



**Energy Audit Report
Arvindbabu Deshmukh Mahavidyalaya,
Bharsingi, Nagpur, Year 2020-21**



**ENERGY AUDIT REPORT
CONSULTATION REPORT**



Arvindbabu Deshmukh Mahavidyalaya
Bharsingi, Pin – 441305, Nagpur
India

PREPARED BY

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Year: 2020-21





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ACKNOWLEDGEMENT

Empirical Exergy Private Limited (EEPL), Indore (M.P) takes this opportunity to appreciate & thank the management of **Arvindbabu Deshmukh Mahavidyalaya Bharsingi, Nagpur** for giving us an opportunity to conduct energy audit for the college.

We are indeed touched by the helpful attitude and co-operation of all faculties and technical staff, who rendered their valuable assistance and co-operation the course of study.




Rajesh Kumar Singadiya

(Director)

M.Tech (Energy Management), PhD (Research Scholar)
Accredited Energy Auditor [AEA-0284]
Certified Energy Auditor [CEA-7271]
(BEE, Ministry of Power, Govt. of India)
Empanelled Energy Auditor with MPUVN, Bhopal M.P.
Lead Auditor ISO50001:2011 [EnMS) from FICCI, Delhi
Certified Water Auditor (NPC, Govt of India)
Chartered Engineer [M-1699118], The Institution of Engineers (India)
Member of ISHRAE [58150]




CERTIFICATION OF ACCREDITATION

 **BUREAU OF ENERGY EFFICIENCY**

Examination Registration No.: **EA-7271**

Accreditation Registration No.: **AEA-284**



Certificate of Accreditation

This is to certify that Mr./Ms. **Shri. Rajesh Kumar Singadiya** having its trade/registered office at has been given accreditation as accredited energy auditor. The certificate shall be effective from **9th** day of **May, 2018**


The certificate is subject to the provisions of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

This certificate shall be valid until it is cancelled under regulation 9 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

On cancellation, the certificate of accreditation shall be surrendered to the Bureau within fifteen days from the date of receipt of order of cancellation.

Your name has been entered at AEA No. **284** in the register of list of accredited energy auditors. Your name shall be liable to be struck out on the grounds specified in regulation 8 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

Given under the seal of the Bureau of Energy Efficiency, Ministry of Power, this **5th** day of **October, 2018**


Secretary,
Bureau of Energy Efficiency
New Delhi

EXECUTIVE SUMMARY

The executive summary of the energy audit report furnished in this section briefly gives the identified energy conservation measures and other recommendation during the project that can be implemented in a phased manner to conserve energy, increase productivity inside the college campus.

ENERGY MANAGEMENT INITIATIVE TAKEN BY COLLEGE

✚ 10 KWp SOLAR PHOTOVOLTAIC ROOFTOP INSTALLATION:

- College has 10 KWp solar photovoltaic roof top grid connected system installed on college main building. Solar unit generation for the year 2020-21 from July to June is **6,350 units. It is about 66.14 % of total Energy consumption of the college.**

Solar Unit Generation (July 2020-June-2021)	Grid Unit Consumption (July 2020-June-2021)	Total Unit Consumption (Solar+Grid)	RE Share (%) Year 2020-21
6,350	3,250	9,600	66.14%

- ✚ **LIGHTING SYSTEM:** College has installed 57 No. energy efficient LED lighting (20 W) for new construction under energy policy of the college.

RECOMMENDATION FOR IMPROVEMENT

✚ LIGHTING SYSTEM

- Replacement of 185 No of “conventional T-12 (40 Watt)” tube light by energy efficient LED lighting (20Watt) fixture .
- Installation of “**Timer control on focus light,street lighting and high mask**” in college campus recommended for energy saving in the campus.

✚ CEILING FAN :

- Replacement of “conventional ceiling fan (80 Watt)” by BLDC based energy efficient fan (28 Watt) in “admin building, class rooms, and faculties cabin” which has 8-10 Hrs/day running, great potential for energy saving.



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✚ IOT BASED ENERGY MONITORING SYSTEM AT MAIN FEEDER

- Installation of “Cloud based (IoT based) energy monitoring system” at main panel for energy monitoring on day to day basis. Expected energy saving potential about 2 to 4%. It will give real time measurement of power factor and line losses from the cable.
- Installation of “Cloud based fuel and unit generation monitoring system” in DG set will help to monitor specific unit generation by DG set failure of the grid power. At present college management has only fuel consumption details. Energy generation measurement will help to determine efficient operation of DG set and also find out specific generation (kWh/ Liter of Fuel) of DG set.



