature is the major parameter of thermal comfort. The human body needs some specific range of temperature, RH and other parameters to keep the adequate level of comfort. Hence the mechanical systems are required to keep these parameters at the desired range under the fluctuating ambient conditions.

Evaporative Coolers, Ceiling & Exhaust Fans

A ceiling fan is a mechanical fan, usually electrically powered, suspended from the ceiling of a room that uses hub-mounted rotating paddles to circulate air. In Government College, Balrampur building, there are total 85 numbers of ceiling mounted fan. Some Evaporative Coolers are also installed in facility for meeting thermal comfort up to its best.

Figure - Ceiling Fans installed in facility

In this facility, near about 38% of total connected load is dedicated for Ceiling Fans/Exhaust Fans. Fans are installed in building, which too carry higher electrical load in the building overall. Following are the list of equipment installed in the project:

S. No.	Comfort System Type	Quantity	Watt/Fixture	Total Load in (kW)
1	Ceiling Fan	85	85	7.2
2	Exhaust Fans	16	60	0.96
3	Evaporative Cooler	1	150	0.15
Total Load of Equipment's (kW)				**8.31**

Table- Summary of Fans & Evaporative Coolers

Figure – Window AC installed in facility

Window AC installed in facility has No-star rating. It has usually came in working. It has been suggested that it should be replaced as per minimum ECBC requirement of BEE 3-Star Rating.

EEM-1 – Replacement of existing fans with Energy Efficient fans

Option-I: Replacing 85 existing Fan of 85 W with Energy Efficient fans of 50 W –

Total connected load of the existing 85W fans = $85 * 85 = 7{,}225\ W$

Total connected load of the 50W fans = $85 * 50 = 4{,}250W$

Net reduction in the fan load = $7{,}225 - 4{,}250 = 2{,}975\ W$

Assuming that these fans runs for average 7 hours/day for 270 working days /year

Total reduction in the energy consumption in a year by replacing the fans -

$= 2{,}975 * 7 * 270 = 56{,}22{,}750\ Wh\ or\ 5{,}622.75 kWh$

Electric Utility rates as mentioned above in "section 7.2.5" is = Rs. 5.5/unit

Approximated total cost savings per year = $5{,}622.75 * 5.5 = 30{,}925/year$

Hence by adopting this EEM an approximated cost saving of Rs. 30,925/year and energy saving of 5,622.75kWh/year can be achieved.

Payback Period –

One unit of energy efficient 5 Star fans (50W) would cost around 1200.

Total investment on replacing the 85 existing fans= $1{,}200 * 85 = 1{,}02{,}000$

Total cost saving by adopting 50W fans= Rs. 30,925/year

The payback period would be approximately around 3.3 years.

Option-II: Replacing 85 existing Fan of 85 W with Energy Efficient fans of 30 W –

Total connected load of the existing 85W fans= $85 * 85 = 7{,}225\ W$

Total connected load of the 30W fans $= 85 * 30 = 2{,}550\ W$

Net reduction in the fan load $= 7225 - 2550 = 4{,}675 W$

Assuming that these fans runs for average 7 hours/day for 270 working days /year

Total reduction in the energy consumption in a year by replacing the fans -

$= 4{,}675 * 7 * 270 = 88{,}35{,}750\ Wh\ or\ 8{,}835.75\ kWh$

Electric Utility rates as mentioned above in "section 7.2.5" is = Rs. 5.5/unit

Approximated total cost savings per year= $8{,}835.75 * 5.5 = Rs.\ 48{,}596.6/year$

Hence by adopting this EEM an approximated cost savings of Rs. 48,596.6/year and energy saving of 8,835.75 kWh/year could be achieved.

Payback Period –

One unit of energy efficient 5 Star fan (30W) would cost around 3,000.

Total investment on replacing the 85 existing fans= $3{,}000 * 85 = 2{,}55{,}000$

Total cost saving by adopting 30W fans= Rs. 48,596.6/year

The payback period would be approx. around 5.2 years.

EEM-2 – Replacement of existing exhaust fans with Energy Efficient fans

Total connected load of the existing 60W fans= $60 * 16 = 960\ W$

Total connected load of the 30W fans $= 30 * 16 = 480W$

Net reduction in the fan load $= 960W - 480W = 480\ W$

Assuming that these fans runs for average 7 hours/day for 270 working days /year

Total reduction in the energy consumption in a year by replacing the fans -

$= 480 * 7 * 270 = 907200\ Wh\ or 907.2kWh$

Electric Utility rates as mentioned above in "section 7.2.5" is = Rs. 5.5/unit

Approximated total cost savings per year = $907.2 * 5.5 = 4{,}990/year$

Hence by adopting this EEM an approximated cost saving of Rs. 4,990/year and energy saving of 907.2kWh/year can be achieved.

Payback Period –

One unit of energy efficient 5 Star exhaust fan (30W) would cost around 1500.

Total investment on replacing the 16 existing fans= $1500 * 16 = 24{,}000$

Total cost saving by adopting 30W fans= Rs. 4,990/year

The payback period would be approximately around 4.8 years.

Lighting & Controls

10 Lighting and Controls

The facility is college building. This building includes office area, Class room and Lab spaces. Lighting Load is contributing near about 18% of total connected load. The facility has following type of fixtures installed in the buildings:

Lighting fixture load segregation

S. No.	Fixture Description	Serving Area	Quantity	Watt / fixture	Total Wattage
1	CFL Tube (36W)	Interior	8	36	288
2	Tube light (40W)	Interior	80	40	3200
3	LED (9W)	Interior	44	9	396
4	CFL (28W)	Exterior	6	28	168
Total lighting connected load (kW)					**4.1**

