A REPORT ON
DETAILED ENERGY AUDIT

Study conducted at

CHRIST (DEEMED TO BE UNIVERSITY), BANGALORE

Study conducted by

Department of Electrical and Electronics Engineering,
School of Engineering and Technology,
In association with Department of Physics and Electronics.
CHRIST (Deemed to be University),
BANGALORE.

MAY, 2024

ACKNOWLEDGEMENT

The Consortium of Energy auditors are thankful to the Christ (Deemed to be University), Bangalore for providing us an opportunity to conduct Baseline audit and for extending their valuable co-operation.

The excellent co-operation, extensive support and valuable help provided by the following persons in carrying out the study, is gratefully acknowledged.

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2	Dr Fr Viju P D	Pro Vice Chancellor (Deemed to be University)
3	Dr. Anil Joseph Pinto	Registrar, Christ (Deemed to be University)
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REPORTING

This is to convey that energy auditing work is carried out in Christ (Deemed to be University) from 12-03-2024 to 18-03-2024. The above work has been done as per the provisions of Bureau of Energy Efficiency and is carried out by the Energy Manager who holds the Certificate of Competency. The information, proposals and recommendations are inked with respect to the reporting format of the Bureau of Energy Efficiency.

Signature of the Project Coordinator
(Dr. Venkataswamy R)

Signature of the **Project Advisor**
(Dr. Joseph Rodrigues)

CHRIST (Deemed to be University)
Dept of Electrical and Electronics Engineering
School of Engineering and Technology

Signature of the **Energy Auditor**
(Mr. Haneesh K M)
EA-7313

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1. EXECUTIVE SUMMARY

- This section presents a brief summary of the results of the comprehensive energy audit carried out at Bangalore Central Campus, Christ (Deemed to be University) in March 2021. The study covered with a focus on energy conservation measures including performance assessment of vital energy consuming equipment.

- A team of two consultants were involved in the comprehensive energy audit study. The energy audit was mainly targeted at identifying practical, sustainable and economically viable energy saving opportunities in all sections of the facility, resulting from a detailed study and analyses of technical parameters. The energy audit involved using a wide range of sophisticated, portable, diagnostic and measuring instruments to generate refined data and facilitate in complex analyses to give a more reliable basis for evaluation of performance, energy saving measures and economic viability.

- Electricity, Solar PV System & Diesel are the major sources of energy to the facility. The study has identified several energy conservation proposals. The EC proposals paybacks were calculated.

- During the study, there was continuous interaction with the facility personnel, all the recommendations have been thoroughly discussed with concerned facility officials and also at group meetings. There has been close involvement of senior officials, which ensured the necessary co-ordination required for the study.

1.1 UNIT DETAILS

Unit Name	Bangalore Central Campus, Bangalore
Unit Description	Educational Institute
Address	Hosur Road, Near Dairy Circle, Bangalore, Karnataka 560029 Phone: 080-40129000 Email: mail@christuniversity.in
Contact Person	Dr. Manoj B, Professor Department of Physics CHRIST (Deemed to be University) Bangalore mobile: 9480580090/9108674543 site: www.christuniversity.in email: manoj.b@christuniversity.in
Contract Demand	990kVA/1250 kVA (till 12-08-2022)

	1990 kVA (13-08-2022 onwards)
Client Reference	CUCEA0005

1.2 CONSORTIUM DETAILS

Consortium Name	Consortium of Energy Auditors Formed by, Department of Electrical and Electronics Engineering, CHRIST (Deemed to be University), Bangalore
Project Advisor	Dr. Joseph Rodrigues Head of the Department, Department of Electrical and Electronics Engineering, School of Engineering and Technology, Christ (Deemed to be University), Bangalore Email: joseph.rodrigues@christuniversity.in Phone: 9420594564
Consortium Description	Engineering
Address	Kanminike, Kumbalagudu Post, Kengeri Bangalore Web:https://christuniversity.in/faculty-of-engineering/electrical-and-electronics-engineering
Energy Auditor	Mr. Haneesh K M EA-7313 (Bureau of Energy Efficiency, Govt of India) Assistant Professor, Department of EEE, Christ (Deemed to be University), Bangalore Email: haneesh.km@christuniversity.in venkataswamy.r@christuniversity.in Phone: +91-7829222446
Consortium Coordinator	Dr. Venkataswamy R Assistant Professor, Department of EEE, Christ (Deemed to be University), Bangalore Email: venkataswamy.r@christuniversity.in Phone: +91-7829222446
Secretarial assistant	Mr. Prakash S
Consortium Reference	CU/EEE/CEA/2024/02

1.3 EXISTING MAJOR ENERGY CONSUMING TECHNOLOGY

SL No	Load	Remarks
1	Lighting System	11,536 Nos
2	HVAC System	Total Fans = 3476 Nos Total AC= 303 Nos
3	Motors	Borewell Motors = 6 Nos Pumping Motors = 5 Nos

1.4 PROPOSED ENERGY SAVING TECHNOLOGIES WITH COST ECONOMICS

1.4.1 IDENTIFIED TECHNOLOGY UPGRADATION PROPOSALS

SL No	Recommendation	Savings in INR	Investment in INR	Payback in Years
1	Installing Additional 200 kw On Grid Solar Panels	₹ 27,37,500/year	₹1,30,00,000	8 years 0 months
2	Replacing 1,000 numbers of existing 60 W fans with 28W BLDC fans	₹ 6,52,800/year	₹30,00,000	4 years 6 months
3	Sensor Based Switches for lights in 50 classrooms	₹ 43,800/year	₹1,00,000	2 years 0 months

1.4.2 IDENTIFIED ENERGY SAVING PROPOSALS

SL No	Recommendation
1	Submetering EPM 4600 Power Meter
2	Shutdown when computer terminals are idle
3	Energy Efficiency in Transportation
4	Encourage Energy-Conscious Behaviour.
5	All the new lighting installations should be LED lamps
6	All the new installations of Air conditioners should be with higher star ratings

2. INTRODUCTION

CHRIST (Deemed to be University) was born out of the educational vision of St Kuriakose Elias Chavara, an educationalist and social reformer of the nineteenth century in South India. He founded the first Catholic indigenous congregation, Carmelites of Mary Immaculate (CMI), in 1831 which administers CHRIST (Deemed to be University).

Established in 1969 as Christ College, it undertook path-breaking initiatives in Indian higher education with the introduction of innovative and modern curricula, insistence on academic discipline, imparting of Holistic Education and adoption of global higher education practices with the support of creative and dedicated staff. The University Grants Commission (UGC) of India conferred Autonomy to Christ College in 2004 and identified it as an Institution with Potential for Excellence in 2006. In 2008 under Section 3 of the UGC Act, 1956, the Ministry of Human Resource Development of the Government of India, declared the institution a Deemed to be University, in the name and style of Christ University. One of the first institutions in India to be accredited in 1998 by the NAAC, and subsequently in 2004 and 2016, CHRIST (Deemed to be University) has the top grade 'A' in the 4-point scale.

The multi-disciplinary University which focuses on teaching research and service offers Bachelors to Doctoral programmes in humanities, social sciences, science, commerce, management, engineering, education, and law to over 25000 students. The campus is a living example for the harmonious multiculturalism with students from all the states of India and around 60 different countries. CHRIST (Deemed to be University) publishes six peer-reviewed research journals and has published more than 300 books in Kannada and English. A promoter of sports, music and literary activities, it is a nurturing ground for creative excellence. The institute offers UG, PG and Ph. D programs.

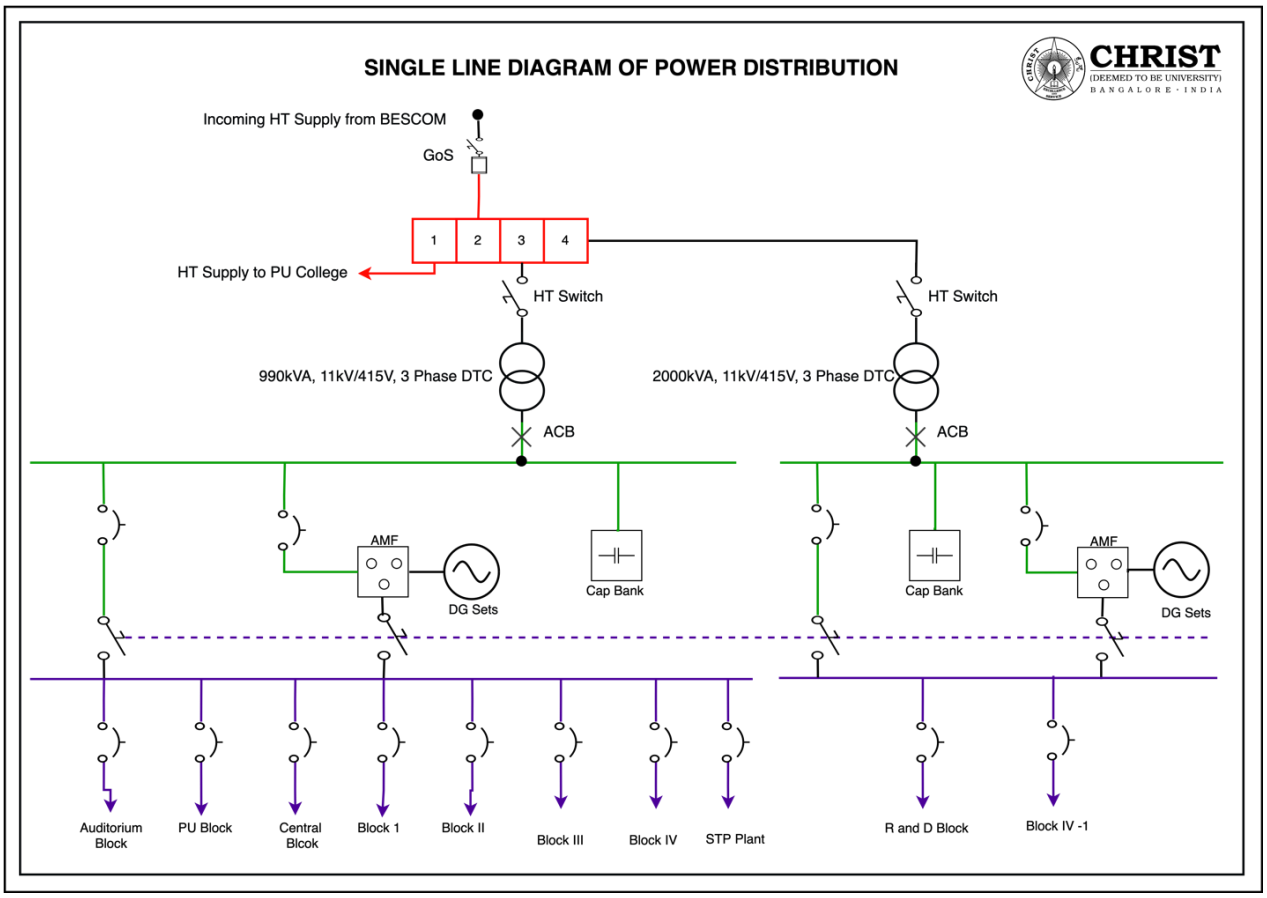
The campus has seven schools, namely,

1. School of Arts and Humanities
2. School of Business Management
3. School of Commerce, Finance and Accountancy
4. School of Education
5. School of Law
6. School of Sciences
7. School of Social Sciences

3. FACILITY OVERVIEW

The campus has the following blocks. The major load in the campus are lighting, computer terminals, fans, AC, borewell and pumping motors.

Block I Built-up area 7645 square meters	25-Classrooms, 13 - Laboratories, 10 - Staff Rooms Mini auditorium, 2 - Separate Wash-rooms for men and women in each floor Staff Club, 4 - Offices of Deans, Placement Office – Undergraduate, 2 - Counselling Rooms, Gymnasium for women Office of Student Welfare and Activity room, With lift facility and ramp
Block II Built-up area 11774.5 square meters	47 - Classrooms, 10 - Laboratories, 36 - Faculty Cabins, 10 - Staff Rooms, 2 - Separate Wash-rooms for men and women in each floor 9 - Counselling Rooms, Seminar Halls, Assembly Hall, Panel Rooms, Centre for Digital Innovation, On-line test centre, With lift facility and ramp
Undergraduate Library 1443 square meters	Reference Section 2 - Stock area, 2 - Reading room Archives section, Reprography, Auditorium with a capacity of 2000+ with all modern, amenities, barco and barco-lighting projector/camera, with wide lounge and 2 - green rooms, With lift facility and ramp
Auditorium Block 8532 square meters	19 - Classrooms, Media and Computer Laboratories, 37 - Faculty Cabins, 2 - Separate Wash-rooms for men and women in each floor, Valuation Centre, Research Centre, 3 - Seminar Halls, IVY Hall Student Centre – 2 –Refreshments, Reprography and reading area Centre for Academic Excellence- 80 accommodation facility, for staff training programmes, South Indian Bank – Christ University Branch and ATM, 2 - Dance Floor, 3 -Music Rooms, Cafeteria, With lift facility and ramp.
Block III 1770 square meters	7 - Classrooms, 18 - Faculty Cabins, 2 - Separate Wash-rooms for men and women in each floor 8 - Research cabins, With lift facility and ramp
Block IV Basement 2653 square meters	Multipurpose hall , 5- varieties of refreshment stalls, Study area and place for group discussions and exhibit area for departmental needs, With lift facility and ramp.
Block IV Academic area 17174 square meters	69 - Classrooms, 120 - Faculty Cabins, 2 - Hotel Management Kitchen/Service Lounge (Dining Hall) /storage area Separate Wash-rooms for men and women in each floor Conference Halls, Auditorium – 800 seating capacity, With lift facility and ramp.
Central Block Basement 3500 m^2	120 - Four wheeler parking facility exclusive for faculty members, With lift facility and ramp.
Research Block 15000 m^2	Research labs, staff rooms, auditoriums and classrooms.