CHAPTER-1 **INTRODUCTION**

1.1 About College

Arvindbabu Deshmukh College of Arts, Science and Commerce also well known as AD College, was established in 1986. In its journey during the past 35 years it has grown in strength from 75 students from its inception to a total strength of 2000 students today. Also there are 1300 students studying in YCMOU through this college. Under the affiliation of Rashtasant Tukadoji Maharaj University of Nagpur. College offers undergraduate and post graduates programs like B.A., B.Com. From 1986 and later in 2008 B.Sc. and M.A. have been started. The college is also identified as community college under scheme of UGC and running a skill oriented diploma course in Welding and Fabrication. Beside that the college also runs as-on courses like Fashion designing and Communicative English. Listed in first top ten for the graduation course in mass media. College having units such as N.S.S. of 250 students, college awarded with best college for N.S.S. by R.T.M.N.U., Nagpur. College having very active sport department. Every year students are performed at National, State, University level and received Gold, Silver and bronze medal. Our college organized International, National, State and University level Conferences, Seminars and Workshops in various subjects. College is popular for its cultural, sports and drama activities and infrastructural facilities.



Fig 1.1 – Satellites image of college from Google map



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VISION

To become a centre of quality education by promoting high academic and social pursuit and competencies of students of rural region for all round development



MISSION

- To impart higher education for all round development of students of rural area and provide them an opportunity to made them competent for development in society
- The priority of the institution is to bring academic excellence along with personality development to compete with the rest of the world.
- The institution is located in the remote area so maximum students belong to backward communities and socio – economically weaker section so provide them opportunity to make themselves competent.
- To provide opportunity in future by providing them quality education, skilled base programme, competitive examination guidance, sports facility etc.

Name of Department :

Following are the teaching department in the college.

Sr. No.	Name of Teaching Departments
1	Department of Marathi
2	Department of English
3	Department of History
4	Department of Political Science
5	Department of Economics
6	Department of Music
7	Department of Home-economics
8	Department of Chemistry
9	Department of Botany
10	Department of Zoology
11	Department of Physics
12	Department of Mathematics
13	Department of Commerce

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Sr. No.	Floor	Department
1.	Ground floor	Administration office, Principal cabin, Classrooms
2.	First floor	Examination cell, IQAC room, Classrooms, Computer lab
3.	Second Floor	Science Laboratory, Audio visual hall, classroom, Girls common room
4.	Third floor	Classrooms, Boys common room
5.	Indoor stadium area	Indoor stadium, gymnasium, college canteen,
6.	Girls hostel	Hostel rooms, Canteen, warden room
7.	Playground	Playground, Basketball court, parking



Fig.- College campus



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1.2 About Infrastructure:

The college is spread over 5807.4 m² plenty of open space and sports area interspersed within academic buildings. The details of various department and building are given in table 1.1:

Table 1.1 :- Name of the various building in the college

Sr. No.	Building	Department
1.	Main Building	3033.115 Sq. m.
2.	Indoor	1176. 15 Sq. m.
3.	Hostel	1458.114 Sq. m.
4.	Canteen	140 Sq. m.