Table – Lighting Summary

Figure - Fluorescent tubes installed in facility

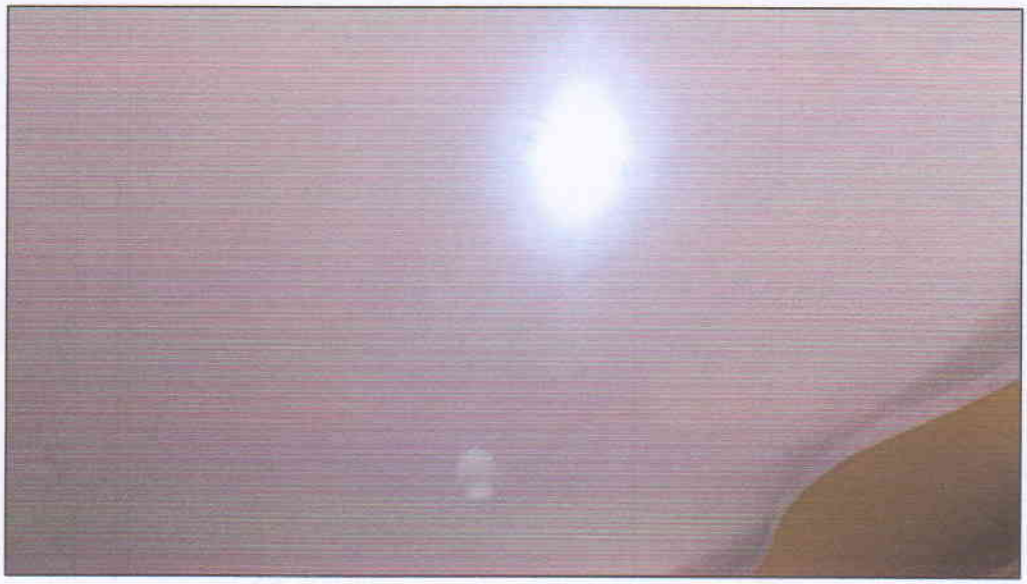


Figure - LED lights installed in facility

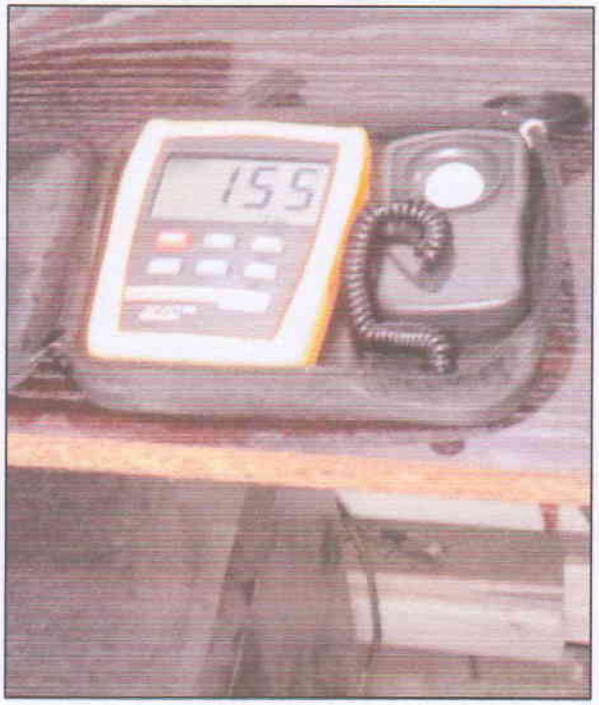
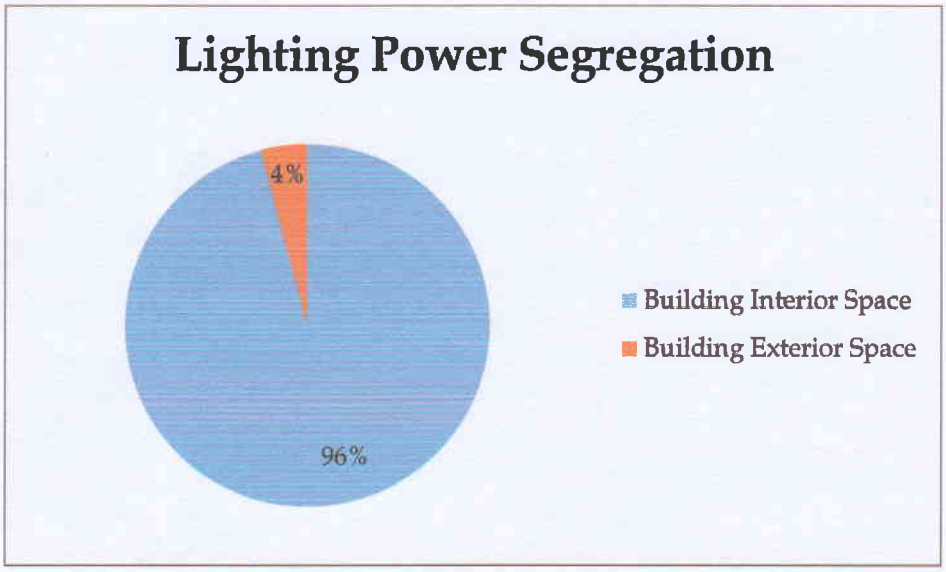


Figure – Shows lux level of room

S. No.	Space	Total Lighting Wattage (W)	% Contribution
1	Building Interior Space	3884	96
2	Building Exterior Space	168	4
Total Lighting Wattage (KW)		**4.1**	

Table – Total Lighting Power Segregation



Pie-Chart- Total Lighting Power Segregation

Figure – Exterior light installed in facility

Lighting Power Density

Building Area Method – The LPD calculated using the building area method is 2.7 which is 75.9% better than the LPD mentioned in ECBC, 2017 standard for the same usage type of building.

S. No.	Fixture Type	Lamp Quantity	Total Fixture Wattage (W)
1	CFL (36W)	8	288
2	Tubelight (40W)	80	3200
3	CFL(28W)	6	396
Total Building Wattage (W)			**3884**
Total Built-Up Area (sqm)			1418
Building Actual Lighting Power Density (W/sqm)			2.7
ECBC 2017 Lighting Power Density (W/ sqm)			11.2
Better than ECBC			**75.9%**

Table – Comparison of LPD by Building Area Method

The overall LPD of the building is 75.9% than the LPD specified in the ECBC 2017. This is the point of good practice.

Real facts about lighting

- Electric lighting burns up to 25% of the average energy budget.
- Lighting consumes 18% power in India.
- As per statistics generation of power in India is around 223.343GW.
- We can save at least 5% of energy from lighting without compromising with quality or quantity.
- Light Emitting Diode (LED) bulbs have revolutionized energy-efficient lighting
- LEDs are small, solid light bulbs which are extremely energy-efficient. New LED bulbs are grouped in clusters with diffuser lenses which have broadened the applications for LED use in the home.