4. ENERGY SOURCES

SL No	Source	Specification	Remarks
1	BESCOM	990 kVA (Contract demand) 842 kVA (Billing demand) HT2C Tariff Scheme, Through 1MVA DT	85% of CD is BD (Till 12-08-2022)
		1000 kVA (Contract demand) 850 kVA (Billing demand) HT2C Tariff Scheme, Through 1MVA DT	85% of CD is BD (13-08-2022 onwards)
		1990 kVA (Contract demand) 1692 kVA (Billing demand)	Current Total
2	DG set	500 kVA 320 kVA 250 kVA 500 kVA 200 kVA	2 Units (DG Room) 1 Unit (DG Room) 1 Unit (DG Room) 2 Units (R & D DG Room) 1 Unit (Labor quarters)

5. RENEWABLE SOURCES

SL No	Source	Specification	Total
1	Solar water heater	5 units * (2500 Lts)	12500 Lts
2	Solar PV grid tried system	100 kW Rooftop	100kW

6. CONTROL ROOM



Figure 1. Main control panel



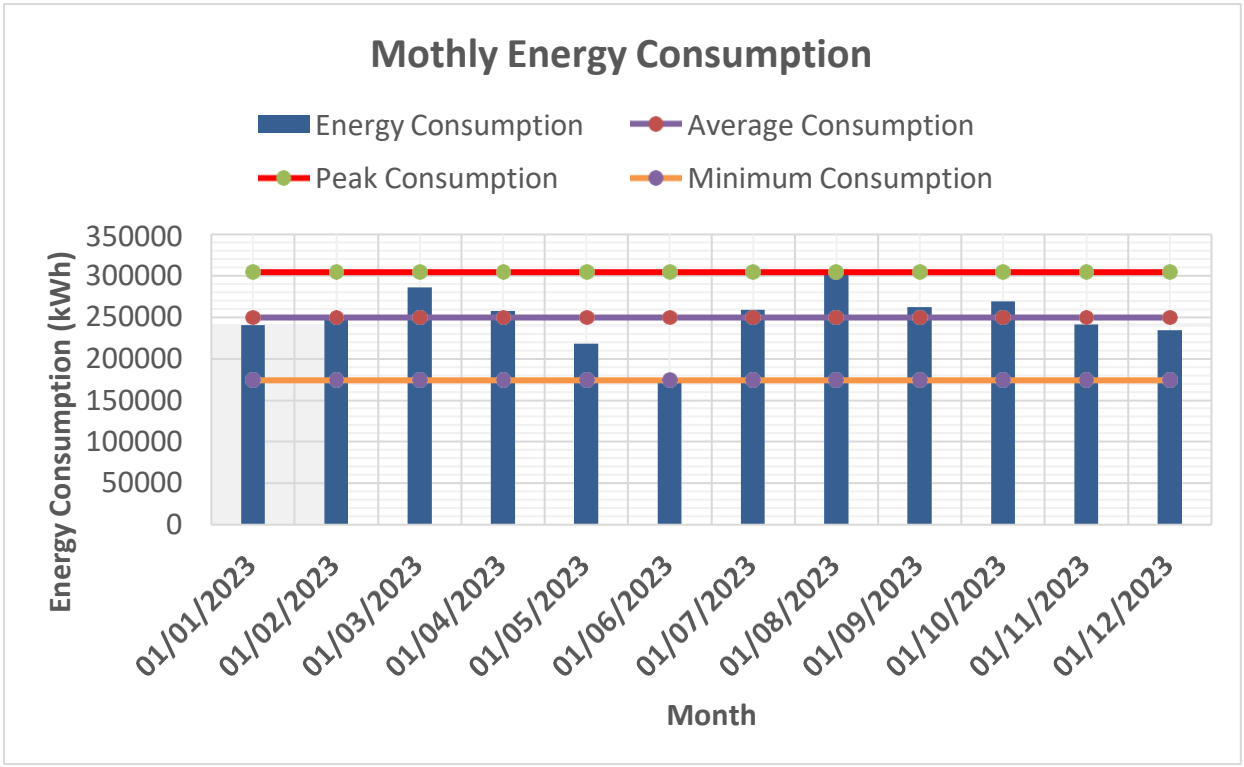
Figure 2. DG Sets at control room



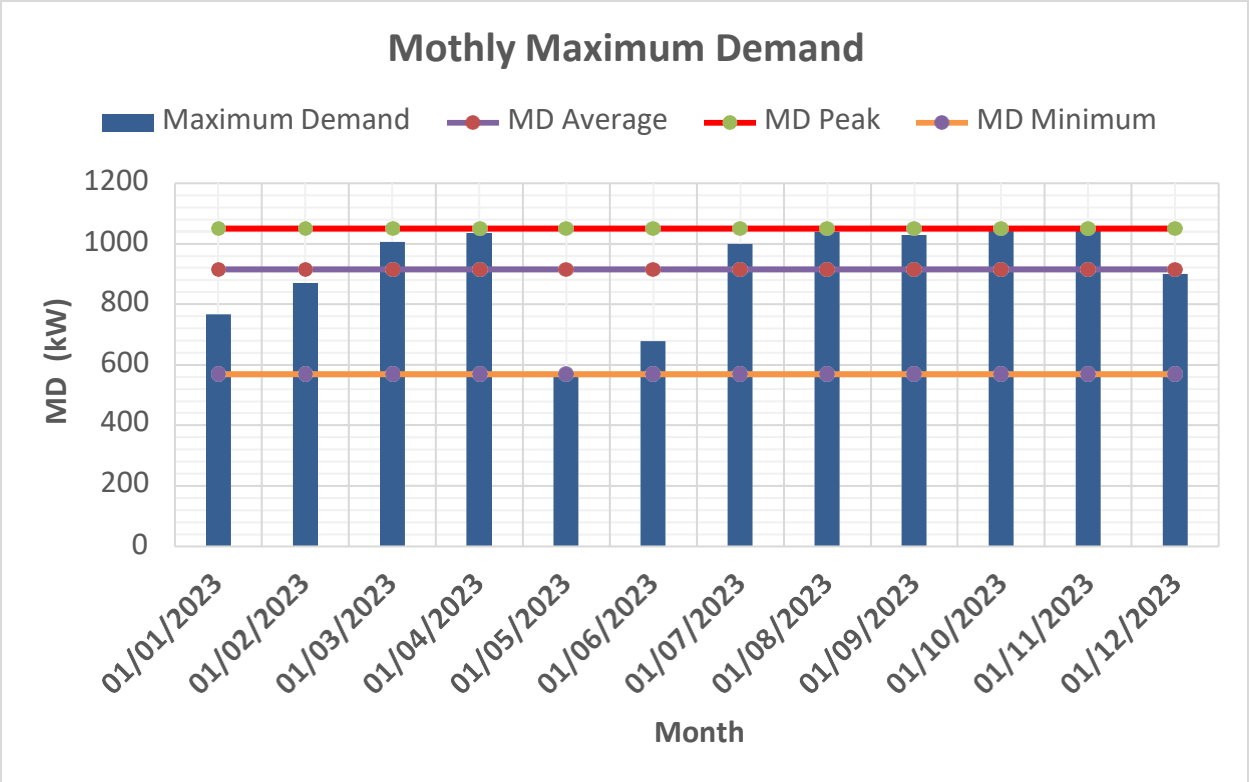
Figure 3. Capacitor bank (APFC)

7. ENERGY CONSUMPTION

7.1 MONTHLY ENERGY CONSUMPTION



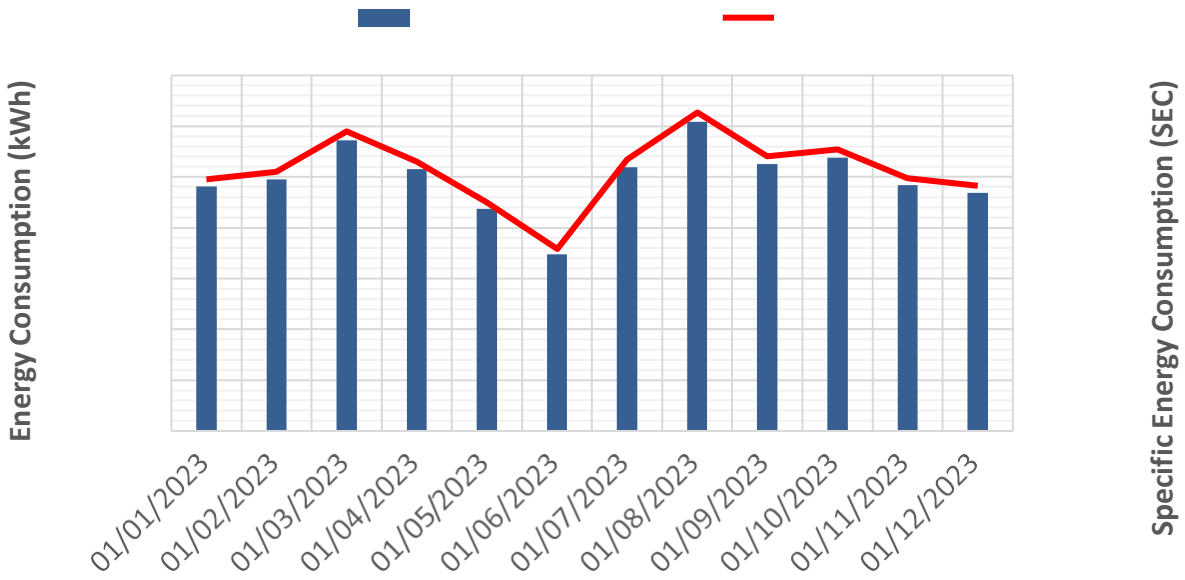
Minimum = 173990.00 kWh (01-Aug-2023)
Peak = 304500.00 kWh (01-Jun-2023)
Average = 249750.83 kWh
Standard Deviation = 33215.97328 kWh



Minimum = 569.00 kWp (01-May-2023)
Peak = 1050.00 kWp (01-Nov-2023)
Average = 915.17 kWp
Standard Deviation = 163.15 kWp

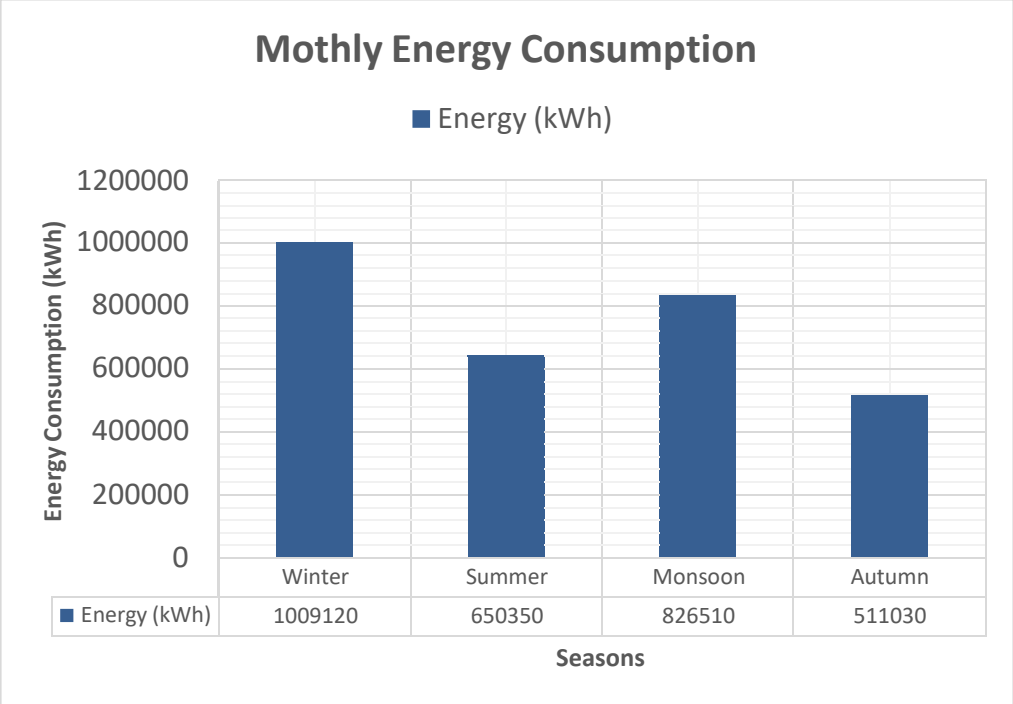
Energy Consumption of the Facility (2023)					
Total Build Up Area	113323.5 sq.m.				
No	**Month**	**Energy Consumption**	**RMD**	**Bill Amount**	**SEC**
1	01/01/2023	240420	766.00	2861871.15	2.1215

2	01/02/2023	247800	870.00	2560053.20	2.1867
3	01/03/2023	286320	1005.00	2821560.63	2.5266
4	01/04/2023	257880	1035.00	2783391.00	2.2756
5	01/05/2023	218480	569.00	2293674.00	1.9279
6	01/06/2023	173990	678.00	2008263.75	1.5353
7	01/07/2023	259560	1000.00	3183035.19	2.2904
8	01/08/2023	304500	1040.00	3371515.94	2.6870
9	01/09/2023	262450	1029.00	2952173.61	2.3159
10	01/10/2023	269170	1041.00	2840812.30	2.3752
11	01/11/2023	241860	1050.00	2535096.96	2.1342
12	01/12/2023	234580	899.00	2342894.82	2.0700
Average		249751	915	2712862	2.2039
Minimum		173990	569	2008264	1.5353
Maximum		304500	1050	3371516	2.6870
Standard Deviation		33216	163	385124	0.2931



Duration considered: 01-01-2023 to 01-01-2024

Season	Energy (kWh)	No of Months
Winter	1009120	4
Summer	650350	3
Monsoon	826510	3
Autumn	511030	2



7.3 DAILY ENERGY CONSUMPTION

Duration considered: 01-01-2023 to 01-01-2024

Average daily consumption = 8210.986301 kWh

8. DTC AND LOAD MANAGEMENT

Duration considered: 01-01-2023 to 01-01-2024



Figure 4. Distribution Transformer

DTC Rating	1000 kVA
Voltage	11kV/433V
Percentage Impedance	5.49
Taps	16
Configuration	Detla-Wye
Average Load	553.9176157 kW
Power factor	0.99
Loading	559.5127432 kW
Efficiency	98.162%
All the efficiency	98.162%
Best Efficiency	98.62 %
Best Efficiency Loading	388.5 kVA



Duration considered: 01-02-203 to 01-01-2024

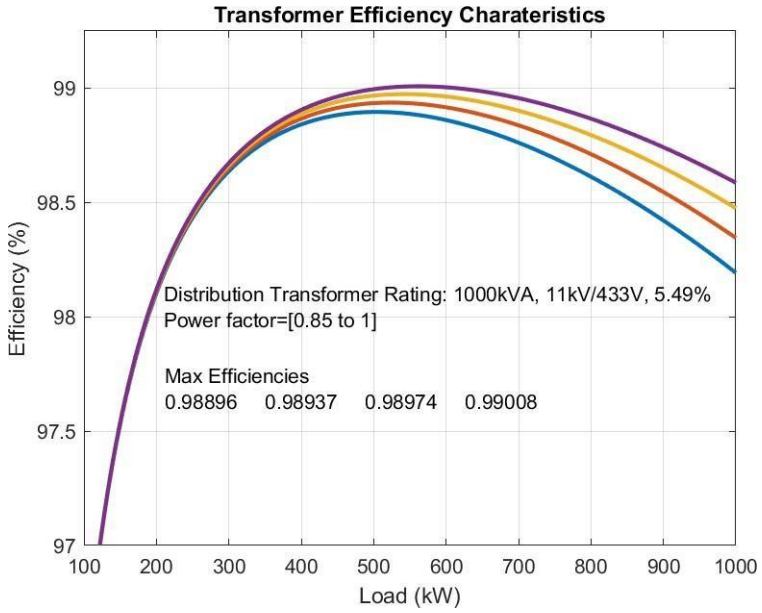
DTC1:

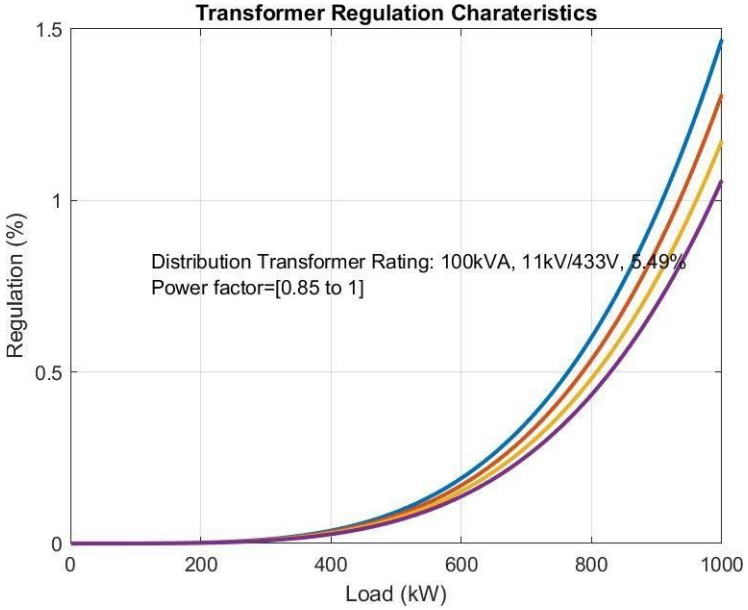
DTC Rating	1000 kVA
Voltage	11kV/433V
Percentage Impedance	5.49
Taps	32
Configuration	Detla-Wye
Average Load	750.0496435 kW
Power factor	0.99
Loading	757.6259025 kW
Efficiency	97.61%
All the efficiency	97.61%
Best Efficiency	98.01 %
Best Efficiency Loading	374.1 kVA



DTC2:

DTC Rating	2000 kVA
Voltage	11kV/433V
Percentage Impedance	5.49
Taps	16
Configuration	Detla-Wye
Average Load	-
Power factor	0.99
Loading	-
Efficiency	98.73%
All the efficiency	98.73%
Best Efficiency	98.86 %
Best Efficiency Loading	-



