Energy Audit Study

of

ADITYA ENGINEERINGCOLLEGE

Aditya Nagar, ADB Road, Surampalem- 533437

June 2022

Study Conducted and Prepared by:

KR Energy Consultants

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Contents

Acknowledgement

KR Energy Consultants (called "KR Energy" hereafter) places on record, its sincere gratitude to the Management of ***Aditya Engineering College***, for entrusting the prestigious project of Energy Audit of their College located at Surampalem, ADB Road, East Godavari District, AP State.

We also wish to thank the officers/ Executives & staff of the institute for providing necessary support extended during energy audit study.

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BEE Certified Energy Auditor no.3398
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Date: 30/06/2022

Executive Summary

M/s KR Energy Consultants has conducted a Detailed Energy Audit of Aditya Engineering College, Aditya Nagar, Surampalem, EG District, AP to identify energy savings measures for reducing energy consumption and electricity bill.

Electricity and HSD are main energy sources for the institute. Grid electricity supply by APEPDCL is the main source of electrical energy, which is augmented with power generation from DG Sets during load shedding:

The institute has also solar power plant of 500 kW capacity for captive use for the entire campus requirement

a) Electrical Energy

Table A: Profile of Electrical Energy Consumption

S. No.	Item	Value
1	Contract Maximum Demand (CMD) kVA	260
2	Average recorded demand , kVA	165
3	Average billed demand, kVA	214
4	Demand variation, kVA	69.5 to 267
5	Solar power plant capacity of the campus, kW	500
6	Solar power generated, kWh	489,496
7	Solar power used for captive requirement, kWh	317,221
8	Solar power export to grid, kWh	172,275
9	Annual billed grid electricity consumption, kVAh /year	424,773
10	Total electricity consumption of the campus, kWh	741,994
11	Total annual electricity bill, Rs. lakhs/year Net Payable bill Rs. Rs. lakhs/year	30.05
12	Power factor	0.92
13	Average cost of electricity, Rs/kWh (only grid power)	10.1

b) Summary of Recommendations

The Tables below presents the summary of recommended energy saving projects, anticipated energy savings, and monetary savings, investment required, and simple payback period:

Table 1: Summary of Suggested Energy Saving Measures with Cost-Benefit Analysis

Energy Conservation Measure	Energy savings (kWh/ year)	Monetary savings (Rs. / year)	Investment (Rs.)	Payback period (months)
Improve power factor from 0.92 to 1.00	29,671	2,90,670	25,000	1
Replace old fans with Energy efficient/Super fans(100nos)	6,000	60,000	180,000	36
Install energy savers for ACs	15,552	155,520	240,000	19
Replace conventional CFLs with LED lights	1,695	16,950	22,600	16
Total	**52,918**	**5,23,140**	**4,67,600**	**11**

- As can be observed from the above Table, the total electrical energy savings are estimated at 52,918 kWh/year and the corresponding monetary savings are Rs.5.32lakh/year. The investment required is Rs.4.67 lakhs which will be paid back in **11** months.

- Equivalent CO2 reductions due to energy savings would be 48 tCO2/ yr.

- Initially, the fans, ACs and tube lights operated for more hours in a day/year can be selected for replacement for maximum benefit.

CHAPTER 1

Introduction

1.1 About Aditya Engineering College

Aditya Academy

Aditya, the premier promoter of quality education in the coastal districts of Andhra Pradesh for the past two decades, comprises from K.G to P.G besides professional colleges like Engineering, Pharmacy and Nursing. Dr. Nallamilli Sesha Reddy as a founder chairman, promoted the educational society in the name and style of Aditya Academy at Kakinada in the year 1984, with a vision and mission to create a platform for holistic growth and success to students at all levels.

Aditya has made its entry into the educational arena with a public school to meet the needs of primary and secondary education. In succession and with rapid strides, the academy established several Junior Colleges, Degree Colleges, PG Colleges, Engineering Colleges, Pharmacy Colleges, Nursing Colleges, and Teacher Training Institutions.

The silver-jubilee educational group with 60,000+ students in 60+ institutions with 6000+ staff across three districts in Andhra Pradesh has become the standard bearer for quality education. In every stream, Aditya has become a spring-board for success through its powered vision, constant innovation, and professional excellence.

Aditya Engineering College

Aditya Engineering College was established in the academic year 2001-02 under the aegis of Aditya Academy, Kakinada with the approval of AICTE and Affiliated to JNTU with an intake of 180 in three UG Courses in Engineering & Technology.

The College is situated in an eco-friendly area of 180 acres with thick greenery at Surampalem, Gandepalli Mandal, East Godavari District, Andhra Pradesh. The College is 15 KM away from Samalkot Railway Station on Howrah-Chennai Railway line in South Central Railway. The College is 35 Km away from Kakinada and Rajahmundry on ADB Road.

The College has five academic Buildings with a total carpet area of 44,524 Sq. Mts. apart from two boy's hostels and one girls hostel buildings. The particulars of academic buildings and the departments / offices accommodated are as follows.

S.No	Building Name	Department/Office
1	Cotton Bhavan	Administrative Office, Accounts, Admission Office, ECE.
2	K. L. Rao Bhavan	Mechanical, Electrical, Petroleum Technology, Mining Engineering and Agricultural Engineering
3	Bill Gates Bhavan	CSE, IT, H&BS, Civil, AI & ML
4	Abdul Kalam Bhavan	MCA, MBA, IMBA, M.Tech & Management Sciences
5	Ratan Tata Bhavan	Examination Cell, Central Library.