10.2.3 Benefits of LED

- **Long-lasting** - LED bulbs lasts 10 times longer than the conventional compact fluorescents, and far longer than typical incandescent.
- **Durable** - Since LEDs do not have a filament, they are not damaged under circumstances when a regular incandescent bulb would have been broken. As they are solid, LED bulbs hold up well to jarring and bumping.

- **Cool**- LED bulb produces 3.4 BTU/Hr heat as compared to 85 BTU/Hr heat for incandescent bulbs resulting in the reduction of cooling load and cutting down the air conditioning costs in the home.
- **Mercury-free** - No mercury is used in the manufacturing of LEDs.
- **More efficient** - LED light bulbs use only 2-10 watts of electricity (1/3rdto 1/30thof Incandescent or CFL). Small LED flashlight bulbs have 10 to 15 times longer battery life than incandescent bulbs. Due to the long life of LED bulbs, energy is also saved in maintenance and replacement costs.
- **Cost-effective** - although LEDs are expensive, the cost is recouped over time and in battery savings. For the AC bulbs and large cluster arrays, the best value comes from commercial use where maintenance and replacement costs are expensive.
- **Light for remote areas**–Since LEDs require low power, using solar panels becomes more practical and less expensive than running an electric line or using a generator for lighting.

10.2.4 Limitations of CFL's

Although CFLs are good source of energy-efficient lighting, they are not always the best choice for all lighting applications. Here are a few limitations to consider:

- **On/Off cycling:** CFLs are sensitive to frequent on/off cycling. Their rated lifetimes of 10,000 hours are reduced in applications where the light is switched on and off very often. Closets and other places where lights are needed for brief illumination should use LED bulbs.
- **Retail lighting:** CFLs are not spot lights. Retail store display lighting usually requires narrow focus beams for stronger spot lighting.
- **Mercury content:** CFLs contain small amounts of mercury which is a toxic metal. This metal may be released if the bulb is broken, or during disposal.
- Low lumen output as comparison to LEDs
- Less life as compared to LEDs
- Energy consumption is higher as compared to LEDs.

Comparing features of LED and CFL

	LED	CFL
Frequent on-off cycling	No effect	Shortens life
Turns on instantly	Yes	Slight delay
Durability	Durable	fragile
Heat emitted	Low(3btu's/hr)	Medium(30btu's/hr)
Sensitivity to temperature	No	Yes
Sensitivity to humidity	No	Yes
Hazardous material	None	5mg mercury/bulb
Replacement frequency (over 50k hours)	1	5

LED's V/s CFL

Light Output(lumens)	LED (Watts)	CFL (Watts)
450	4-5	8-12
450-900	6-8	13-18
1100-1300	9-13	18-22
1600-1800	16-20	23-30
2600-2800	25-28	30-35

10.2.5 Suggestions for Lights

- Turn off the lights when not in use
- Take advantage of daylight by using light-colour, loose-weave curtains on your windows to allow daylight to penetrate the room. Also, decorate with lighter colours that reflect daylight De-dust lighting fixtures to maintain il-lumination
- Use task lighting; instead of brightly lighting an entire room, focus the light where you need it.

10.2.6 Lighting Energy Efficiency Measures

EEM-3 – Replacement of existing tube light (40W) with LED tubes (24W)

It is recommended to replace the 40W tube light having Lumens (Brightness) 3000 of the office facility by 24W LED tube lights. After replacing existing tube light of 40W with LED having same lux level as of earlier installed tube light fixture.

Replacing 80 existing tube lights of 40W with 24W LED –

Total existing lighting load with existing lamps $= 80 * 40 = 3200\ W$

Lighting load after replacing the lamps $= 80 * 24 = 1920\ W$

Reduction in the lighting Load $= 3200 - 1920 = 1280\ W$

Assuming that these lamps runs for average 7 hours/day for 270 working days /year

Total reduction in the energy consumption in a year by replacing the lamps -

$$= 1280 * 7 * 270 = 24{,}19{,}200\ Wh\ or\ 2{,}419.2\ kWh$$

Analysed from recent months bills, Rs 5.5/unit rate of energy, the total cost saving

$$= 2419.2 * 5.5 = 13{,}306/year$$

Hence by adopting this EEM it is assumed that **approximately cost saving of13, 306 INR/Year** and **power consumption saving of 2, 419. 2 kWh/year** could be achieved.

Payback Period –

One unit of 24W tube light would cost around Rs. 800

Total investment on replacing the 80 existing 40W tube lights= $80 * 800 = 64{,}000$

Approximate cost saving by implementing suggested EEM = **Rs. 13, 306**/year

Payback Period would be approx. around 4.8 years.

Electrical & Renewable Energy Systems

11 Electrical System & Renewable System

11.1 Uninterrupted Power Supply

Uninterruptible Power Supply (UPS) system is installed in the building vicinity for computer & other equipment for continuous power supply for the systems wherever is it required.

Government College, Balrampur building consists of an UPS in the building. The UPS is installed in the rooms of first floor having a capacity of 5 kVA each.

Figure – Shows battery installed in facility

11.2 Equipment's Load

There are several equipment's like computers, printers, photocopiers, etc. installed in facility. Computer/Printer contribution in total connected load is around 8% and other equipment's contributes around 36%of total connected load.