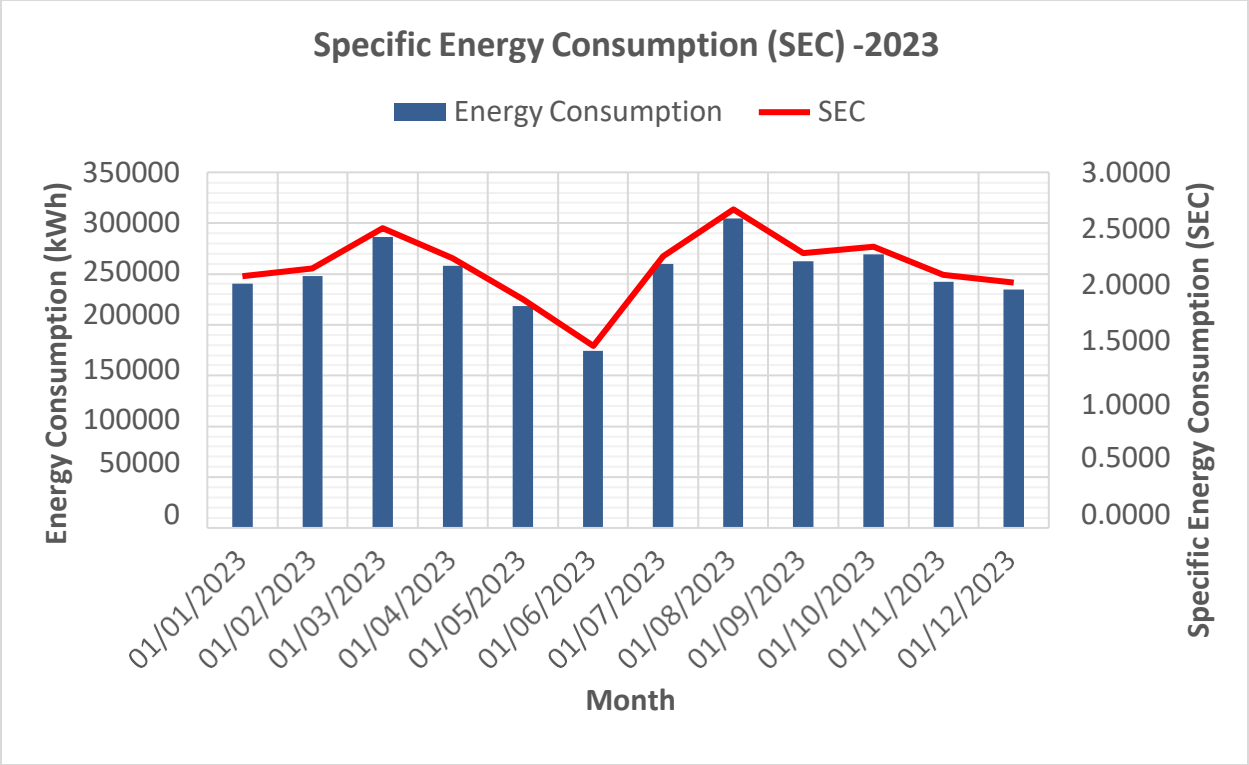


8.1 PRODUCTION SCENARIO

SL No	Month and Year	Production	Unit or Remarks
1	01-03-2022 to 01-03-2023 & 01-03-2023 to 01-03-2024	Nil	No product manufacture or development.

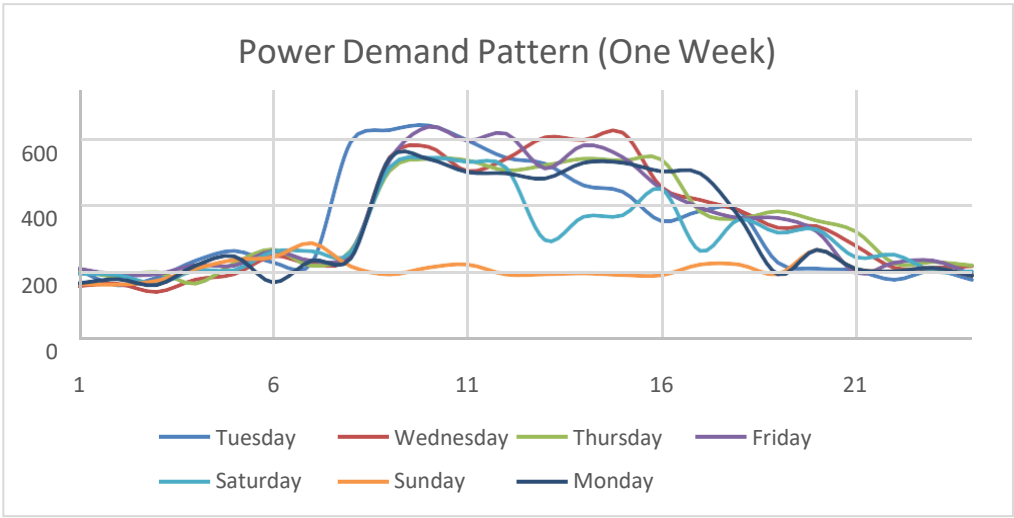
8.2 SPECIFIC ENERGY CONSUMPTION

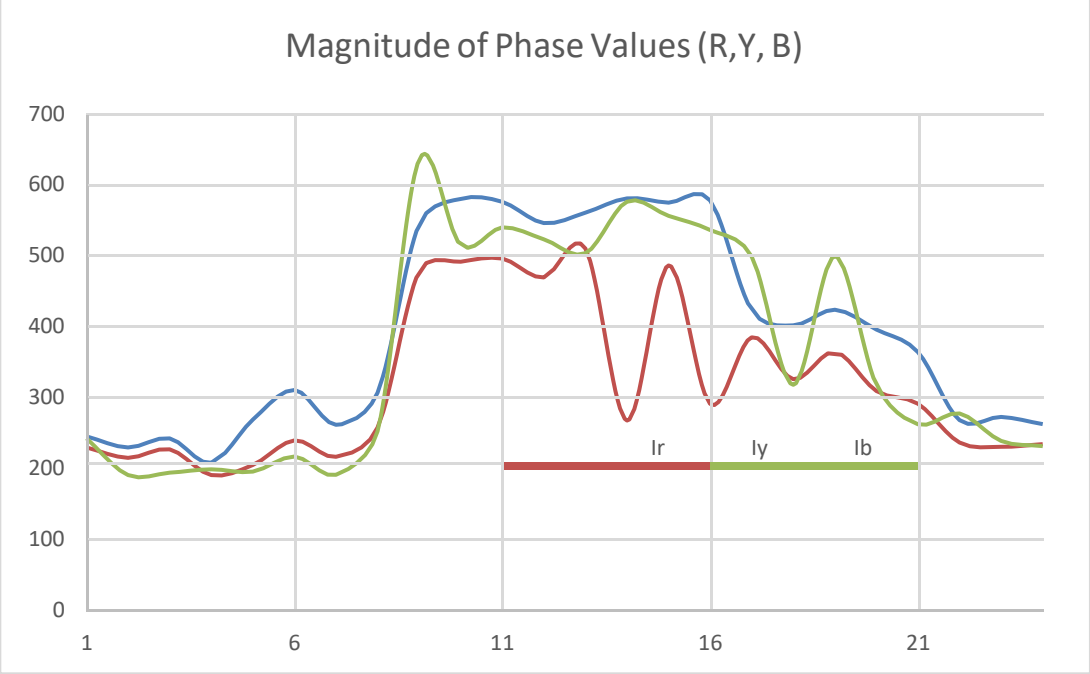
Duration considered: 01-02-2022 to 01-01-2023

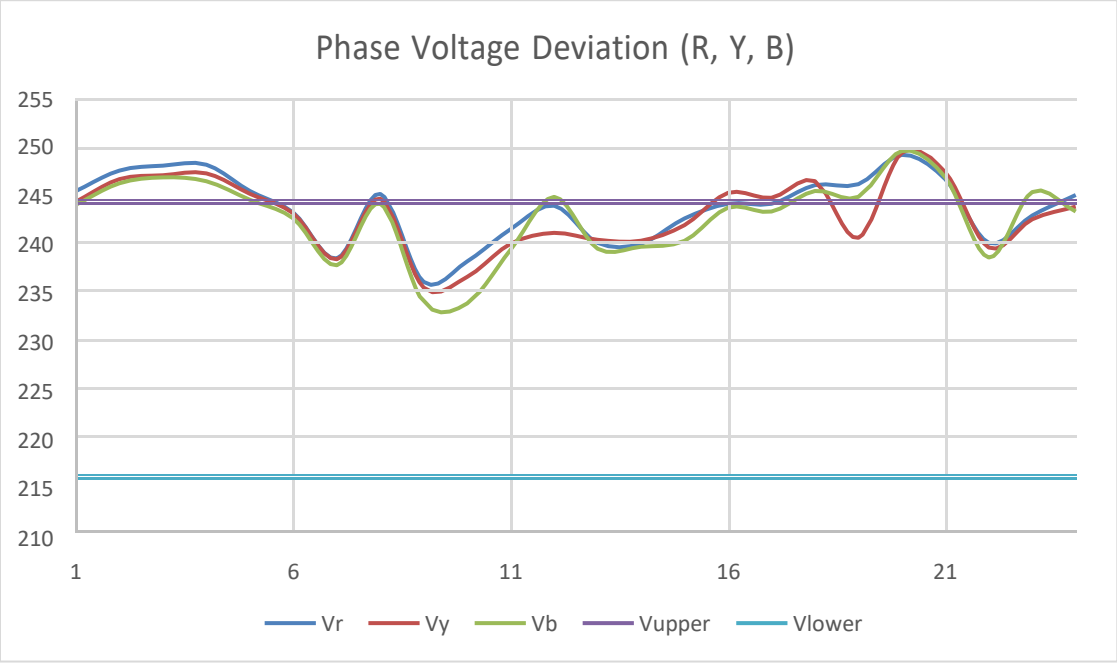


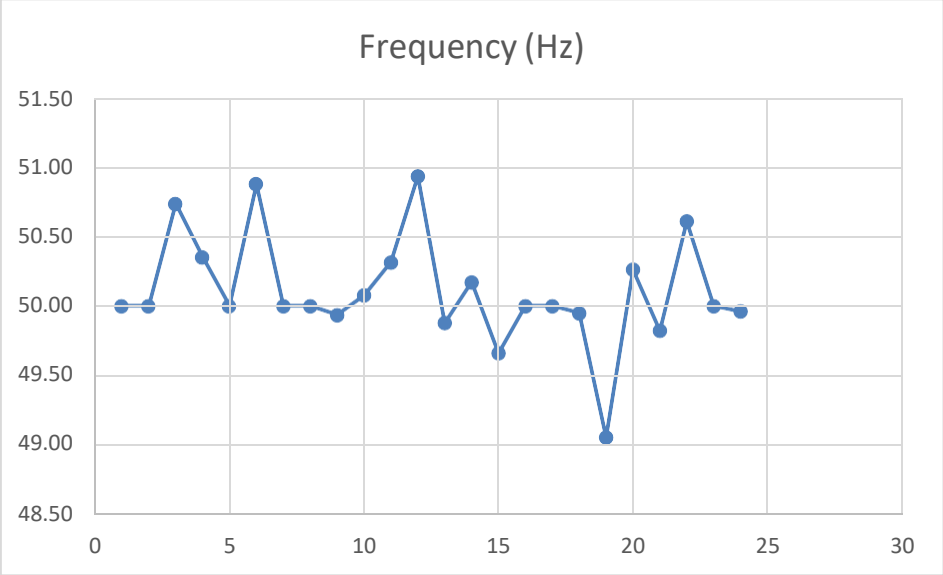
9. POWER QUALITY AND FLOWS

Seven days voltage, current and power factors are measured for each phase. Measured values are analyzed. The measured sample data is given in Annexure VI.




Magnitude of Phase Values (R,Y, B)
700
600
500
400
300
200
100
0
1
6
11
16
21
Ir
Iy
Ib


Phase Voltage Deviation (R, Y, B)
255
250
245
240
235
230
225
220
215
210
1
6
11
16
21
Vr
Vy
Vb
Vupper
Vlower



10. EFFECTIVENESS OF THE 100 KW SOLAR PLANT

The 100 kW solar plant at CHRIST University, Bangalore, Central Campus, was installed on July 7, 2022. Since its installation, the plant has generated a total of 131.27 MWh (131,270 kWh) of electricity, contributing significantly to reducing greenhouse gas emissions. This report evaluates the effectiveness of the solar plant by analyzing its average daily, monthly, and yearly electricity generation. Additionally, the report calculates the financial savings achieved through this renewable energy source.

Greenhouse Gas Emissions Avoided

The solar plant's contribution to reducing greenhouse gas emissions is remarkable. The following are the key greenhouse gases avoided:

- Carbon Dioxide (CO_2): 232,476.83 kg
- Nitrogen Oxide ($NO\chi$): 114.07 kg
- Sulfur Dioxide (SO_2): 6.72 kg

These reductions are equivalent to removing the emissions of 51.25 passenger cars over one year, providing the energy to power 1,009.75 computers for a year, or operating a TV for 912,305.65 hours.

Average Electricity Generation

Based on the total electricity generated so far, we can calculate the average daily, monthly, and yearly generation:

- Total Generation (since July 7, 2022): 131.27 MWh

1. Average Daily Generation:
    - Number of days since installation (assuming the report is generated exactly on August 16, 2024): 771 days
    - Average Daily Generation = Total Generation / Number of Days
      Average Daily Generation=131,270 kWh /771 days≈170.26 kWh/day
2. Average Monthly Generation:
    - Average Monthly Generation = Average Daily Generation × 30
      Average Monthly Generation=170.26 kWh/day×30≈5,107.8 kWh/month
3. Average Yearly Generation:
    - Average Yearly Generation = Average Daily Generation × 365
      Average Yearly Generation=170.26 kWh/day×365≈62,545 kWh/year

Financial Savings

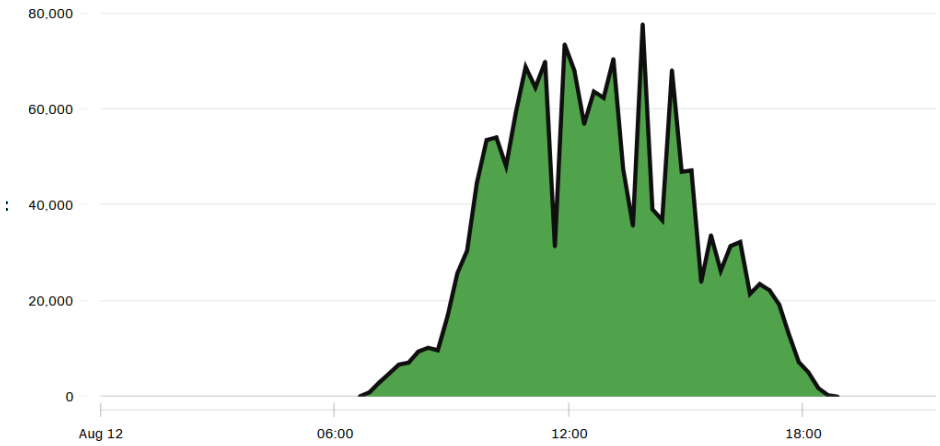
The financial savings from the solar plant are significant. Given that one unit (1 kWh) of electricity costs Rs. 10:

- Total Savings:
  Total Savings=131,270 kWh×10 Rs./kWh=Rs.1,312,700.
- Average Daily Savings:
  Average Daily Savings=170.26 kWh/day×10 Rs./kWh=Rs.1,702.6/day
- Average Monthly Savings:
  Average Monthly Savings=5,107.8 kWh/month×10 Rs./kWh=Rs.51,078/month
- Average Yearly Savings:
  Average Yearly Savings=62,545 kWh/year×10 Rs./kWh=Rs. 6, 25,450/year

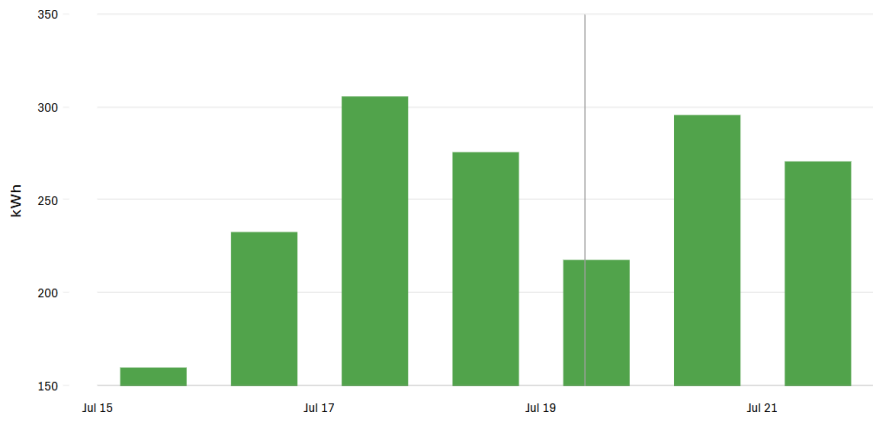
Summary Table

Parameter	Value
Total Generation (since July 7, 2022)	131,270 kWh
Average Daily Generation	170.26 kWh/day
Average Monthly Generation	5,107.8 kWh/month
Average Yearly Generation	62,545 kWh/year
Total Financial Savings	Rs. 1,312,700
Average Daily Savings	Rs. 1,702.6/day
Average Monthly Savings	Rs. 51,078/month
Average Yearly Savings	Rs. 625,450/year

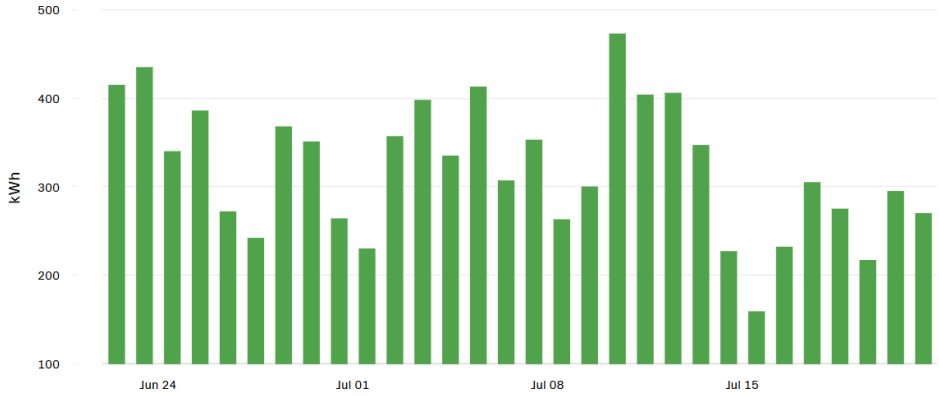
The 100 kW solar plant at CHRIST University, Bangalore, has proven to be highly effective in generating clean energy and reducing greenhouse gas emissions. The plant has not only contributed to significant environmental benefits but also provided substantial financial savings. The consistent energy generation demonstrates the plant's reliability and effectiveness as a sustainable energy source for the campus.