The college offers 10 UG and 10 PG programmes in engineering, MCA, MBA, and IMBA (Integrated) with 20 years of rich standing in the educational era. Besides, the college has added many feathers in its cap which include AICTE-ECI-ISTE Chhatra Vishwakarma Award, Utkrist Sansthan Vishwakarma Award, Swachh Campus ranking, AAA+ Grade by Careers 360, South India 4th rank by Digital Mailers, South India 6th rank by Silicon India, 13th rank out of top 25 engineering colleges by 4Ps, a niche in Asia top 100 colleges by WCRC leaders, Best Placement Award by ASSOCHAM, All India 98th rank-DQ CMR top T-School survey by DATA Quest and 13th position in Top 20 colleges of India by the Sunday Indian. These districts recognition speak volumes of the institute's objective to promote engineering excellence. The total student strength is 5052 with faculty strength of 355 thus giving rise to healthy faculty student ratio.

It is approved by AICTE, recognized by Govt. of Andhra Pradesh, permanently affiliated to Jawaharlal Nehru Technological University Kakinada (JNTUK), and is accredited by National Assessment and Accreditation Council (NAAC) with 'A' Grade. The college also received UGC recognition under Sections 2(f) and 12 (B) of the UGC Act.

Campus Specialties

- A WOW! Campus
- PIO (Person of Indian Origin) Status
- Accredited by TCS
- MoU with Infosys and other companies
- State-of-the-art Infrastructure
- Hygienic Canteen & Food Courts
- Project & Activity Clubs
- Record Placements
- Experienced & Trained Faculty
- Campus Placement Training
- Sunrise Start-up Village
- MOU with AMCAT, CoCUBES
- Technology Business Incubator from DST
- Incubation centre by Govt. of AP
- SIRO Recognition by DSIR
- Technical Skill Development Institute - APSSDC
- Certification Courses

The following courses are offered in the college for under graduation and graduation courses:

Under Graduate Courses:

- B.Tech Civil engineering
- B.Tech Electrical and Electronics Engineering
- B.Tech Mechanical Engineering
- B.Tech Electronics and Communication Engineering
- B.Tech Computer Science and Engineering
- B.Tech Information Technology
- B.Tech Mining Engineering
- B.Tech Petroleum Technology
- B.Tech Agricultural Engineering
- B.Tech Artificial Intelligence and Machine Learning

Post Graduate Courses

- M.Tech Software Engineering
- M.Tech VLSI Design
- M.Tech Embedded Systems
- M.Tech Computer Science & Engineering
- M.Tech Structural Engineering
- M.Tech Power Electronics & Drives
- M.Tech Thermal Engineering
- M.Tech Petroleum Engineering
- Master of Business Administration
- Integrated Master of Business Administration
- Master of Computer Applications

1.2 Energy Conservation Efforts made by the Management

The committee of the institute recognizes its responsibility to conserve and manage energy in all its operations.

- ✓ Make every effort to commit organizational resources towards energy management
- ✓ Minimize energy costs and give priority to energy efficiency (EE) by utilizing available resources more efficiently

Towards this objective, the management has inducted LED lighting and Solar Power Plant of 500kW for captive use of power for the entire campus covering all colleges of the group institutions. The solar hot water systems of 12000 LPD capacity were also installed for the hostel blocks.

The management wants to explore further scope for energy conservation and energy cost reduction in the campus and thus entrusted the job of Energy audit to KR Energy Consultants.

1.3 Objectives of the Energy Audit

The key objectives of the Energy audit is to identify, prioritize, and recommend a set of proven, customized, low-cost, and implementable measures for reducing the consumption of electrical energy in the campus.

1.4 Scope of Work

The Energy audit has laid emphasis on performance assessment of electrical utilities comprising the following equipment/ areas for identification of cost-effective energy saving solutions:

1) Energy Consumption and Analysis
2) Pumps(Utility)
3) Air Conditioners
4) Fans
5) Lighting
6) DG sets

1.5 Methodology Adopted for conducting the Energy Audit study

KR Energy Consulting has conducted Energy audit field studies at the institute in April 2022. As a part of the Energy audit, KR Energy Consulting audit team has visited campus for data collection, on-site measurements, and performance monitoring of various equipment using portable Energy audit instruments. KR Energy Consulting has adopted the following methodology for conducting the Energy audit:

- Kick-off meeting with the concerned personnel to finalize field action plan
- Inventory of all the electrical appliances installed by physical verification like air conditioners, luminaries, computers, and others. Physical inspection of the electrical distribution system.
- Monitoring of electrical parameters such as voltage, amps, kW, power factor etc. For individual equipment's and feeders
- Monitoring of harmonics at the identified DB's, feeders UPS with power and harmonic analyzer
- Collection of photocopies of monthly electricity bills for the past one year
- Critical analysis of data collected/ measured and assessment of energy efficiency and energy losses
- Identification of energy saving measures and assessment of energy saving potential
- Submission of the report

The approach/ methodology adopted for Energy audit is furnished pictorially below in Figure 1.