Fig.- Some pics of college campus



1.3 College Layout Of Various Buildings

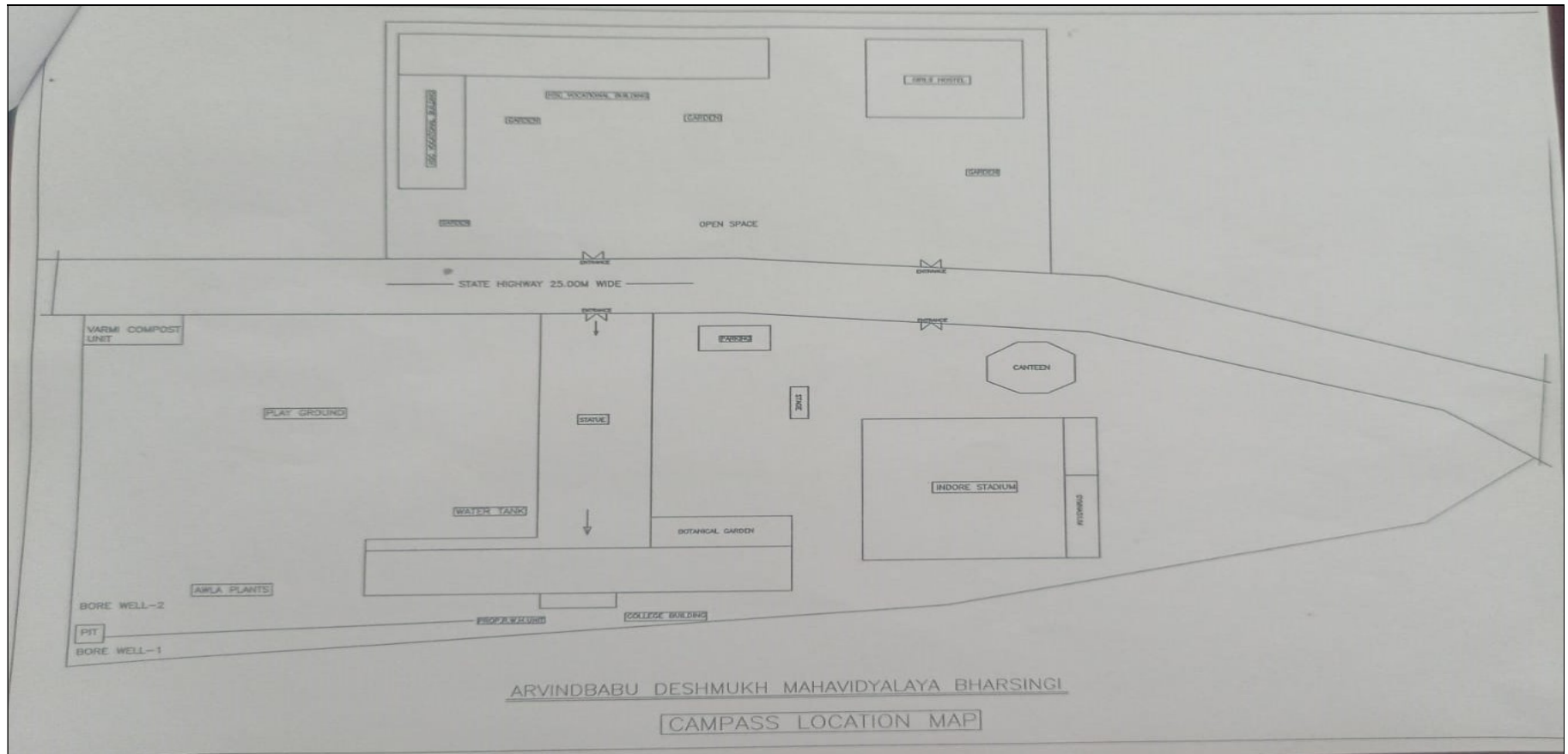
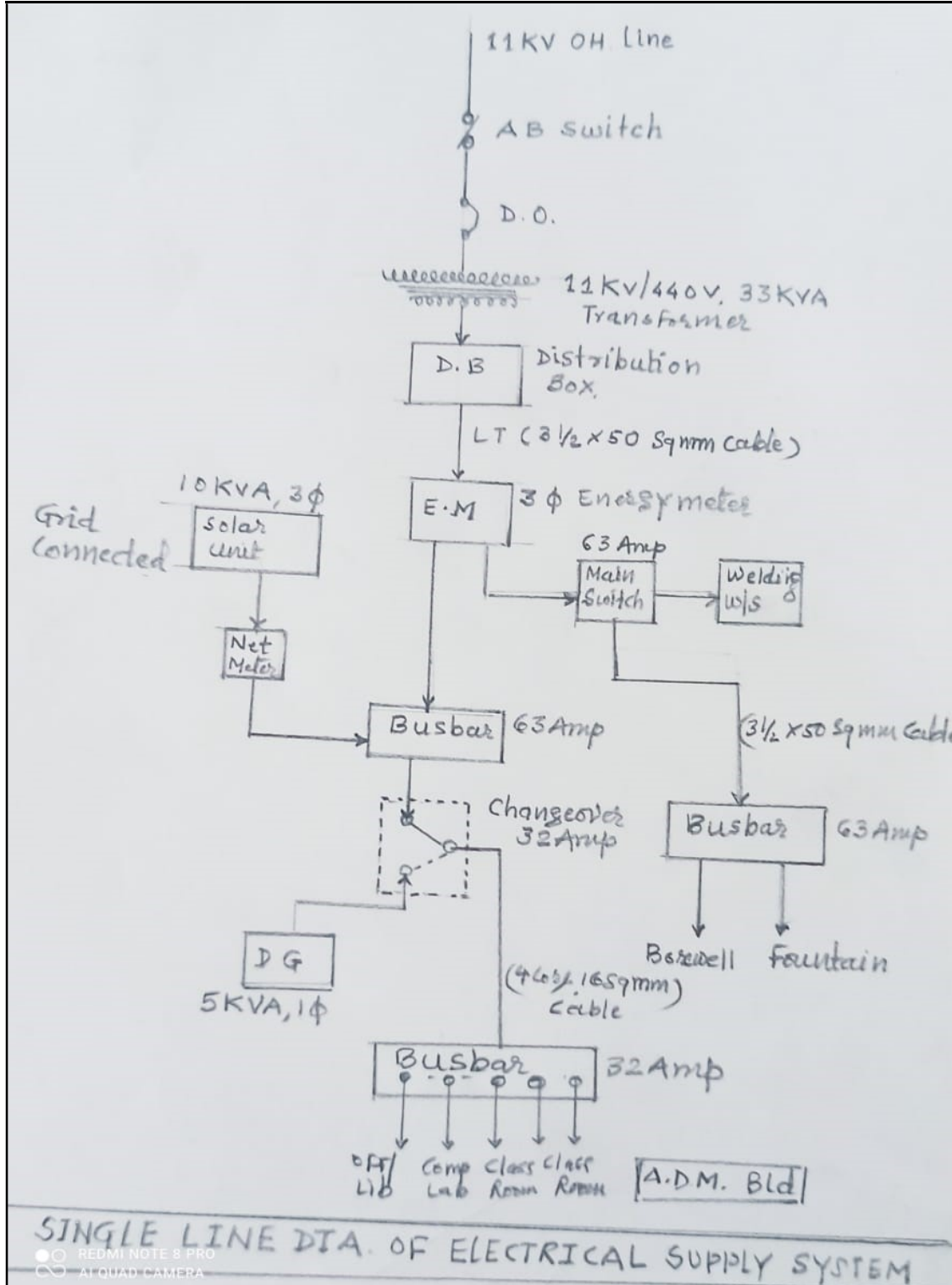