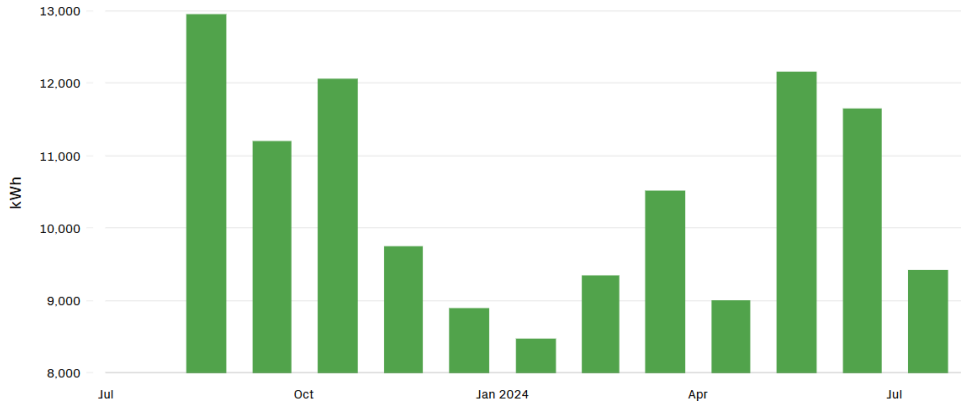
Daily Power Generation in Watts (on 12 -08-2024)



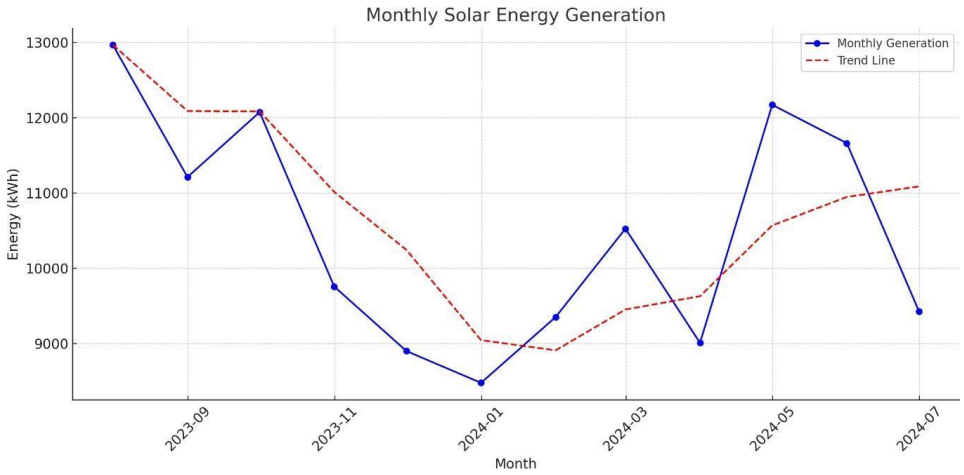
Weekly Generation (15-07-2024 to 21-07-2024)



Monthly Generation Units (22-06-2024 to 21-07-2024)



Yearly Generation in kWh (01-07-2023 to 21-07-2024)



Basic Analysis of the 100 kW Solar Panel Energy Generation (July 2023 - July 2024)

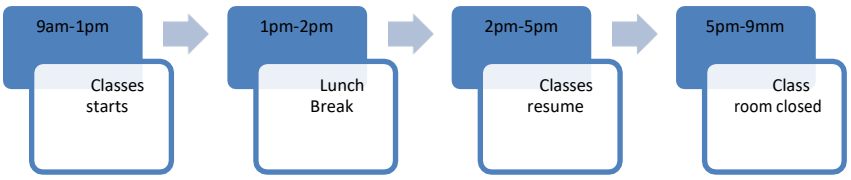
Summary Statistics

- **Count:** 12 months of data
- **Mean Monthly Generation:** 10,461.25 kWh
- **Standard Deviation:** 1,509.11 kWh
- **Minimum Monthly Generation:** 8,478.99 kWh
- **Maximum Monthly Generation:** 12,965.00 kWh
- **Median (50th Percentile):** 10,141.50 kWh

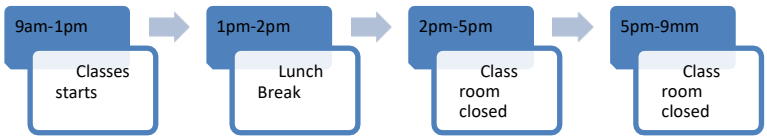
11. PROCESS FLOW DIAGRAM

As stated earlier, the process cycle connected to energy consumption depends on the time table and working hour or active time in the campus. The following time diagrams gives the correlation of energy.

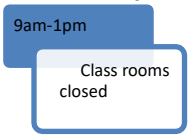
During weekdays:



On Saturday:



On Sunday/Holidays:



12. IDENTIFIED TECHNOLOGY UP GRADATION PROPOSALS

Proposal For Installing Additional 200 kw On Grid Solar Panels
Present Status
100kW Grid connected Solar PV System
Observations
It is observed that, there are feasible area available in roof top for the deployment of Solar PV System. To reduce energy consumption from grid, solar PV system/renewable source of energy is encouraged.
Proposed Modification
Solar Rooftop Calculations: Average solar irradiation in Karnataka state: 1266.52 W/sq.m Average daily electricity generation: 1 kWp solar rooftop plant will generate on average over the year 5.0 kWh of electricity per day (considering 5.5 sunshine hours). Size of Power Plant: Feasible Plant size: 200 kW Cost of the Plant: Current approximate market cost: Rs 65,000/kW Cost of 200 kW plant: Rs. 1,30,00,000 Total Electricity Generation from Solar Plant: Annual energy generation: 3,65,000 kWh Lifetime (25 years) energy generation: 91,25,000 kWh Financial Savings a) Tariff @ Rs. 8.5/kWh (no increase assumed over 25 years) • Monthly: Rs. 2,58,125 • Annually: Rs. 30,97,500 • Lifetime (25 years): Rs. 7,74,37,500 b) Carbon dioxide emissions mitigated: 6,150 tonnes.

This installation will be equivalent to planting 9,840 teak trees over its lifetime. (Data from IISc)

EMI Calculation:
• Loan amount: Rs. 1,30,00,000
• Loan interest rate: 9%
• Loan period: 8 years

EMI for loan amount of Rs. 1,30,00,000 for loan period of 8 years @ 9%: Rs. 1,90,453 / month

Saving

Annual energy generation: 3,65,000 kWh
Lifetime (25 years) energy generation: 91,25,000 kWh
Annual cost saving: ₹ 27,37,500/- (₹7.5 per unit)

Investment

Current approximate market cost: Rs 65,000/kW
Cost of 200 kW plant: Rs. 1,30,00,000

Payback: 8 Years

Replacing 1,000 numbers of existing 60 W fans with 28W BLDC fans

Present Status

Not installed

Observations

There are 1000 conventional ceiling fans are installed whose wattages is 65W.

Proposed Modification

Replacement 1000 of available 60W ceiling fan with BLDC fan of 28W.

Initial Costs:
Number of fans to replace: 1,000
Cost per BLDC fan: ₹3,000
Total Initial Cost=1,000×3,000=₹3,000,000

Energy Consumption:
Existing 60 W fans:
Power consumption per fan: 60 W
Total power consumption: 1,000×60 = 60,000 W = 60 kW
Daily energy consumption: 60 kW×8 hours60 = 480 kWh
Annual energy consumption: 480 kWh/day×300 days = 144,000 kWh

New 28 W BLDC fans:
Power consumption per fan: 28 W
Total power consumption: 1,000×28 W = 28,000 W = 28 kW
Daily energy consumption: 28 kW×8 hours28 = 224 kWh
Annual energy consumption: 224 kWh/day×300 days = 67,200 kWh

Energy Savings:
Annual energy savings: 144,000 kWh−67,200 kWh=76,800

Monetary Savings:
Energy cost per kWh: ₹8.5 (assuming this is the rate for the campus)
Annual monetary savings: 76,800 kWh×8.5 ₹ =₹652,800

Payback Period:
The payback period is the time it takes for the savings to cover the initial investment.
Payback Period=Total Initial Cost/Annual Monetary Savings
Payback Period=₹3,000,000₹652,800≈4.6 years

Summary:
Initial Investment: ₹3,000,000
Annual Energy Savings: 76,800 kWh
Annual Monetary Savings: ₹652,800
Payback Period: Approximately 4.6 years

Replacing the 1,000 existing 60 W fans with 28 W BLDC fans involves an initial investment of ₹3,000,000, leading to annual energy savings of 76,800 kWh and monetary savings of ₹652,800. The payback period for this investment is approximately 4.6 years.

AC Charging stations for four wheelers
Present Status
Nil
Observations
To meet future needs of electrical vehicles of university and support some emergency needs of faculty/students/parents
Proposed Modification
Installation of 2 AC charging stations in the campus
Saving
Savings will be in there in terms of carbon emissions
Investment
2 units @₹60,000 = ₹1,20,000
Payback
Direct calculation is not possible

Replacing two low efficiency 5 HP pumping motors with high efficiency ones
Present Status
The pumping efficiency of two motors are low (around 70%) due to aging and heating. These needs to be replaced with high efficiency ones
Observations
New high efficiency motors offer around 90% efficiency
Proposed Modification

Replacement of two 5HP motors with higher efficiency motors
Saving
Present 5HP motors running 5 hours daily, consuming around 5965 units of electricity (with 70% efficiency, 320 days per year), higher efficiency motors will be consuming only 4592 units of electricity per year. (@90%, 320 days per year). @8/kWh this saving on bill will be ₹10,984/Motor. For two motors, savings per year will be ₹21,968
Investment
2 units @₹35,000 = ₹70,000
Payback
3 years 2 months

13. IDENTIFIED ENERGY SAVING PROPOSALS

1. Installation of Sub Meters in Each Block

It is recommending the installation of sub meters in every block of the campus. The strategic placement of these sub meters will provide detailed insights into energy consumption and load patterns, enabling more effective energy management and cost savings. Below are the key benefits and considerations for this recommendation.

Benefits of Installing Sub Meters:

Accurate Monitoring: Sub meters will provide precise data on energy consumption for each block, allowing for better tracking and analysis. This will help identify high energy-consuming areas and times of peak demand.

Load Pattern Analysis: By monitoring load patterns, the university can optimize energy use, shifting non-essential loads to off-peak times to benefit from lower tariffs. Understanding load patterns helps in identifying and addressing inefficiencies and potential issues before they become significant problems.

Improved Energy Management: With detailed consumption data, the facility management team can implement targeted energy-saving measures and monitor their effectiveness. Sub meters enable the assessment of the impact of energy conservation initiatives and adjustments to operational practices.

Cost Savings: Identifying and mitigating energy wastage can result in significant cost savings on utility bills. Real-time data from sub meters can help in avoiding peak demand charges by managing loads more effectively.

Enhanced Accountability: Departments and individual blocks can be made accountable for their energy usage, promoting a culture of energy conservation among staff and students. Energy usage reports can be shared with block managers to encourage responsible energy use

2. Sensor Based Switches for lights in 50 classrooms

The cost-benefit analysis for implementing sensor-based lamps in classrooms considers an unwanted usage of lighting for 1 hour per day, in addition to the regular 7-hour usage. With 50 rooms, each using 240 W of lighting, the analysis reveals that without sensors, the total annual energy consumption would be 35,040 kWh. By installing sensors, the energy consumption can be reduced to 30,660 kWh, resulting in an annual energy savings of 4,380 kWh. This translates to a cost savings of Rs. 43,800 per year. The initial investment for installing sensors and switches across all rooms remains Rs. 100,000. The increased energy savings make this investment even more beneficial, offering a faster return on investment by reducing unnecessary energy consumption.

Description	Value
Total Energy Consumption without Sensors (kWh)	35040
Total Energy Consumption with Sensors (kWh)	30660
Total Energy Savings (kWh)	4380
Annual Cost Savings (Rs)	43800
Total Cost of Sensors and Switches (Rs)	100000

3. Additional Recommendations

3.1 Energy Efficiency in Transportation

a. Promote Awareness and Sustainable Practices:

Launch campaigns to raise awareness about energy efficiency on campus, encouraging walking, carpooling, and the use of electric vehicles.

b. Collaborate on EV Charging Infrastructure:

Partner with service providers to install electric vehicle charging stations at key locations on campus.

c. Prioritize Electric Vehicles in Parking:

Designate preferred parking spaces for electric vehicles to encourage their use among the campus community.

d. Regular Energy Efficiency Checks for Campus Fleet:

Implement routine energy efficiency assessments for all university-owned vehicles to ensure optimal performance and reduced emissions.

e. Minimize Non-Essential Vehicle Use:

Encourage pooling and reduce the use of non-essential vehicles on campus to lower energy consumption and environmental impact.

3.2 Optimize HVAC Systems

a. **Upgrade HVAC Systems:** Replace outdated heating, ventilation, and air conditioning (HVAC) systems with energy-efficient models that offer better performance and lower energy consumption.

b. **Regular Maintenance:** Conduct regular maintenance of HVAC systems to ensure they operate at peak efficiency.

c. **Use Smart Thermostats:** Install programmable or smart thermostats to optimize temperature settings based on occupancy and time of day.

d. **Improve Insulation:** Enhance insulation in walls, roofs, and windows to reduce the need for heating and cooling.

e. **Seal Leaks:** Identify and seal any air leaks around windows, doors, and other openings to prevent energy loss.

3.3 Promote Renewable Energy Usage

a. **Solar Water Heating**: In addition to Solar rooftop plants, Implement solar water heating systems for dormitories, canteens, and laboratories.

b. **Rainwater Harvesting Systems:** Implement rainwater harvesting systems to reduce the demand on water supply and the energy required for water processing and distribution.

3.4 Upgrade to Energy-Efficient Appliances

a. **Use Energy Star Appliances:** Replace old computers, printers, and other appliances with energy-efficient models that consume less electricity.

b. **Efficient Laboratory Equipment:** Ensure that all laboratory equipment is energy-efficient, particularly high-use items like fume hoods and freezers.