S. No.	Description	Quantity	Wattage	Total Wattage
1	Computer	6	150	900
2	Printer	3	300	900
3	TV	1	150	150
4	Water	3	750	2,250

5	Aqua guard	1	1400	1400
6	Projector	1	100	100
7	Oven	2	2000	4000
Total Load of Equipment's (kW)				**11.5**

Table – Equipment Load Segregation

Figure – Induction oven installed in facility

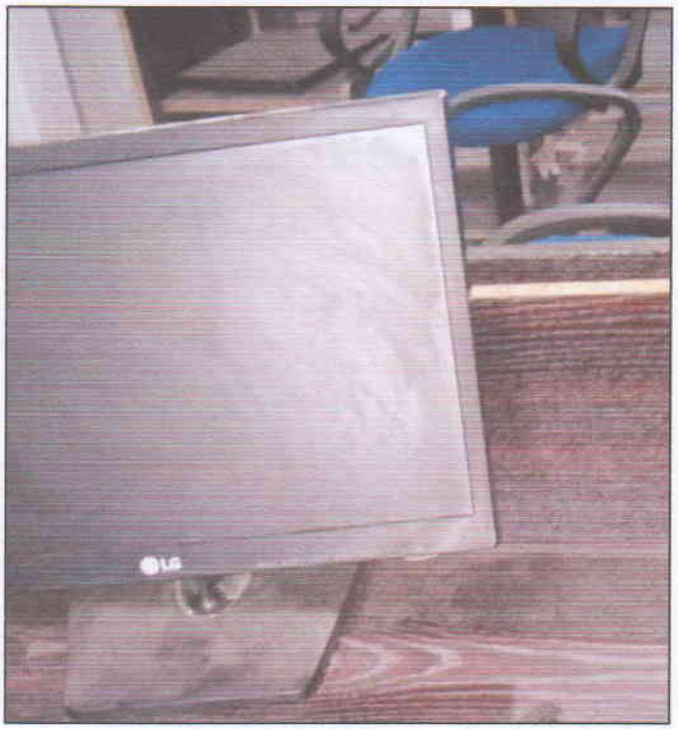


Figure – System installed in facility

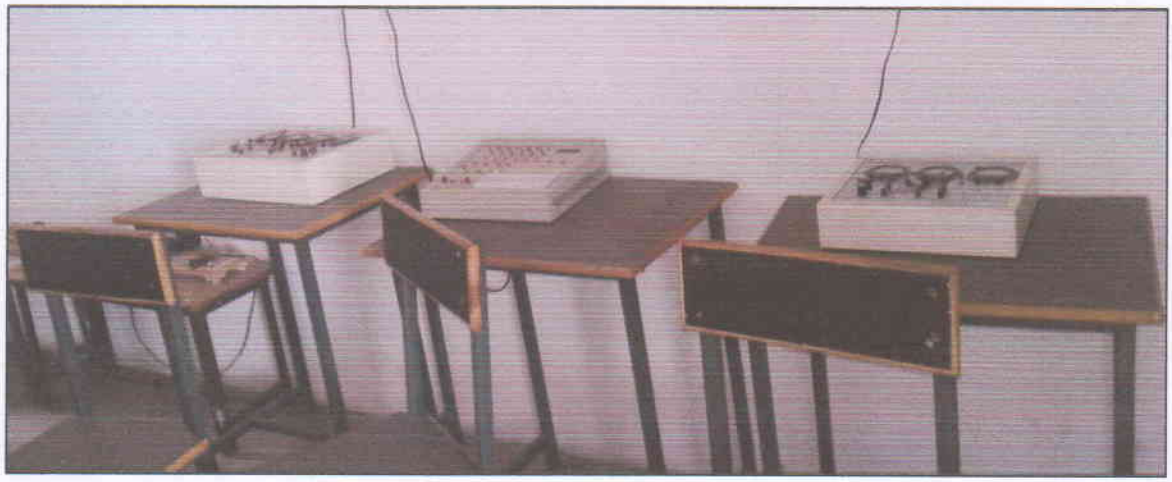


Figure – Lab Apparatus installed in facility

Figure – Projector & Mic System installed in facility

Suggestion for computers:

- Turn off your home office equipment when not in use. A computer that runs 24 hours a day, for instance, uses - more power than an energy-efficient refrigerator.
- If your computer can't be turned off then turn off the monitor; this device alone uses more than half the system's energy.
- Setting computers, monitors, and copiers to sleep-mode when not in use helps cut energy costs by approximately 40%.
- Battery chargers, such as those for laptops, cell phones and digital cameras, draw power whenever they are plugged in and are very inefficient. Turn off the switches and pull off the plug when not required.
- Screen savers save computer screens, not energy. Start-ups and shutdowns do not use any extra energy, nor are they hard on your computer components. In fact, shutting computers down when you are finished using them actually reduces system wear - and saves energy.

11.3 Transformer

Building facility has 1 transformer used for supplying the electricity to the building. Rating capacity of the transformer is about 100 kVA for power supply.

Transformer		
Make	Century	
Type	Aluminum Wound Transformer	
Rating in kVA	100	
Rated Volts (V)	H.V.	11000
	L.V.	433
Rated Current in Amps	H.V.	12.24
	L.V.	266.69
No. Of Phases	H.V.	3
	L.V.	3
Type of Cooling	ONAN	
Frequency Hz	50	
Year of Manufacture	2015	

Table- Transformer Details

Figure – Transformer installed in facility

11.4 Electrical Panel Temperature Analysis

Following table showing the temperature measurement at panels:

Temperature Measurement at Panels			
S. No.	Feeder	Temperature Measurement Points (°C)	
		Panel Body	Control Wiring
1	Panel - 1	25°	26.7°

Table – Temperature Measurement

The temperature at panels were analysed by Thermal Imaging Camera. The images below show the snap shot taken by thermal imaging camera

Figure: Fully Infrared and Fully Visible Thermal Images taken at panel

It has been observed that there is a fluctuation in current distribution between three phases (R-Y-B). Y phase is hotter than other phases as extracting higher amount of current at electric panel.

Suggestion:

Phase Balancing Devices are available in market; they lead proper balancing of all phases which doesn't cause any abnormal distribution of current/load in all phases. They also reduce the chance of fire hazards in panels or facility.