Fig.-1.2 College Layout Of Various Buildings



1.4 Single Line Diagram (SLD) Substation & college





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1.5 Green Monitoring Committee

NAAC Re-accredited with 'B' Grade
VSPM Academy of Higher Education
Ph : 2333

ARVINDBABU DESHMUKH MAHAVIDYALAYA
BHARSINGI, Dist. Nagpur - 441305

Dr. Prakash Pawar
Officiating Principal

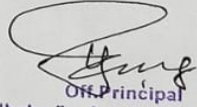
Ref.No. : *ADM/2022/117* Date *12/02*

Energy, Environment & Green audit committee

Energy, Environment & Green audit committee consist of following members.


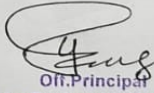
Sr. No.	Name	Designation
1.	Dr. P. D. Pawar	Chairperson
2.	Dr. M.M. Varma	Convener
3.	Dr. S. B. Thakare	Member
4.	Dr. S. P. Gudadhe	Member
5.	Dr. A. R. Gharpure	Member
6.	Dr. A. L. Gadre	Member
7.	Dr. S. R. Bansod	Member
8.	Mr. S. R. Sinkar	Member
9.	Mr. B. B. Madhavi	Member
10.	Mr. C.B. Barapatre	Administrative Member

This committee working period is for 03 year up to June 2024 and after that committee will be reconstructed.


Off. Principal
Arvindbabu Deshmukh Mahavidyalaya,
Bharsingi Dist. Nagpur

e-mail : adm_bharsingi@rediffmail.com website : www.adm.edu.in, Ph : 07105-233533, 233330

1.6 Integrated Energy, Environment & Green Policy

 Dr. Prakash Pawar Officiating Principal	STD : 07105 NAAC Re-accredited with 'B' Grade VSPM Academy of Higher Education ARVINDBABU DESHMUKH MAHAVIDYALAYA BHARSINGI, Dist. Nagpur - 441305 Ph : 233329
Ref.No. : <i>Adm/2022/117</i>	Date <i>12/02/2022</i>
Integrated Energy, Environment & Green Policy	
<p>Management of our institution is committed to go green for making our nation to Atma-Nirbhar (Self-Sustainable) in area of energy and environment.</p>	
<p>Our emphasis is to:-</p>	
<ul style="list-style-type: none"> • Ensure continuous enhancement in our energy and water conservation and usage. • Continuous monitoring the energy consumption pattern through periodic reviews and using latest informative system. • Procure and use energy efficient equipment's and products. • Create awareness regarding necessity of energy conservation and making environment pollution free to all the stakeholders by arranging awareness activity such as seminar, webinar, rallies and guest lectures etc. • Carry out regular energy, environment and green audit by certified auditors to identify the areas for improvement. 	
 Off. Principal Arvindbabu Deshmukh Mahavidyalaya, Bharsingi Dist. Nagpur e-mail : admv_bharsingi@rediffmail.com website : www.adm.edu.in, Ph : 07105-233533, 233330	

1.7 The Audit Team

The study team constituted of the following senior technical executives from Empirical Exergy Private Limited,

- ✚ Mr. Rajesh Kumar Singadiya, [Director & Accrediated Energy Auditor , AEA-0284]
- ✚ Mr. Rakesh Pathak, [Director]
- ✚ Mrs. Laxmi Raikwar Singadiya, [Energy Engineer]
- ✚ Mr. Lokesh Kumar Verma, [Project Engineer]
- ✚ Mr. Ajay Nahra, [Site Engineer]

1.8 About Energy Audit

Energy audit helps to understand more about the ways energy is used in any plant and helps in identifying areas where waste may occur and scope for improvement exists. The overall energy efficiency from generation to final consumer becomes 50%. Hence one unit saved in the end user is equivalent to two units generated in the power plant.

Energy audit is the most efficient way to identify the strength and weakness of energy management practices and to find a way to solve problems. Energy audit is a professional approach in utilizing economic, financial, and social and natural resources responsibility. Energy audits “adds value” to management control and is a way of evaluating the system.

Empirical Exergy Private Limited (EEPL), Indore M.P. carried out the “Energy Audit” at the site to find gaps in the energy consumption pattern for college. A technical report is prepared as per the need and the requirement of the project.

1.9 Objectives of Energy Auditing

An energy audit provides vital information base for overall energy conservation program covering essentially energy utilization analysis and evaluation of energy conservation measures. It aims at:

- Identifying the quality and cost of various energy inputs.
- Assessing present pattern of energy consumption in different cost centers of operations.
- Relating energy inputs and production output.
- Identifying potential areas of thermal and electrical energy economy.
- Highlighting wastage in major areas.
- Fixing of energy saving potential targets for individual cost centers.
- Implementation of measures for energy conservation & realization of savings.