4. Encourage Energy-Conscious Behaviour

a. Energy Awareness Programs

Workshops and Training Sessions: Organize regular workshops and training sessions focused on energy conservation techniques. These sessions can cover topics such as the importance of turning off lights and electronics when not in use, optimizing HVAC settings, and understanding the impact of personal energy consumption on the environment. Faculty experts or external sustainability professionals can lead these sessions to provide in-depth knowledge and practical tips.

b. Campus-Wide Campaigns: Launch campus-wide campaigns to promote energy-saving behaviors. This could include initiatives like "Energy Conservation Week," where specific themes such as reducing electricity usage, minimizing water heating, or unplugging devices are highlighted each day. Use posters, emails, social media, and digital displays to spread the message and involve the entire campus community.

c. Energy Conservation Challenges: Introduce friendly competitions among students, faculty, and departments to see who can reduce their energy usage the most over a set period. Offer incentives, such as recognition or rewards, for those who demonstrate the greatest reduction in energy consumption.

d. Integration into Curriculum: Encourage faculty to integrate energy conservation topics into their courses where relevant. For example, engineering students could work on projects related to energy efficiency, while business students could analyze the cost benefits of sustainable practices.

e. Real-Time Energy Monitoring Systems: Install energy monitoring systems in key areas of the campus, such as academic buildings, dormitories, and common areas. These systems should track and

display real-time energy usage data, allowing students, faculty, and staff to see how much energy is being consumed at any given time. This visibility helps to reinforce the importance of energy conservation by making the impact of everyday actions more tangible.

f. Public Display of Energy Data: Set up digital dashboards or monitors in common areas that publicly display real-time energy usage data, historical trends, and energy-saving tips. Seeing this information regularly can motivate individuals to adopt more energy-efficient behaviors.

g. Energy Usage Feedback: Provide departments and dormitories with regular feedback on their energy consumption. Monthly or quarterly reports can highlight areas where energy usage is high and offer suggestions for improvement. Recognizing areas that have successfully reduced energy consumption can also encourage continued efforts.

h. Mobile and Web Applications: Develop or implement mobile apps or web portals where individuals can track their own energy usage on campus, set personal energy-saving goals, and receive tips tailored to their specific consumption patterns. This personalized approach can increase engagement and motivation to conserve energy.

• Shutdown when computer terminals are idle
• Automatic borewell management system
• Proper temperature settings of Air conditioners
• All the new lighting installations should be LED lamps
• All the new installations of Air conditioners should be with higher star ratings

AREA: Shutdown when computer terminals are idle
Notes
A the computers are enables with energy saving mode. That is, system should shut down when there is no activity or idle. Note: Server machines should not be configured for energy saving mode.

AREA: Automatic borewell management system
Notes
All the motors should enable with water level sensor both at overhead tank and underground. If underground water is available and overhead tank is empty, then only it has to pump water from underground and to overhead tank.

Pumps should be scheduled at off-peak time so that peak load issue would not arise.

14. BEST PRACTICES AND STANDARDS

Constitution of Energy Management Cell
Notes
This cell is responsible for developing policies, monitoring and reviewing all the energy management activities

Rolling out energy management manual
Notes
This manual describes the roles and responsibilities of stakeholders and describes the standard energy management procedures to follow

Awareness campaigns and rewards
Notes
Regular awareness campaigns on energy management to students and staff. Also rewards for top performing divisions or units

AREA: Submetering
Notes
Floor wise and wing wise electrical functional parameters acquisition would transform the system to smart system. Smart system provides automated control and monitoring system. Recommended: EPM 4600 Power Meter     Simple space and cost saving installation with the capability of measuring 8 – Three phase or 24 – Single phase inputs

Standardization of naming and use of tags in wirings
Notes

1. Use pegs to mark the route of underground cables
2. Use identification tags to mark the wires and cables
3. Display danger boards in HT control panels

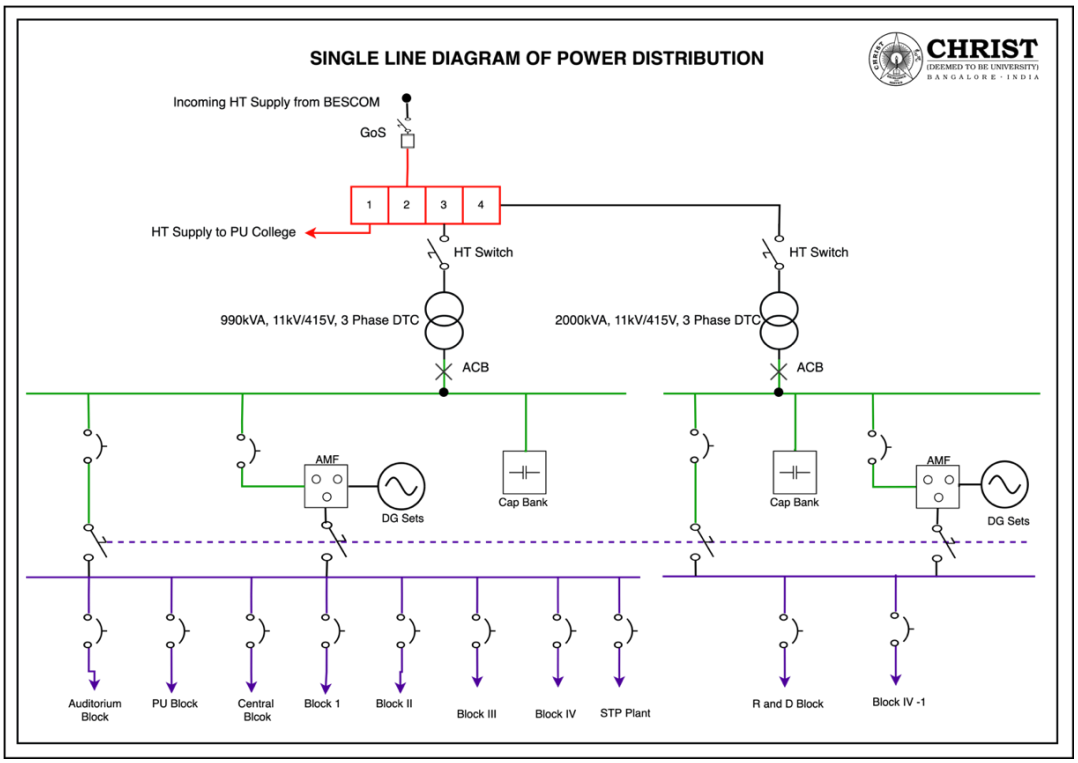
15. CONCLUSIONS

Presently, the average annual energy consumption is 249750 in AY 2023-24. Institution is paying 2712862 rupees as bill amount in 2023-24 respectively. Short-, medium- and long-term proposals are given so that the energy consumption from utility comes down to 5%. Advanced technical deployments recommended for an institution transforming towards smart campus.

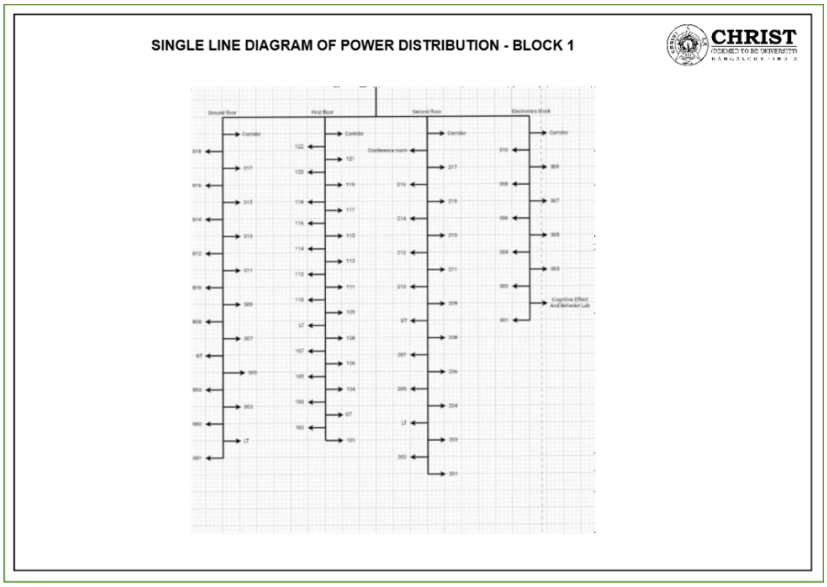
ANNEXURES

ANNEXURE I: SINGLE LINE DIAGRAMS

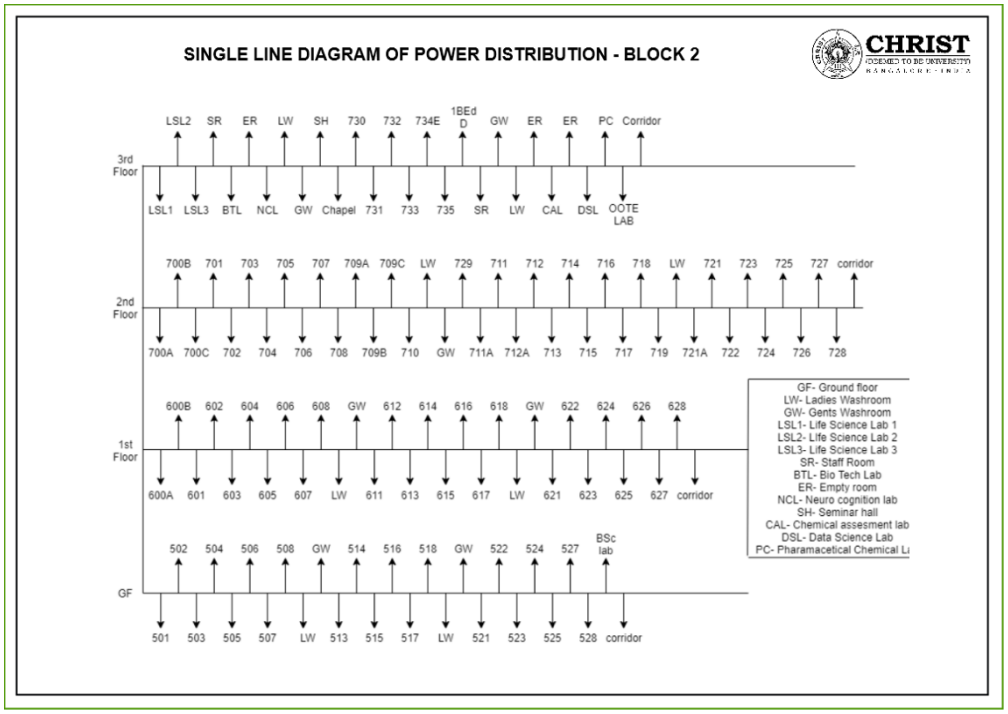
MAIN SLD:



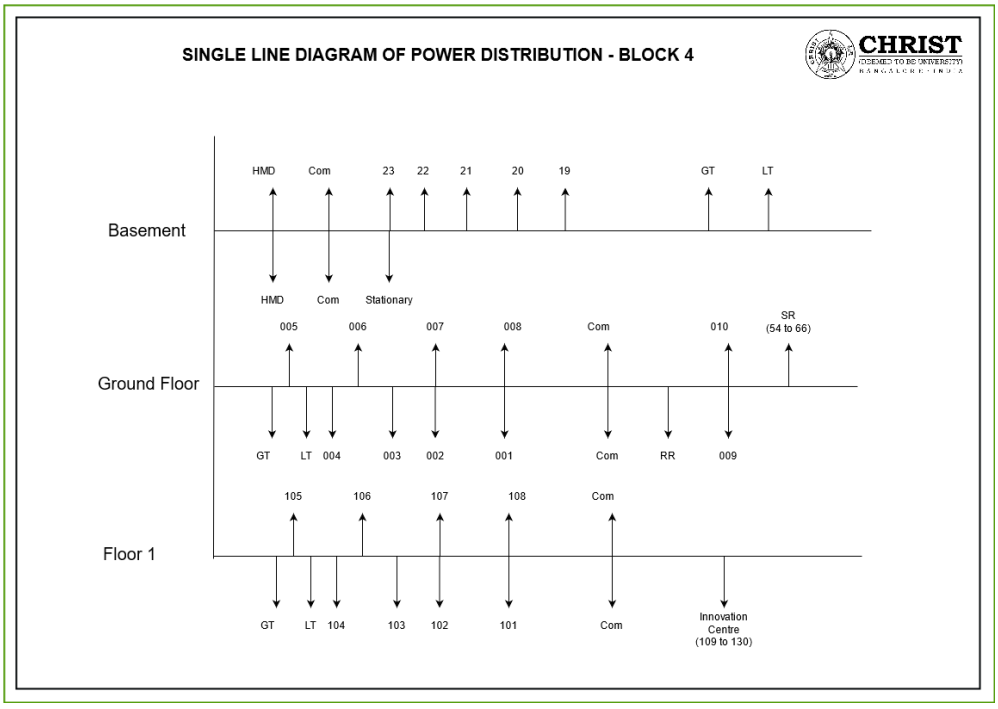
BLOCK 1:



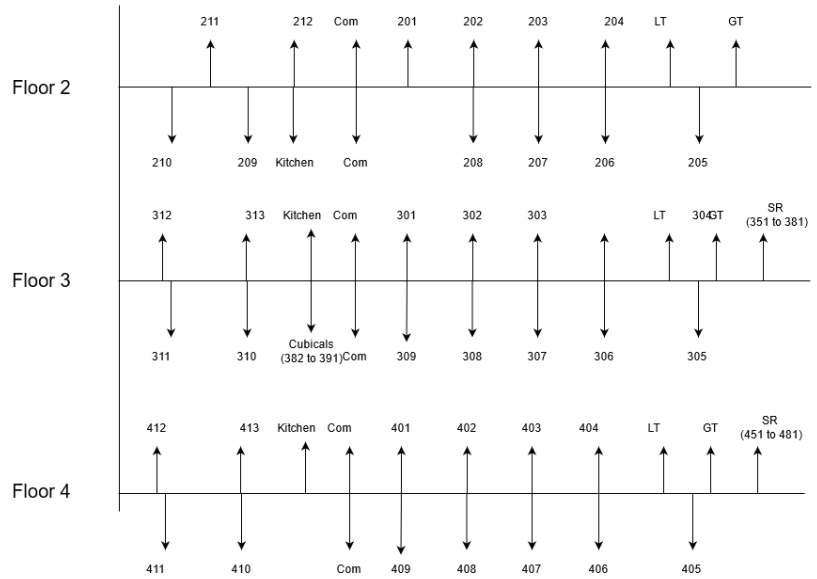
BLOCK 2:



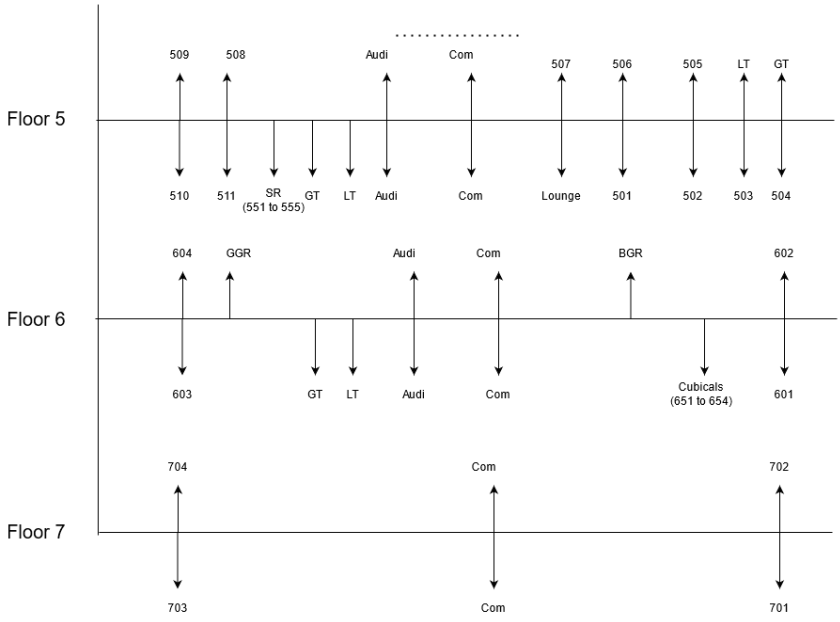
BLOCK 4:



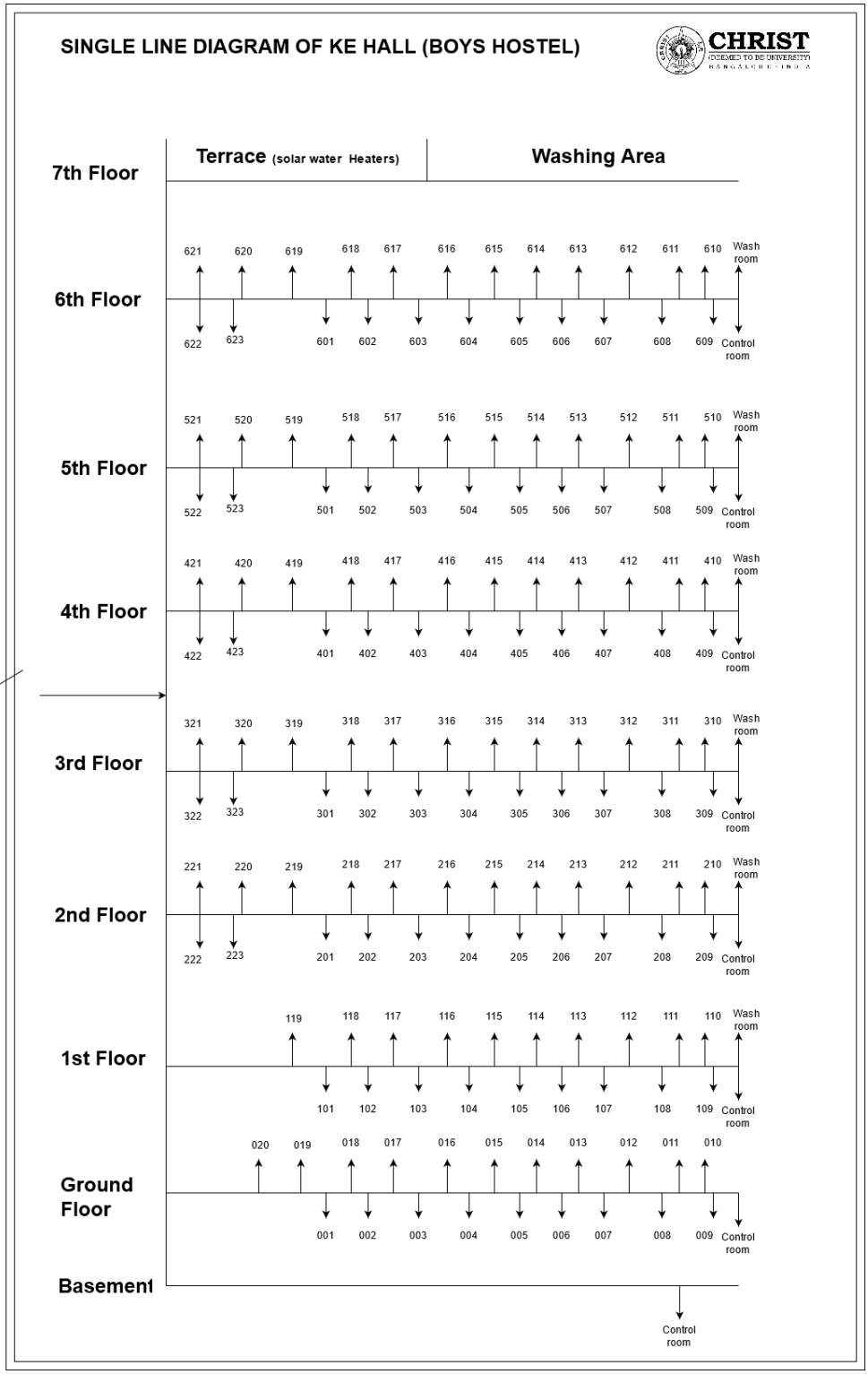
SINGLE LINE DIAGRAM OF POWER DISTRIBUTION - BLOCK 4



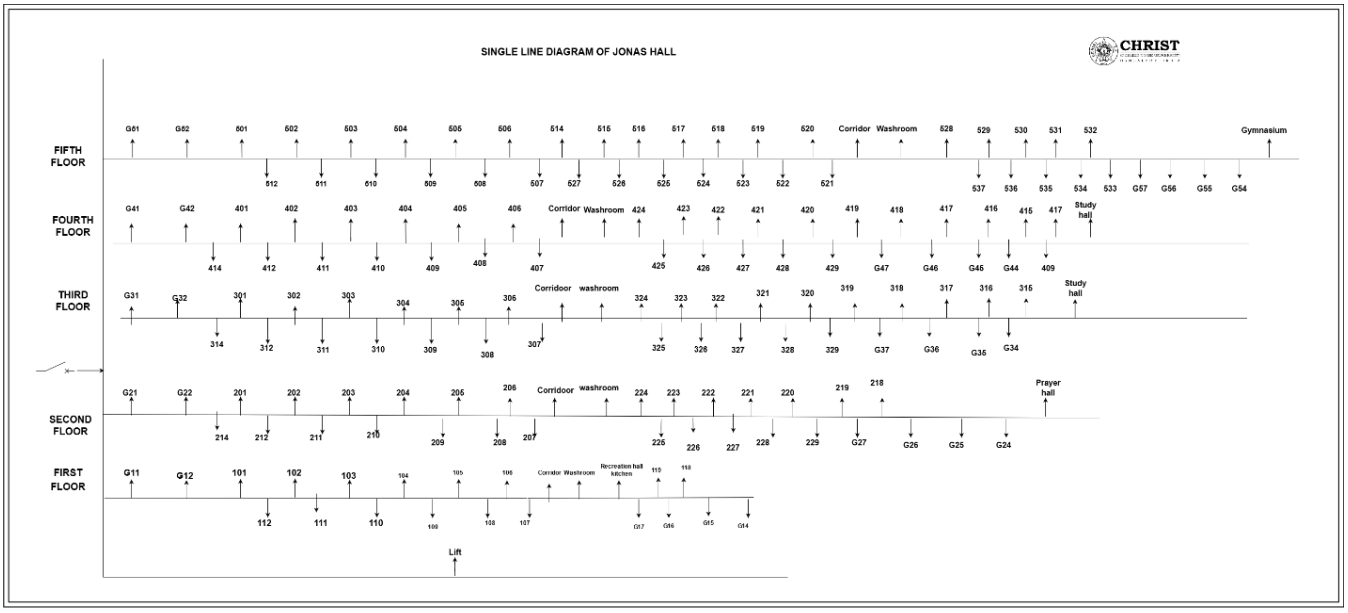
SINGLE LINE DIAGRAM OF POWER DISTRIBUTION - BLOCK 4



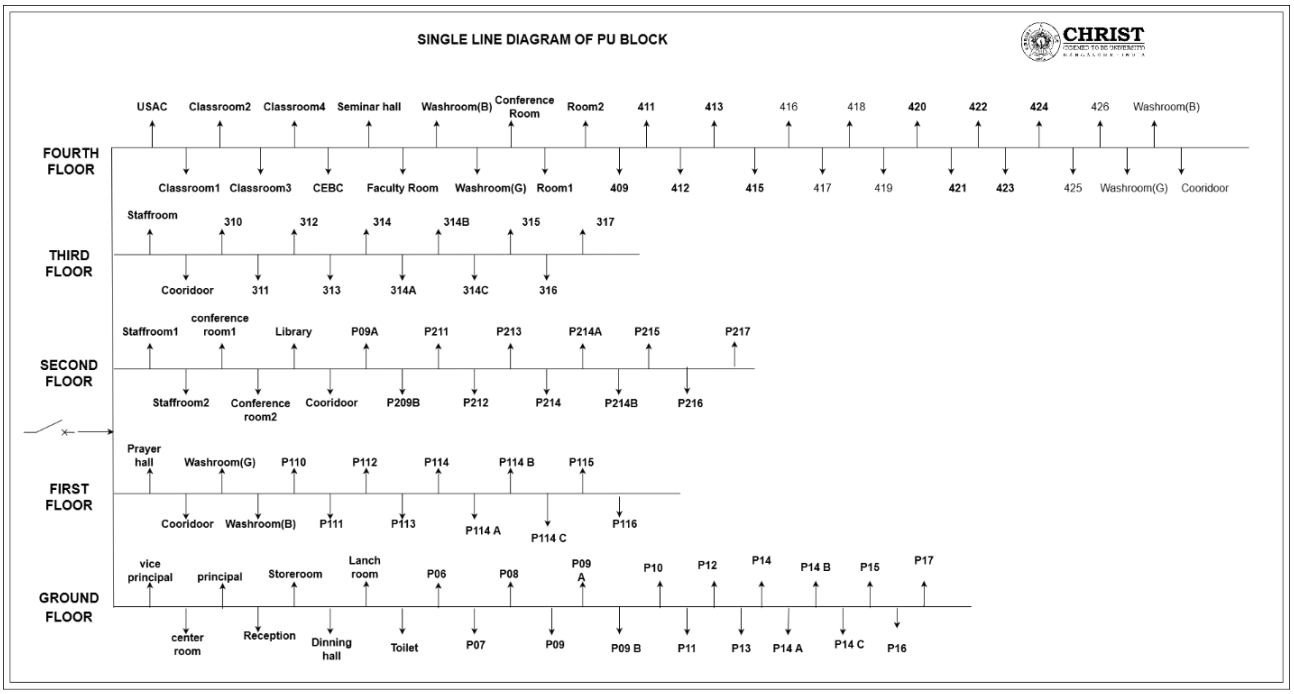
KE BLOCK:


SINGLE LINE DIAGRAM OF KE HALL (BOYS HOSTEL)
CHRIST
(DEEMED TO BE UNIVERSITY)
Terrace (solar water Heaters)
Washing Area
7th Floor
6th Floor
621 620 619 618 617 616 615 614 613 612 611 610 Wash room
622 623 601 602 603 604 605 606 607 608 609 Control room
5th Floor
521 520 519 518 517 516 515 514 513 512 511 510 Wash room
522 523 501 502 503 504 505 506 507 508 509 Control room
4th Floor
421 420 419 418 417 416 415 414 413 412 411 410 Wash room
422 423 401 402 403 404 405 406 407 408 409 Control room
3rd Floor
321 320 319 318 317 316 315 314 313 312 311 310 Wash room
322 323 301 302 303 304 305 306 307 308 309 Control room
2nd Floor
221 220 219 218 217 216 215 214 213 212 211 210 Wash room
222 223 201 202 203 204 205 206 207 208 209 Control room
1st Floor
119 118 117 116 115 114 113 112 111 110 Wash room
101 102 103 104 105 106 107 108 109 Control room
Ground Floor
020 019 018 017 016 015 014 013 012 011 010
001 002 003 004 005 006 007 008 009 Control room
Basement
Control room

JONAS HALL:



PU BLOCK:



ANNEXURE II: TARIFF DETAILS

Tariff Code: 1HT2C2

Description

Tariff (Jan-2023 to March-2023)	Rs.260/-	725 Ps	765 Ps
Tariff (April-2023 to Jan-2024)	Rs.300/-	750Ps	750 Ps

https://bescom.karnataka.gov.in/page/Customer+Relations/BESCOM+Tariff/en

ANNEXURE III: MEASURED DATA

Date	No	Time	VR	VY	VB	IR	IY	IB	PF
23-03-2024	1	1.00AM	243.7	245.9	243.7	249.3	211.7	215.16	1
	2	2.00AM	240.8	239.1	245	205.3	170.1	176.1	1
	3	3.00AM	247.8	245.9	248.6	229.3	199.3	179.5	1
	4	4.00AM	250.4	241	243	271.9	215.3	202.5	1
	5	5.00AM	244	244.9	241.7	303.3	224.6	213.5	1
	6	6.10AM	277.1	241.9	240.1	268.7	264.1	220.7	1
	7	7.05AM	238.9	238.4	242.2	272.2	247.1	229.5	1
	8	8.00AM	237.1	243.6	245	630.1	277	621.9	1
	9	9.00AM	241	239.8	243.6	666.3	574.7	633.4	1
	10	10.00AM	245	241.6	240.2	679.4	575.6	630.1	1
	11	11.00AM	240.3	244.2	245.1	636.9	574.4	629	1
	12	12.00PM	241.1	248.3	244.7	587.8	517.4	603.7	1
	13	1.00PM	245	248.1	242	564	523.1	566.9	1
	14	2.00PM	248.1	249.6	246.9	496.2	506.1	505.4	1
	15	3.00PM	250	244.8	249.1	480.6	458.7	749.4	1
	16	4.00PM	243.4	250.9	243	392	313.9	298.3	1
	17	5.00PM	399.07	353.9	332.4	429.12	428.3	428.3	1
	18	6.00PM	111.3	132.1	244.6	427.12	419.3	424.3	1
	19	7.00PM	243.56	245.8	242.5	268.1	258.9	253.8	1
	20	8.00PM	250	244.4	239.1	249.2	211.4	240.8	1
	21	9.00PM	253	243.9	248.7	246.6	244	241.3	1
	22	10.00PM	244	240.4	240.1	257.2	209.4	247.8	1
	23	11.00PM	246	250.9	239.7	248.6	241	239.3	1
	24	12.00AM	252.9	248.4	221.9	221.9	203.1	207.2	1
24-03-2024	1	1.00AM	243	245	239.4	202.5	192.4	210.5	1
	2	2.00AM	243.3	241.7	244.8	203.8	179.7	171.8	1
	3	3.00AM	251.4	248.6	250.2	180.7	167.4	162.2	1

	4	4.00AM	251	243.4	245.3	224.5	178.4	172.4	1
	5	5.00AM	243.4	244.2	246.7	239	184.9	164.7	1
	6	6.10AM	240.6	242.4	247	289.3	217.3	201.4	1
	7	7.05AM	237.5	237.3	234.8	264.9	209.5	186.8	1
	8	8.00AM	242.8	249.4	245.1	291.4	248.1	236.2	1
	9	9.00AM	229.3	236.1	228	580.6	561.4	606.3	1
	10	10.00AM	237.8	233.4	234	621.4	522.8	617.2	1
	11	11.00AM	241.2	238.6	236.9	540.2	520.8	542.2	1
	12	12.00PM	244.7	239.2	246.8	579.2	538.7	588.7	1
	13	1.00PM	246.8	244	245	642.6	595.3	622.4	1
	14	2.00PM	247.3	243.2	237.8	635.7	583.6	632.4	1
	15	3.00PM	248.5	240.6	242.4	654	566.8	648	1
	16	4.00PM	250.7	246.5	250	495.2	465.7	477.7	1
	17	5.00PM	242.2	248.1	249.3	462.1	396	440.2	1
	18	6.00PM	251.7	237.3	239.1	422.1	336.1	388.4	1
	19	7.00PM	244.7	241.8	246.3	379.2	310.1	283.2	1
	20	8.00PM	243	251.8	242.7	376.7	325.5	319	1
	21	9.00PM	248.3	240.5	242	317.7	299.3	283.8	1
	22	10.00PM	240.9	238.8	241.3	256.6	281.5	249.8	1
	23	11.00PM	247	246.2	237.2	251.6	239.5	244.9	1
	24	12.00AM	239.9	245.4	242.6	265.5	226.8	245.9	1
25-03-2024	1	1.00AM	244.6	241.5	247.2	242.6	225.8	240.8	1
	2	2.00AM	252.7	241.8	243.4	230	216.2	194	1
	3	3.00AM	245.2	252.2	247	238.7	230.1	197.4	1
	4	4.00AM	252.3	251.4	242.6	203.3	194.9	202.2	1
	5	5.00AM	248.6	240.3	239.7	265.2	202.1	200	1
	6	6.00AM	245.4	248.3	243.8	307	244.8	221.2	1
	7	7.00AM	242.7	235.6	243	263.9	218.6	195.4	1
	8	8.00AM	243.3	247.8	240.3	311.1	259.8	247.8	1
	9	9.00AM	241.3	239.7	234.2	539.7	474.2	631.9	1
	10	10.00AM	235.4	233.8	234.1	577.6	492.6	520.2	1
	11	11.00AM	243.7	239.2	243.6	571.3	492.1	541.3	1
	12	12.00PM	245.1	237.3	243	546.3	467.4	520.5	1
	13	1.00PM	237.3	245.6	234.7	559.1	515.3	507.8	1
	14	2.00PM	239.2	237.5	237.9	580.2	266.7	576.5	1
	15	3.00PM	242.8	242.1	241.5	573.1	485.4	554.5	1
	16	4.00PM	248.3	244.4	242.9	583.4	296.2	539.6	1
	17	5.00PM	245.3	248.9	247.5	419.5	387	499.2	1
	18	6.00PM	241.2	248.6	247.6	407.2	325.1	322.3	1
	19	7.00PM	249.3	243.8	250	425.2	362.6	495.7	1
	20	8.00PM	244.3	251.5	253.7	394.2	310.4	319.4	1
	21	9.00PM	251.8	246.5	243	362.4	288.5	264.7	1
	22	10.00PM	244.3	237.8	243.8	273.6	236.7	281.9	1
	23	11.00PM	239.1	240.7	242.5	272	230.7	234.2	1
	24	12.00AM	246.2	244	240.5	259.9	237.6	228.8	1
26-03-2024	1	1.00AM	243.4	243.9	250.6	250.2	207.3	210.5	1
	2	2.00AM	251.5	248.1	250.6	233.8	200.8	179.4	1