11.5 Renewable Energy System

The Building has provided with a renewable energy source on-site i.e., solar plant (PV) with a capacity of 5 kWp and it's only serving the first floor of the building and not the ground floor. The building is dependent on grid based conventional energy source, as well as the installation of Solar PV plant also contributes in that which reduced the dependency on the grid based electricity. A provision for installation of renewable energy generation systems is mandatory in ECBC 2017 which is complying with code. The current building has following provisions:

1. Solar PV on Roof Top: Available
2. Solar Hot Water System: Not Available/Not Applicable

Total energy generation from Solar PV (5kWp) installed at site has been taken 7,395 kW per year. Energy generation data taken from *Solar PVwatts calculator.*

Figure - Solar PV at roof of facility

Figure - Solar PV meter in facility

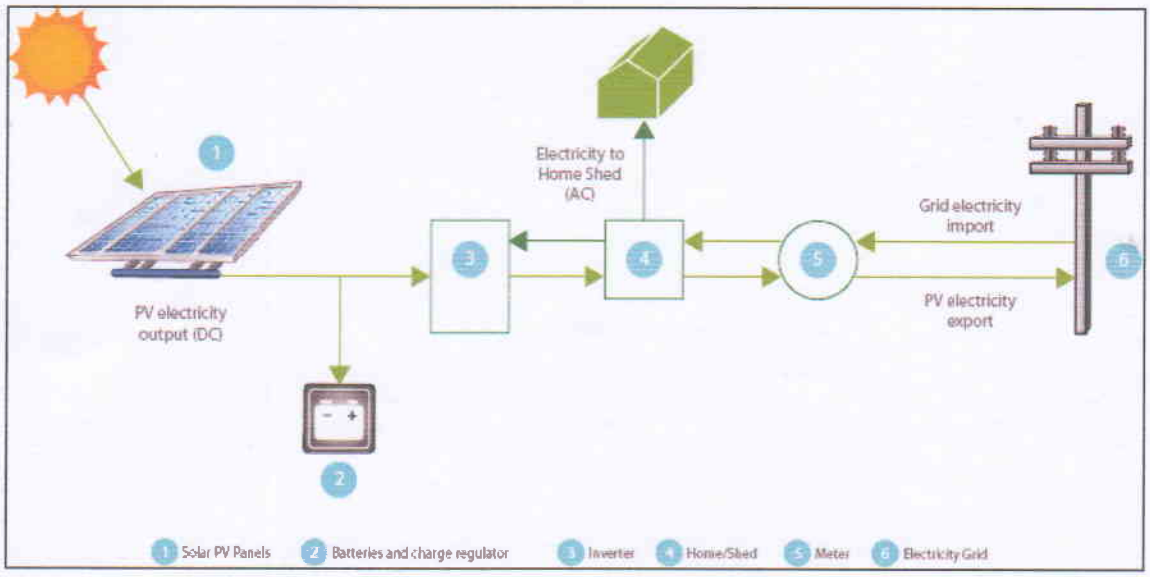


Figure – Conversion of Solar energy

11.6 Fire Fighting Systems

While carrying out building energy audit, it is also necessary to check whether provisions are provided for fire fighting in facility. Fire Safety audit is a systematic and independent evaluation of the fire risks present in the premises and involve recommendations about appropriate measures to control and mitigate the effects of fires.

Following are the points observed in **Government College, Balrampur** Facility:

- Building has no fire fighting systems.
- Fire Extinguishers should be placed in each floor of the building.
- Fire, sand bucket need to be placed in panel room & near to UPS system.

- Trainings should be conducted for prevention from the life hazard while fire event.
- Fire Evacuation Plan should be drafted and should be located to keep visible to occupants.
- Proper signage's are also required during evacuation of occupants while fire events.

11.7 DG Set

A Diesel Generator (DG) is a combination of diesel engine with electrical generator (often called an alternator) to generate electricity. DG sets are used in places that have no connection to power grid or as emergency power-supply if the grid fails.

The Building has only one DG set for power back-up having output rating of 62.5 kVA.

DIESEL GENERATOR	
Diesel Generator-1	62.5 kVA

Figure – DG installed in facility

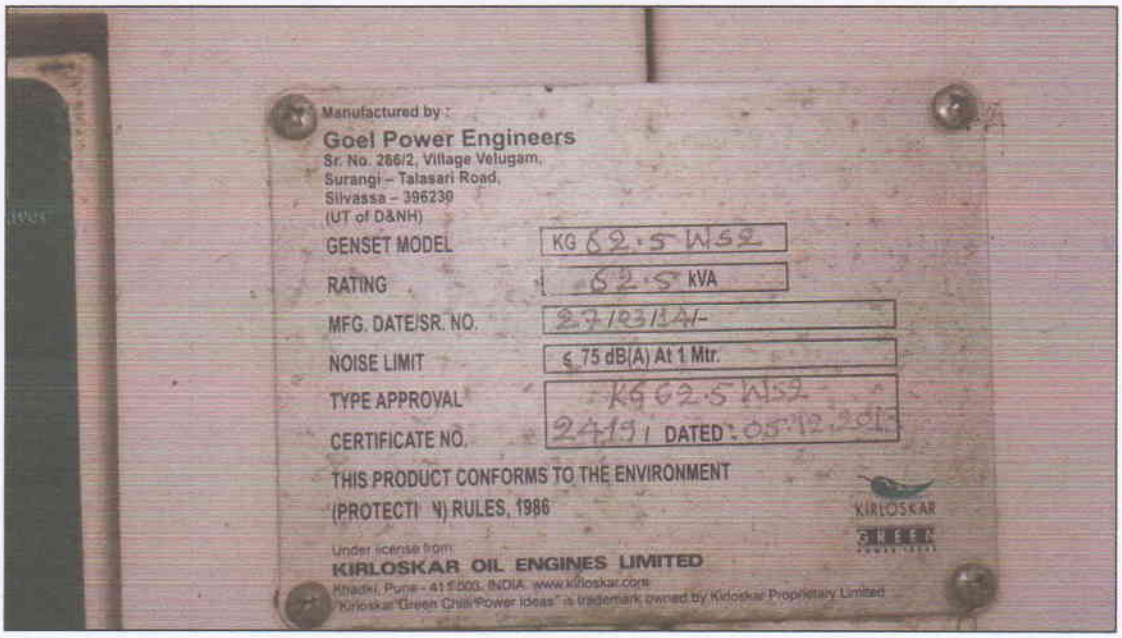


Figure – Show details of DG installed in facility

DG set Generation (past 12 months)	
kWh Generation per liter of high speed diesel	10 kWh
Total diesel consumed (liters)/year	200 liter
Total electrical generation per year	**2000 kWh**

Table – DG Set energy generation

12 Final Summary

D2O team has performed thorough energy audit of the Government College, Balrampur. The calculations were done using all the measurement taken at all energy consuming units at the facility. The results obtained after the calculation were thoroughly observed. The possible energy efficiency measures were given for the units to reduce the energy consumption and to improve the overall energy efficiency of the facility building. The energy efficiency measures given for each unit are summarized in the below table with the investment, saving and Payback Period quotient. The costs mentioned in the report are estimated and may vary in some cases.

