ENERGY AUDIT FOR THE ASSESSMENT YEAR

2020-21 IN LINE WITH NAAC REQUIREMENTS

Ambe Durga Education Society's Dadasaheb Balpande College of Pharmacy (DBCOP), Besa, Nagpur

05/10/2021
Version 01

By:
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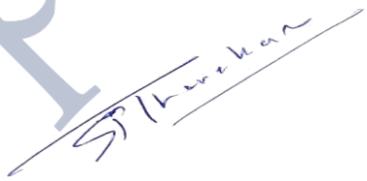
DISCLAIMER

Audit Team has prepared this report for Ambe Durga Education Society's Dadasaheb Balpande College of Pharmacy (DBCOP), Nagpur based on input data submitted by the representatives of college and after having complemented with the best judgment capacity of the expert team.

While all reasonable care has been taken in its preparation, details contained in this report have been compiled in good faith based on information gathered.

It is further informed that the calculations are arrived following best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit Team in this report or for any director consequential loss arising from any use of the information, statements or forecasts in the report.



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Scope of Work

Topics to be covered as part of the assessment are:

✓ Solar Passive Architecture

- How the buildings are constructed to utilize the solar energy efficiently. This includes use of day light as lighting source and avoidance of GHG intensive technology example AC as source of cooling due to solar heat gains.

✓ Implementation of measures to reduce wastage of energy

- This includes effective and objective evidences to create awareness towards wastage of electric energy. Hoardings, placards, messages, posters etc. planted at key locations in college, hostels and cafeterias. PCRA (Petroleum Conservation Research Association, Govt. of India) and BEE (Bureau of Energy Efficiency) posters are exhibited.
- It can also be extended to include papers presented by the students on avoidance of electricity at college or day to day life.
- Appointment of joint committees of teachers and students to save electricity
- Controlling of Power Factor by installation of APFC and getting rebate (up to 5% or MSEDCL norms) from MSEDCL for maintaining unity Power factor

✓ Energy Efficient Procurement

- This includes evaluation of energy efficient procurement practices. This does not exactly mean that you need to buy the most efficient, but you need to buy the most efficient which is financially viable. Example AC with efficiency star ratings, Transformer etc.
- Replacement of lighting sources to CFL or LED
- Replacement of Copper Ballast with Electronic Ballast
- Centralized controls of lighting, auditorium etc. to avoid any misuse of electricity
- Procurement of LED monitors to phase-out CRT Monitors
- Shift to paperless regime wherever not required, example attendance muster replaced by biometrics, DG logbook replaced by computerized logbook, daily reports converted from paper to paperless, HoD meetings converted to paperless formats, and all such examples.
- Installation of Solar panels, Power Purchase Agreements with Solar Power Plant owners to buy environmentally friendly energy Source etc.
- Documentary evidences as feasible to calculate the above impacts and finally into the value of avoidance of tCO_2 emitted to atmosphere.

✓ Duration of the Energy Audit

- The Energy audit field observations data collection was carried from 4th September 2021 to 5th October 2021 for the session 2020-21. The submitted data was monitored by the college throughout the year and assessed by Assessment Team during the visit.

Scorecard

NAAC Criteria Key Indicator - 7.1 Institutional Values and Social Responsibilities		
Environmental Consciousness and Sustainability		**Audit Team Assessment**
7.1.2 The Institution has facilities for alternate sources of energy and energy conservation measures:		
1. Solar energy	✓	Annexure –V: Solar Panel Installations
2. Biogas plant		
3. Wheeling to the Grid		
4. Sensor-based energy conservation	✓	Annexure –II: Lighting Survey 2020 – 21
5. Use of LED bulbs/ power efficient equipment	✓	Annexure –VI: Solar Passive Structure
Options: A. 4 or All of the above *B.* Any 3 of the above ✓ C. Any 2 of the above D. Any 1 of the above E. None of the above		

Contents

List of Annexure

Introduction of the College

Dadasaheb Balpande College of Pharmacy (DBCOP) was established in the year 2006 which offered Degree course in Pharmacy (BPharm.) with the intake capacity of 60 seats. With the constant quest of excellence, DBCOP introduced a post graduate course in pharmacy (M. Pharm), in two specializations Pharmaceutics and Pharmaceutical Quality Assurance in 2012-2013.

The institute is recognized under section 2f and 12B of UGC and permanently affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur. The college has received an approval of research center for Doctorate of Philosophy (Ph.D.) from RTM Nagpur University in 2018.

All the courses at DBCOP are recognized by Pharmacy Council of India (PCI), All India Council for Technical Education (AICTE), New Delhi, Directorate of Technical Education, Mumbai, Government of Maharashtra state and affiliated to RTM, Nagpur University, Nagpur.

The Institute was accredited by NAAC, the apex accrediting body of Government of India in 2017-18. The institute has been rewarded with Platinum grade in AICTE CII survey. The institute is determinedly obtaining high academic standards along with excellence in teaching and research by providing Quality Pharmacy education.

Laboratories of DBCOP are equipped with latest sophisticated scientific instruments and facilities. The institute primarily aims in satisfying the ever-changing dynamics to create pharmacist of global standards who could provide total pharmaceutical solutions to the society.

Medicinal garden of college is named as "Dhanvantari Medicinal Garden". This garden is spread in 44,000 Sq. Ft. at southern side of the college. More than 184 medicinal plants are present at garden. These plants are selected on the basis of research activities carried out at college. DBCOP received a grant of one lakh rupees from Maharashtra State Biodiversity Board for conservation of endangered medicinal plant species. A small bio-fertilizers unit is functional at DBCOP.

Bio-waste generated from garden is collected and reused as manure processed in bio-fertilizer unit. This manure is used to fortify the plants for their nutritional demand. Arrangement of green shed is made for plants especially in summer to protect them from heat. Plants are adopted by faculty members and students to sensitize them regarding our environment protection responsibility. Each plant is properly labeled for its identity.

At DBCOP the overall personality of students is developed through excellence in academics, co-curricular, extracurricular and social activities The college strives to develop a sense of social obligation and discipline among students not only to make a better professional but also a better human being.

The college is making steadfast progress under the leadership of honorable President of ADES Shri. Manoj V. Balpande, and Dr. (Mrs.) Ujwala Mahajan, Principal, DBCOP

Objective of Energy Audit

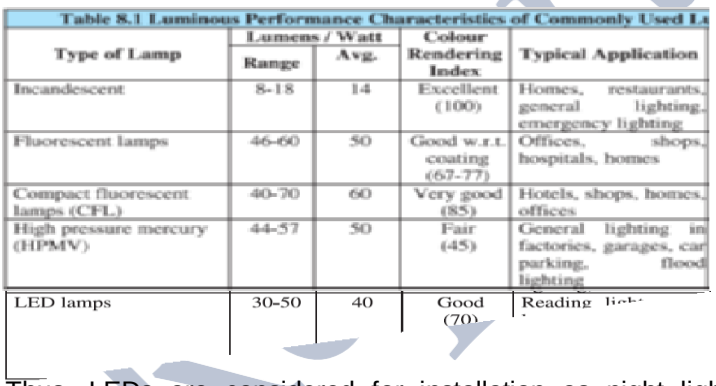
The Energy Audit Team focused on Material[1] Issues pertaining to college which have the highest influence on the Energy Attributes of the College. To evaluate steps taken by college management towards green campus below material issues are discussed chapter wise:

1. Lighting
2. Operation of Electronic Equipment's
3. Renewable Energy
4. Transportation
5. Energy and Carbon Footprint

Checklist approach is adopted for transparent evaluation of the topics and increase readability for independent reader.

[1]Definition: as per Global Reporting Initiative : **GRI 101:** FOUNDATION2016
An organization is faced with a wide range of topics on which it can report. Relevant topics, which potentially merit inclusion in the report, are those that can reasonably be considered important for reflecting the organization's economic, environmental, and social impacts, or influencing the decisions of stakeholders. In this context, 'impact' refers to the effect an organization has on the economy, the environment, and/or society (positive or negative). A topic can be relevant – and so potentially material – based on only one of these dimensions.

1. Lighting

How college is utilizing daylight?	The college building is situated in such a manner that it is getting the full advantage of good airflow enabling good ventilation and sun light. It is a building having large windows and open space in all directions. During the day time, it is possible to carry out activities without air conditioners and air fans during operational days.
Is college utilizing any incandescent lights? Can they be replaced with compact fluorescents (energy saving bulbs)?	The college timings are from 10:00 AM to 5 PM. Thus, requirement of daytime lighting (powered by electricity) is limited. Energy efficient lighting system is followed. the contemporary best practices will recommendations on lighting by Bureau of Energy Efficiency, Book-3, Chapter 8, table 8.1  Table 8.1 Luminous Performance Characteristics of Commonly Used L Type of Lamp | Lumens / Watt: Range, Avg. | Colour Rendering Index | Typical Application Incandescent | 8-18 | 14 | Excellent (100) | Homes, restaurants, general lighting, emergency lighting Fluorescent lamps | 46-60 | 50 | Good w.r.t. coating (67-77) | Offices, shops, hospitals, homes Compact fluorescent lamps (CFL) | 40-70 | 60 | Very good (85) | Hotels, shops, homes, offices High pressure mercury (HPMV) | 44-57 | 50 | Fair (45) | General lighting in factories, garages, car parking, flood lighting LED lamps | 30-50 | 40 | Good (70) | Reading Thus, LEDs are considered for installation as night lights, security street lights by the college. The term reading light[2] normally refers to lamps or lights which focus light dedicated for readings, thus LEDs were not considered for class room lightings initially. Fluorescent lamps were utilized for class rooms (as the same are stated to be suitable for office illumination level requirements). LED lights started replacing the conventional tube light as a replacement measure after failure. LED lighting survey was also undertaken by the Audit Team. Please refer below assessments in details. During the onsite visit the Audit Team visited each department and physically counted the installed lights by their types (Fluorescent tube lamp, CFL and LED). It is confirmed that there is no incandescent light installed for lighting purpose. As per the published article: http://www.usailighting.com/stuff/contentmgr/files/1/92ffeb328de0f4878257999e7d46d6e4/misc/lighting_comparison_chart.pdf LED light has lumen/ watt in the range of 80-100 whereas CFL has lumen/ watt in the range of 70-90 **Recommendation:** **As per the replacement policy the college should continue to install LED lights in the class rooms in place of conventional tube lights. The existing CFL lamps[3] should be replaced by the LED lamps.**
Has the college evaluated	The lighting arrangements are well balanced with arrangements