1.10 Methodology:

Methodology adopted for achieving the desired objectives viz.: Assessment of the current operational status and energy savings include the following:

- ✚ Discussions with the concerned officials for identification of major areas of focus and other related systems.
- ✚ Team of engineers visited the site and had discussions with the concerned officials / supervisors to collect data / information on the operations and load distribution within the plant and same for the overall premises. The data was analyzed to arrive at a base line energy consumption pattern.
- ✚ Measurements and monitoring with the help of appropriate instruments including continuous and / or time-lapse recording, as appropriate and visual observations were made to identify the energy usage pattern and losses in the system.
- ✚ Trend analysis of costs and consumptions.
- ✚ Capacity and efficiency test of major utility equipment's, wherever applicable.
- ✚ Estimation of various losses
- ✚ Computation and in-depth analysis of the collected data, including utilization of computerized analysis and other techniques as appropriate were done to draw inferences and to evolve suitable energy conservation plan/s for improvements/reduction in specific energy consumption.

1.11 Present Energy Scenario:

College uses energy in the form of electricity purchased from grid and 10 KWp solar grid connected system. The electricity bill is based on the MSEDCL, Tariff Category 52 LT-II commercial 3 Phase < 20 KW. The college has sanction load 10 KW. The college has contract demand of 3.73 KW.

Total billing amount of electricity bill of college has been found to be about INR 4,875/- for 12 months analysis period from July - 2020 to June- 2021.

College has installed 10 kWp grid connected roof top solar plant on college campus. Solar Unit generation for the Year 2020-21 from July to June is **6,350** Unit.

CHAPTER- 2

POWER SUPPLY SYSTEM

2.1 Power station

The electricity bill is based on the MSEDCL, Tariff Category 52 LT-II commercial 3 Phase < 20 KW. The college has sanction load 10 KW. The college has contract demand of 3.73 KW

2.2 DG Set

There is 1 DG set in college campus . Detailed of the DG Sets are given table.2.3

Table 2.1 Monthly Diesel Consumption of DG Set

Month & Year	Monthly Diesel consumption (Ltr per Month)	Monthly Running (Hrs)
Jul-20	1.2	0.30
Aug-20	1.2	0.30
Sep-20	1.2	0.30
Oct-20	6	2
Nov-20	9	4
Dec-20	9	4
Jan-21	14	6
Feb-21	12	5
Mar-21	3	1
Apr-21	3	1
May-21	4	1.5
Jun-21	3	1
	TOTAL = 66.6	26.4

2.3 Grid Connected Solar Photovoltaic System (10 KWp)

There is 10 KWp solar photovoltaic roof top grid connected systems installed on college building.



Figure 2.1: Solar Power Plant 10 KWp

Table 2.2 Solar Unit Genration (10 KWp)

Sr.No.	Month & Year	Unit Generation (2020-21)
1	Jul-20	454
2	Aug-20	363
3	Sep-20	342
4	Oct-20	393
5	Nov-20	000
6	Dec-20	000
7	Jan-21	150
8	Feb-21	560
9	Mar-21	555
10	Apr-21	535
11	May-21	560
12	Jun-21	630
	Total	4,542