Investment Category:

S. No.	Category	Range of Investment (INR)
1	Low Investment	Below 1,00,000
2	Medium Investment	1,00,000 < 3,00,000
3	High Investment	Above 3,00,000

Comfort Systems and Controls (HVAC):

S. No.	Description	Investment (INR)	Investment Category	Energy Savings/ year (kWh)	Cost Saving/ year (INR)	Payback Period (Years)
1	**EEM -1 – Replacement of existing Fan with Energy Efficient Fans**	Option – I 1,02,000	Medium Investment	5,622.75	30,925	**3.3**
		Option – II 2,55,000	Medium Investment	8,835.75	48,596.6	**5.2**

2	EEM -2 – Replacement of existing **Exhaust Fan** with Energy Efficient Fans	24,000	Low Investment	907.2	4,990	4.8

Lightings and Controls:

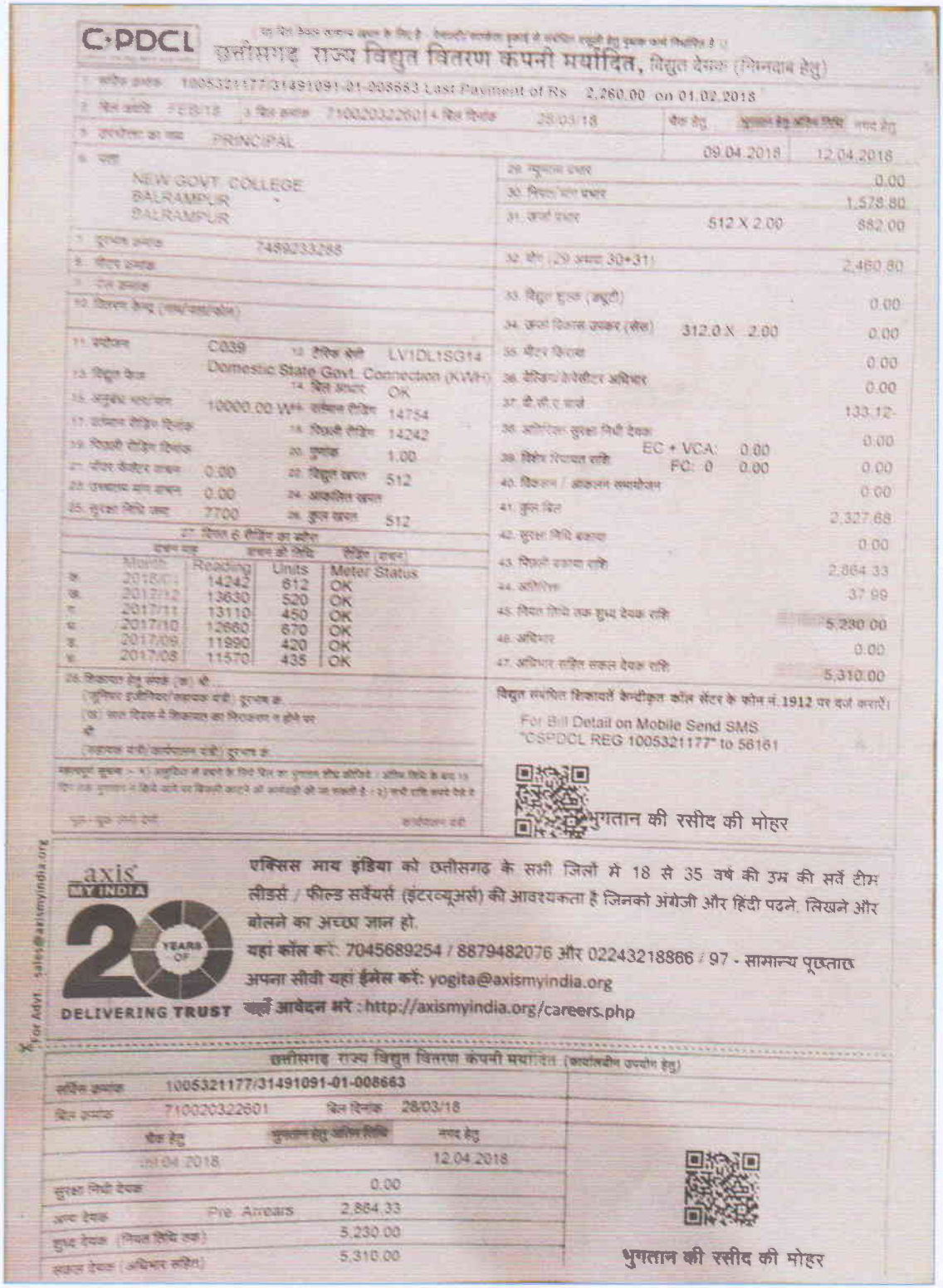
S. No.	Description	Investment (INR)	Investment Category	Energy Savings/ year (kWh)	Cost Saving/ year (INR)	Payback Period (Years)
1	EEM-3 – Replacement of existing tube light (40W) with LED tubes (24W)	64,000	Low Investment	2,419.2	13,306	4.8

Expected EPI post implementation of suggested EEM's in facility:

S. No.	Category	Suggested EEM's for implementation	Energy Savings (kWh) post implementation of EEM's	Energy Consumption post implementation of EEM's (kWh)	Expected EPI (kWh/ year/m^2)
1	Comfort Systems	**EEM -1 – Replacement of existing Fan with Energy Efficient Fans**	5,622.75	14,459	**10.2**
2	**Lighting & Controls**	**EEM-3 – Replacement of existing tube light (40W) with LED tubes (24W)**	2,419.2	17,662	**12.4**

Electricity Utility Bills

Following are the available bills attached of Government college facility:



CSPDCL छत्तीसगढ़ राज्य विद्युत वितरण कंपनी मर्यादित, विद्युत देयक (भिनवाब हेतु)

1005321177/31491091-01-008663 Last Payment of Rs 2,260.00 on 01.02.2018

FEB/18 | 710020322601 | 28/03/18

PRINCIPAL

09.04.2018 | 12.04.2018

NEW GOVT COLLEGE
BALRAMPUR
BALRAMPUR

7489233288

C039 | LV1DL1SG14
Domestic State Govt. Connection (KWH)
OK
10000.00 W
14754
14242
1.00
512
512