[2] https://www.collinsdictionary.com/dictionary/english/reading-light

[3] The CFL lamps have problem as they contain mercury. Mercury is very toxic to human health and the environment.

existing lighting for opportunities to reduce lighting in over-lit areas?	to switch ON and OFF lights independently. There are therefore practically no over lit areas.
Are the light switched duly labelled to make more obvious which switches relate to which appliances?	Switch arrangements are lucid. The fan switches are adjacent to fan speed regulators. Light switches are arranged in order of lighting. The buttons are marked.
Are the lights switched off to make use of daylight? (e.g. lights parallel to windows or in corridors)	There is minimum or practically negligible use of lights during day time as the building structure has possibility of daylight usage. The lux level in the classrooms was measured and found above 265. On the outcast days some places register lower lux level. The locations were pinned and college management confirmed to take subsequent corrective actions.
Is the college utilizing natural lighting when possible?	Yes, natural lighting is first preference.
For the spaces like store rooms, toilets, kitchen areas, copying rooms, corridors etc is there scope for automatic lighting controls?	The college avails the sensor-based lighting arrangements to control the night illumination. The lighting sensors automatically switch on and switch off lights depending on the lux levels. **Recommendation:** **The students and staff washrooms can be equipped with the proximity sensors to control the lighting arrangements.**
Can main lighting ever be switched off and dedicated lighting be used?	As such there are no dedicated lamps which can replace overhead lighting. However, redundant lighting can be switched off when it is not required.
Are the light fittings clean?	The staff is responsible for day-to-day cleaning was interviewed during onsite visit. Cleanliness is well maintained. In-house light fittings are cleaned regularly some light fittings need cleaning. However, the installed fittings were not cleaned as Covid-19 Pandemic caused shortage of staff.
Do windows and skylights need cleaning to allow in more natural light?	The window and skylight were not clean as Covid-19 Pandemic caused shortage of staff.
Has the college installed lighting occupancy sensors?	No, lights are negligibly operated during day time. The lights are operated manually. The night lights are however operated based on the sensors which operate lights based on the illumination levels.
Is there mechanism in place to immediately report inoperable occupancy light sensors?	Yes, in case of failure of the existing sensor, the night lights will not operate.
What is the % contribution of the LED lighting?	We have evaluated the % LED installation at Passage and ground and all other floor. The value is determined and presented under Annexure V.

Further Scope of Improvement

- **The students and staff washrooms can be equipped with the proximity sensors to control the lighting arrangements.**

Conclusion

- **The students and employees were interviewed and no complains was identified within respect to the sufficiency of lighting measures.**
- **Sufficient lux levels above 265 are common in class rooms and work-stations based on the survey of audit team.**
- **Negligible lighting load is observed during day time as college makes good use of daylight.**
- **Replacement policy to further improve lighting efficiency (as stated above) is already implemented.**

2. Cooling and Ventilation

How are the Air Conditioning Controls? For the local controls, how it is ensured that AC is working only ON when necessary. What is temperature setting of the AC?	The AC usage is very high as the temperature in Nagpur district is (Max temperature is above 42°C[4]) hottest day in Nagpur was registered with temperature of 47.9[5]°C). The AC temperature is set at 28°C. Awareness is created and measures are implemented in line with the recommendations of Ministry of Power (https://www.cseindia.org/a-step-in-the-right-direction-says-cse-of-power-ministry-s-move-to-fix-starting-temperature-of-room-air-conditioners-at-24oc-and-not-lower-to-save-energy-8814)
What is the mechanism of reducing heat in-grace? Are the closing blinds or fitting reflective film to windows installed to reduce solar gain?	The building is designed to make best use of day light and avoid the heat in-grace. Blinds are available in office to control unnecessary heat in-grace.
Are all external doors and windows closed when air conditioning is on?	There are 10 number of AC's in college. Based on interviews, it is confirmed that the practice of closing doors and windows is maintainedwhen air conditioning is in operation.
Is there a scenario where air conditioning is wasted in unused spaces, such as cupboards, corridors?	There are no such instances observed. Arrangements are duly implemented to avoid losses.
Are Efficient and energy labelled AC's utilized for cooling purposes?	There are 10 number of ACs in the college out of which 4 are central AC's, 5 are 3 star and 1 is 2 stars. These AC's run for 5-6 hours during summer and rainy season, **Recommendation:** **The 2 start AC is not the most economical AC for the sustained working hours of 5-6 hours for approximately 100 days a year. It is recommended to replace the AC with more energy efficient AC (at least 3 Star ratings or above).** **Below guidelines can be considered by college in future while selecting between the AC and evaporative cooling.** **Evaporative Cooling System (for computer lab)** The Assessment team has undertaken document review and analysis of the data for the assessment of the air conditioning system. Based on the same it was found that there exists scope for the use of evaporative based cooling which is energy effective compared to the reversed Bryon cycle i.e., Vapour Compression Cycle. The basic reason for the same installed system has COP of 1.5 kW/TR of refrigeration compared to evaporative cycle which draws 0.3-0.5 kW based on the size of installation.
Further Scope of Improvement ➢ **The 2 start AC is not the most economical AC for the sustained working hours of 5-6 hours for approximately 100 days a year. It is recommended to replace the AC**	

[4] http://www.imd.gov.in/section/climate/climateimp.pdf
[5] https://timesofindia.indiatimes.com/city/nagpur/Nagpur-records-all-time-high-temperature-at-47-9-C/articleshow/20216419.cms

with more energy efficient AC (at least 3 Star ratings or above). ➢ Evaporative cooling can be availed for computer lab.
Conclusion ➢ The 2-star AC needs to be replaced by at least 3 Star AC or better at the end of their technical lifetime. ➢ Evaporative cooling can be availed for computer lab.

3. Operation of Electronic Equipment

Are computers, printers, photocopiers and other equipment switched off at the end of the day?	Yes
Is there any mechanism by which the screens and other equipment be controlled during the day?	The college has availed the services of the Energy Audit from session 2017-18 onwards. The college has appropriately disabled the screen savers and programmed the computers for sleep mode operations. Please refer to Annexure VI.
Are the screen savers disabled?	Yes, please refer above assessment.
Are computers programmed to 'power down' mode?	Computers are programmed for the sleep operation.
Is the user entrusted with the rights to modify standby settings? (E.g. TVs, LCD projectors, printers etc.)	No, the college has the administrative rights. Such changes cannot be initiated by users.
What is status of the photocopiers, fax machines and other equipment? Are they programmed on 'Energy Saver' mode during the day?	The equipment like photocopiers, fax machines are shutdown when not in use, computers are turned to sleep mode whenever not in use.
Are the power management settings enabled on all the computers/ monitors/ all-in-one machines?	All machines are governed by the college. All are equipped by power management settings as already described above.
Conclusion: ➢ **The Electrical Equipment's are well operated. Redundant operations are avoided.**	

4. Renewable Energy

Is the college having solar, wind, or other forms of renewable energy?	Yes. The college has installed Solar lights in the campus. **Recommendation:** **The college needs to install Solar PV System.**
Is the college purchasing renewable power from third party or renewable	No.

energy certificates for its electricity use?	
Is the college offering renewable energy lessons / programs?	This already assessed under chapter 01 of this report.

Further Scope of Improvement

- **The college needs to install Solar PV System.**

Conclusion

- **College Management has installed solar lights in the campus.**

5. Purchasing Practices

Describe the purchasing that confirms the better environmental performance?	Printers with duplex printing facility is installed at the computer lab and Library. There is culture of the two-sided printing. Paper is not wasted.
How does the college limit the purchase of single-serve bottles and containers?	The college has RO system; guests are served with water from RO system. Single serve bottles are not utilized unless requested by the guest.
Is the college having water fountains/stations to promote easy filling of reusable water bottles?	Yes, the water dispensers are connected to output of RO system. Clean and potable water is available to staff, student and guests.

Further Scope of Improvement:

The college should further emphasize on the purchase of:

- **No- to low-odor (VOC) markers**
- **No- to low-VOC paints? (Via Facilities)**
- **paper/paper products with maximum recycled content**
- **refillable pens/pencils**
- **compostable bags for compost collection**

Conclusion:

- **Focus on the replacement of lighting as per above stated recommendation needs to be considered**
- **Focus of the recommendation pertaining to the environmental preference of evaporative cooling over AC needs to be considered.**
- **One sided paper is utilized by college to avoid use of fresh papers**

6. Energy and Carbon Footprint

Has the college undertaken energy audit?	Yes, the energy audit was undertaken and electrical measurements were undertaken at the college. Please refer the Annexure –XVI of this report. Energy audit is an effective tool in identifying and perusing a comprehensive energy management program. Energy Audit highlights the areas of energy savings, thereby reducing the energy costs. The following are the major consumers of electricity in

<table>
<tr><td></td><td>the facility
Computers
Lighting
Air-Conditioning
Fans
Pumps
Other Lab Equipment</td></tr>
<tr><td>What are the steps undertaken during the energy audit?</td><td>The Assessment Team undertook the analysis of the college premise:
To study electricity bills
Study of lighting system and its measurement.
Air conditioner
Study of loads in particular at the labs
Identification of energy saving opportunity and energy conservation.</td></tr>
<tr><td>What methodology was adopted?</td><td>The energy assessment involved desk review and onsite measurements. Review of energy bill received from MSEDCL was undertaken. Review of lighting, HVAC, fuel usage, pumping systems etc. was undertaken. Energy conservation and saving opportunities are identified and included below.</td></tr>
<tr><td>What are the suggested energy conservation measures?</td><td>Below energy conservation measures are suggested
The one switch for college concept should be implemented in the college. This will avoid unwanted operation and wastage of electricity.
There are 40 W tube lights with copper chokes. As per replacement policy the LED tube-light should be installed. The T8 LED tube has wattage of 20 W, thus the energy saved is 40-20 = 20 watt/fitting. As per study there are 84 tubes of 40 W in college. After the replacement based on failure the energy savings will be approximately 1680 kWh. With average electricity cost of INR 13 /kWh, the annual savings will be approximately INR 21840 per year.
Air conditioner shall be operated between temperature range of 24-28^{0}C to maintain lower cooling load on compressor to save energy.
The existing non-star labelled AC's and reached end of their service life. The ACs should be replaced by the 5-star AC's (as daily usage is above 4 hours).
<table>
<tr><th></th><th>0.75 ton</th><th>1 ton</th><th>1.5 ton</th><th>2 ton</th></tr>
<tr><td>1 Star AC (mostly non Inverter)</td><td>627</td><td>843</td><td>1246</td><td>1648</td></tr>
<tr><td>2 Star AC (mostly non Inverter)</td><td>596</td><td>800</td><td>1184</td><td>1626</td></tr>
<tr><td>3 Star AC (mix of Inverter and non Inverter)</td><td>542</td><td>747</td><td>1104</td><td>1448</td></tr>
<tr><td>4 Star (mostly Inverter)</td><td>464</td><td>645</td><td>945</td><td>1293</td></tr>
<tr><td>5 Star (mostly Inverter)</td><td>450</td><td>554</td><td>840</td><td>1113</td></tr>
<tr><td></td><td colspan="4">Annual Electricity Consumption (Units or kWh for 1600 hrs) based on data from BEE</td></tr>
</table>
Application of evaporative cooling should be promoted in place of AC's. The basic reason for the same installed system has COP of 1.5 kW/TR of refrigeration compared to evaporative cycle which draws 0.3-0.5 kW based on the size of installation. If even the 5 non labelled AC are replaced, then the savings will be (1-0.5) *300 days*4 hours per day*4 (number of AC) = 3000 kWh. With cost of INR 6/kWh, the savings will be INR 18,000 per year.
All Class Rooms and labs must sensitize students regarding optimum use of electrical appliances in the room like, lights, fans, computers</td></tr>
</table>

<table>
<tr><td></td><td>

The comfort air conditioning temperature to be set between 24˚C to 26˚C.
Lights in toilet area may be kept OFF during day time. Additional sensors can be installed in washrooms to automatically regulate the light and exhaust fans.