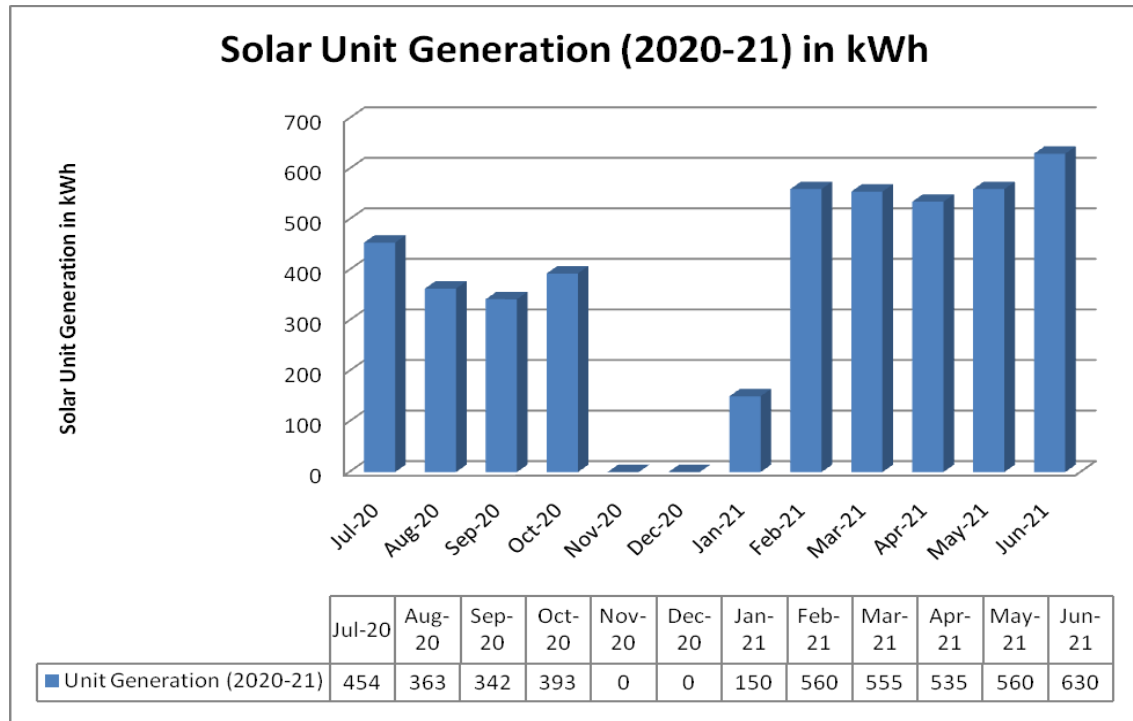


Figure: - 2.2 Graphical presentation of Solar unit generation

Observation: -

- ✚ It is big contribution for toward CO₂ emission reduction. (Reference: Central Electricity Authority (CEA) Baseline Carbon Dioxide Emission database.
- ✚ http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/database_11.zip) Electricity Purchased from the grid

CHAPTER- 3
ELECTRICITY BILL ANALYSIS

3.1 Monthly Energy Consumption of College (Year 2020-21)

Table 3.1 Energy consumption and billing amount (year 2020-21)

Sr. No	Month & Year	Generation	Export Unit (kWh)	Import Unit (KVAh)	Total Amount (Rs./Month)
1	Jul-20	454	450	239	403/-
2	Aug-20	363	360	246	403/-
3	Sep-20	342	338	235	403/-
4	Oct-20	393	390	261	403/-
5	Nov-20	000	000	261	406/-
6	Dec-20	000	000	296	610/-
7	Jan-21	150	145	516	601/-
8	Feb-21	560	558	225	403/-
9	Mar-21	555	545	349	406/-
10	Apr-21	535	532	232	415/-
11	May-21	560	556	159	415/-
12	Jun-21	630	622	165	415/-
		Total =4,542	Total =4497	Total =3,184	Total =5,292/-

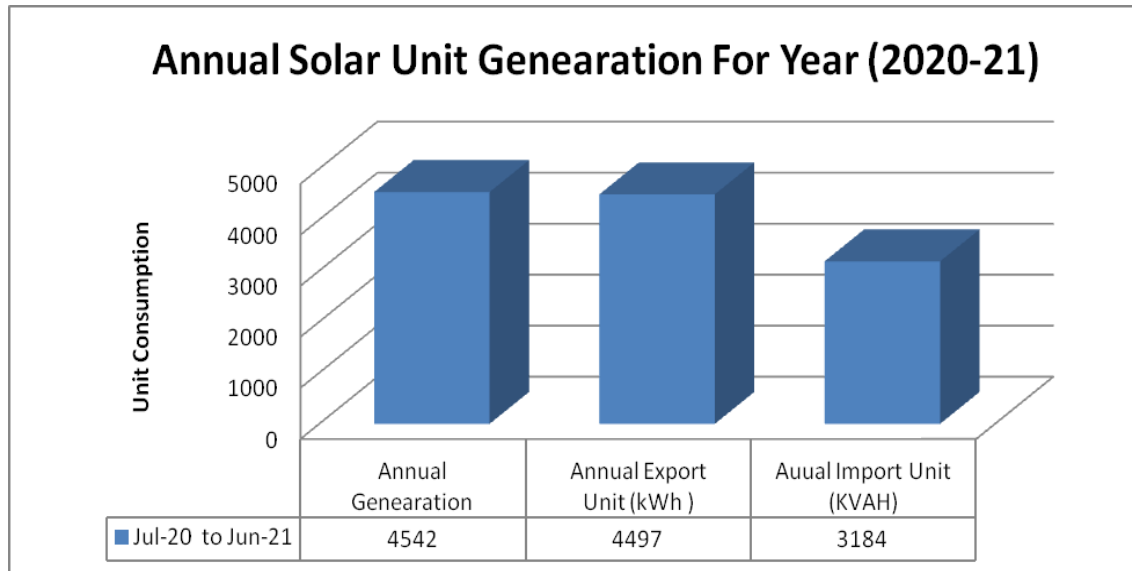


Fig.-3.1 Annual Energy Consumption for year (2020-21)

Observation :

It was observed that total solar power plant unit generation is 4,542.

3.2 Solar System (10KWp) per KWp Unit Generation (kWh/kWp/Day)

Table -3.2 Solar System (10KWp) per KWp Unit Generation (kWh/kWp/Day)

Sr. No	Month & Year	Solar Unit Generation	Per unit Generation (kWh/KWp/day)
1	Jul-20	454	1.5
2	Aug-20	363	1.2
3	Sep-20	342	1.1
4	Oct-20	393	1.3
5	Nov-20	0	0.0
6	Dec-20	0	0.0
7	Jan-21	150	0.5
8	Feb-21	560	1.9
9	Mar-21	555	1.8
10	Apr-21	535	1.8
11	May-21	560	1.9
12	Jun-21	630	2.1
		Total =4,542	1.2