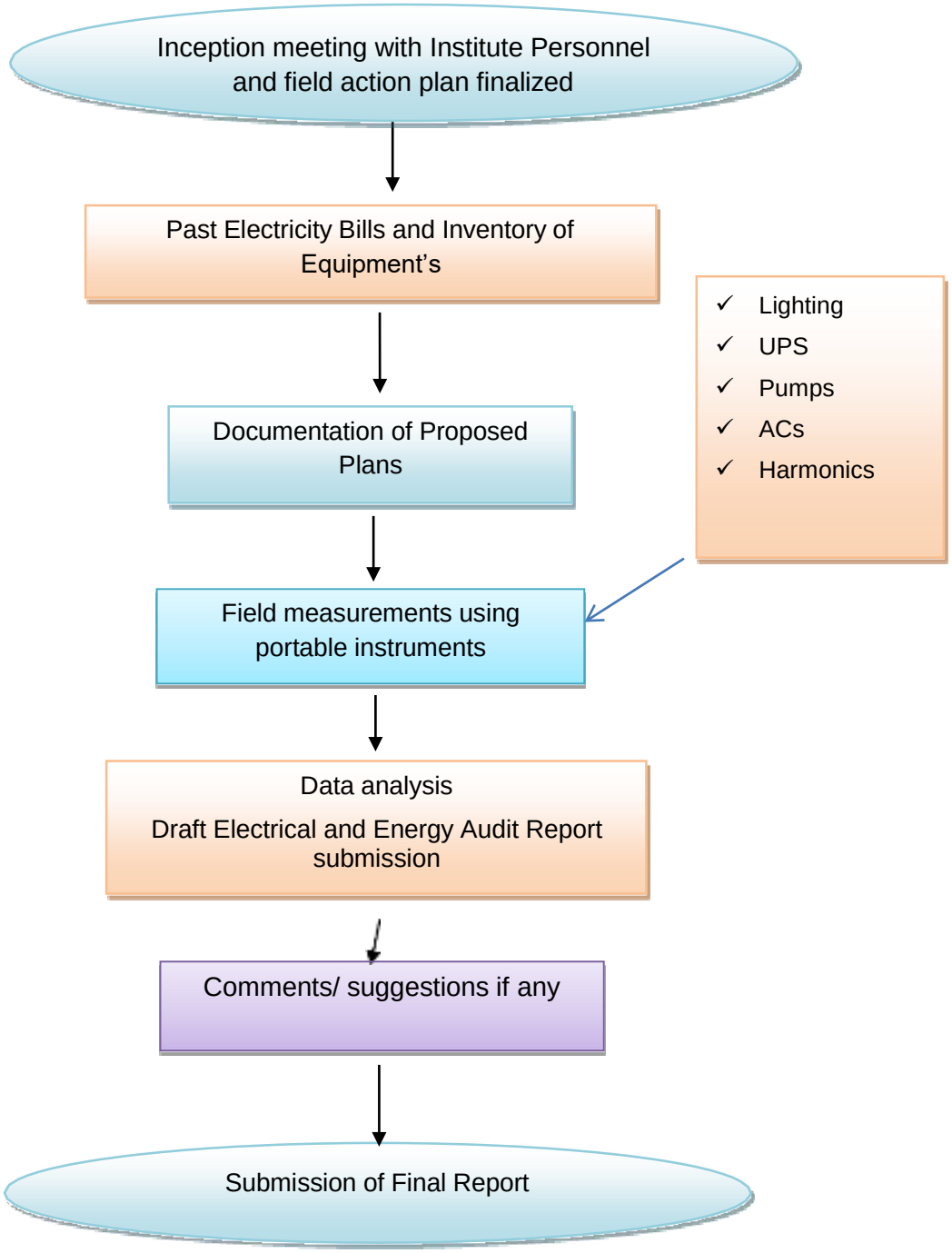


Figure 1: *Approach/ methodology adopted for conducting Energy Audit of Aditya Engineering College, Surampalem, ADB Road, East Godavari District, AP State*

1.6 Measuring Instruments used for the Electrical and Energy Audit

KR Energy Consulting has used portable, micro-processor based, state-of-the-art, calibrated instruments for on-field monitoring of equipment performance during Energy audit. The list of portable instruments used in the study is as follows:

- Nanovip Plus Load Manager
- Harmonic Analyzer
- Lux meter
- Temperature measuring instruments
- Thermal Imager

CHAPTER 2

Energy Consumption & Analysis

The chapter presents the description of various energy inputs used in the Institute, their consumption trends & analysis, annual energy costs, and share of different energy inputs in total energy cost.

2.1 Energy Inputs

Energy sources for the institution are:

- Electricity
- HSD

Electricity is the major energy source in the institute used for lighting, fans, motors etc.
DG Sets are operated as standby to grid power and will run during load shedding. HSD is the fuel for DG Sets.
The campus also has a roof top solar power plant of 500 kW and the electricity generated is used for all the colleges and for captive purpose for the entire campus.

2.2 Electrical Energy Analysis

Grid electricity is supplied by the AP Eastern Power Distribution Company Limited (APEPDCL) voltage of 11kV. The connection meets the entire campus electricity requirement including all colleges of the group in the campus. During grid power shortage/ failure, DG Sets supply the required electricity. The institution has a Contract Maximum Demand (CMD) is 260 kVA for the entire campus in the name of “Aditya Educational Academy“

Data on monthly CMD, recorded MD, billed units, and bill amount for period year from January 2021 to December 2021 is collected, analyzed, and presented in Table 2.1 below:

Table 2.1: *Month-wise CMD, Recorded MD, Billed MD, Billed Units, and Bill Amount (June 2021 to May 2022)*

S.NO	MONTH	CMD	RMD KVA	BILL KVA	PF	kWh	kVAh	Nett Payable Rs.	Solar Units consumption (kWh)
1	Jun-21	260	69.48	208	0.94	11749	12459	0	15547
2	Jul-21	260	113.1	208	0.94	21018	22422	149812	19067
3	Aug-21	260	191	208	0.95	33994	35779	291598	27807
4	Sep-21	260	211	211	0.96	38910	40740	343753	23095
5	Oct-21	260	163.7	208	0.95	37527	39444	296420	19751
6	Nov-21	260	163.8	208	0.95	43534	45857	367576	22743
7	Dec-21	260	162.2	208	0.90	30522	34068	268534	24698
8	Jan-22	260	127.26	208	0.87	20146	23210	143331	21596
9	Feb-22	260	186.7	208	0.89	27453	30877	220006	27941
10	Mar-22	260	267.12	267.12	0.85	31078	36411	307187	34692
11	Apr-22	260	---	---	---	---	47184	558076	35130
12	May-22	260	--	--	--	--	56322	58758	45154
		2080	**1655.36**	**1667**	**6.582243**	**295931**	**424773**	**3005051**	**317221**
		260	**165**	**214**	**0.92**	**29593**	**35398**	**250421**	**26435**

The variation of electricity consumption, recorded demand, billed demand, solar power, and power factor demand is graphically furnished in fig 2.1. 2.2, 2.3, 2.4 and 2.5