</td></tr>
<tr><td>Has the college calculated its carbon footprint?</td><td>For the first time college is calculating the carbon footprint. The data applicable to Scope-2 emission (electricity purchase from grid) is available. The emissions pertaining to Scope-01 are limited to HSD use in DG, buses and LPG usage in Labs.</td></tr>
<tr><td>How is college promoting zero emission transportation options?</td><td>Not applicable. There is no internal transportation within the college.</td></tr>
<tr><td>Are all the applicable emission sources calculated?</td><td>The emission source pertaining to grid-based electricity source is calculated. Scope-01 emission source data pertaining to DG, HSD consumption in DG, LPG consumption in labs is calculated, Scope 2 emission on account of electricity imported from grid is considered.
Scope-01 Emissions:
<table>
<tr><th>Year</th><th>HSD Consumption in DG</th><th>LPG consumption in Labs</th></tr>
<tr><td>Session</td><td>lit</td><td>kg</td></tr>
<tr><td>2020-21</td><td>55.1</td><td>71</td></tr>
</table>
Equivalent Scope-01 Emissions are as below[6]:
<table>
<tr><th>Year</th><th>HSD Consumption in DG</th><th>LPG consumption in Labs</th><th>Total GHG Emission (Scope-1)</th></tr>
<tr><td>Session</td><td>tCO_2</td><td>tCO_2</td><td>tCO_2</td></tr>
<tr><td>2020-21</td><td>0.20</td><td>0.26</td><td>0.46</td></tr>
</table>
Scope -2 Emissions are tabulated as follows[7]:
<table>
<tr><td colspan="3"></td></tr>
<tr><td>Session</td><td>kWh</td><td>tCO_2</td></tr>
<tr><td>2020-21</td><td>3416</td><td>34.15</td></tr>
</table>
Total CO_2 emissions for financial year 2020 - 21
= Scope-01 + Scope-02
<table>
<tr><td colspan="4"></td></tr>
<tr><td>Session</td><td>tCO_2</td><td>tCO_2</td><td>tCO_2</td></tr>
<tr><td>2020-21</td><td>0.46</td><td>34.15</td><td>34.61</td></tr>
</table>
</td></tr>
</table>

[6]With 10 % uncertainty
[7]With 10 % uncertainty

7. Energy Audit

Description of Energy Audit

An energy audit is an inspection, survey and analysis of energy flows, for energy conservation in a building, process & system to reduce the amount of energy input into the system without affecting the output(s). An energy audit is the first step in identifying opportunities to reduce energy expense and carbon footprints. The term energy audit is commonly used to describe a broad spectrum of energy studies ranging from a quick walk-through of a facility to identify major problem areas to a comprehensive analysis of the implications of alternative energy efficiency measures sufficient to satisfy the financial criteria of sophisticated investors.

Major process of Energy Audit: -

- The analysis of building and utility data, including study of the installed equipment and analysis of energy bills;
- The survey of the real operating conditions;
- The understanding of the building behavior and of the interactions with weather, occupancy and operating schedules;
- The selection and the evaluation of energy conservation measures;
- The estimation of energy saving potential;
- The identification of customer concerns and needs.

Generally, four levels of analysis can be outlined: -

Level 0 – Benchmarking: Breakout of electric and fuel consumptions into end-use components (space heating, fan energy, lighting consumption, etc.). Comparison of the building's consumptions to other buildings of typical size, use and geographic location.

Level I – Walk-through audit: Preliminary analysis made to assess building energy efficiency to identify not only simple and low-cost improvements but also a list of energy conservation measures to orient the future detailed audit. This inspection is based on visual verifications, study of installed equipment and operating data and detailed analysis of recorded energy consumption collected during the benchmarking phase; **Level II – Detailed/General energy audit:** Based on the results of the pre-audit, this type of energy audit consists in energy use survey in order to provide a comprehensive analysis of the studied installation

Level III – Investment-Grade audit: Detailed Analysis of Capital-Intensive Modifications focusing on potential costly ECOs requiring rigorous engineering study.

Chapter 1 – Description of Process and Measurements

Instrument Used for the Study: -

1. 3 Phase power Data Logger – Fluke 1735 model

The 3-phase power analyzer and data logger were used to measure and log the electrical parameters data for the various load centers in the facility. Most of the loads have variation in power requirement and therefore logging helps to observe the variations as well as the average electrical consumption of the load centers.

Using the logger, all major electrical parameters of voltage, current, power, power factor, apparent power, harmonics etc. are recorded at fixed intervals of time.

The variation of parameters like power are plotted and shown with time on X axis and parameter on Y axis. Observations are made based on these measurements.

Some Basic terms:

1. Power – kilowatt (kW) – It is the power consumed by the equipment. This value is varying as per load requirements.
2. Energy – kilowatt hour (kWh) – It is the energy (electrical units) consumed by the equipment. If average power for an electrical load is 2 kW, it means that it consumes 2 kWh units per hour.
3. Apparent power kilo Volt Ampere (kVA) – It is a measure of demand Power / power factor.

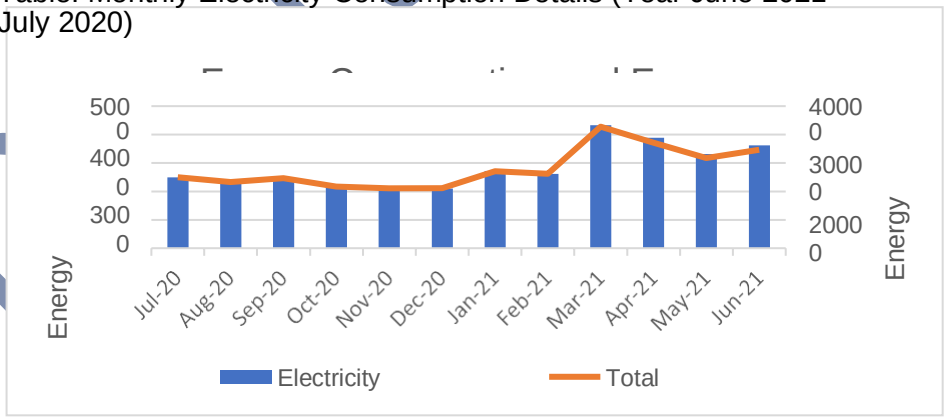
Chapter 2 – Electrical Bill Analysis

Electricity bill pattern under consideration is from June 2021 to July 2021

Consumer No	413250009073
Tariff	73 LT-VII B I
Category	LT-X Educational
Connected Load	10.40 kW
Contract Demand	10.40 KVA
50% of Contract Demand	5.20 KVA

Sr. No.	Month	Energy Consumption	Rate/kWh	Energy Charges	Total Charges
1	Jun-21	3623	4.68	16955.64	27669.48
2	May-21	3312	4.68	15500.16	25333.06
3	Apr-21	3889	4.68	18200.52	29667.86
4	Mar-21	4331	4.68	20994.12	34194.49
5	Feb-21	2618	4.86	12723.48	20897.95
6	Jan-21	2719	4.86	13214.34	21687.28
7	Dec-20	2101	4.86	10210.86	16857.55
8	Nov-20	2099	4.86	10201.14	16841.91
9	Oct-20	2166	4.86	10526.76	17365.53
10	Sep-20	2464	4.86	11975.04	19694.43
11	Aug-20	2329	4.86	11318.94	18639.39
12	Jul-20	2495	4.86	12125.7	19936.69
Average		2845.5	4.8	13662.225	22398.80
Yearly		34146	-	163946.7	268785.62

Table: Monthly Electricity Consumption Details (Year June 2021-July 2020)



Graphical Representation of Electricity Consumption and Total Energy Charges

Observations from Bill Analysis for year June 2021- July 2020:

1. Average monthly MSEDCL energy consumption are 2845 Units (kWh) and avg. monthly bill is Rs.22400.00
2. Average of 12 months' unit cost is Rs. 4.8 / kWh. (Excluding Tax).