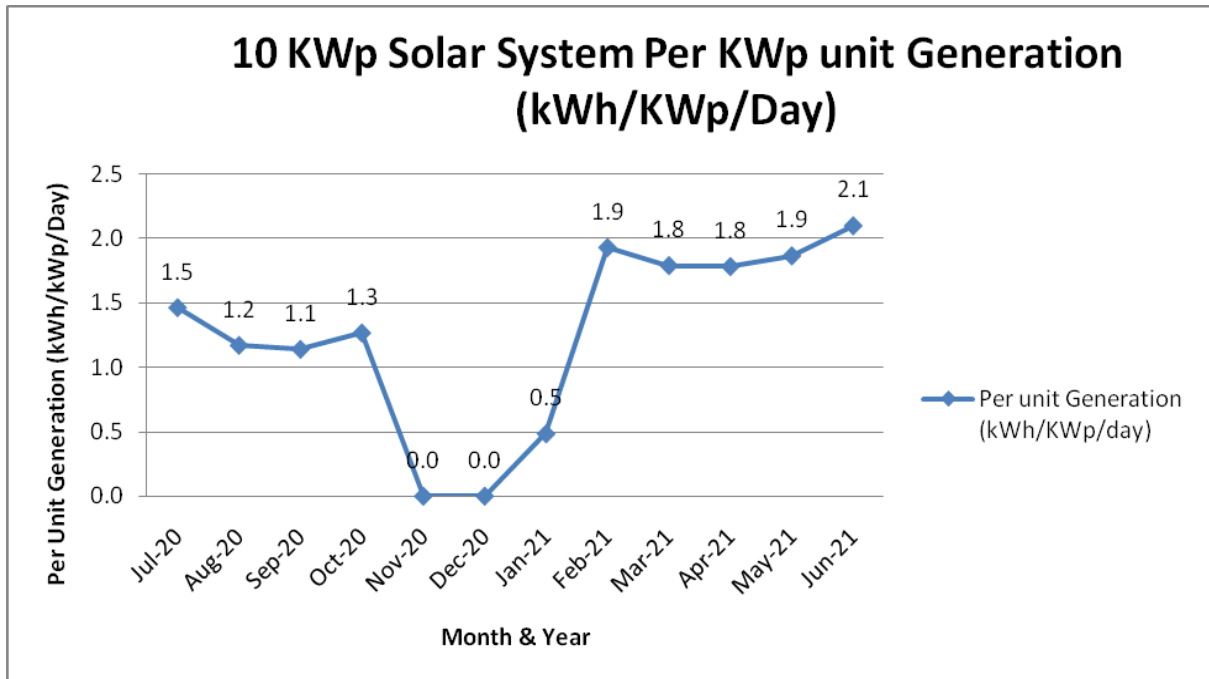


Fig.-3.2 Solar System (10KWp) in KWp Unit Generation (kWh/kWp/Day).

Obserbation :

It was observe that solar power plant unit generation is very poor.



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CHAPTER -4
CONNECTED LOAD DETAILS & POWER MEASUREMENT

4.1 Connected Load of College:

Table 4.1 :- Connected load of Building wise

Sr. No	Location/ Name of Building	Type of Electrical Equipment	Rated watt	Quantity (no)		
1	Admin Building	Tube Light (FTL)	40	140		
		Tube Light (LED)	20	30		
		Ceiling Fan	80	133		
		Exhaust Fan	150	5		
		Window AC	1 Ton	0		
		Window AC	1.5 Ton	0		
		Split AC	2 Ton	0		
		PC	75	66		
		Laptop	35	2		
		Printer	75	9		
		Photocopy M/c	550	3		
		2	Indoor Stadium	Tube Light (FTL)	40	18
				Tube Light (LED)	20	04
Ceiling Fan	80			14		
Exhaust Fan	150			0		
Window AC	1 Ton			0		
Window AC	1.5 Ton			0		
Split AC	2 Ton			0		
PC	75			0		
Laptop	35			0		
Printer	75			0		
Photocopy M/c	550			0		
3	Hostel Building			Tube Light (FTL)	40	31
				Tube Light (LED)	20	23
		Ceiling Fan	80	56		
		Exhaust Fan	150	0		
		Window AC	1 Ton	0		
		Window AC	1.5 Ton	0		
		Split AC	2 Ton	0		
		PC	75	0		
		Laptop	35	0		
		Printer	75	0		
		Photocopy M/c	550	0		

Sr. No	Location/ Name of Building	Type of Electrical Equipment	Rated (watt)	Quantity (no)	Total Watt	Load (%)
1.	Campus	Tube Light (FTL)	40	185	7,400	22.1
		Tube Light (LED)	20	57	1,140	3.41
		Ceiling Fan	80	203	16,240	48.6
		Exhaust Fan	150	05	750	2.24
		PC	75	66	4,950	14.83
		Laptop	35	02	70	0.20
		Printer	75	09	675	2.02
		Photocopy M/c	550	03	1650	4.94
2.	Main Gate (Street Light)	LED	100	05	500	1.49
Total Connected Load					33,375	100.00