Month	Reading	Units	Meter Status
2018/01	14242	612	OK
2017/12	13630	520	OK
2017/11	13110	450	OK
2017/10	12660	670	OK
2017/09	11990	420	OK
2017/08	11570	435	OK

29.	0.00
30.	1,578.80
31. 512 X 2.00	882.00
32. (29 अथवा 30+31)	2,460.80
33. विद्युत शुल्क (छूट)	0.00
34. 312.0 X 2.00	0.00
35.	0.00
36.	0.00
37.	133.12
38. EC + VCA: 0.00 FC: 0	0.00
39.	0.00
40.	0.00
41. कुल देय	2,327.68
42.	0.00
43.	2,864.33
44.	37.99
45.	5,230.00
46.	0.00
47.	5,310.00

विद्युत संबंधित शिकायतें केन्द्रीकृत कॉल सेंटर के फोन नं.1912 पर दर्ज कराऐं।

For Bill Detail on Mobile Send SMS
"CSPDCL REG 1005321177" to 56161

भुगतान की रसीद की मोहर

छत्तीसगढ़ राज्य विद्युत वितरण कंपनी मर्यादित (कार्यालयीन उपयोग हेतु)

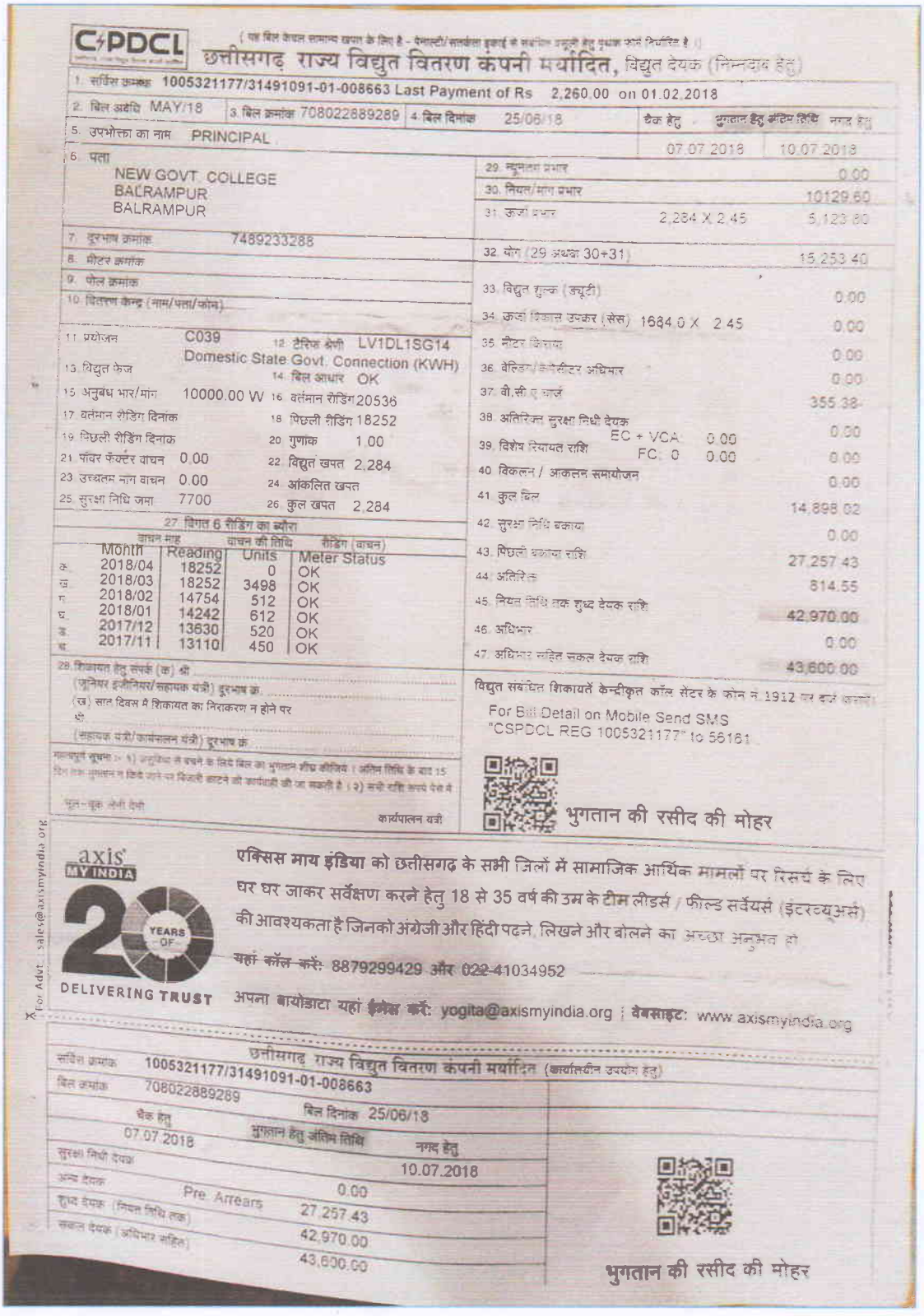
1005321177/31491091-01-008663

710020322601 | 28/03/18

देय हेतु	भुगतान हेतु अंतिम तिथि	नगद हेतु
09.04.2018		12.04.2018

सुरक्षा निधि देयक		0.00
अन्य देयक	Pre. Arrears	2,864.33
कुल देयक (नियत तिथि तक)		5,230.00
संकलन देयक (अधिभार सहित)		5,310.00

भुगतान की रसीद की मोहर



CSPDCL

छत्तीसगढ़ राज्य विद्युत वितरण कंपनी मर्यादित, विद्युत देयक (निम्नदाब हेतु)