Chapter 3: Electrical Logging for Main Feeder

Start (India Standard Time)	Vrms_AN_avg	Vrms_BN_avg	Vrms_CN_avg	Vrms_AB_avg	Vrms_BC_avg	Vrms_CA_avg	Irms_A_avg	Irms_B_avg	Irms_C_avg	VIdistorsion_VA_avg	VIdistorsion_VB_avg	VIdistorsion_VC_avg	VIdistorsion_IA_avg	VIdistorsion_IB_avg	VIdistorsion_IC_avg
11:40:40	247	247	254	428	434	432	26.3	40.9	30.4	1.9	1.8	2.1	10.5	8.8	13.2
11:40:50	247	247	254	429	434	432	26.2	41.1	30.3	1.9	1.8	2.1	10.4	8.7	13.2
11:41:00	247	247	254	429	434	432	26.6	41.2	30.2	1.9	1.8	2	10.4	8.6	13.3
11:41:10	247	247	254	429	434	432	28.1	41.1	30.1	1.8	1.8	2	9.9	8.6	13.6
11:41:20	247	246	254	428	434	432	28.1	41.1	30.1	1.9	1.8	2	10.2	8.5	13.8
11:41:30	247	246	254	428	434	432	27.7	41	30.1	1.8	1.8	2	10.5	8.6	13.7
11:41:40	247	246	254	428	434	433	27.6	41	30.1	1.8	1.8	2.1	10.3	8.6	13.7
11:41:50	247	246	254	428	434	433	26.6	41	30.2	1.8	1.8	2	10.6	8.7	13.6
11:42:00	247	246	254	428	434	432	26	39.4	30.2	1.9	1.8	2.1	10.5	9	13.6
11:42:10	247	247	254	429	434	433	26.3	34.8	30.1	1.9	1.9	2.1	10.9	10.1	13.6
11:42:20	247	247	254	429	434	433	25.8	34.7	30	1.9	1.9	2.1	10.5	10.1	13.7
11:42:30	247	247	254	429	435	433	25.4	34.6	29.6	2	1.9	2.1	11.1	10.1	14
11:42:40	247	247	255	429	435	433	25.7	34.7	29.6	2	1.9	2	11.4	10.2	13.9
11:42:50	247	247	254	429	434	433	25.1	34.6	29.6	2	1.9	2	11.3	10.2	13.5
11:43:00	247	247	254	429	435	433	24.4	34.6	29.6	2	1.9	2	11.5	10.2	13.5
11:43:10	247	247	254	429	435	433	24.9	34.7	29.2	2	2	2	11.6	10.4	14.2
11:43:20	247	247	254	429	434	433	24.7	34.6	29.1	2	1.9	1.9	11.6	10.3	15
11:43:30	247	247	254	429	434	433	24.7	34.6	29.1	2	1.9	2	12.1	10.3	14.7
11:43:40	247	246	254	429	434	433	24.1	35.6	29	2	1.9	2	11.8	9.8	14.4

11:43:50	247	246	254	429	434	433	25.8	36	29	1.9	1.8	2	12	9.7	14.4
11:44:00	247	246	254	428	434	433	26.7	36.1	29	1.9	1.8	1.9	12.1	9.5	14.4
11:44:10	247	246	254	428	434	432	24.6	36	29	1.9	1.8	1.9	11.6	9.4	14.4
11:44:20	247	246	254	429	434	432	24.8	36	29	1.9	1.9	2	11.8	9.5	14.5
11:44:30	247	246	254	429	434	432	24.9	36.7	29.8	1.9	1.9	2	11.7	9.7	14.8
11:44:40	247	246	254	429	434	432	24.6	36.4	29.7	1.9	1.9	2	11.7	9.6	14.8
11:44:50	247	246	254	429	434	432	24.8	36.1	29.1	1.9	1.9	2	11.6	9.6	15.6
11:45:00	247	247	254	428	434	432	24.9	36.2	28.5	1.9	1.9	1.9	11.5	9.6	16.5
11:45:10	247	247	254	429	435	433	24.5	36.1	27.1	1.9	1.9	1.9	11.5	9.5	17
11:45:20	247	247	254	429	434	433	23.8	36	26.6	1.9	1.9	2	11.9	9.6	16.2
11:45:30	247	247	255	429	435	433	26	36.3	26.9	1.9	1.9	2	11.1	9.7	15.8
11:45:40	247	247	254	429	435	433	28.8	37	29.4	1.9	1.8	2	11.3	10.9	16
11:45:50	247	247	254	429	435	432	30.6	38.3	32.1	1.8	1.8	1.9	12.4	12.1	16.6
11:46:00	247	247	255	429	435	433	28	36.2	28.5	1.9	1.9	2.1	10.1	9.8	14.6
11:46:10	247	247	254	429	434	433	28.1	41.6	28.7	1.9	1.9	2	10.1	8.7	14.5
11:46:20	247	247	255	429	435	433	28.1	42.7	29.3	1.9	1.9	2	10	8.4	14.2
11:46:30	247	247	255	428	435	433	28.2	41.8	28.8	1.9	1.8	2	10	8.6	14.4
11:46:40	247	247	255	428	435	433	28.2	40.8	28.9	1.9	1.8	2	10	8.8	14.4
11:46:50	247	247	255	429	435	433	28.2	41.3	29.3	1.9	1.8	2	9.9	8.7	14.2
11:47:00	247	247	255	429	435	433	28.1	41.7	28.8	1.9	1.8	2	10	8.6	14.4
11:47:10	247	247	255	430	435	433	28.2	42	29.1	1.9	1.8	2	10	8.6	14.1
11:47:20	247	247	255	429	435	433	28.2	42.1	29.3	2	1.9	2	10	8.6	14.2
11:47:30	247	247	255	429	435	433	31.4	41.2	28.6	1.9	1.8	2	10.4	8.8	14.2
11:47:40	247	247	255	429	435	433	30.4	42.2	29.3	1.9	1.8	2.1	10.5	8.6	13.6

11:47:50	247	247	255	429	435	433	28.2	42.6	29.1	1.9	1.8	2.1	10	8.5	13.7
11:48:00	247	247	255	429	434	433	28.1	42.7	28.8	1.9	1.8	2.1	9.9	8.5	13.8
11:48:10	247	247	255	429	434	433	28.2	42.6	29.6	1.9	1.8	2	10	8.5	13.4
11:48:20	247	247	255	430	435	433	28.2	41.8	29.5	1.9	1.9	2.1	10.1	8.7	13.6
11:48:30	247	247	255	430	435	433	28.5	43.5	29.6	1.9	1.9	2.1	10.2	8.7	14
11:48:40	248	247	255	430	435	434	28.2	43.4	30.1	2	1.9	2.1	10.2	8.6	13.4
11:48:50	247	247	255	429	435	434	32.4	42.9	29.7	1.9	1.8	2.1	9	8.6	13.2
11:49:00	248	247	255	430	436	434	28.5	41.8	29.6	1.9	1.8	2.1	10	8.7	12.8
11:49:10	248	247	255	430	436	434	28.4	42.3	30	1.9	1.9	2.1	9.9	8.6	12.6
11:49:20	247	248	255	430	436	434	28.2	38.2	29.8	1.9	1.9	2.1	10	9.3	12.6
11:49:30	247	248	255	429	436	434	28.1	36.9	30	1.9	1.9	2.1	10	9.7	12.4
11:49:40	247	247	255	429	436	434	28.3	36.1	30.1	1.9	1.9	2.1	9.9	10	12.3
11:49:50	247	247	255	429	436	434	28.1	36	29.8	1.9	1.9	2.1	10.2	10	12.5
11:50:00	247	247	255	429	436	433	28.7	36.8	30.1	1.9	1.9	2.1	9.9	9.8	12.4
11:50:10	247	247	255	428	435	433	31	36.8	30.2	1.9	1.9	2.1	9.3	9.8	12.3
11:50:20	248	247	255	430	436	434	28.6	36.2	29.4	2	1.9	2.1	10	10	12.6
11:50:30	247	247	255	429	436	433	29.4	36	30.1	2	1.9	2.2	9.9	10.1	12.3
11:50:40	247	247	255	429	435	433	29.7	36.9	30.4	2	1.9	2.1	9.7	9.7	12.1
11:50:50	247	247	255	429	435	433	29.4	36.8	29.7	1.9	1.9	2.1	9.8	9.7	12.3
11:51:00	247	247	255	429	435	433	28.5	36.2	30.5	2	1.9	2.1	10	10	12
11:51:10	247	248	255	430	436	433	29.1	36.1	30.2	2	1.9	2.1	10.3	10.2	12
11:51:20	247	248	255	430	436	433	27.8	36.9	29.9	2	2	2.1	10.5	10	12.2
11:51:30	248	248	255	430	436	434	27.8	36.9	30.5	2	2	2.1	10.6	10.1	11.9
11:51:40	247	248	255	430	436	433	28	36.2	30.4	2	2	2.2	10.3	10.3	11.9

11:51:50	248	248	255	430	436	433	27.8	36	30.1	2	2	2.1	10.6	10.3	12
11:52:00	247	247	254	429	435	432	32.2	41.4	36.4	1.8	1.7	2	13.7	12.3	14
11:52:10	248	247	255	429	435	433	28	37.3	31	2	1.9	2.1	10.9	10.5	12.6
11:52:20	248	247	255	429	436	434	27.3	35.8	30.3	2	1.9	2.1	10.7	10.3	12
11:52:30	248	247	255	430	436	434	27.7	35.9	30.3	2	1.9	2.1	10.4	10.2	12
11:52:40	248	247	255	430	436	434	27.7	36.7	30.2	2	1.9	2.1	10.5	10.1	12
11:52:50	248	247	255	430	435	433	27.5	36.6	30.5	2	1.9	2.1	10.7	10	11.8
11:53:00	248	247	255	430	435	433	27.6	36.3	31	2	1.9	2.1	10.8	10.3	12
11:53:10	248	247	255	430	435	434	27.6	36.3	30.3	2	1.9	2.1	10.7	10.4	12.2
11:53:20	248	247	255	429	435	433	28.8	39.9	32.4	2	1.9	2.1	11.8	10.4	12.9
11:53:30	248	246	255	429	434	433	30.3	46.1	34.2	1.9	1.8	2	12.8	10.2	14.1
11:53:40	248	247	255	430	435	434	27.7	41.6	30	2	1.9	2.1	10.5	9.1	12
11:53:50	248	247	255	430	435	433	27.6	41.5	30.5	2	1.9	2.1	10.6	9.1	11.9
11:54:00	247	247	255	429	435	433	27.7	42.2	31.8	2	1.9	2.1	10.4	8.9	11.4
11:54:10	247	247	255	429	435	433	27.6	42	32.4	2	1.9	2.1	10.5	9	11.1
11:54:20	247	247	255	429	435	433	27.7	41.3	32.2	1.9	1.9	2.1	10.5	9.1	11.3
11:54:30	247	247	255	429	435	433	27.7	41.5	32.1	2	1.9	2.1	10.5	9	11.3
11:54:40	247	247	255	429	435	433	27.4	42.1	31.2	2	1.9	2.2	10.7	8.9	11.6
11:54:50	247	247	255	429	435	433	27.5	42.2	32.2	2	1.9	2.1	10.4	8.8	11.2
11:55:00	247	247	255	429	435	433	27.7	41.4	31.8	1.9	1.9	2.1	10.5	9	11.4
11:55:10	247	247	255	429	435	433	27.8	41.9	31.3	1.9	1.8	2.1	10.5	8.9	11.5
11:55:20	247	247	255	429	435	433	27.5	42.6	30	1.9	1.8	2.1	10.5	8.7	12
11:55:30	247	247	255	429	434	433	27.8	42.8	29.7	1.9	1.8	2	10.3	8.6	12.2
11:55:40	247	247	255	429	434	433	27.5	41.8	29.7	1.9	1.8	2	10.4	8.8	12.2