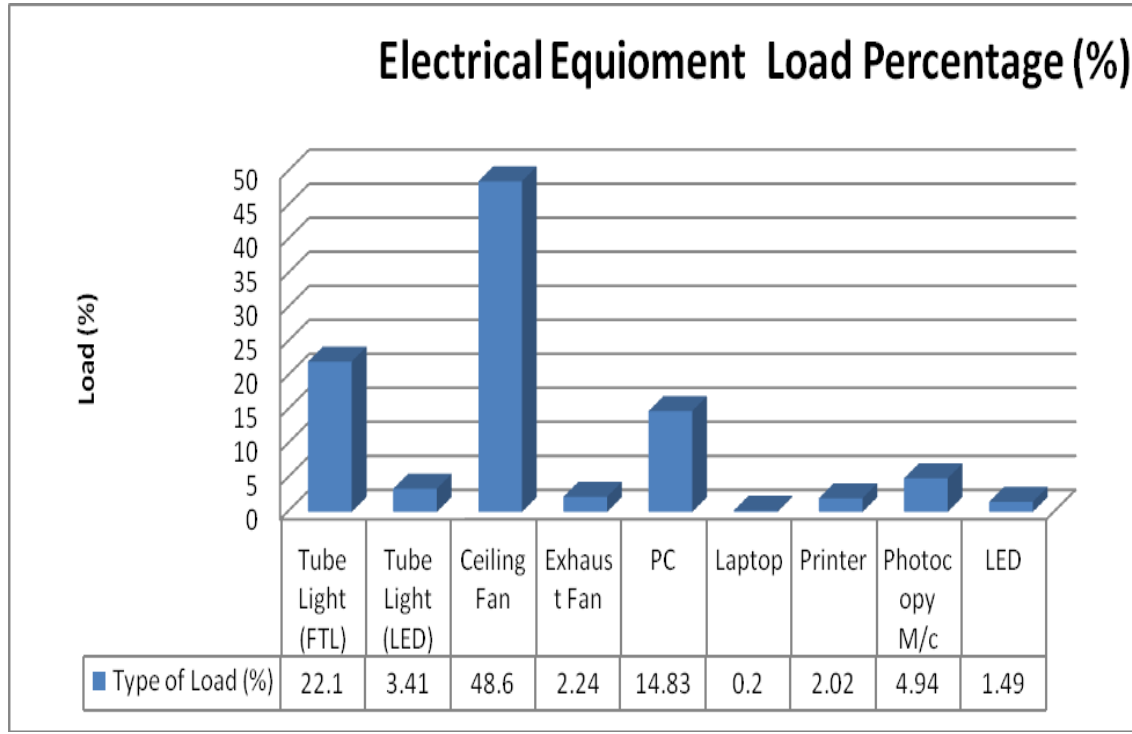


Fig.-4.1 Types of Electrical Equipment Load Percentage (%)

4.2 ON Site power measurement in college campus

Table 4.2 ON Site power measurement in college campus

Sr. no	Building Name	Volt	Amp	Power (KW)
1	College Building (Main Panel)	360	6.9	2.98
2	Borewell	357	7.2	3.78



Fig.-4.2 Photograph of ON Site power measurement in college campus

CHAPTER- 5

ENERGY CONSERVATION MEASURES

5.1 Case Study No.1

Replacing 40W tube lights with 18 W LED tube lights:

Sr. No	Items	Parameters	Units
1	Total (40W) Ceiling light FTL	No.	185
2	Rated Power	Watt/ unit	40
3	Operating Hrs	Hrs/day	12
4	Operating Annual Days	Days/Year	250
5	Unit Consumed Annually (AI*AII*B*C)/1000)	kWh/Year	22200
6	REPLACEMENT		
7	Replacement with 18 W LED Light	Watt/unit	18
8	Unit Consumed Annually	kWh/Year	9990
9	Energy Saving (Old- New Annual Consumption)	kWh	12210
10	Annual Energy Cost Saving @ Rs. 1.61 per unit	INR	19,658/-
11	COST BENEFIT CALCULATION		
12	Capital Cost @Rs180/- per item	INR	33,300/-
13	TOTAL INVESTMENT	INR	33,300/-
14	Net Annual Saving	INR	19,658/-
15	Simple payback (Investment/annual savings)	Month	20.33

5.2 Case Study No.2

Replacing Ceiling Fan 80W by 28 W BLDC Ceiling Fan

Sr. No	Items	Parameters	Units
1	Total Ceiling Fan 80	No.	203
2	Rated Power	Watt/ unit	80
3	Operating Hrs	Hrs/day	12
4	Operating Annual Days	Days/Year	250
5	Unit Consumed Annually (AI*AII*B*C)/1000)	kWh/Year	48720
6	REPLACEMENT		
7	Replacement with 28 W BLDC Ceiling Fan	Watt/unit	28
8	Unit Consumed Annually	kWh/Year	17052
9	Energy Saving (Old- New Annual Consumption)	kWh	31668
10	Annual Energy Cost Saving @ Rs. 1.61 per unit	INR	50,985/-
11	COST BENEFIT CALCULATION		
12	Capital Cost @1800 per item	INR	3,65,400/-
13	TOTAL INVESTMENT	INR	3,65,400/-
14	Net Annual Saving	INR	50,985/-
15	Simple payback (Investment/annual savings)	Month	86.00