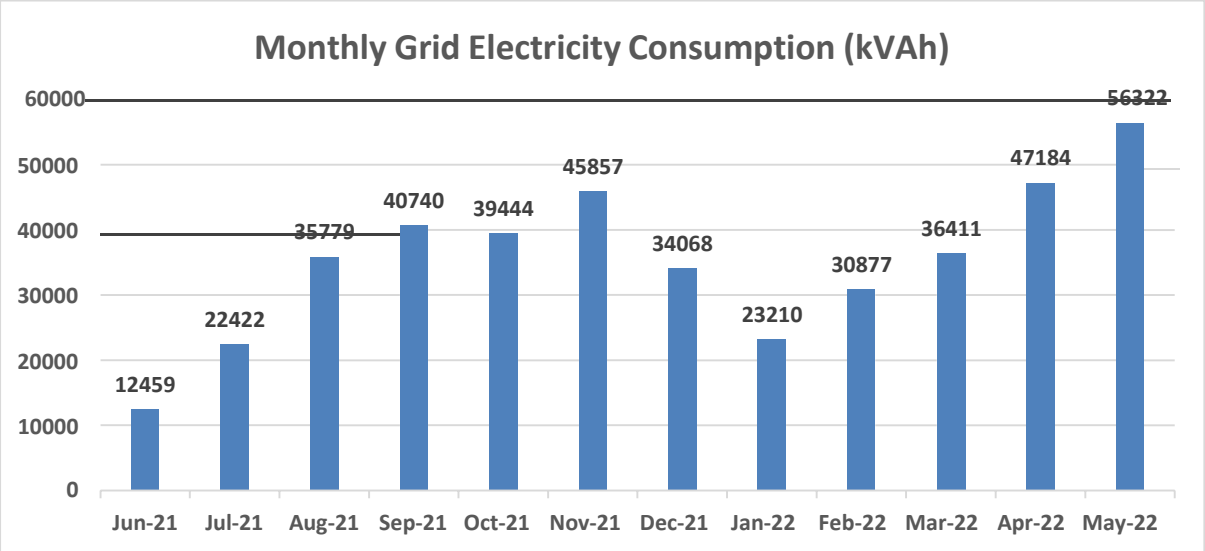


Fig 2.1: Monthly Grid Power Energy Consumption

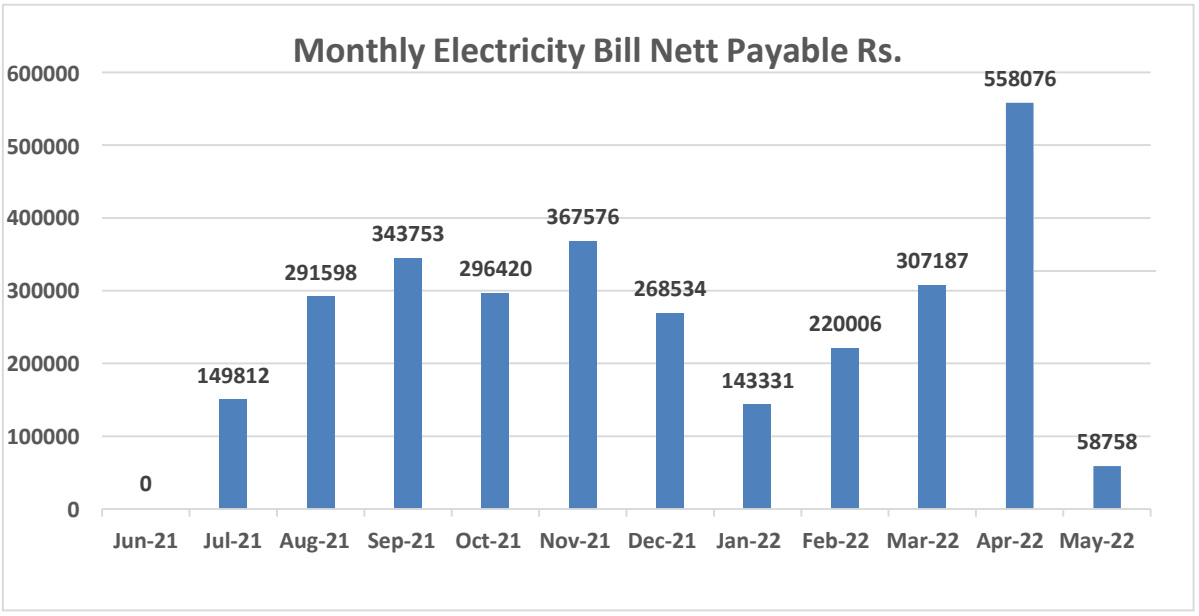


Fig 2.2: Monthly Grid Electricity Bill Net Payable

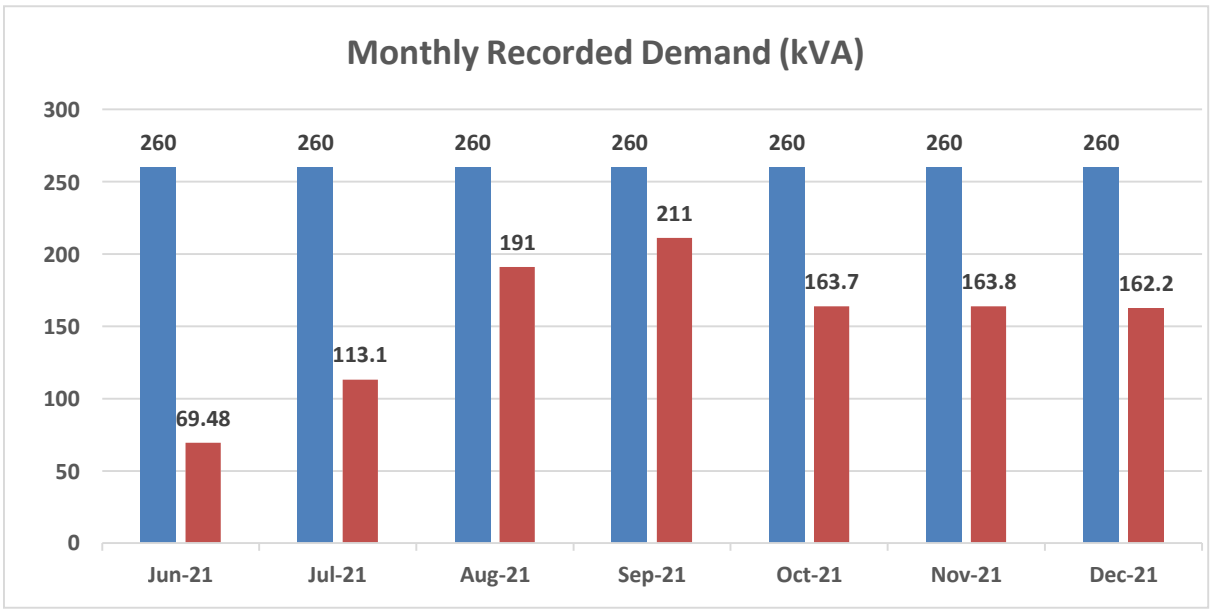


Fig 2.3: Monthly Recorded Demand Variation

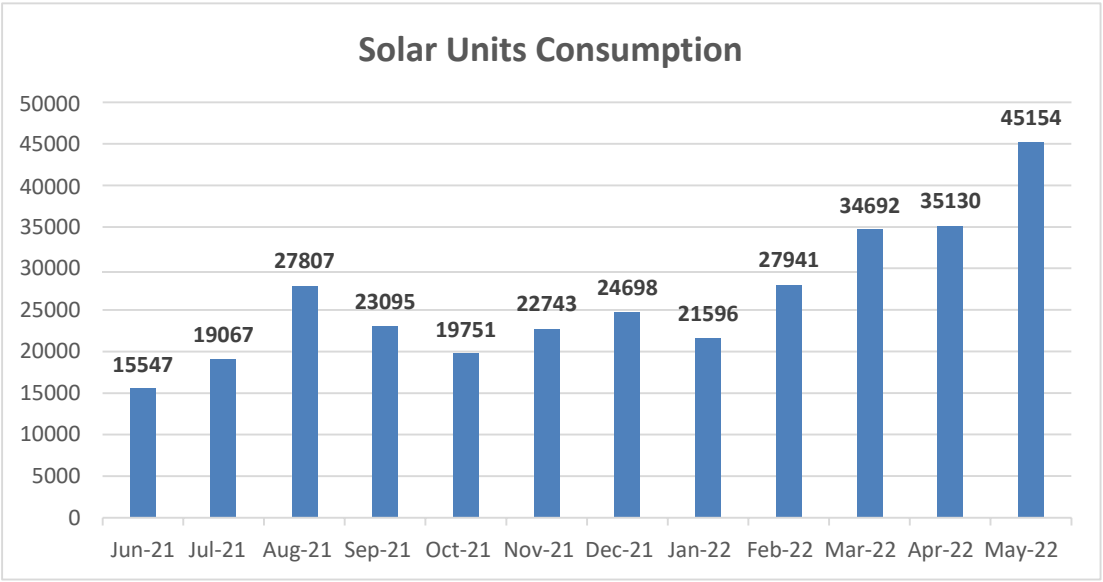


Fig 2.4: Monthly Solar Power Consumed

The key observations made from the analysis of the above data are furnished in Table 2.2 below:

Table 2.2: *Summary of Electrical Energy Consumption Data of the entire campus and colleges (Aditya Educational Academy) – January 2021 – December 2021*

S. No.	Item	Value
1	Contract Maximum Demand (CMD) kVA	260
2	Average recorded demand , kVA	165
3	Average billed demand, kVA	214
4	Demand variation, kVA	69.5 to 267
5	Solar power plant capacity of the campus, kW	500
6	Solar power generated, kWh	489,496
7	Solar power used for captive requirement, kWh	317,221
8	Solar power export to grid, kWh	172,275
9	Annual billed grid electricity consumption, kVAh /year	424,773
10	Total electricity consumption of the campus, kWh	741,994
11	Total annual electricity bill, Net Payable bill Rs. Rs. lakhs/year	30.05
12	Power factor	0.92
13	Average cost of electricity, Rs/kWh (only grid power)	10.1

Considered Rs 10.00/kWh for electrical energy savings in the report

2.3 GHG Emissions

The major energy form used for the institute is grid electricity supplied by AP Eastern Power Distribution Company Ltd (APEPDCL): The emission factor for grid electricity is 0.92 kgs of CO2/kWh and is calculated month wise and is furnished below in Table 2.3

Table 2.3: *GHG emissions due to grid electricity use*

Month& Year	Monthly units	Monthly GHG Emissions (tCO2)
Jun-21	12459	11.46
Jul-21	22422	20.63
Aug-21	35779	32.92
Sep-21	40740	37.48
Oct-21	39444	36.29
Nov-21	45857	42.19
Dec-21	34068	31.34
Jan-22	23210	21.35
Feb-22	30877	28.41
Mar-22	36411	33.50
Apr-22	47184	43.41
May-22	56322	51.82
	424,773	**390.79**