11:55:50	247	247	255	429	434	433	27.7	42.5	30.8	1.9	1.8	2.1	10.2	8.6	11.8
11:56:00	247	246	255	429	434	433	27.7	43.1	29.8	1.9	1.8	2.1	10.3	8.4	12.2
11:56:10	247	246	255	429	434	433	28.2	43.2	29.6	2	1.8	2.1	10.6	8.4	12.3
11:56:20	247	246	255	429	434	433	29.9	42.2	29.5	2	1.8	2.2	11.1	8.7	12.3
11:56:30	247	246	255	429	434	433	29.3	42.6	29.2	1.9	1.8	2.1	10.8	8.6	12.4
11:56:40	247	246	255	429	434	433	27.9	43.3	29.2	2	1.8	2.1	10.4	8.4	12.4
11:56:50	247	247	255	429	434	433	27.6	37.1	29.2	1.9	1.8	2.1	10.4	9.5	12.4
11:57:00	247	247	255	429	434	433	27.8	35.5	29.3	1.9	1.8	2.1	10.7	10	12.4
11:57:10	247	247	255	429	434	433	27.4	36	29.6	1.9	1.8	2.1	10.6	9.8	12.4
11:57:20	247	247	255	429	434	433	27.8	36.7	29.4	1.9	1.8	2.1	10.7	9.6	12.4
11:57:30	247	247	255	429	434	433	27.5	36.4	29.4	2	1.8	2.2	10.6	9.8	12.4
11:57:40	247	247	255	429	434	433	27.8	35.6	29.4	2	1.9	2.2	10.8	10	12.4
11:57:50	247	246	254	428	434	433	27.5	36.3	29.4	1.9	1.8	2.1	10.4	9.6	12.2
11:58:00	247	246	254	428	434	433	28.1	36.6	29.3	1.9	1.8	2.1	10.5	9.5	12.2
11:58:10	247	246	254	429	434	433	27.4	36.3	29.3	2	1.8	2.1	10.4	9.7	12.3
11:58:20	247	246	254	429	434	433	27.5	35.5	29.3	2	1.8	2.2	10.6	10	12.4
11:58:30	247	246	254	429	434	432	27.4	36.4	29.3	2	1.8	2.2	10.4	9.7	12.3
11:58:40	247	246	254	429	434	432	27.4	36.6	29.3	2	1.9	2.2	10.3	9.8	12.3
11:58:50	247	247	254	429	434	432	27.6	36	29.2	2	1.9	2.2	10.5	9.9	12.3
11:59:00	247	247	255	429	436	433	27.2	35.7	29.1	2	1.9	2.2	10.3	10.1	12.3
11:59:10	247	247	255	430	436	433	27.5	36.7	29.1	2	1.9	2.2	10.5	9.8	12.4
11:59:20	247	247	255	430	435	433	27.2	36.6	29.1	2	1.9	2.2	10.3	9.7	12.4
11:59:30	248	247	255	430	435	433	27.4	35.8	29.1	1.9	1.9	2.2	10.5	10	12.5
11:59:40	248	247	255	430	435	433	27.2	35.8	29.2	1.9	1.9	2.2	10.4	9.9	12.4

11:59:50	247	247	255	429	435	433	28.9	36.6	29.3	2	1.9	2.1	10.1	9.7	12.2
12:00:00	247	247	255	429	435	433	31.2	36.6	29.3	2	1.9	2.1	9.5	9.8	12.2
12:00:10	248	247	255	430	435	433	28	35.7	29.3	2	1.9	2.2	10.6	10.2	12.3
12:00:20	248	247	255	430	435	434	27.2	36.3	29.3	2	1.9	2.1	10.5	9.9	12.3
12:00:30	248	248	255	430	436	434	27.7	36.7	29.4	2	1.9	2.1	10.7	9.8	12.4
12:00:40	248	247	255	430	435	434	30	38.2	29.3	2	1.9	2.2	9.9	9.4	12.4
12:00:50	248	247	255	430	435	434	28	42.3	29.3	2	1.8	2.2	10.5	8.7	12.5
12:01:00	248	247	255	430	435	434	28.9	42.2	29.2	2	1.8	2.2	10.4	8.7	12.4
12:01:10	248	247	255	430	435	434	27.5	42	29.2	1.9	1.8	2.1	10.4	8.7	12.3

The following table gives the results of voltage & Current data logging for main Feeder.

	Voltage Variation (V) – L1	Voltage Variation (V) – L2	Voltage Variation (V) – L3	Current Variation (A) – L1	Current Variation (A) – L2	Current Variation (A) – L3
Minimum	247.00	246.00	254.00	23.80	34.60	26.60
Maximum	248.00	248.00	255.00	32.40	46.10	36.40
Average	247.21	246.86	254.69	27.65	38.65	29.82

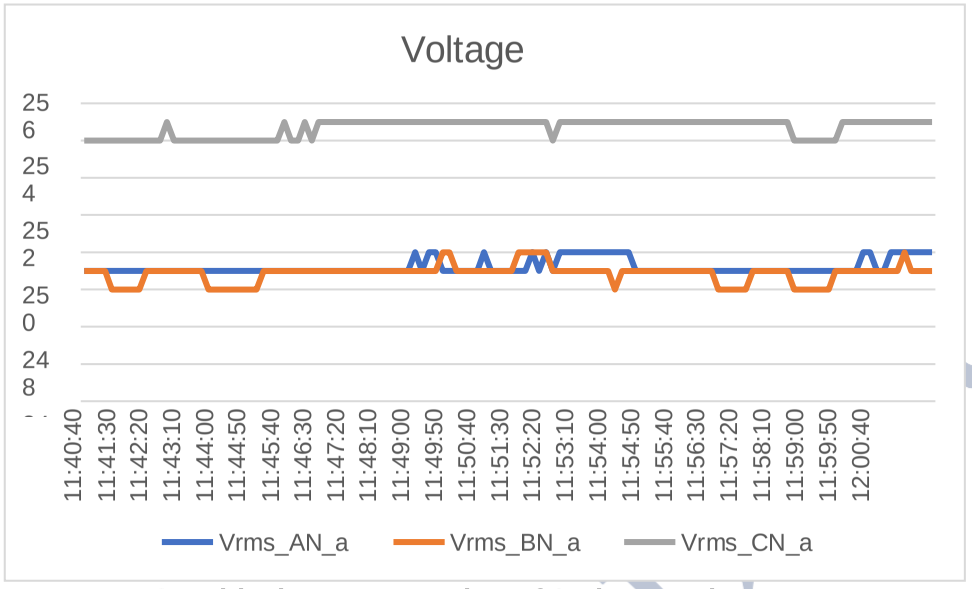
The following table gives the results of power data logging for main Feeder.

	Total Harmonics Distortion – Voltage (THD L1)	Total Harmonics Distortion – Voltage (THD L2)	Total Harmonics Distortion – Voltage (THD L3)	Total Harmonics Distortion – Current (THD L1)	Total Harmonics Distortion – Current (THD L2)	Total Harmonics Distortion – Current (THD L3)
Minimum	1.80	1.70	1.90	9.20	9.00	8.40
Maximum	2.00	2.00	2.20	13.70	12.30	17.00
Average	1.94	1.86	2.08	10.60	9.47	13.06

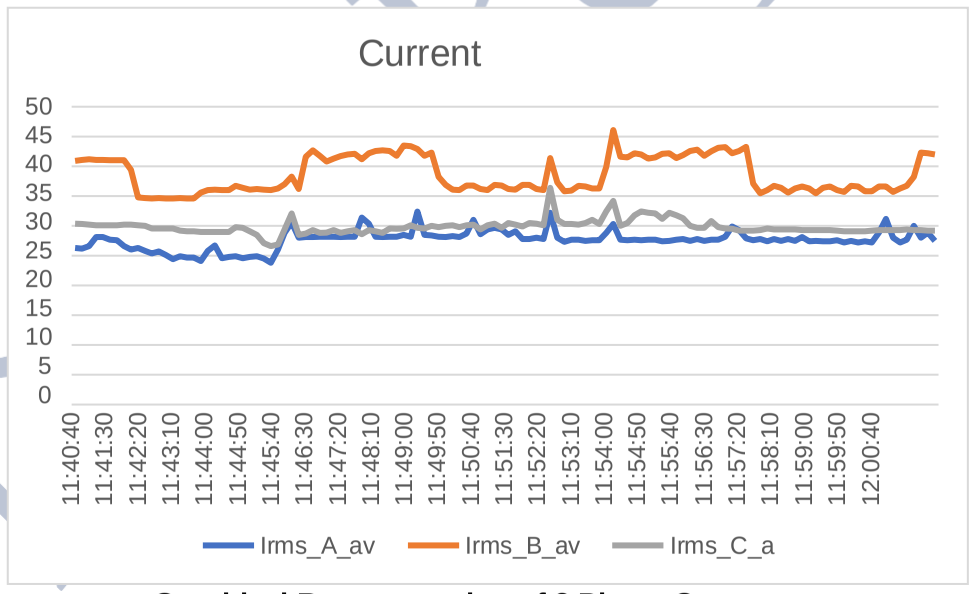
Observations for Main Feeder Logging

- The voltage variation from was recorded in range of 246 V to 255 V. Increase in voltage levels can damage the electrical equipment's such as Lightings. Use of voltage stabilizer at the source end will deliver a constant value of voltage. It is recommended to use 15 KVA Voltage Stabilizer at the source end.
- There is unbalance in current. The unbalance in 3 phases is around 10 – 15 % which is high. The unbalance in network was recorded due to some load connected in the Line 2. It is recommended that the single-phase loads on each phase are distributed properly so that the current in each phase will be balanced.
- Voltage harmonics are found to be within acceptable limits. The maximum allowable voltage harmonics is about 5 %. Voltage harmonics are a function of the supply from service provider and indicate pollution of the electrical grid system by non-linear loads. Observed voltage harmonics are up to 2%.