	3	3.00AM	253	253.2	251.3	239.8	210.6	191.6	1
	4	4.00AM	252.2	252.6	245.4	262.5	208.4	195.3	1
	5	5.00AM	245.1	243.6	243.4	265.1	207.7	201.8	1
	6	6.00AM	248.3	241.2	242.1	303.7	244.5	218.3	1
	7	7.00AM	243.2	444.2	239.8	279.6	210.3	180.6	1
	8	8.00AM	238.1	242.6	234.1	301	242.5	253.4	1
	9	9.00AM	238.6	235	233.1	580.5	487.1	526.6	1
	10	10.00AM	230.4	236.1	234.6	681.2	540.3	627.3	1
	11	11.00AM	238.5	246.3	229.9	631.9	537.7	647.2	1
	12	12.00PM	238.3	237.3	231.1	660	495.7	571.4	1
	13	1.00PM	245.3	240.9	240.7	549.8	472.9	579.8	1
	14	2.00PM	240.3	243.3	244	619	559.2	594.2	1
	15	3.00PM	241.6	244.4	236.3	586.7	498.8	539.3	1
	16	4.00PM	241.4	240.2	238.5	490	434.6	455	1
	17	5.00PM	240.9	244.4	246	438	390.9	431.2	1
	18	6.00PM	247.5	243.7	422.5	407.1	312.6	308.9	1
	19	7.00PM	238.5	246.8	244	407.3	314.7	306	1
	20	8.00PM	245.2	245.6	247	369.2	318	289.8	1
	21	9.00PM	239.3	238.2	244.8	239.9	289.8	265.2	1
	22	10.00PM	244.5	244.6	424.8	273	275.3	267.9	1
	23	11.00PM	246.4	239.7	417.8	282.1	250.6	259	1
	24	12.00AM	237.5	245.5	421.2	232.7	220.6	231	1
27-03-2024	1	1.00AM	239.3	246.7	241.2	239	196.4	198.7	1
	2	2.00AM	245.6	247	427.3	230.4	195.5	208	1
	3	3.00AM	245.7	248.8	244.5	209	182	184.4	1
	4	4.00AM	247.2	244.7	244	253.1	189.4	197.4	1
	5	5.00AM	239.3	244	242.5	248.5	210.1	187.5	1
	6	6.00AM	236	237.3	243.8	308.9	261.3	242	1
	7	7.00AM	243.3	237	238.6	305.1	240.6	225.7	1
	8	8.00AM	229.3	232.4	237.2	300.4	236.6	208.4	1
	9	9.00AM	233.1	243	239.5	557.1	471.9	479.5	1
	10	10.00AM	233.7	236.4	239.5	581	533.2	5653.3	1
	11	11.00AM	237.4	229.8	238.1	576.2	501.2	577.3	1
	12	12.00PM	231.1	231	238	557	462.1	518.5	1
	13	1.00PM	239.1	239.5	245.7	343.5	339.1	407.5	1
	14	2.00PM	235	236.1	243.7	406.2	343.2	395.2	1
	15	3.00PM	236.1	243.4	235	409.1	363.7	422.9	1
	16	4.00PM	245.2	238.1	237.7	495.6	427.5	437.3	1
	17	5.00PM	249.8	248.6	249.9	306.2	259.8	246.2	1
	18	6.00PM	245.8	242.3	244.5	396.1	324.7	330.3	1
	19	7.00PM	234	251.2	231.5	363.4	303.3	278	1
	20	8.00PM	239.1	244	236.9	368.5	299.7	304.8	1
	21	9.00PM	244.8	236.3	240.6	286.4	277.4	285	1
	22	10.00PM	243.3	239.7	244.1	293.9	264	269.9	1
	23	11.00PM	236.9	238.6	238.7	241.7	226.2	230.4	1
	24	12.00AM	238.1	235.6	240.6	242.2	230.3	225.5	1

28-03-2024	1	1.00AM	240.2	244.1	244.9	203.3	192.2	214	1
	2	2.00AM	242.3	241.2	236.6	202.9	176.4	191.2	1
	3	3.00AM	243.4	247.8	245.4	220.6	187.6	183	1
	4	4.00AM	241.2	247.9	247.2	251.8	206.8	206.1	1
	5	5.00AM	235.9	238.3	242	281.4	239.1	221.2	1
	6	6.00AM	244.6	237.1	242.5	287.2	242.1	242.8	1
	7	7.00AM	232.6	240.5	233.6	324.5	288.4	235.1	1
	8	8.00AM	237.1	238	244.1	263	200.5	205.9	1
	9	9.00AM	245.7	238.3	234.5	232.8	213.4	247.8	1
	10	10.00AM	238.7	236.3	249	254.4	217.7	242.1	1
	11	11.00AM	246	242.7	236.1	268.6	238.5	250.3	1
	12	12.00PM	246.1	241.3	235.1	236.9	242.5	256.3	1
	13	1.00PM	238.1	241.6	240.2	237.4	216.1	222.2	1
	14	2.00PM	245.2	243.6	249	243.2	247.2	240.2	1
	15	3.00PM	246.3	250.1	244	235.3	210	222.2	1
	16	4.00PM	247.3	245.4	252.3	231.6	210.8	213.6	1
	17	5.00PM	249.1	240.5	243.1	262.5	217.2	204.2	1
	18	6.00PM	244.5	243.2	243.5	269.4	198.9	178.8	1
	19	7.00PM	242	244.7	239.7	235.4	219.4	258.3	1
	20	8.00PM	245	241.1	239.4	311.5	247	250.1	1
	21	9.00PM	241.2	247.6	248.1	256.6	235.6	243.5	1
	22	10.00PM	249.5	239.7	241	247.3	215.8	227.4	1
	23	11.00PM	239.5	239.8	236.2	259.4	223.2	225.3	1
	24	12.00AM	237.8	242.9	235.3	235	221.8	258.4	1
29-03-2024	1	1.00AM	239.9	240.8	239.3	210	182.5	185.6	1
	2	2.00AM	243.9	240.1	238.5	225.6	294	207	1
	3	3.00AM	242.3	246.8	244.8	202	188.2	189.9	1
	4	4.00AM	243.6	245.1	242.7	265.4	212.9	192	1
	5	5.00AM	235.2	254	236.7	286	243.4	219.1	1
	6	6.00AM	245.1	243.9	243	2122	198.7	213.1	1
	7	7.00AM	238.1	241.9	236.3	272.5	210.7	207.4	1
	8	8.00AM	239.5	240.2	231.7	288.3	223.7	254.6	1
	9	9.00AM	240	239.7	236.5	583	573.5	625	1
	10	10.00AM	238.3	231.1	237.5	575.2	602.6	637	1
	11	11.00AM	237.9	236	237.2	542	465.3	588.2	1
	12	12.00PM	239.7	237.7	232.6	539.3	498.5	560.5	1
	13	1.00PM	239	232.6	232	521.8	448.4	521.1	1
	14	2.00PM	235.8	239.9	238.9	570.9	497.5	550.4	1
	15	3.00PM	243.5	241.8	248.8	540.1	287.6	520.6	1
	16	4.00PM	245.4	248.9	246.7	537	486.8	498	1
	17	5.00PM	238.6	238.7	248.3	407.9	377.4	355.4	1
	18	6.00PM	240.6	238.7	245.3	411.9	376.4	351.4	1
	19	7.00PM	243.3	239.3	243.8	494	416	505.3	1
	20	8.00PM	243.9	245.2	247	418.2	333.4	311.5	1
	21	9.00PM	238.3	242	243.3	395.1	313.3	293.1	1
	22	10.00PM	243.9	235	236.5	344.1	262	275.3	1

	23	11.00PM	233.4	235.3	238.8	256.7	246.8	238.2	1
	24	12.00AM	238.4	235.3	243.1	273.7	220	240.2	1

ANNEXURE IV: FIRE SAFETY SYSTEM

	
Jockey Pump (26kW)	Booster Pump (75kW)

No	Building	Jockey Pump	Booster Pump	Public Address system	Smoke detectors	Beam detectors
1	Central block	1	2	0	1	1
2	Block 1 (Audi)	1	2	0	1	2
3	KE Hall	0	1	0	0	0
4	Block 4	0	1	1	4	2
Total		2	6	1	6	5

ANNEXURE IV: ELEVATORS

Block	Number	Total Capacity(Persons)	HP
Audi	2	16	10
Junior College	1	10	7.5
Central	7	83	15
Block 1	1	8	7.5
Block 2	2	20	7.5
Block 4	2	40	15
K E Hall	2	20	7.5
Jonas Hall	1	10	7.5

Research Block	4	20	30

ANNEXURE V: Electricity Bill Data

No	Bill No	Billing Period From	Billing Period To	Bill Date	Type	Tariff
1	786404643793	01/01/23	01/02/23	01/02/23	Educational Institutions-HT2C	1HT2C2
2	786405566318	01/02/23	01/03/23	01/03/23	Educational Institutions-HT2C	1HT2C2
3	786400372862	01/03/23	01/04/23	01/04/23	Educational Institutions-HT2C	1HT2C2
4	786404701254	01/04/23	01/05/23	01/05/23	Educational Institutions-HT2C	1HT2C2
5	786402045322	01/05/23	01/06/23	01/06/23	Educational Institutions-HT2C	1HT2C2
6	786409553153	01/06/23	01/07/23	01/07/23	Educational Institutions-HT2C	1HT2C2
7	786400671604	01/07/23	01/08/23	01/08/23	Educational Institutions-HT2C	1HT2C2
8	786405731392	01/08/23	01/09/23	01/09/23	Educational Institutions-HT2C	1HT2C2
9	786403872472	01/09/23	01/10/23	01/10/23	Educational Institutions-HT2C	1HT2C2
10	786408030724	01/10/23	01/11/23	01/11/23	Educational Institutions-HT2C	1HT2C2
11	786401140068	01/11/23	01/12/23	01/12/23	Educational Institutions-HT2C	1HT2C2
12	786401531795	01/12/23	01/01/24	01/01/24	Educational Institutions-HT2C	1HT2C2

No	Billing Period From	Billing Period To	Contract Demand KVA	Recorded Demand KVA	Billing Demand KVA
1	01/01/23	01/02/23	1990	766	1990
2	01/02/23	01/03/23	1990	870	1990
3	01/03/23	01/04/23	1990	1005	1990
4	01/04/23	01/05/23	1990	1035	1990
5	01/05/23	01/06/23	1990	569	1990
6	01/06/23	01/07/23	1990	678	1990
7	01/07/23	01/08/23	1990	1000	1990
8	01/08/23	01/09/23	1990	104	1990
9	01/09/23	01/10/23	1990	1029	1990
10	01/10/23	01/11/23	1990	1041	1990
11	01/11/23	01/12/23	1990	1050	1990
12	01/12/23	01/01/24	1990	899	1990

No	Billing Period From	Billing Period To	Energy KWH	Energy KVAH	MD	PF
1	01/01/23	01/02/23	240420.00	241510.00	44927	1.0000
2	01/02/23	01/03/23	247800.00	248250.00	44958	1.0000
3	01/03/23	01/04/23	286320.00	287490.00	44986	1.0000
4	01/04/23	01/05/23	257880.00	259240.00	45017	1.0000
5	01/05/23	01/06/23	218480.00	219230.00	45047	1.0000
6	01/06/23	01/07/23	173990	177950	45078	1.0000
7	01/07/23	01/08/23	259560.00	261100.00	45108	1.0000

8	01/08/23	01/09/23	304500.00	305690.00	45139	1.0000
9	01/09/23	01/10/23	262450.00	263200.00	45170	1.0000
10	01/10/23	01/11/23	269170.00	269830.00	45200	1.0000
11	01/11/23	01/12/23	241860.00	242170.00	45231	1.0000
12	01/12/23	01/01/24	234580.00	234910.00	45261	1.0000

No	Billing Period From	Billing Period To	Demand Charges Per Unit	Energy Charges Per Unit1	Energy Charges Per Unit2	Fuel cost Adjustment Cost Per Unit	PF Adjustment Cost Per Unit
1	01/01/23	01/02/23	260.00	7.25	7.65	0.06	0.00
2	01/02/23	01/03/23	260.00	7.25	7.65	0.06	0.00
3	01/03/23	01/04/23	260.00	7.25	7.65	0.06	0.00
4	01/04/23	01/05/23	300.00	7.50	7.50	0.65	0.00
5	01/05/23	01/06/23	300.00	7.50	7.50	0.00	0.00
6	01/06/23	01/07/23	300.00	7.50	7.50	0.45	0.00
7	01/07/23	01/08/23	300.00	7.50	7.50	2.05	0.00
8	01/08/23	01/09/23	300.00	7.50	7.50	1.15	0.00
9	01/09/23	01/10/23	300.00	7.50	7.50	1.01	0.00
10	01/10/23	01/11/23	300.00	7.50	7.50	0.35	0.00
11	01/11/23	01/12/23	300.00	7.50	7.50	0.20	0.00
12	01/12/23	01/01/24	300.00	7.50	7.50	-0.37	0.00

No	Billing Period From	Billing Period To	Demand Charges	Energy Charges1	Energy Charges2	Fuel Cost Adjustment Charges
1	01/01/23	01/02/23	439920	725000	1074213	14425.2
2	01/02/23	01/03/23	439920	725000	1130670	14868
3	01/03/23	01/04/23	439920	725000	1425348	17179.2
4	01/04/23	01/05/23	507600	750000	1184100	167622
5	01/05/23	01/06/23	507600	750000	888600	0
6	01/06/23	01/07/23	507600	750000	554925	78295.5
7	01/07/23	01/08/23	507600	750000	1196700	532098
8	01/08/23	01/09/23	507600	750000	1533750	350175
9	01/09/23	01/10/23	507600	750000	1218375	265074.5
10	01/10/23	01/11/23	507600	750000	1268775	94209.5
11	01/11/23	01/12/23	507600	750000	1063950	48372
12	01/12/23	01/01/24	507600	750000	1009350	-86794.6

ANNEXURE V: Electricity Bill Data

Energy Management Policy

Mission

Manage all the activities of CHRIST (Deemed to be University) to ensure practical minimum consumption of energy and natural resources.

Commitment

CHRIST (Deemed to be University) is dedicated to managing energy consumption across all our facilities and operations with the highest efficiency, wherever it is economically viable.

The energy management targets of CHRIST (Deemed to be University)

- To prevent resource wastage
- To minimize unnecessary spending on energy bills
- To guarantee the safest possible use of energy
- To increase the share of renewable energy in our total consumption
- To enhance working conditions with an optimal and safe energy supply
- To adopt practices that lower carbon emissions and broadly safeguard the environment

Energy management goals

- To track and analyze energy flow consistently across all major facilities
- To oversee energy consumption, preventing unnecessary operation of connected equipment
- To upgrade outdated and inefficient equipment and systems with more efficient alternatives
- To maintain electrical safety installations on all floors and within buildings
- To boost the proportion of renewable energy systems to 20% of the total connected load by 2025.