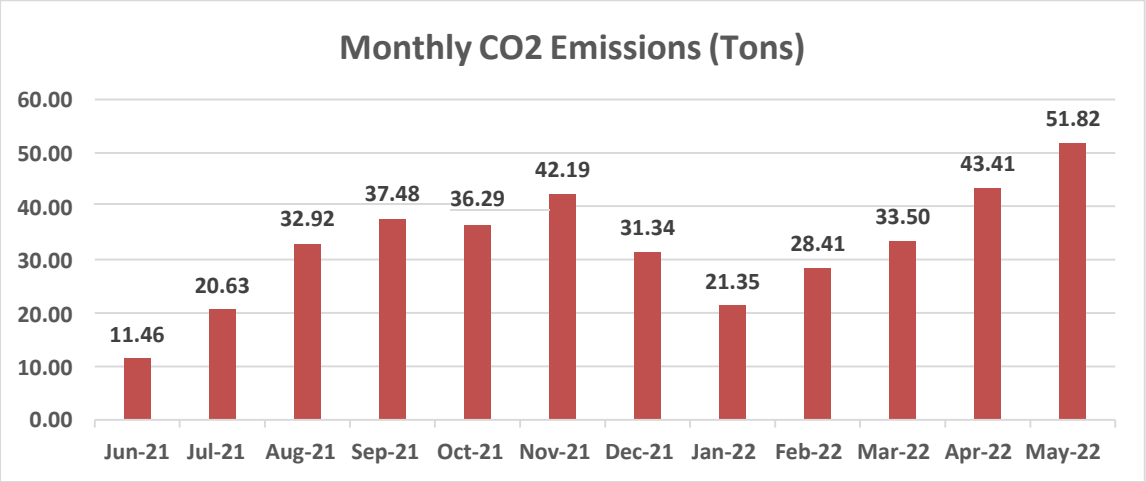


Fig 2.6: Monthly Carbon dioxide Emissions due to grid electricity use

2.4 Solar Power Plant GHG Emissions Reduction

The management has installed a roof top SPV Power plant as an initiative to offset GHG emissions to the world. The capacity of the SPV power plant is 500 kW with net metering facility.

So far, about 489.496 *MWh has been generated from June 2021 to May 2022, the solar power is used for captive requirement for the campus, the power is also exported to grid during holidays is about 172.275 MWh. Due to solar power plant, about 450.3 tons of* CO_2 *is avoided in the climate every year and is almost offset of the grid power used during the same period.*

2.5 Power Factor and Maximum Demand

Power factor, billing demand and recorded MD for period from *January 2021 to December 2021* is collected and presented in Table 2.4 below:

Table 2.4: *Monthly Power Factor and Recorded Maximum Demand*

Month	CMD (kVA)	Recorded Demand (kVA)	PF
Jun-21	260	69.48	208
Jul-21	260	113.1	208
Aug-21	260	191	208
Sep-21	260	211	211
Oct-21	260	163.7	208
Nov-21	260	163.8	208
Dec-21	260	162.2	208
Jan-22	260	127.26	208
Feb-22	260	186.7	208
Mar-22	260	267.12	267.12
Apr-22	260	--	--
May-22	260	--	--
Average	**260**	**165.4**	**0.92**

(a) Contract Demand

- Contract Maximum Demand is 260 kVA and average recorded demand is 165 kVA, the RMD is low, as the college is out of operation due to COVID Problem
- The highest maximum demand recorded during the last 12 months is 267 kVA due to low PF, few capacitors may be failed, or output may be deteriorated
- The maximum demand is OK for the present utilization and is satisfactory.
- The minimum billing demand is 80% of the CMD and is 208 kVA

(b) Power Factor

The average monthly power factor was 0.92 as noted and as per electric bills. The power factor is low, and it is suggested to improve the power factor.

At present, the distribution companies are billing on kVAh basis and not on kWh. Hence, there is direct impact on the power factor. If the power factor is unity, the kWh is equal to kVAh, if the power factor is less than unity, the kVAh billing increases. Hence, it is suggested to maintain the power factor close to unity.

Apart from reduction in electricity bill, the demand charges reduces and stabilizes system voltage.

Hence, it is recommended to install additional capacitor banks for improving the power factor from 0.92 to 1.00. Based on the present PF and present load usage, about 50 kVAR capacitor banks always to be connected at the main bus bar in the facility for maintaining unity Power factor or automatic power factor controller can be installed. The cost benefit analysis of improving the power factor is furnished below:

Table 2.4: *Cost Benefit Analysis of Improving Power Factor*

S.no	Details	Value
1	Present average power factor	0.92
2	Power factor after improvement	1
3	Average monthly energy consumption , Lakh kVAh	30907
4	Average monthly electricity bill, Rs. In lakhs	2.16
5	% Reduction in energy bill, %	8

6	Energy savings kVAh (rounded off) per month, kVAh Energy savings per annum, kVAh	2473 29671
7	Unit cost of Electricity, Rs./Unit	10
8	Monetary Savings ,Rs in lakhs/year	2.97
9	Investment required for KVAR capacitor bank , Rs lakhs	0.25
10	Payback, Months	1.0

2.7 Harmonics

This term refers to a wide variety of electromagnetic phenomena that characterize the voltage and current at a given location of a power system any power problem manifested in voltages, current, or frequency deviations those results in failure or malfunctioning of customer equipment. Power quality has become increasingly important for industrial and commercial electric power customers, particularly as today control processes rely on computerized equipment which is sensitive to power system interruptions and disturbances.

As harmonic levels increase, the probability of experiencing problems also increases. Typical problems include:

- Malfunctioning of microprocessor-based equipment by disruptions of operations.
- Heating effects in power handling equipment's such as motors, transformers, overheating in neutral conductors. There by reduces the operating life
- Deterioration or failure of power factor correction capacitors.
- Erratic operation of breakers and relays.
- Pronounced magnetic fields near transformers and switchgear.

The harmonics were measured for the selected panel stand UPS. The Voltage & Current harmonics are ranged as below:

Table 2.4 *Harmonics Measurements values for Panel by Harmonic Analyzer*

Reference	$THD_{rms,v}$	$THD_{rms,i}$
Main panel	0.6% to 1.7% Voltage Harmonics within the limits	3.0% to 8.5%
Recommendation	No Harmonics exists and harmonics are within the limits	

2.6 DG Sets

The institution has three DG sets of 160 kVA each for meeting the total campus load of 160 kVA (1no). The DG sets are operated as per the requirement and during grid power failures.