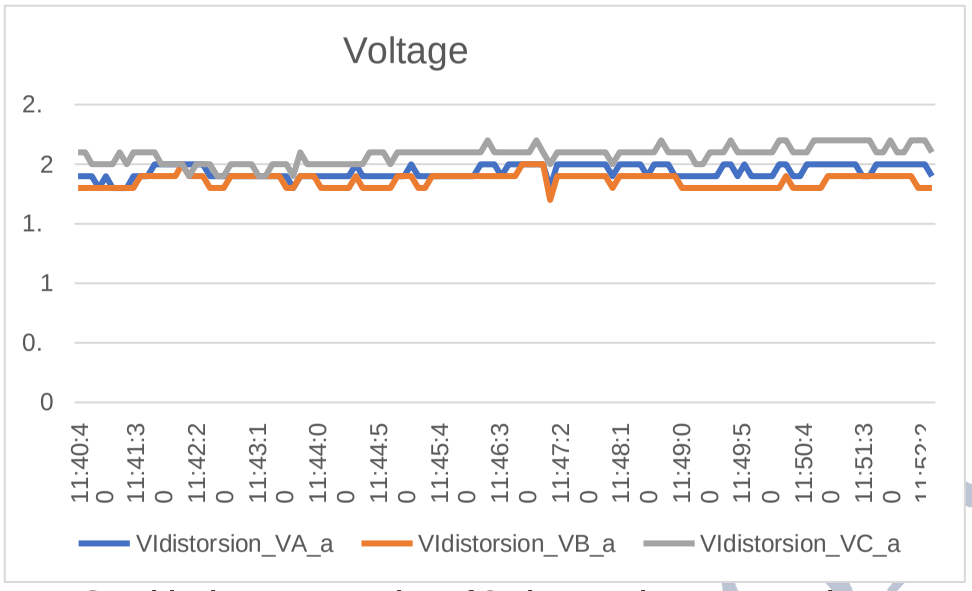
Graphical Representations of Measured



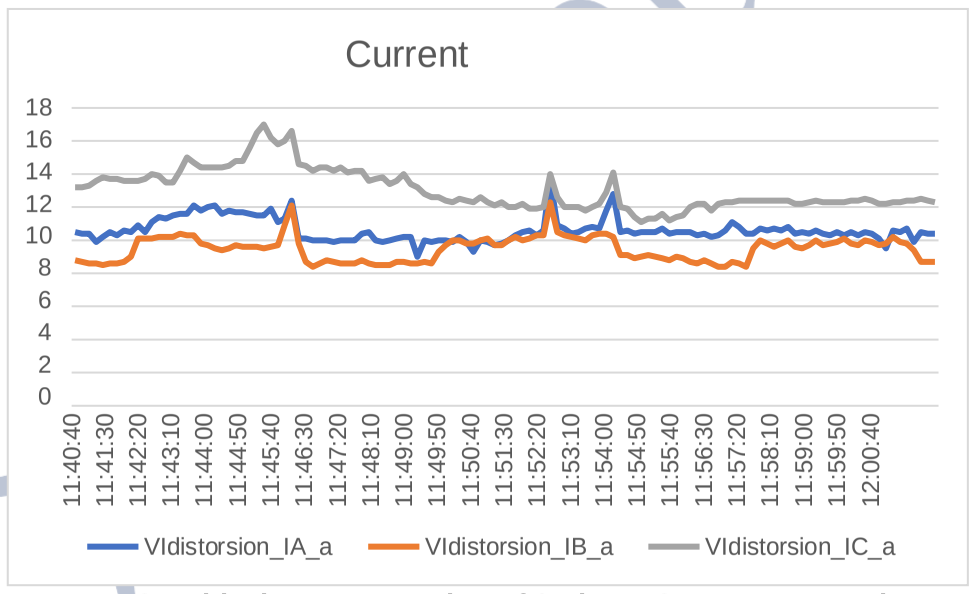
Graphical Representation of 3 Phase Voltage



Graphical Representation of 3 Phase Current



Graphical Representation of 3 Phase Voltage Harmonics



Graphical Representation of 3 Phase Current Harmonics

1. Reference Techno Commercial Proposal for Grid Tied Solar PV

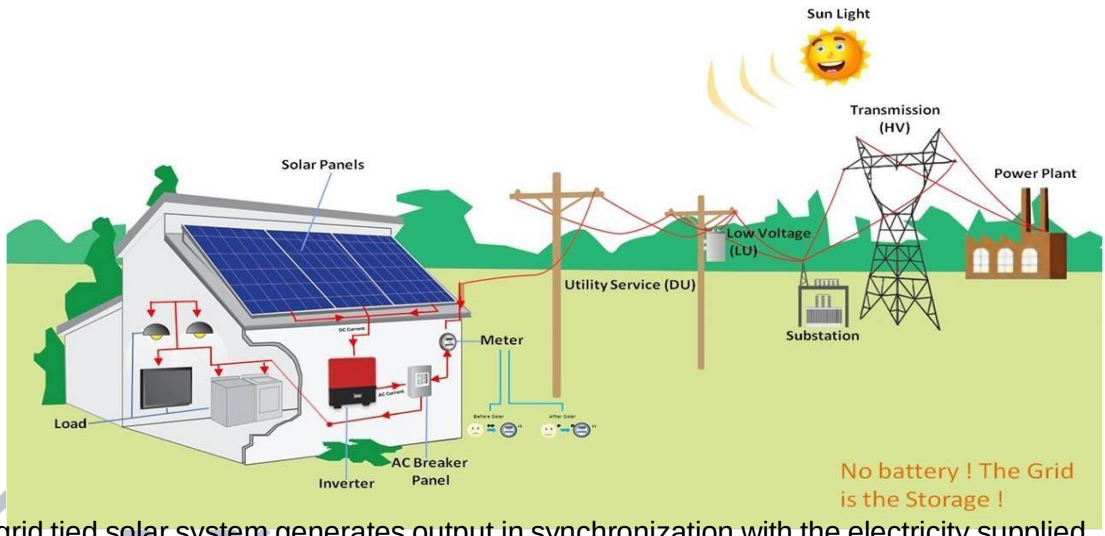
1.1 Background

A 25 kWp rooftop Solar Photo Voltaic System is proposed to be installed at your college premises
at Ambe Durga Education Society's Dadasaheb Balpande College of Pharmacy.
This proposal is based on following points discussed during our meeting/conversation.

- You have a three phase LT connection from Maharashtra State Electricity Distribution Co. Ltd with sanctioned load of 10 kW.
- Considering Average electricity consumption is about 2845 units per month. (Average consumption from June-21 to July 20)
- Present average electricity tariff is Rs. 4.8 /kWh. (Excluding Taxes)
- Space required is 2500 sq. Ft. facing south direction with clear rooftop available.

1.2 Proposed System

Based on your requirement, a grid tied three phase solar system is proposed to be installed on your space available.



A grid tied solar system generates output in synchronization with the electricity supplied from the utility (MSEDCL).

1.3 Operation Details of proposed system

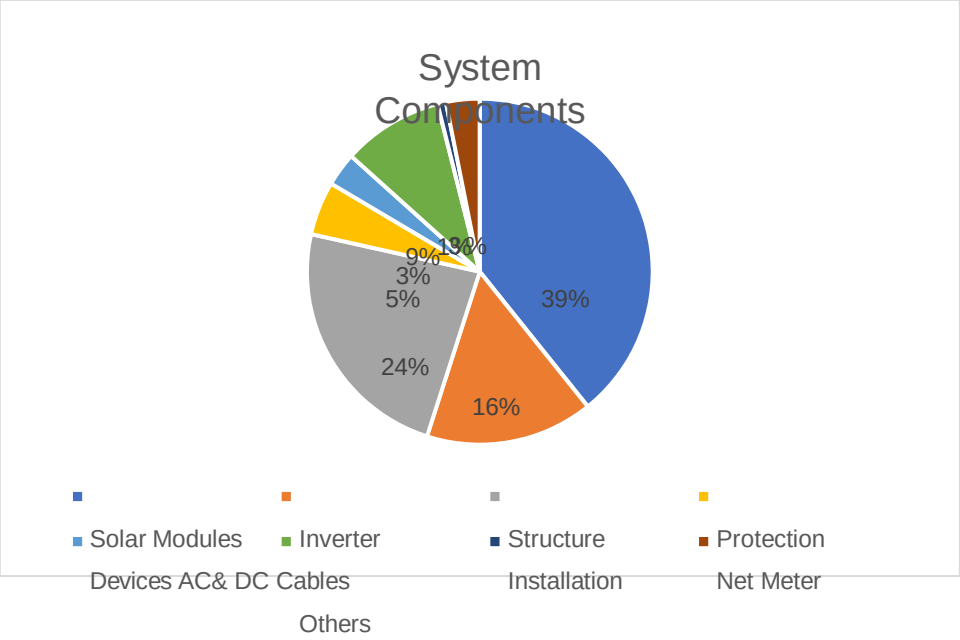
- The generated solar power is used for local consumption decreasing the demand of electricity from the grid.
- As long as the captive power requirement is more than the output of solar, the excess power required is feed by the grid.
- If the captive power requirement is lower than the output of solar, the electricity is exported to grid.
- Whenever there is no power supply from the grid, the solar PV system goes in standby mode and its output cannot be used.

1.4 Advantages and benefits

- The life of solar system is 25 years with 25 years' linear power output warranty from the manufacturer of solar module.
- Dynamic system with no moving parts, hence no wear and tear of systems.
- With no batteries connected, maintenance is limited to cleaning of solar modules once in 15 days.
- Inverter output and grid power are on same bus, there is no effect of load fluctuations on the system.
- Generation of renewable energy results in reduction of carbon footprints.
- The effective cost of power generated from solar energy is as lower as Rs. 3/kWh. Thus, any investment in solar system now gives healthy returns over next 25 years.

1.5 Technical Details

SR.NO	DESCRIPTION	Details	MAKE / MODEL
1	Solar PV Module	25 kWp	Trina/Canadian/Renesys/others
2	Grid Tied Inverter	25 KVA	Growatt/Delta/Polycab /Other
3	Module Structures	M S Galvanized	Own
4	DC Distribution Box	As required	Own
5	AC Distribution Box	As required	Own
	Surge Protection	Type 2 for AC and DC	Mersen/Dehn/Equivalent
6	DC Cables	As required	Polycab / Siechem/ others
7	AC Cables	As required	Polycab / Siechem/ others
8	Lightning Arrestor	As required	ISI Complaint
9	Earthing	As required	ISI Complaint
10	Net Meter	Approved by Discom	Secure



1.6 Scope of Work

Scope of work includes Supply Design, Engineering, Procurement, Supervision,

Installation, Testing & Commissioning and one-year warranty on installed Solar PV system.