1. सर्विस क्रमांक 1005321177/31491091-01-008663 Last Payment of Rs 2,260.00 on 01.02.2018
2. बिल अवधि MAY/18 | 3. बिल क्रमांक 708022889289 | 4. बिल दिनांक 25/06/18 | चैक हेतु 07.07.2018 | भुगतान हेतु अंतिम तिथि 10.07.2018 | नगद हेतु
5. उपभोक्ता का नाम PRINCIPAL
6. पता
NEW GOVT COLLEGE
BALRAMPUR
BALRAMPUR
7. दूरभाष क्रमांक 7489233288
8. मीटर क्रमांक
9. पोल क्रमांक
10. वितरण केन्द्र (नाम/पता/कोड)
11. प्रयोजन C039 | 12. टैरिफ श्रेणी LV1DL1SG14
Domestic State Govt. Connection (KWH)
13. विद्युत फेज | 14. बिल आधार OK
15. अनुबंध भार/मांग 10000.00 W | 16. वर्तमान रीडिंग 20536
17. वर्तमान रीडिंग दिनांक | 18. पिछली रीडिंग 18252
19. पिछली रीडिंग दिनांक | 20. गुणांक 1.00
21. पॉवर फैक्टर वाचन 0.00 | 22. विद्युत खपत 2,284
23. उच्चतम माग वाचन 0.00 | 24. आंकलित खपत
25. सुरक्षा निधि जमा 7700 | 26. कुल खपत 2,284

27. विगत 6 रीडिंग का ब्यौरा

क्र.	वाचन माह Month	Reading	Units	वाचन की तिथि रीडिंग (वाचन) Meter Status
क	2018/04	18252	0	OK
ख	2018/03	18252	3498	OK
ग	2018/02	14754	512	OK
घ	2018/01	14242	612	OK
ङ	2017/12	13630	520	OK
च	2017/11	13110	450	OK

28. शिकायत हेतु संपर्क (क) श्री
(जूनियर इंजीनियर/सहायक यंत्री) दूरभाष क्र.
(ख) सात दिवस में शिकायत का निराकरण न होने पर
श्री
(सहायक यंत्री/कार्यपालन यंत्री) दूरभाष क्र.

महत्वपूर्ण सूचना :- 1) अनुरोध से बचने के लिये बिल का भुगतान शीघ्र कीजिये। अंतिम तिथि के बाद 15 दिन तक भुगतान न किये जाने पर बिजली काटने की कार्यवाही की जा सकती है। 2) सभी राशि रुपये पैसे में

मुंशी/लेखा लेखी देखी
कार्यपालन यंत्री

29. न्यूनतम प्रभार 0.00
30. नियत/माग प्रभार 10129.60
31. ऊर्जा प्रभार 2,284 X 2.45 5,123.80
32. योग (29 अथवा 30+31) 15,253.40
33. विद्युत शुल्क (ड्यूटी) 0.00
34. ऊर्जा विकास उपकर (सेस) 1684.0 X 2.45 0.00
35. मीटर किराया 0.00
36. वेल्डिंग/कंपेसीटर अधिभार 0.00
37. वी.सी.ए चार्ज 355.38
38. अतिरिक्त सुरक्षा निधि देयक 0.00
39. विशेष रियायत राशि EC + VCA 0.00 FC 0 0.00 0.00
40. विकलन / आकलन समायोजन 0.00
41. कुल बिल 14,898.02
42. सुरक्षा निधि बकाया 0.00
43. पिछली बकाया राशि 27,257.43
44. अतिरिक्त 814.55
45. नियत तिथि तक शुद्ध देयक राशि 42,970.00
46. अधिभार 0.00
47. अधिभार सहित सकल देयक राशि 43,600.00

विद्युत संबंधित शिकायतें केन्द्रीकृत कॉल सेंटर के फोन नं 1912 पर दर्ज कराएं।
For Bill Detail on Mobile Send SMS "CSPDCL REG 1005321177" to 56161

भुगतान की रसीद की मोहर

छत्तीसगढ़ राज्य विद्युत वितरण कंपनी मर्यादित (कार्यालयीन उपयोग हेतु)

सर्विस क्रमांक 1005321177/31491091-01-008663
बिल क्रमांक 708022889289 | बिल दिनांक 25/06/18
चैक हेतु 07.07.2018 | भुगतान हेतु अंतिम तिथि | नगद हेतु 10.07.2018
सुरक्षा निधि देयक 0.00
अन्य देयक Pre Arrears 27,257.43
शुद्ध देयक (नियत तिथि तक) 42,970.00
सकल देयक (अधिभार सहित) 43,600.00

भुगतान की रसीद की मोहर

Acknowledgment Letter From Facility:

Ref. No.....

Date.....

TO WHOM-SO-EVER IT MAY CONCERN

In the reference to letter number **CREDA/ECBC/SMD/F-66/7821,** we confirm that Executive/s from M/s Design2Occupancy Services LLP, Jaipur have visited our facility 'Govt. College, Balrampur, Chhattisgarh'.

Building Energy Audit was performed by M/s Design2Occupancy Services LLP, under the project of conducting Energy Audits in Chhattisgarh state supported by Chhattisgarh State Renewable energy development agency (CREDA). Govt. College, Balrampur facility team has supported to the auditing team and CREDA at their best level.

Authorized Signatory

प्राचार्य
शासकीय नवीन महाविद्यालय बलरामपुर
जिला- बलरामपुर (छ.ग.)

Working Principle of Energy Saver Devices for AC's:

They are programmable microprocessor - based AC Energy Saver with Dual Sensors for "Reading" & Display of both Room and Coil temperature, and also referencing the Ambient temperature and guarantees savings up to 20% while maintaining and displaying the Precise Set Temperature at payback of barely 3-6 months.

Specifications:

- AC's lack *intelligence* and work simply on a mechanical timer and relay while this type of devices retrofits intelligence to the AC.
- AC's don't have a room temperature sensor but rely on the Return Air Temperature which measures the temperature of the warm air leaving the room. This leads to the over cooling and wastage in the cooler periods.
- The Energy Saver devices has an additional sensor to measure the actual room temp, thus preventing over cooling and saving substantial electricity.
- AC's don't measure coil temperature which leads to thermodynamic saturation and wastage. Energy Saver Devices measures the actual coil temperature as well as the differential between Room and Coil Temperature. It offers more savings.
- This Devices cuts off the compressor when it detects over cooling in the evaporation coil, at a coil temp programmed by you.
- Energy Saver Devices is programmable for your geographical location and climate and adapts automatically to changes in season and ambient conditions.