CHAPTER 3

Fans & Air conditioners

This chapter presents the type of air conditioners and fans used, their energy performance, and cost-effective energy conservation measures for reducing energy consumption in air conditioners and fans.

Hostels

The institution has two hostel blocks for boys and girls separately.

S.No	Hostel Block	Rooms	Students	Fans	C.F.L	Tube Lights	LED
1.	**B**	**152**	**291**	**324**	**-**	**317**	**331**
2.	**D**	**255**	**160**	**335**	**-**	**336**	**374**

There are 407 rooms in the hostel and 451 students residing in the hostels. The main electrical equipment's/gadgets used are fans. Tube lights, geysers, ACs etc.

3.1 Details of Fans

The ceiling fans are installed, and the inventory of the fans and connected load is given below in Table 3.1:

Table 3.1:*No. of Fans installed and Wattage*

S.No.	Name of the Building	Fans each 50Watt
1	Cotton Bhavan	269
2	KL Rao Bhavan	435
3	Bill Gates Bhavan	587
4	Abdul Kalam Bhavan	384
5	Ratan Tata Bhavan	134
6	Hostel	659
	Total	**2084**
	Connected load kW	**123.4**

3.2 Fans- Observations & recommendations

- Fans are provided with fixed and running capacitor. The speed drops if the value deteriorates with time. Timely replacement of capacitor is necessary.
- Presently, in many rooms conventional electrical regulators are installed and it is suggested to replace old conventional regulators with new electronic type regulators.
- In majority of the rooms, the fans are consuming more power than rated.

a) Cost benefit Analysis of Replacing old Ceiling Fans with new efficient fans

Energy savings can be achieved by replacing the existing old ceiling fans with 5 Star Rating (BEE) energy efficient ceiling fans:

- Option 1: 5 Star rated Fans
- Option 2: Super Fans

Initially, it is recommended to replace old fans of 100 nos. and after successfully achieving the savings, other fans can be replaced in a phased manner. The cost benefit analysis made for a sample of replacement of 100 fans fewer than two Options are furnished below:

i) Option (1) Replace old fans with 5 Star Rated Fans

Star Rating	Min. Air Delivery (AD) m^3/ min	Input Power in Watts	Service Factor (SV=AD/ Power) m3/min/Watt	Cost (Rs)
5 Star	215-225	50-53	>=4	1,850-2,200

A few good brands of the 5 Star rated Fans are Ortem, Relaxo, Orient, Usha, Crompton Greaves, Bajaj, and Havells. Normally, these fans come with a warranty of two years.

ii) Option 2: Super-Efficient Ceiling Fans

Features of Super-Efficient Ceiling fans are:

- Energy savings, more than 50% savings, lower electricity bill
- Remote control, no regulator needed, saves space on switchboard
- High air delivery
- Inverter/UPS friendly – Runs twice longer, no extra noise, no speed drop
- No speed change due to supply variations or low voltage
- Power factor better than 0.9
- Service value of more than 6 - more air per watt
- BLDC Motor runs cool - No heat generated

- LED Indication for remote operation
- Attractive colors and designer leaves
- 5 years warranty
- Cost Around Rs 3,200 per Fan

Presently, Super fan is the company, which manufactures these types of fans.

The comparison of ordinary fan, 5 star fan, and super fan in terms of design and operational aspects are furnished below in Table 3.2:

Table 3.2: *Comparison between Ordinary Fan, 5 Star Rated fan & Super Fan (1200mm)*

S.No	Parameter	Ordinary fan	5 Star rated Fan	Super fan
1	Rated Power, Watt	60-90	40	30
2	Min. Air Delivery, m^3/min	210-215-220	215-220	220
3	Service Factor, m^3/min/Watt	3.35-3.73	4.0-5.0	6.28
4	Cost, Rs/Fan	1200-1300	1800	2500
5	Life, Years	10-12	10-15	15
6	Warranty, Years	1	2	3-5

The cost-benefit analysis of replacing the existing ordinary fans with (i) 5 star rated fans and (ii) super-efficient fans is provided in Table 3.3:

Table 3.3: *Cost Benefit Analysis of Replacing Fans with 5 Star Rated & Super-Efficient Fans*

Description	Unit	Option1: 5 Star Rated Fans	Option2: Super-Efficient Fans
Number of Fans (*Considered 100 Nos. as sample for case study*)	Nos.	100	100
Actual power consumed	Watts	70	70
Power consumption of new Fan	Watts	40	30
Average operation	hours/day	8	8
	Days/year	250	250
Annual energy savings	kWh/yr.	6,000	10,000
Cost of energy	Rs/kWh	10	10
Total Annual saving	Rs	60,000	1,00,000
Cost of new Efficient fans	Rs/Fan	1,800	2,500
Investment	Rs	1,80,000	2,50,000
Simple Payback period	Months	36	30

Note: Price is subjective and be further reduced if taken on bulk quantity. The average life of fans is 10 years.

Initially, the management can replace 100 no's in first phase and after successfully achieving savings and recurring savings, all the fans can be replaced for power savings.

3.3 Air conditioners

The air-conditioning systems available at Institute are of split air conditioners. There are total of 16 air conditioners in the hostel and college administration block. The rated capacity of AC's is 1.5 TR each and total capacity is 72 TR.

S.No.	Name of the Building	AC 1.5 Ton
1	Cotton Bhavan	19
2	KL Rao Bhavan	5
3	Bill Gates Bhavan	22
4	Abdul kalam Bhavan	2
5	Ratan Tata Bhavan	-

3.4 Air conditioners -Observations & Recommendations

(a) Observations

It is beneficial to install 5 Star rated ACs in future as 5 star rated ACs will consume less power than 3 star rated, and additional investment is less as compared to the savings. Air conditioners over 10 years can be replaced with new 5 star rated ACs.

(b) Recommendations

(i) Install Energy Saver for ACs

Airtron is the most advanced AC SAVER with all the controls of a Precision AC.