- Documentations and approvals
  a. Application and approval from Discom for Net metering/Gross Metering purpose.
- Design & Engineering.
  a. System design.
  b. Engineering drawings.
  c. Detailed Bill of Materials & Project Report.
- Procurement and supply of material.
  a. Solar PV Modules
  b. Solar Grid Inverter
  c. Solar Module Mounting Structure
  d. Solar Grade, UV protected DC Cable
  e. AC Cable
  f. DC and AC Distribution Box
  g. Earthing & Lightning Arrestor
  h. All other related accessories.
  i. Net Meter
- Civil Installation Work.
  a. Module mounting structure installation.
    i. The structure will be installed on pillars above terrace and on available terrace space will elevation such that a person can easily walk and use terrace.
  b. Civil work for module mounting structure.
- Electrical Works.
  a. Wiring of Modules.
  b. Cabling from modules to DC distribution box.
  c. Cabling from DC distribution box to Inverter.
  d. Cabling from Inverter to AC Distribution box.
  e. Earthing and Lightning Protection.
- Testing & Commissioning.
- Net Metering.

Exclusion

- Construction Power and Water.
- All other activities, documentation, services, etc. which are not specifically mentioned in this offer.

2. Estimated Output & Returns

- Detailed estimation of output of solar PV system is done considering location of installation, proposed direction of solar panels, data of solar irradiance at the location, system losses, and other related data.

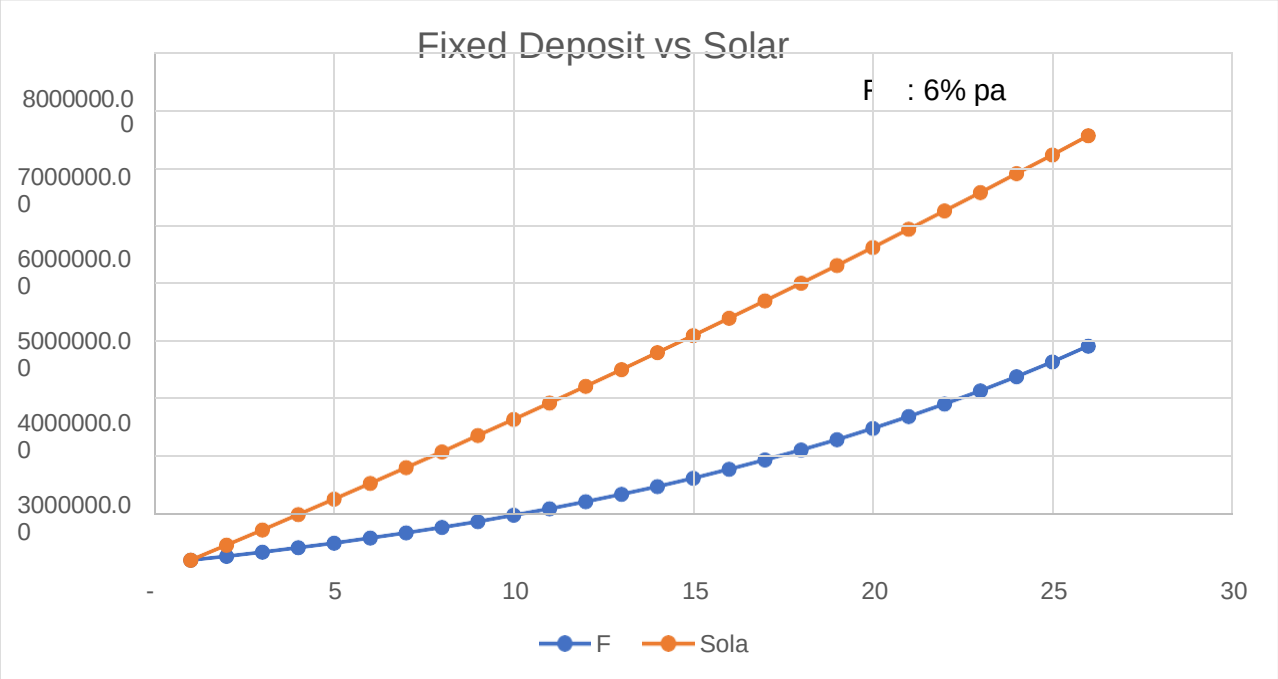
2.1 Basis of estimation

- Solar PV Capacity: 25 kWp
- Location: Ambe Durga Education Society's Dadasaheb Balpande College of Pharmacy.
- The solar panels are expected to be free of shadow.
- Generation is based on radiation of 1000W/m2 and grid availability.
- Assumed clear sunny 330 days/year.
- Space required is 2500 sq. facing south direction with clear rooftop available.
- Assumption for Cost of Electricity is Rs. 7/kWh including energy charges and

2.2 Estimated output

- Daily generation from solar: 112 kWh/day
- Monthly generation: 3375 kWh/month
- Total Annual output: 37125 kWh/annum

3.3 Comparison with Bank Fixed



3. Commercial Offer

3.1 Cost of System

Description	Amount (INR)
Supply, Design, Installation, Testing and Commissioning of 25 kWp Grid Tied Solar PV System	Rs. 11,25,000.00
GST	Extra at Actual
Any other taxes and duties	Nil at present

3.2 Returns

The Solar system gives excellent result as shown below

- Estimated savings of **Rs.2,60,000** from first year.
- Return on investment: **23.10 %pa.**
- **Payback/ Breakeven** time of **5 years** out of operating life of 25 years.

No	Capital Cost	Savings in Electricity bills	Net Cash Flow	Cumulative cash flow
Year 1	1125000.00	259875.00	-865125.00	-865125.00
Year 2		262473.75	262473.75	-602651.25
Year 3		265098.49	265098.49	-337552.76
Year 4		267749.47	2,67,749.47	-69803.29
Year 5		270426.97	2,70,426.97	200623.68
Year 6-25	Savings in Electricity of Rs.2,70,000.00/Annum			

Assumptions:

- Increase in tariff rate assumed at 1% pa.
- Above pricing is for indicative purpose only and may vary depending upon specific location, plant load factor, operation and maintenance cost, location based, extra supporting structure for solar module, civil work, et

Annexure

Annexure – I: Reference Documents / Surveys

Sr. No	Reference Documents / Surveys pertaining to
1.	Electricity Bills for duration of June 2020 to July 2021.
2.	Declaration on Operational Controls of System Department with Respect to IT Management & Other Electronic Equipment's.
3.	Roll Of Staff, Students & Management to Save Electricity in Campus.
4.	Lighting Survey undertaken by the Energy Audit Team.
5.	AC Survey undertaken by the Energy Audit Team.

Annexure –II: Lighting Survey (2020 – 21)

List of Assumptions:

- During the survey specific hours for each class room, wash room, office space was assessed and accordingly average daily hours were considered
- The kW ratings of the installed lights are taken from the College data
- The calculations cover the two approaches
  - Approach: Calculation of LED contribution based on the total lighting load energy consumption.

    Note: The Lumen/Watt for 28 W tube light is up to 110; which is almost same as LED is: 110-120[8]

  - The Energy Audit Team acknowledges the criteria for introduction of LED lights as LED lights do not have disposal problems. Tube lights face problem of mercury contamination.
  - Conversely the college also faces the problem of disposal of existing tube lights. The sudden disposal of tube lights on large scale and within their service life will lead to huge amount of e-waste which has critical impact on environment. The college management is thus looking for the replacement policy and lighting (tube light, CFL) will be upgraded to eco-friendly LED after failure of existing lighting system.

Lux Levels observed at working place - 250

Calculated Contribution of various lighting arrangements: Calculated for 200 working days

Light Sources	Daily Wh Consumption
Tube light	9920
LED	7767
CFL	1199.5

Light Sources	% Contribution
Tube light	53%
LED	41%
CFL	6%

Light Sources	Number
Tube light	84
LED	128
CFL	22

Light Sources	% Contribution
Tube light	36%
LED	55%
CFL	9%

[8] https://www.google.co.in/amp/s/www.bijlibachao.com/lights/comparing-led-lights-with-fluorescent-lights.html%3fisamp=1

Lighting Survey 2020 – 21

Room Name/no.	Tube light	Watts	Daily average hrs	W.hr	LED	Watts	Daily average hrs	W.hr	CFL	Watts	Daily average hrs	W.hr	Fan	Watts	Daily average hrs	W.hr
Director Cabin	-	-	-	-		-	-	-	2	15	2	60	2	80	3	480
Conference Room	-	-	-	-	4	50	2	400	-	-	-	-	6	100	2	1200
Staff Room	-	-	-	-	3	20	5	300	-	-	-	-	6	80	5	2400
IQAC Room	1	40	5	200	-	-	-	-	-	-	-	-	1	80	5	400
Principal Cabin	1	40	0.5	20	6	15	5	450	1	10	1	10	1	80	5	400
Placement Room	-	-	-	-	7	12	5	420	-	-	-	-	1	80	5	400
Admin Office	-	-	-	-	6	20	5	600	4	26	5	520	6	80	5	2400
Exam Room	1	40	2	80	1	20	2	40	-	-	-	-	2	80	2	320
DFT	3	40	3	360	-	-	-	-	-	-	-	-	6	80	3	1440
Micro Lab	3	40	4	480	-	-	-	-	-	-	-	-	6	80	4	1920
Plants Lab	1	40	4	160	-	-	-	-	-	-	-	-	1	80	4	320
G - 22	-	-	-	-	-	-	-	-	5	15	0.5	37.5	-	-	-	-
Store Room	1	40	2	80	-	-	-	-	-	-	-	-	1	80	2	160
Machine room	3	40	3	360	19	20	3	1140	-	-	-	-	2	80	3	480
Store Room	2	40	1	80	-	-	-	-	-	-	-	-	3	80	1	240
G - 24	1	40	1	40	-	-	-	-	-	-	-	-	-	-	-	-
Girls Common Room	3	40	2	240	-	-	-	-	-	-	-	-	5	80	2	800
Corridor	2	40	1	80	1	7	1	7	1	20	1	20	-	-	-	-
F - 9	3	40	4	480	-	-	-	-	-	-	-	-	4	80	4	1280
F - 10	1	40	4	160	-	-	-	-	1	15	4	60	2	80	4	640
F - 11	3	40	4	480	-	-	-	-	-	-	-	-	6	80	4	1920
F - 12	3	40	4	480	-	-	-	-	-	-	-	-	6	80	4	1920
F - 13	1	40	2	80	1	10	2	20	-	-	-	-	2	80	2	320
F - 14	3	40	2	240				0	-	-	-	-	6	80	2	960
F - 15	-	-	-	-	3	10	2	60	-	-	-	-	1	80	2	160