Immediate objectives

- Establish an energy management team to implement the energy management policy
- Develop a routine maintenance schedule for lighting, air conditioning, and water pumping facilities
- Implement clear labeling of cables and wiring to enhance safety
- Conduct regular energy management awareness campaigns on campus
- Place energy management signboards and notices throughout all major facilities

Energy Management Policy

Preface

a) CHRIST (Deemed to be University) will develop and implement Energy Management (EM) policies, including the introduction of new utilities or the enhancement of existing ones.

b) The university will craft an appropriate Energy Policy Statement within the EM policy framework, periodically reviewing and updating it as necessary.

c) A management structure will be established by the university for the efficient planning and execution of Energy Conservation (EC) strategies.

d) CHRIST (Deemed to be University) will allocate the necessary human and financial resources to achieve energy conservation goals.

e) A Certified Energy Manager will oversee the execution of EC initiatives.

f) The university will compile an Energy Management Manual detailing campus-level energy conservation instructions, including EC targets achieved through retrofitting/replacing inefficient equipment or by adding new facilities as needed.

g) Compliance with Energy Management at the plant level will be ensured by the university, which will also review the progress of EC initiatives and outline directions for future enhancements.

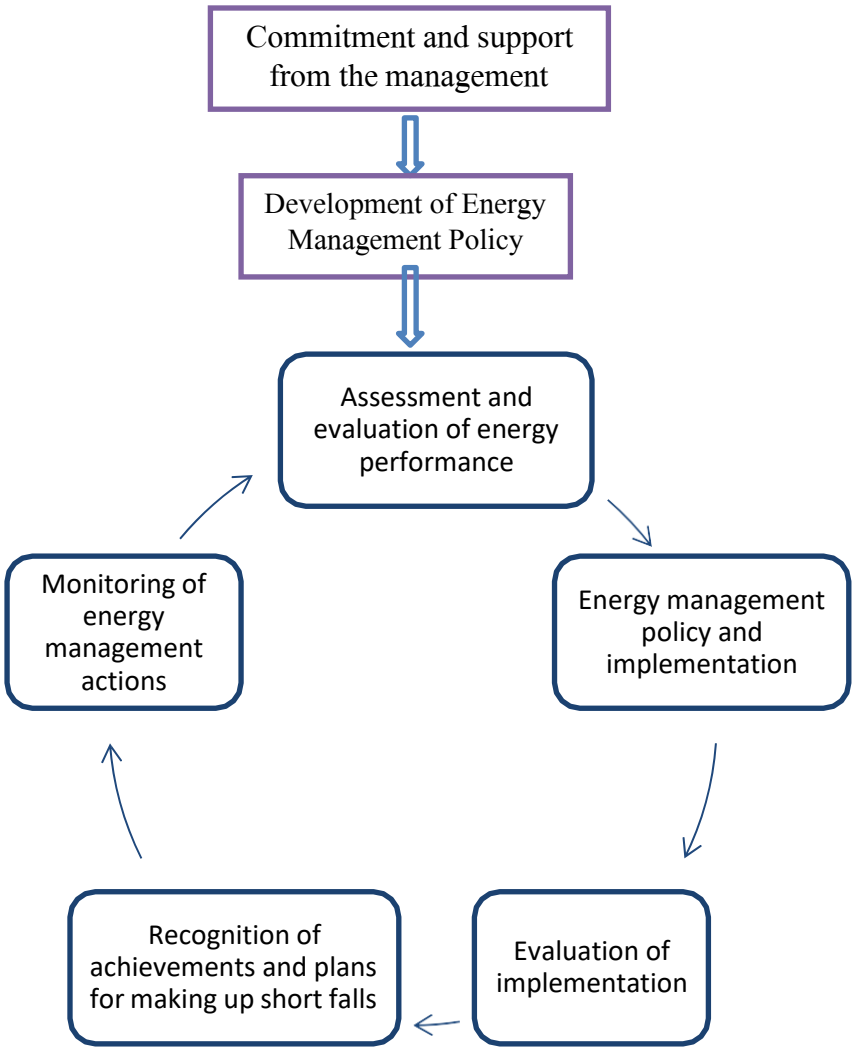
h) The Energy Management Manual and its adherence will be periodically reviewed and updated based on feedback from plant personnel.

i) The university will engage with employees about the Energy Management Manual and offer training to enhance their capabilities.

j) Proper monitoring and documentation for each major facility will be maintained by the university, enabling the generation of individual facility status reports.

k) Regular calibration of all monitoring and measurement instruments will be undertaken by the university to guarantee data accuracy.

Structure of Energy Management Policy Implementation



ISO 50001 establishes a set of requirements that enable organizations to:

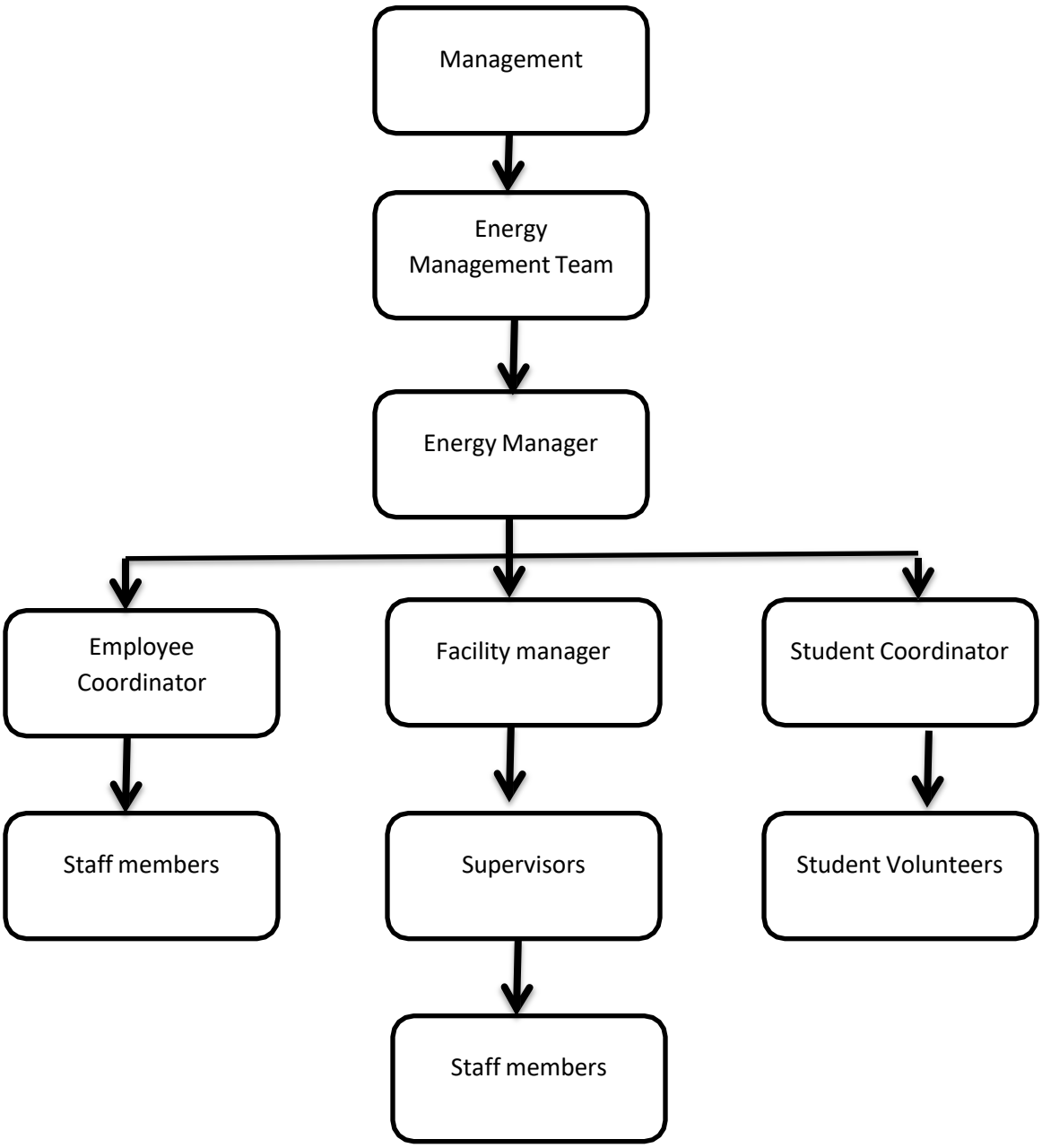
- Formulate a policy aimed at enhancing energy efficiency
- Establish goals and objectives aligned with this policy
- Analyze data to gain insights and inform decisions regarding energy consumption
- Assess the outcomes
- Evaluate the effectiveness of the policy, and
- Persistently refine energy management practices.

Energy Management Policy Implementation

- Encouraging engagement from both employees and students
- Raising awareness through educational programs
- Empowering individuals to take responsibility
- Offering incentives such as certificates or rewards for motivation
- Fostering a spirit of healthy competition to save energy and embrace sustainable practices
- Welcoming and implementing innovative suggestions from the community

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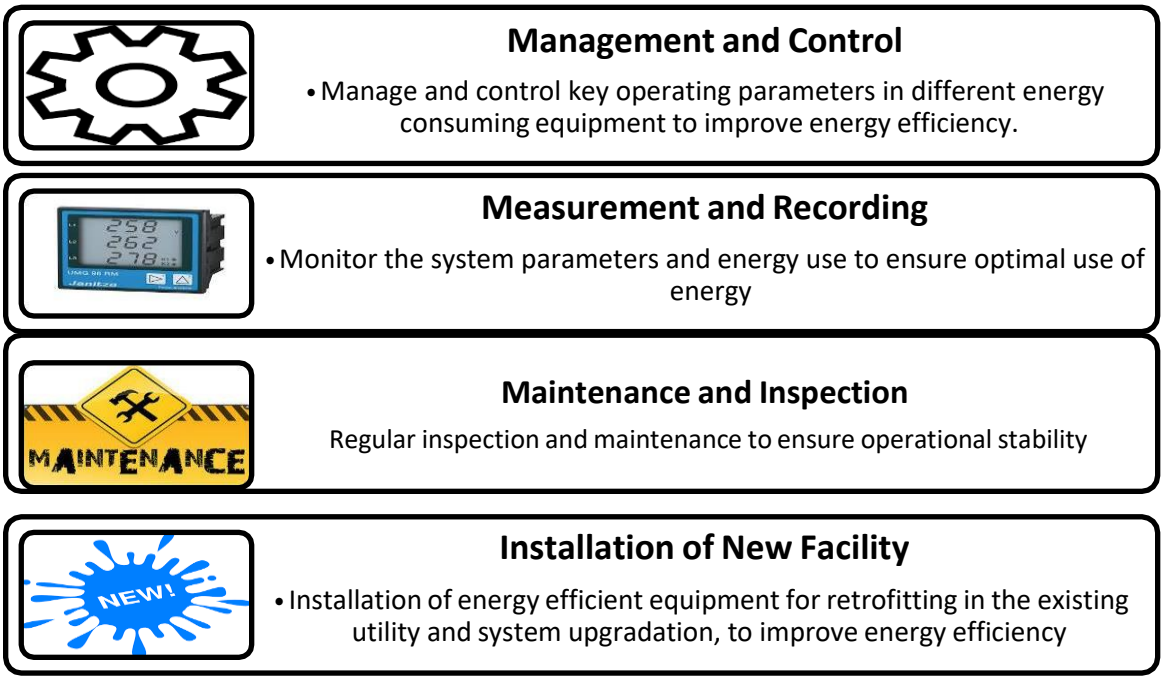
Hierarchical Structure



Energy Management Manual

This manual outlines how CHRIST (Deemed to be University) can enhance resource efficiency, conserve energy and funds, and minimize greenhouse gas emissions through effective resource management. Serving as a practical guide, it offers strategies for rolling out an energy management program designed to achieve the university's energy conservation objectives. It assists the energy management team in coordinating actions and directs both employees and students towards fulfilling these goals. Additionally, as a tool for ongoing improvement, the manual supports efforts to save energy and reduce the carbon footprint. By adopting best practices, the organization can lower energy expenses by 5-7%, and also diminish water usage and waste production.

General Principles



Students and Faculty

Lighting Systems

- Only turn on the necessary amount of lighting for academic or extracurricular activities to prevent wasteful usage.
- Ensure lights are turned off when leaving classrooms or labs.
- Promptly report any lighting issues, such as flickering, dimness, or unusual noises from fixtures.
- Maximize the use of natural daylight.
- Encourage a culture of resource conservation among peers, family, and friends.

HVAC (Heating, Ventilation, and Air Conditioning) Systems

- Operate only the necessary number of fans.
- Adjust fan speed to achieve the desired level of comfort.
- Prefer natural ventilation by opening windows and curtains when possible.
- Use air conditioning within the suggested temperature settings.
- Turn off fans and air conditioners when leaving the room.
- Report any ventilation problems immediately, such as ineffective cooling, malfunctioning fan controls, or unusual noises.
- Regularly practice and promote energy-saving habits within your community.

UPS (Uninterruptible Power Supply) Systems

- Utilize the appropriate power supply for each task to avoid wasting stored energy.
- Report any issues with insufficient backup or poor power quality.
- Turn off computers and screens when not in use.
- Ensure audio systems and projectors are turned off when not needed.

Operating Staff Duties

Lighting Systems

- Turn off lights that are not needed.
- Quickly address any lighting issues that have been reported.
- Verify that all connections and installations are secure and safe.
- Report any significant power line problems immediately.
- Keep track of electricity consumption.

HVAC Systems

- Turn off equipment when not in use.
- Respond to reported problems without delay.
- Regularly check the condition of air conditioners, fans, and regulators.
- Inform management of any serious issues encountered.
- Routinely monitor energy consumption.

Water Pumps

- Aim to operate water pumps during off-peak hours when feasible.
- Operate pumps at efficient load levels to avoid low-load inefficiency.
- Check that smart controllers are functioning correctly to prevent dry running, overflow, and motor damage.
- Ensure there are no leaks in valves or pipelines.

Fire Fighting System

- Perform regular checks on the firefighting equipment.
- Execute scheduled mock drills.

UPS Systems

- Consistently monitor battery performance.
- Check that all terminals and wires are correctly installed to prevent leaks.
- Carry out maintenance activities as recommended.
- Watch the system load to prevent overloading and energy loss.
- Check the inverter output to ensure the quality of power.

Solar Water Heaters

- Regularly inspect pipe pressure.
- Frequently monitor water temperature.
- Keep the heating surface clean.
- Conduct scheduled maintenance tasks.

Management Responsibilities

Lighting Systems

- Upgrade to more efficient lighting systems for any replacements or new installations.
- Integrate motion sensor controls in high-power nighttime lighting systems.

- Perform regular cleaning of lighting fixtures to eliminate dust.
- Optimize natural light through thoughtful selection of window design, paint colors, and curtains.
- Install intelligent lighting controls.

HVAC Systems

- Conduct frequent checks on fans and their speed regulators.
- Schedule routine air conditioning maintenance to clean and ensure efficiency.
- Guarantee thermal insulation in rooms with air conditioning to enhance efficiency.
- Purchase and install only air conditioners with a 4/5 star efficiency rating.
- Opt for BLDC fans for all new installations to ensure energy efficiency.
- Implement smart ventilation solutions in basement areas.

Water Pumps

- Monitor water usage to ensure it is optimized.
- Adjust the water pumping schedule to off-peak hours to minimize energy costs.
- Introduce intelligent controllers for water pump motors.
- Implement at least one solar-powered water purification system.
- Regularly assess and upgrade inefficient pumping motors.
- Maintain pipelines to prevent pressure losses and ensure efficient water flow.

Fire Fighting System

- Regularly schedule and conduct mock drills.
- Provide a dedicated diesel generator (DG) for the fire-fighting system.
- Maintain fire-fighting readiness across all major facilities.

UPS Systems

- Monitor batteries and inverters routinely.
- Use only high-quality batteries, wires, and inverters to enhance power quality and longevity.
- Prevent system overload to avoid inefficiency and overheating.
- Ensure critical loads are supported by UPS systems and eliminate non-essential connections.
- Solar Water Heaters
- Commit to the regular maintenance of solar water heating systems to ensure optimal performance.

*** End of Report ***