Airtron's dual sensors reference the Room and Coil Temperature and working in tandem with its multiple algorithms in a "closed -loop circuit" ensure the high savings and adapts AC to Ambient Temperatures and Climatic changes, by maintaining room temperature while compressor run time is reduced.

Airtron allows to program the AC to climate & geographical locations and automatically adjusts itself to change the ambient conditions to save electricity. AIRTRON is available with a Remote for setting the Room Temperature and in Non-Flammable Polycarbonate Enclosure with SMPS Power Supply, to tolerate wide Voltage and Current fluctuations, Surges, Spikes and Sags.

Airtron has been validated on all ACs- Inverters, 5 Star, Splits, Multi-Splits, Packages, Ductable, Windows, Cassettes from 1.0 - 20.0 TR.

The salient features of Airtron AC saver are:

- ✓ Most advanced AC saver
- ✓ Display Room & Coil Temperature
- ✓ Automatically adapts AC to changes in ambient temperature & Climate
- ✓ Easy to install
- ✓ Applicable on ACs from 1.0 to 20TR, saves equally on inverters & 5 Star/ 1-Star AC's
- ✓ Energy saving up to 15 to 20%

Table 3.5: *Cost-benefit Analysis - Installation of AC Saver*

Description	Unit	Split AC
Total number of ACs	Nos.	48
Total AC load	kW	86.4
No. of hours of operation/ day	Hours/day	6
No. of days per annum	Days/year	200
Annual Energy Consumption	kWh/year	1,03,680
Power saving due to AC Saver @15%	kWh/year	15,552
Annual monetary savings(*@Rs.10.0 per kWh*)	Rs.	1,55,520
Investment for AC Savers *(@Rs.5,000 x 48 no's*	Rs.	2,40,000
Payback period	Months	19

3.4.1 Best Practices for Efficient Operation Air Conditioners

- *False ceiling*: excellent quality false ceiling must be maintained in the air conditioned rooms by keeping all doors and windows closed properly to prevent cool air go out and warm air come in.
- *Curtains*: Always keep curtains on windows to prevent direct sunlight inside the room to avoid heating of cooled air. This reduces AC load significantly.
- *Maintenance*: Proper maintenance and cleaning of ACs is required at regular intervals to make it work efficiently. Any dirt in filter may reduce efficiency of ACs very significantly.
- *Operation*: ACs should be switched on 15 minutes before actual use and should be switched off before leaving the room
- Outdoor units need to be kept under shady area and direct expose to sunlight will increase the power consumption of the compressor

- AC false ceiling to be provided for the AC rooms, for better air conditioning and reduction of room area and heat losses
- By adopting the above measures, a minimum of 10% to 15% of electricity consumption by ACs can be reduced.

CHAPTER 4

Lighting

4.1 Details of Lighting

Lighting system was assessed through visual observation and technical specification data were noted. The inventory data of the luminaries was provided by the department. The total lighting load of the unit is considerable of the total electrical load of the unit and hence, lighting needs equal emphasis along with other energy consuming areas. The plant has the following types of luminaries as under:

- LED Tube Lights
- LED Street Lights
- CFLs

Table 4.1:*Lighting load details*

S.No.	Name of the Building	C.F.L 10Watt	Tube Lights 20Watt	LED
1	Cotton Bhavan	62	161	
2	KL Rao Bhavan	44	324	
3	Bill Gates Bhavan	21	376	
4	Abdul Kalam Bhavan	83	244	
5	Ratan Tata Bhavan	16	97	
6	Hostel Block D		317	331
7	Hostel Block B		336	374
	Total	**226**	**1855**	**705**
		2.26	**37.1**	**14.1**

Majority of the tube lights are LED tube lights in the institution, and some are CFLs. The total connected load of lighting is 53.46 kW. It is suggested to replace the CFLS with LEDs bulbs or lights. The cost benefit analysis is furnished below:

Table 4.1:*Cost benefit Analysis of replacing CFLs with LEDs.*

Description	Unit	CFLS
Total number of CFLs	Nos.	226
Wattage	W	10
No. of hours of operation/ day	Hours/day	6
No. of days per annum	Days/year	250
Annual Energy Consumption	kWh/year	3,390
Power saving due to LEDs @50%	kWh/year	1,695
Annual monetary savings(*@Rs.10.0 per kWh*)	Rs.	16,950
Investment for AC Savers *(@Rs.100/- per bulb or light*	Rs.	22,600
Payback period	Months	16

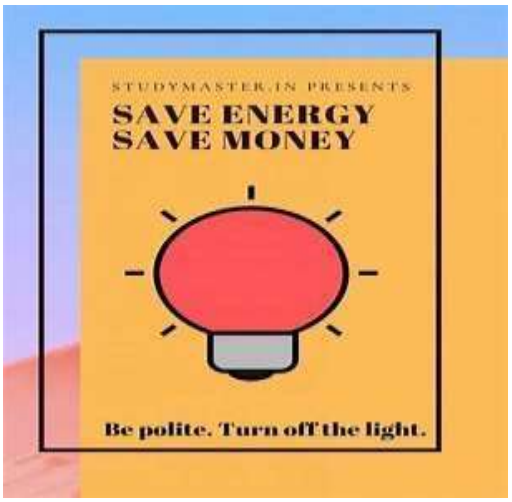
CHAPTER 5

General Observations

5.1 General Observations

All Class Rooms, hostel rooms and laboratories are observed to have Display Messages or Posters regarding optimum use of electrical appliances in the room like, lights, fans, computers, and projectors. Few sample posters is furnished below:

(a) Sample Posters for Awareness towards Energy Conservation



Also have stickers/labels of slogans/lines for energy saving in Class rooms/ Common areas

- Energy saved is energy produced.
- Switch of Lights/ Fans if not used
- Conservation: It does not cost. It saves.
- Spare a Watt; Save a Lot
- Save Today. Survive Tomorrow
- Energy misused cannot be excused

(b) Safety posters