F - 16	2	40	5	400	1	20	5	100	-	-	-	-	7	80	5	2800
Corridor	2	40	0.5	40	1	10	0.5	5	-	-	-	-	-	-	-	-
Stair Case	-	-	-	-	1	10	0.5	5	-	-	-	-	-	-	-	-
S - 8	2	40	5	400	1	20	5	100	-	-	-	-	3	80	5	1200
S - 9	2	40	5	400	-	-	-	-	-	-	-	-	2	80	5	800
S - 10	3	40	3	360	-	-	-	-	-	-	-	-	3	80	3	720
S - 11	3	40	3	360	-	-	-	-	-	-	-	-	3	80	3	720
S - 12	2	40	3	240	-	-	-	-	-	-	-	-	4	80	3	960
S - 13	1	40	3	120	-	-	-	-	-	-	-	-	-	-	-	-
S - 14	-	-	-	-	15	20	6	1800	-	-	-	-	6	80	2	960
S - 15	-	-	-	-	-	-	-	-	4	26	3	312	3	80	3	720
S - 16	3	40	1	120	1	20	1	20	-	-	-	-	2	80	1	160
S - 17	2	40	4	320	-	-	-	-	-	-	-	-	6	80	4	1920
S - 18				0	2	20	4	160	-	-	-	-	4	80	4	1280
S - 19	2	40	4	320	1	20	4	80	-	-	-	-	4	80	4	1280
S - 20	-	-	-	-	-	-	-	-	1	20	5	100	1	80	5	400
S - 21	2	40	2	160	1	20	2	40	-	-	-	-	4	80	2	640
S - 23	1	40	2	80	1	20	2	40	1	20	2	40	1	80	2	160
Corridor	1	40	1	40	2	20	1	40	2	20	1	40	-	-	-	-
Stair Case	1	40	0.5	20	-	-	-	-	-	-	-	-	-	-	-	-
T - 1	-	-	-	-	12	20	3	720	-	-	-	-	16	80	3	3840
T - 4	-	-	-	-	12	20	2	480	-	-	-	-	14	80	2	2240
T - 5	3	40	4	480	1	10	1	10	-	-	-	-	7	80	4	2240
T - 6	-	-	-	-	1	20	4	80	-	-	-	-	1	80	4	320
T - 7	3	40	4	480	-	-	-	-	-	-	-	-	5	80	4	1600
T - 8	3	40	4	480	-	-	-	-	-	-	-	-	4	80	4	1280
T - 9	1	40	4	160	1	10	1	10	-	-	-	-	4	80	4	1280
T - 10	3	40	4	480	-	-	-	-	-	-	-	-	4	80	4	1280

T - 12	2	40	2	160	-	-	-	-	-	-	-	-	6	80	4	1920
T - 13	-	-	-	-	15	20	2	600	-	-	-	-	5	80	2	800
Girls Wash Room	1	40	2	80	-	-	-	-	-	-	-	-	-	-	-	-
Boys Wash Room	1	40	2	80	-	-	-	-	-	-	-	-	-	-	-	-
Corridor	2	40	0.5	40	6	10	0.5	30	-	-	-	-	-	-	-	-
Stair Case	-	-	-	-	2	10	0.5	10	-	-	-	-	-	-	-	-
	84			**9920**	**128**			**7767**	**22**			**1199.5**	**195**			**52080**

On & off culture practiced in college

Use of LED lights in college

Sensor based lighting installed in college

Annexure –III: Undertaking by the System Department regarding control of Electronic Equipment's

Ambe Durga Education Society's
DADASAHEB BALPANDE COLLEGE OF PHARMACY
Near Swami Samarth Dham Mandir, Besa, Nagpur - 440037 (M.S.)
◆ Accredited by NBA, NAAC ◆ AICTE-CII "PLATINUM" RANK
• Approved by A.I.C.T.E, P.C.I. D.T.E. Govt. of Maharashtra, Recongnized under 2(f) and 12(B) of UGC ACT.
• ISO Certified | Permanently Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur (M.S.)
Founder : Late Shri Dadasaheb alias Vitthalrao C. Balpande
07103-281244, 281277, 9860815776 | www.dbcop.org | dbcop_edu | dbcop_edu | dbcop.office@gmail.com
President : Shri Manoj V. Balpande | Principal : Dr. Ujwala Mahajan

Ref. No. / DBCOP / 4950/B/2020 Date : 11/12/2020

Certificate

The administrative Rights of computer setting are with the administrative department of the college.

As part of the sustainable and eco-friendly setting, the system department has initiated below setting in the copters of all the users.

1. All the computers screen savers are disabled.
2. The computers are turned to sleep mode if they are Ideal.
3. The computers setting cannot change as the administrative rights are with the department.
4. With regards to the uses policy of photocopier and other equipment user "POWER ON" when in used and "POWER OFF" when not in use.

The statement is issued in response to the query raised during the green audit.

SEAL

Mahajan 11/12/2020
PRINCIPAL
DADASAHEB BALPANDE COLLEGE
OF PHARMACY, BESA, NAGPUR - 37

Annexure– IV: List of Electronic Equipment's in College

Dadasaheb Balpande College Of Pharmacy
Near Swami Samarth Dham Mandir, Besa, Nagpur – 440037

Eletricals equipement bill deatail

Session 20-21

Sr.no	Date	Bill No	Vendor Name	Material Name	Qty
1	9/9/2019	8271	Bright Eletricals	Celling Fan 1200 mm Bianco	25
2	10/10/2020	1069	Shree Computer Bazar	Desktop Asseceries	sets
3	2/10/2020	SC/DEC20-21/0010	Sunita computer & mobile	Desktop Asseceries	sets

Annexure –V: Solar Panel Installations

Solar Lamps Installed in Campus

Solar Pv System for Water Distillation System

Annexure –VI: Solar Passive Structure

Adequate light in classrooms without using electrical lighting

Adequate light in labs without using electrical lighting

Use of false ceiling to reduce air-conditioned volume and reducing AC load

Use of blinds for windows to reduce heat

AC Condenser exposed to direct sunlight

Ambe Durga Education Society's

Dadasaheb Balpande College of Pharmacy (DBCOP)

Near Swami Samarth Mandir, Besa, Nagpur-37

Standard Operating Procedure for Energy saving and Environment conservation

1. Staff will be responsible for control of common areas of the building with a minimal number of lights turned on during occupancy for lighting and safety.

2. Staff will utilize natural lighting as much as possible by opening up window blinds as available. Blinds should be left closed, however, when the incoming sun is too warm and creates additional load on the HVAC.

3. When staff coming to work, will see that lights in common areas are on according to need.

4. All routes of exit in case of emergency shall be illuminated.

5. All staff will be responsible for turning off lights in areas such as conference rooms, hallways, bathrooms and offices when unoccupied or when exiting rooms after working hours.

6. All staff will turn off computers and screens before leaving the office daily.

7. Water consumption should be minimized wherever and whenever possible.

8. Low flow toilets, showers, and faucets shall be utilized whenever possible.

9. Water should not be left running and unattended.

10. All plumbing leaks, dripping faucets, constantly running toilets and broken sprinkler heads shall be immediately reported to the Facilities Department in work order form.

11. All water leaks shall be repaired in a timely manner.

12. Irrigation systems will be monitored to minimize water usage.

13. When spray irrigating, water shall not hit the building or pavement.

14. Single use plastics are not allowed in campus

15. Share the vehicles to save the fuel

DADASAHEB BALPANDE COLLEGE OF PHARMACY * BESA, NAGPUR-37 * SEAL

Mahajan

Dr. Ujwala Mahajan
Principal
DBCOP, Besa, Nagpur

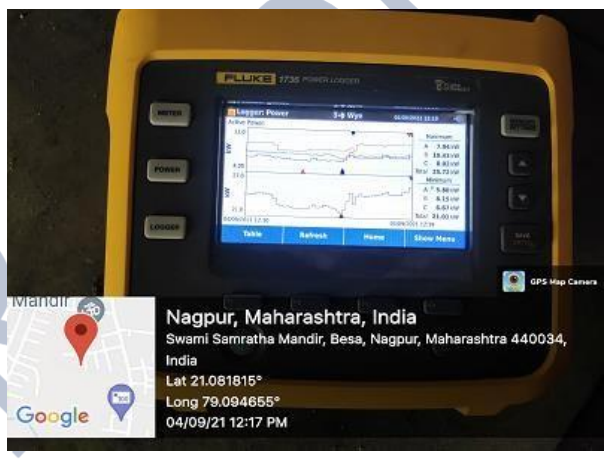
PRINCIPAL
DADASAHEB BALPANDE COLLEGE OF PHARMACY, BESA, NAGPUR - 37

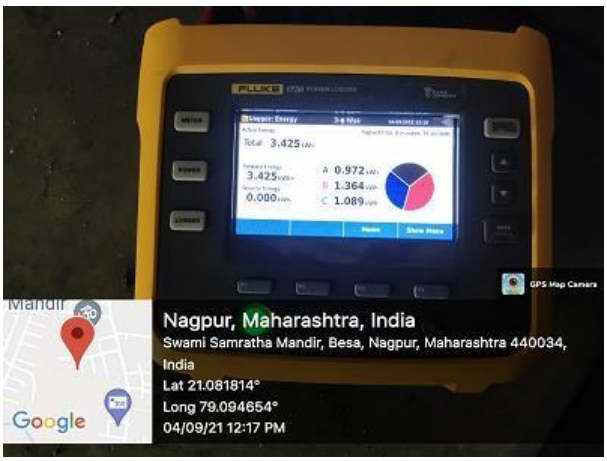
DBCOP/IQAC/14 Environment Protection Policy

SOP for Energy Saving & Environment Conservation

Annexure –VII: Onsite Measurements (Sample Pictures)

Onsite measurements taken by Energy Audit Team





Energy Audit measurements

Audit Team in discussion with the Principal

Audit Team interviewing the staff members

Audit Team interviewing the students

Notes:

Coordinates:

Swapnil Thanekar
Sustainability |Energy |Water
(Certified Energy Auditor – EA4416)

Plot Number 09, Shivaji Nagar,
Opposite LAD college Ground,
North Ambazari Road,
Pin- 440010, Nagpur

A-3, Flat 305, Sneha Vihar,
Dangat Patil Nagar, Shivne,
Off- NDA Road,
Pin 411023- Pune

Phone - 0091- 8149190608, 8975664570
Email: swanil_thanekar@yahoo.co.in